Offshore Energy Strategic Environmental Assessment

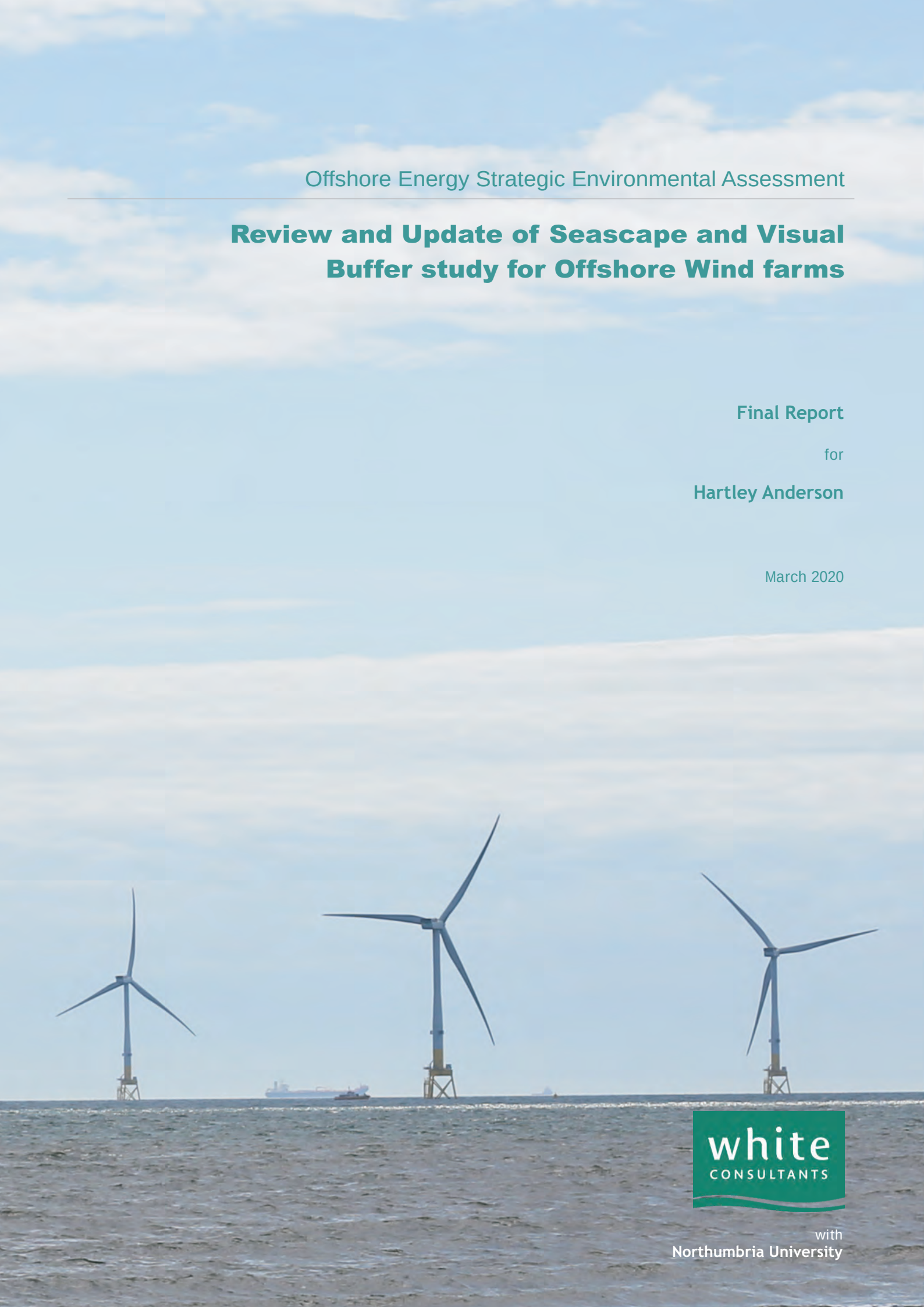
Review and Update of Seascape and Visual Buffer study for Offshore Wind farms

Final Report

for

Hartley Anderson

March 2020



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Northumbria University

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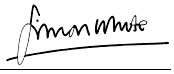
		Signature			

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1. Introduction

1.1. White Consultants was commissioned in July 2019 by Hartley Anderson to undertake an updated seascape and visual buffers study to inform future offshore wind farm leasing, for which the Department for Business, Energy and Industrial Strategy (BEIS) is undertaking a Strategic Environmental Assessment (SEA) programme. Two previous studies have been undertaken- one completed in January 2009 and informing the OESEA2 (Offshore Energy SEA) and one in February 2016 informing OESEA3.

1.2. The published OESEA3 Environmental Report (March 2016) stated as part of Recommendation 1 that developments (individually or cumulatively) should aim to avoid causing significant detriment to amenity and well-being as a consequence of deterioration in valued attributes such as landscape, tranquillity and other factors. In the discussion on visual buffers (derived from White Consultants (2016)) the report states:

'Further conclusions of the work were that for high value and high sensitivity coastlines, a distance of 30km from the coast (the limit of visual acuity) could be attributable to developments for a range of sizes (e.g. 3.6MW to 15MW), whereas distances for areas of medium value and sensitivity may be in the order of 13km (3.6MW turbines), 20km (4-8MW turbines) or 20+km (10-15MW turbines).' (p291).

1.3. This report seeks to update consideration of these distances.

The Brief

1.4. The brief states that the project will update the previous seascape assessments informing OESEA and OESEA3 in relation to offshore wind development. This includes an update on:

Stage 1

- Planning policy context and seascape assessment guidance (including an international perspective).
- Analysis of wind farms coming forward in respect of their seascape and visual impact assessments (SVIAs), focussing on visual impact of a proposed development alone and cumulatively with other wind farms.

Stage 2

- Additional analysis using wirelines to consider larger scales of turbines up to 400m high to blade tip (20MW + capacity).

Stage 3

- The effect of visibility modifiers (e.g. haze) on limiting the effects of wind farms at various distances referring to research and UK weather data.
- A review on how other nations implement seascape buffers.
- The effect of lighting (navigational and aviation lighting) in contributing to development effects.
- Cumulative effects of existing and proposed wind farms.
- A site review of constructed wind farms against their SVIAs.

1.5. The above evidence will be brought together to inform a revised set of seascape buffers to national scale. It is important to note that buffers are a strategic level tool to identify where effects are likely and do not necessarily suggest no-go areas for development. These areas would need to be subject to careful further assessment and consideration should development be proposed within them.

1.6. The research undertaken for the study was carried out primarily in July to early September 2019 to inform the draft Stage 1 and 2 baseline report in early October and draft Stage 3 in early November 2019. In finalising the report some other relevant documents have come to light which have been commented on.

1.7. The report considers the updated context (Chapter 2), policy (Chapter 3), guidance (Chapter 4), SVIA analysis (Chapter 5), wireline analysis (Chapter 6), visibility modifiers (Chapter 7), international offshore wind farm development patterns (Chapter 8), the effect of lighting (Chapter 9), cumulative effects (Chapter 10), site review (Chapter 11), and findings and discussion (Chapter 12).

2. OESEA context and previous study findings

Context

2.1. Strategic Environmental Assessment (SEA) is the process of appraisal through which environmental protection and sustainable development may be considered, and factored into national and local decisions regarding Government (and other) plans and programmes – such as oil and gas licensing rounds and other offshore energy developments, including renewables and gas and carbon dioxide storage.

2.2. The SEA process aims to help inform Ministerial decisions through consideration of the environmental implications of the adoption of a proposed plan/programme. The Department for Business, Energy and Industrial Strategy (BEIS) as the principal regulator of the offshore wind industry, has taken a proactive stance on the use of SEA as a means of striking a balance between promoting economic development of the UK's offshore energy resources and effective environmental protection.

2.3. The SEA Directive sets out the information to be included in the environmental report of the Strategic Environmental Assessment, including the likely significant effects on the environment, including issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the inter-relationship between the factors.

2.4. BEIS's predecessors, the Department of Trade and Industry (DTI) and Department for Energy and Climate Change (DECC) undertook the offshore energy SEA (OESEA), OESEA2 (DECC, 2009) and OESEA3 (DECC, 2016). The OESEA4 area for offshore wind applies to the territorial and offshore waters of England (all schemes) and Wales (for schemes with installed capacity over 350MW).

2.5. The report is being undertaken in advance of the OESEA4 scoping exercise. The OESEA3 scoping report stated that the SEA objectives for landscape/seascape were:

> *'To accord with, and contribute to the delivery of the aims and articles of the European Landscape Convention and minimise significant adverse impact on seascape/landscape including designated and non-designated areas.'* (DECC, 2015, p108)

2.6. The SEA indicators were stated as:

- *'No significant impact on nationally designated areas.*
- *Extent of the visual resource potentially affected by the particular developments.*
- *Number of areas of landscape sensitivity affected by proposed developments.*
- *Trajectory of change in coastal National Character Areas shows no adverse effects arising from plan activities.*
- *Change in tranquillity based on national mapping projects.'* (DECC, 2015, p108)

2.7. Although the objectives and indicators for OESEA4 are not yet available, the relevant national policy has not changed.

OESEA visual buffers findings

2.8. The OESEA3 report (DECC, 2016) addressed the visual impacts of turbines from 3.6MW to 15MW turbines based on the conclusions of White Consultants, February 2016.

2.9. The interpretation of the threshold of significance was derived from a 'worst case' scenario in the DTI (2005) seascape and visual impact assessment guidance which states that moderate adverse effects could be judged as significant (although it is most likely they are not). OESEA stated this was '*highly precautionary*' (Page 291, Paragraph 2).

2.10. The results from the SVIA analysis stated in the report were as follows (page 291, second paragraph):

'In most cases the threshold of no significance for medium sensitivity receptors was ~24km, and beyond 24km for high sensitivity receptors or 15MW turbines in all cases. Further conclusions of the work were that for high value and high sensitivity coastlines, a distance of 30km from the coast (the limit of visual acuity) could be attributable to developments for a range of sizes (e.g. 3.6MW to 15MW), whereas distances for areas of medium value and sensitivity may be in the order of 13km (3.6MW turbines), 20km (4-8MW turbines) or 20+km (10-15MW turbines).'

Further, the document stated (page 291, paragraph 3):

'….any consideration of coastal "buffers" is too generalised an approach to take into consideration the many anthropogenic and natural variations along the coast and the variety of development scenarios which might take place (e.g. device type and design, array orientation).'

2.11. The results of the wireline assessment of representative wind farm scenarios were noted (page 291, Table 5.26):

Table 2.1 Threshold for 'significance' for representative 500 MW wind farm scenarios viewed at 22 m ASL

Turbine size(MW)	Distance from shore			
	13km	18km	24km	35km
3.6	Moderate and moderate/large	Small and small/moderate	Small	n/a
5	Moderate and large	Moderate and moderate/large	Small and small/moderate	n/a
7/8	Moderate and large	Moderate and large	Small	Very small
10	Large	Moderate and large	Small and small/moderate	Very small
15	Large	Moderate and large	Moderate	Very small

2.12. These conclusions will be clarified and updated in this report.

3. Current and planned offshore wind farm developments

Overview

3.1. Existing offshore wind farms from previous rounds of development are shown on **Figure 3.1.** This indicates the status of wind farms including those in operation, under construction, consented and in planning. Overall there is currently 9.3GW of offshore wind energy operational and a further 4.4GW under construction (Crown Estate, September 2019).The current Round 4 bidding areas are shown on **Figure 3.2.**

3.2. Each round is discussed in turn to provide a background to the development of offshore wind energy. It should be noted that, in the tables below, the turbine capacity and number of wind turbines are the maximum assessed in SVIAs, not necessarily those installed.

Round 1

3.3. The Crown Estate launched the first round of site awards in December 2000. Developments had to comply with a number of conditions:

- Sites had to be within the 12 nautical mile territorial limit
- Sites had to be at least 10km apart (unless agreement made between developers to develop adjacent or in close proximity)
- Site areas were limited to 10km^2
- Site had to be a minimum generating capacity of 20MW
- Sites were restricted to a maximum of 30 turbines

3.4. A summary of Round 1 wind farms is shown in **Table 3.1.**

Table 3.1 Round 1 offshore wind farms

Site Name	Capacity (MW)	Turbine Capacity (MW)	No. of Turbines	Development Status
Burbo Bank	90	3.60	25	Operational
Gunfleet Sands	108	3.60	30	Operational
Inner Dowsing	108	3.60	30	Operational
Kentish Flats	90	3.00	30	Operational
Lynn	86.4	3.60	24	Operational
North Hoyle	60	2.00	30	Operational
Rhyl Flats	90	3.60	25	Operational
Robin Rigg East	90	3.00	30	Operational
Robin Rigg West	84	3.00	28	Operational
Scroby Sands	60	2.00	30	Operational
Ormonde Offshore	150	5.00	30	Operational
Teesside	62.1	2.30	27	Operational
Barrow	90	3.00	30	Operational
Cirrus Shell Flat Array	284	3.15	90	Application Withdrawn
Scarweather Sands	108	3.00	30	Application Withdrawn
Cromer	108	4.00	30	Abandoned

3.5. The implemented turbines capacities ranged from 2MW at North Hoyle through to 5MW at Ormonde Offshore. Most are 3MW or 3.6MW. Typical heights of turbines are 154m to blade tip. The number of turbines range from 24 to 30.

Round 2

3.6. The DTI's consultation paper 'Future Offshore' (2002), set out the Government's policy direction and commitment to take a more strategic approach to offshore wind farm development. The paper set out the Government's intention to restrict development to strategic areas and undertake a Strategic Environmental Assessment (SEA) prior to the implementation of the SEA Directive. Three strategic areas were proposed:

- The Greater Wash
- The Thames Estuary
- The North West (Liverpool Bay).

3.7. Completed in 2003, the DTI requested that the Crown Estate make available seabed areas in these strategic regions for the purpose of further wind farm development. The DTI issued guidance including a precautionary coastal exclusion zone of 8-13km from the coast to reduce the visual impact of development. The SEA set out development scenarios limiting the total development possible within these three areas to 4-7.5GW (including the contribution from Round 1).

3.8. A summary of Round 2 wind farms is shown in **Table 3.2**.

Table 3.2 Round 2 offshore wind farms

Site Name	Installed Capacity (MW)	Turbine Capacity (MW)	No. of Turbines	Development Status
Lincs	270	3.60	75	Operational
Dudgeon East	402	6.00	67	Operational
Greater Gabbard	504	3.60	140	Operational
Gunfleet Sands II	64.8	3.60	18	Operational
Gwynt y Môr	576	3.60	160	Operational
Humber Gateway A	219	3.00	73	Operational
London Array Phase 1	630	3.60	175	Operational
Race Bank A	580	6.00	91	Operational
Sheringham Shoal	317	3.60	88	Operational
Thanet	300	3.00	100	Operational
Walney 1	183	3.60	51	Operational
Walney 2	183	3.60	51	Operational
West of Duddon Sands	389	3.60	108	Operational
Westermost Rough A	210	6.00	35	Operational
Triton Knoll	900	6.00	150	Consent Granted
London Array Phase 2	240	2.93	341	Abandoned
Docking Shoal A	540	5.00	108	Consent Refused

3.9. The installed turbine capacities range from 3MW at Humber Gateway through to 6MW at Dudgeon East, Race Bank and Westermost Rough. Most are 3.6 MW. Typical heights of turbines are at 154m to blade tip. The number of turbines in each array generally significantly exceeds the Round 1 wind farms, ranging from 18 to 175.

Round 2.5

3.10. Extensions to existing wind farms outside the Rounds 2 and 3 zones are put into the Round 2.5 category. These are set out in **Table 3.3**.

Table 3.3 Round 2.5 offshore wind farms

Site Name	Installed Capacity (MW)	Turbine Capacity (MW)	No. of Turbines	Development Status
Burbo Bank extension	258	8.00	32	Operational
Galloper Wind Farm	336	6.00	56	Operational
Kentish Flats 2	49.5	3.30	15	Operational
Walney 3	649	6.00	110	Operational
Thanet extension	340	10-12	34	Awaiting decision

3.11. The turbines used range from 3.3MW at Kentish Flats 2 through to 8MW at Burbo Bank Extension. Typical heights of the 8MW turbines are 190m to blade tip. The Burbo Bank Extension is, at its closest, the same distance offshore as the existing wind farm but with significantly larger turbines at wider spacing.

Round 3

3.12. In December 2007, the UK Secretary of State for BERR, John Hutton, announced an SEA for a draft plan for further development of UK offshore energy resources, including some 25GW of additional offshore wind power generation capacity. In June 2008, the Crown Estate announced a 'Round 3' leasing process to provide the additional 25GW.

3.13. The potential development zones for Round 3 leasing were typically well offshore but limited to a water depth of 60m for technical reasons. Much of this available sea floor is in the area south of the Dogger Bank, more than 111km offshore, and nearly four fifths is at depth of 40-60m.

3.14. The zones for consideration were nominally revised down from 11 to 9 zones around the UK coast in September 2008.These were:

- Moray Firth
- Firth of Forth
- Dogger Bank
- Holderness
- Norfolk
- Hastings
- West Isle of Wight
- Bristol Channel
- Irish Sea

3.15. Subsequently, due to technical problems encountered by developers two zones were withdrawn- Bristol Channel and the Irish Sea.

3.16. A summary of Round 3 wind farms is shown in **Table 3.4**.

Table 3.4 Round 3 offshore wind farms

Site Name	Installed Capacity (MW)	Turbine Capacity (MW)	No. of Turbines	Development Status
Hornsea Project One (centre)	1,200	7.00	171	Operational
Rampion Offshore Wind Farm (Hastings Zone)	400	3.6/5.00	116	Operational
East Anglia ONE (EA 1)	700	7.00	102	Construction
Hornsea Project One (east and west)	1,200 (with centre above)	7.00	171 (with centre above)	Construction
Hornsea Project Two - Optimus and Breesea	1,800	5.00	360	Construction
Moray East (was Telford, Stevenson and MacColl)	950	9.5	100	Construction
Dogger Bank Creyke Beck A & B	2,400	5.00	360	Consent Granted
Dogger Bank Teesside A & B	2,400	5.00	480	Consent Granted
East Anglia THREE	1,200	10.00	120	Consent Granted
Moray West	850	10-11.8	72-85	Consent Granted
Seagreen Alpha	525	7.00	75	Consent Granted
Seagreen Bravo	525	7.00	75	Consent Granted
Hornsea Project Three	2,400	Unspecified	Up to 300	Application Submitted
Norfolk Vanguard	1850	9-20	90-200	Application Submitted
Norfolk Boreas *	1800	9-20	90-200	Application Submitted
Seagreen Alpha & Bravo (Optimised)	1500	Unspecif-ied	Up to 120	Application Submitted
East Anglia ONE North	Up to 800	12 to 19	Up to 67	Pre-application
East Anglia TWO	Up to 900	12 to 19	Up to 75	Pre-application
Hornsea Project Four	1000	Unspecif-ied- blade tip height 370m above LAT	180	Pre-application
Atlantic Array 1 - Bristol Channel Zone	1,200	5.00	240	Application Withdrawn
Navitus Bay	970	5.00	121	Consent Refused

3.17. The consented/operational turbines capacities range from 3.6MW at Rampion (which was chosen for implementation instead of 5MW) through to 10MW at East Anglia THREE and 11.8MW at Moray West. The number of turbines in each commercial array range from 67 or 75 for the East Anglia and Seagreen arrays (although these join to form larger groups) to 480 at Dogger Bank Teesside A and B. The latter, along with a number of the other larger schemes, lie a long distance offshore.

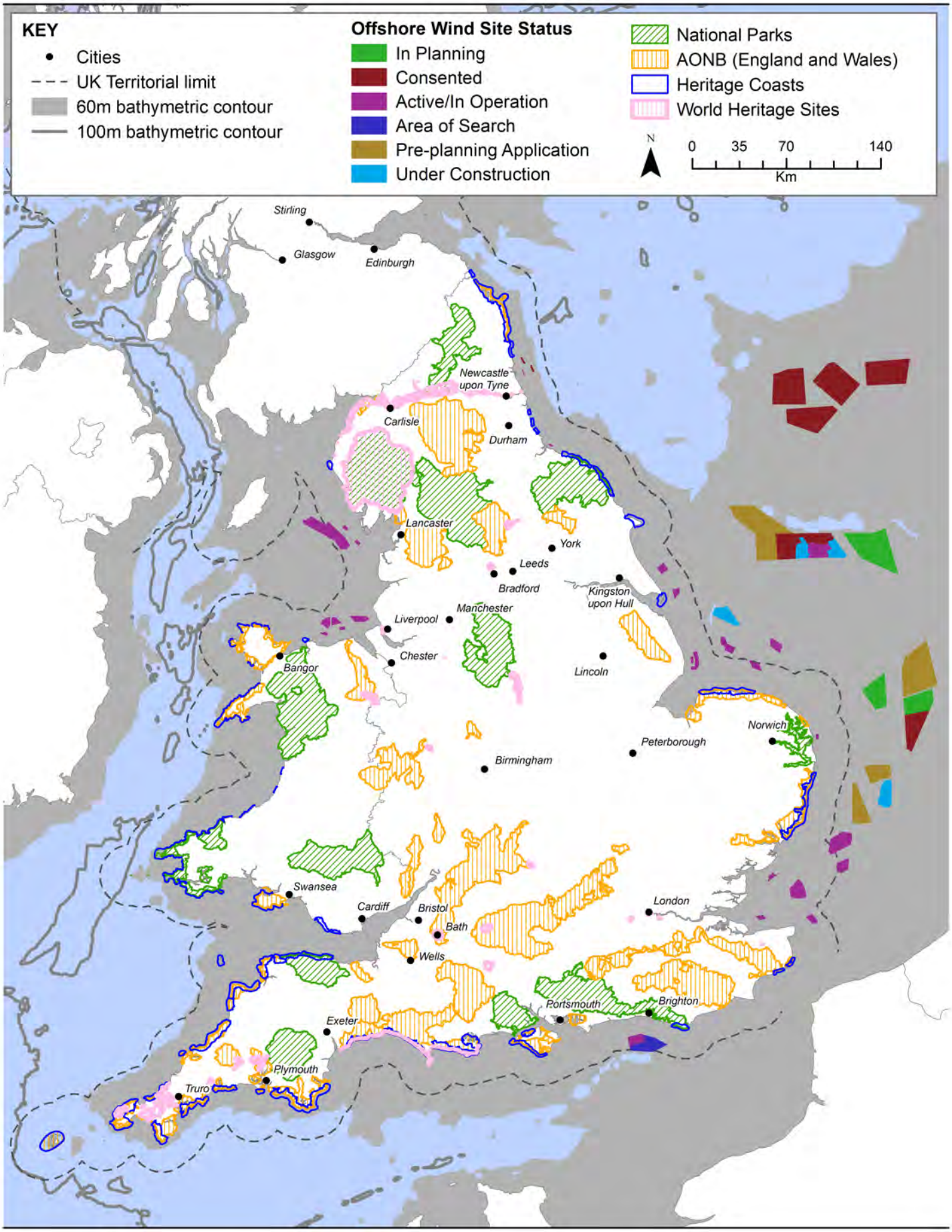

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Figure 3.1
Consented and operational windfarms and national landscape constraints

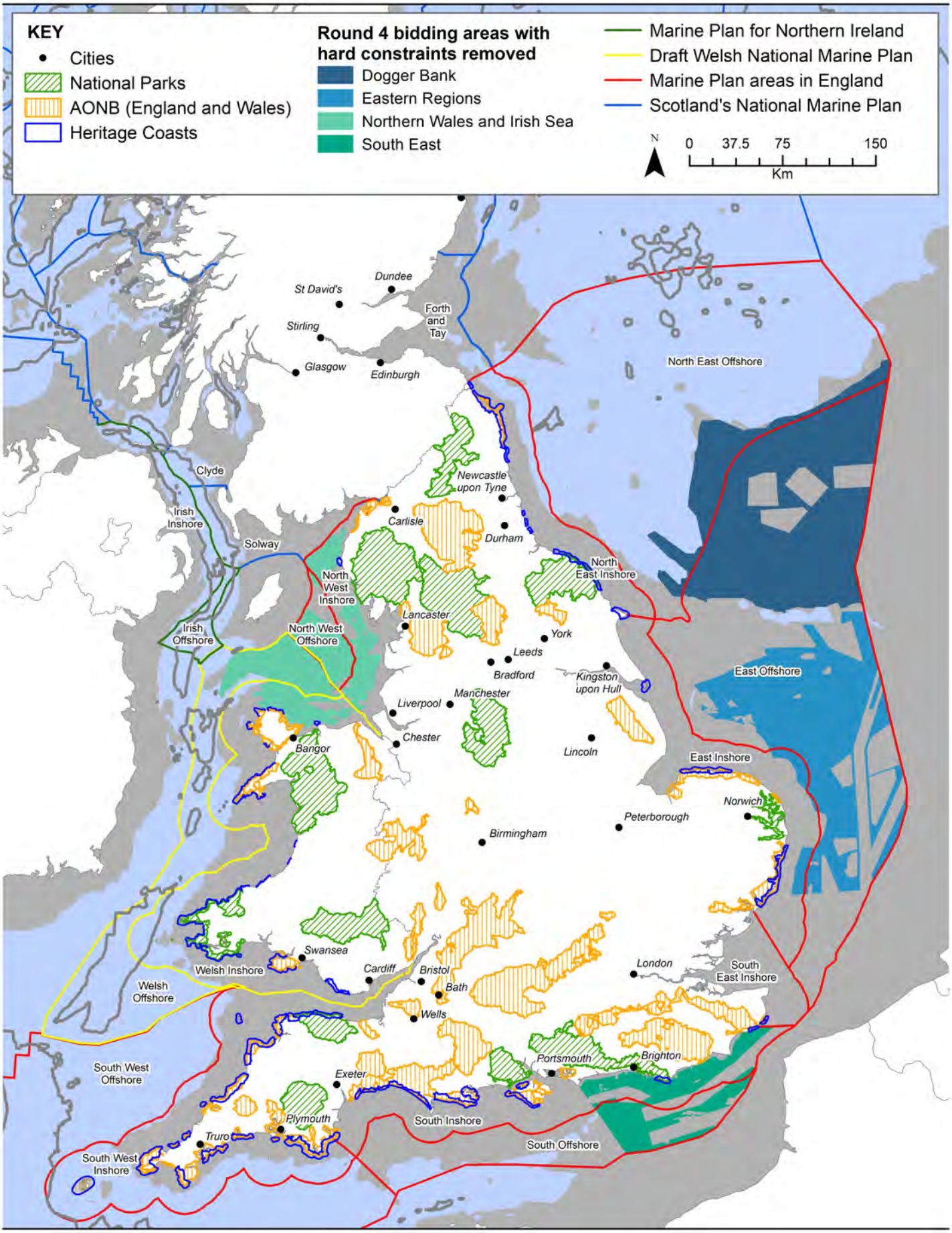

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Figure 3.2
Round 4 offshore windfarm zones, marine plan areas, national landscape designations and Heritage coasts

Scottish Territorial Waters (STW) - schemes and draft plan options

3.18. At the time the Scottish territorial water leases were granted, the consenting regime was different for these waters, but Scottish Ministers now have full remit over renewables across their territorial and offshore waters. The following wind farms have been consented.

Table 3.5 Offshore wind farms in Scotland

Site Name	Installed Capacity (MW)	Turbine Capacity (MW)	No. of Turbines	Development Status
Hywind Scotland Pilot Park (Hywind 2) Demonstrator (Floating)	30	6.00	5	Operational
European Offshore Wind Deployment Centre (EOWDC) (Aberdeen Bay-Demonstration site)	100	10.00	10	Operational
Beatrice	581	7.00	83	Operational
Kincardine Offshore (Floating)	50	2 + 8.4	1 + 6	Construction
Neart na Gaoithe	450	8.3	54	Consent Granted
Inch Cape	784	min. 9.5MW	40-72	Consent Granted
Dounreay Tri demonstrator	10	5	2	Under construction but on hold

3.19. Hywind is a demonstrator project for floating turbines designed for deep water. EOWDC was designed to test a range of large scale turbines around 10MW and, as a demonstrator, is very close inshore (2-4km). The 11 turbines installed are two 8.8MW and nine 8.4MW units. The other three wind farms are commercial and use from 54 to 83 7-9.5MW turbines. Though they will be implemented in STW waters, some of these wind farms have been used in the SVIA analysis (**Chapter 7**) as they use large wind turbines and are representative of those deployed more widely across the UKCS.

3.20. The draft sectoral marine plan areas[1] for Scotland are being consulted on with draft plan options (DPOs) for offshore wind. The related Scottish Government (2019) SEA addresses seascape and visual amenity in a brief summary. It states that greater effects are likely for nearshore devices than those located further offshore and also for larger turbines with a greater height and thus greater visibility. It states that field observations revealed that turbines may be visible at distances of 42km in daytime and 39 km at night (5.1.54). They may be the focus of visual attention at distances up to 16km but these distances are considered to be influenced by turbine height and the shape of arrays relative to the coastline.

3.21. The SEA refers to the NRW (2019) report with 15km quoted as the maximum distance of medium effect (5.1.54). The text goes on to state that beyond this distance there is potential for mitigation through spatial planning, array design and turbine selection (5.1.55). 15km is then used as a yardstick in the assessment of every DPO. This does not take into account that the 15km is a buffer related to non-designated landscapes. This approach appears to be an oversimplification of the NRW (2019) report findings and does not fully take into account the increased adverse effects of larger turbines coming forward and their likely significant effects on high or very high sensitivity receptors at

[1] Https://consult.gov.scot/marine-scotland/draft-sectoral-marine-plan-for-offshore-wind/

distances far in excess of 15km as discussed in this report. Having said this, the SEA does comment on the existing baseline information on the sensitivity of individual DPO coastlines and the potential effects different types and scales of development (e.g. DPO W1).

3.22. The vast majority of the development plan options for offshore wind are in deep water, with a depth greater than 60m.The Hywind and Kincardine projects therefore appear to be very important to the future of offshore wind energy in Scotland. The implication is that if the technology can be mastered, it can also be deployed in the waters of England and Wales opening up areas hitherto unallocated for development. Areas would include the deep seas off the western seaboard peninsulas e.g. Cornwall, Pembrokeshire and Llyn as well as parts of the North Sea off the coast of north east England. In addition, those areas which have been found to be technically unfeasible/uneconomic for turbines with seabed foundations, such as the Bristol Channel Zone, may also become viable.

EXTENSIONS TO EXISTING WIND FARMS

3.23. In February 2017, The Crown Estate launched an opportunity for existing wind farms to apply for project extensions with a deadline of May 2018. Eight project applications were received, of which seven have now both been consulted on and passed the Habitats Regulations assessment stage (in August 2019). These are:

- Sheringham Shoal
- Dudgeon
- Greater Gabbard
- Galloper
- Rampion
- Gwynt y Môr
- Thanet

3.24. The developers will now progress with project specific environmental assessments before seeking planning consent through the statutory planning process.

CROWN ESTATE ROUND 4

3.25. The Crown Estate launched Offshore Wind Leasing Round 4 in September 2019. This is for at least 7GW of new seabed rights in four broad areas up to 60m water depth. This is significantly less than Round 3 but excludes Scotland. Leases for the areas will be for 60 years (extended from 50 years in previous rounds). A tender process commenced in October 2019 and will run until autumn 2020. The bidding areas (see **Figure 3.2)** are:

- Dogger Bank
- Eastern Regions
- South East
- Northern Wales and Irish Sea.

3.26. These areas have been derived from a two-stage regions refinement process reducing the 18 seabed regions initially identified. The reasons for removal and refinement have included visual sensitivity (i.e. where development would predominantly or entirely be within 13km off shore), defence ranges and exercise areas, overlap with busy shipping routes or potential cumulative environmental impacts risks particularly in relation to ornithology.

3.27. The analysis included a visibility analysis from four types of designations (National Parks, AONBs, Heritage Coasts and World Heritage Sites) that included some element of visual

protection or had landscape as a component of their protected features and subsequent review using the distance from shore thresholds mentioned in the OESEA3, 2016 report. These were 0-30km for high sensitivity receptors and three ranges for medium sensitivity receptors depending on size of turbine (0-13km for 3.6MW turbines, 13-20km for 4-8MW turbines and 20-30km for 10-15MW turbines).

3.28. In Region 6 Eastern area, for example, 18% of the overlaps with the 30km threshold from high sensitivity receptors (Suffolk Heritage Coast, Suffolk Coast and Heaths AONB and the Broads Authority). A qualitative assessment is made with the receptor rating judged as '*interaction acceptable with significant mitigation*' and an area rating judged as '*the constraint will present the need to implement significant and/or strategic level mitigation measures to enable acceptable development within the whole area*'.

3.29. Spatial modelling work was also run to look at the visibility of 250m and 350m high turbines from landscape designations but this does not seem to have been either quantitatively or qualitatively fed through into the area analyses. This is discussed further in Section 4 and illustrated in **Figure 4.6.**

3.30. Stakeholders raised concerns during the consultation process about the thresholds for significant visual impact in the OESEA3, 2016 report. The Crown Estate has maintained this as the most contemporary source available to characterise visual impact issues, but caveats have been noted in the methodology report and characterisation documents. This is the key issue that this report will address using up to date data and analysis. It should be noted that the OESEA3 report stated that 30 km was the limit of visual acuity rather than the limit of visual significance noted in the source White Consultants 2016 report.

CONSIDERATION OF SAMPLE WIND FARMS IN RELATION TO DESIGNATED LANDSCAPES

3.31. In order to explore the issues of the differing views of SVIA assessors and regulatory authorities and effects on national landscape designations we study the decisions and assessments of six wind farms. Three were included in the 2016 White Consultants OESEA3 background report and five were considered by the same consultants in their 2019 visual effects ready reckoner report for NRW[2]. These all remain relevant and are considered in date order:

- Race Bank, which was consented July 2012
- Atlantic Array, which was withdrawn November 2013
- Rampion, which was consented July 2014
- Walney Extension, which was consented August 2014
- Navitus Bay, which was refused June 2015
- Burbo Bank Extension, which was consented August 2015

Race Bank

3.32. The wind farm was given development consent in July 2012 by the Secretary of State without an inquiry. It was for 116 x 5MW wind turbines generating an capacity of up to 508MW. The development was located 27km offshore from the Norfolk Coast AONB at its nearest point.

3.33. The SVIA considered cumulative impacts of the proposed development alongside other offshore wind farms- Lynn and Dowsing, Lincs, Sheringham Shoal and the proposed

[2] White, S. Michaels, S. King, H. 2019. Seascape and visual sensitivity to offshore wind farms in Wales: Strategic assessment and guidance. Stage 1- Ready reckoner of visual effects. NRW Evidence Series. Report No: 315, 94pp, NRW, Bangor.

Docking Shoal. It stated that the development would add a significant number of turbines into the seascape. The effects on Norfolk Coast AONB, when considered on its own and in conjunction with the other wind farms, was stated to be of minor significance on the coast reducing to negligible moving inland.

3.34. In response to concerns about visual impact the developer referred to the DTI 2003 SEA report (mentioned earlier in this report) quoting 24km as a distance beyond which a low effect could be expected.

3.35. The Secretary of State concluded that cumulative visual impact of the proposed Development when viewed alongside other wind farm projects was not likely to be so significant that it required the Secretary of State to withhold consent for the Development.

3.36. Subsequent to this issue being raised the Developer amended the Original Application to reduce the proposed project in scale and gave a commitment to use a smaller number of larger turbines. The Secretary of State considered that these modifications together should have the effect of reducing the visual *extent* of the proposed Development.

Atlantic Array

3.37. The developer abandoned the Atlantic Array wind farm scheme in November 2013 and terminated the agreement with the Crown Estate due to technical challenges including substantially deeper waters and more adverse seabed conditions than expected.

3.38. The scheme lay within the Round 3 Bristol Channel Zone. The final assessed array was approximately 22.25 km from South Wales coast, 15.5km from the North Devon coast and 13.5km from Lundy Island. It was around 25.8km long by 12.6km wide at its extremities, amounting to around 200km2- greater than the Gower AONB (which is 188km2). The worst case scenario assessed in both the draft and final SVIAs was for 240 5MW turbines,180m to blade tip. The alternative layout of 150 8MW turbines, 220m to blade tip was also presented in visualisations. There was disagreement over which was the worst case with the NRW considering the larger turbines had a greater visual impact.

3.39. The decision to abandon the scheme came during the decision making process so assessments of visual impact had been carried out not only by the SVIA assessors, RWE, but also by bodies opposed to the scheme including, in Wales, NRW and the City and County of Swansea (Gower AONB), Pembrokeshire Coast National Park Authority (PCNPA) and the National Trust. A comparative table of effects on visual receptors in Wales is set out in **Appendix C.** This compares the three relevant consultants' viewpoint visual impact assessments. Data for the English viewpoints has not been obtained in this study as they are generally closer and less helpful in determining the limits of visual significance.

3.40. The SVIA assessor identified five significant effects on viewpoints in the two designated areas, two of which were small magnitude of change (at 27.5 and 27.9km) and three of which were medium magnitude of change(at 23.09-24.61km).

3.41. The PCNPA assessor identified six significant effects on viewpoints in the Park, all of which were medium magnitude of change (at 27.5-29.27km).

3.42. The NRW assessor identified eleven significant effects on viewpoints in the designated areas, six of which were moderate/slight (equivalent to small) magnitude of change (at 27.93-29.27km), three of which were moderate magnitude of change (at 24.61-27.9km) and two of which were substantial/moderate (at 23.09 and 23.74km).

3.43. The array proposed was very large even in its final reduced form, running parallel to the coasts. As it was sandwiched between designated areas either side of the Bristol Channel at relatively close proximity there was limited room to reduce effects on all sensitive visual receptors. Whilst this may not have been the reason for withdrawal, the seascape and visual effects would have been significant. There was agreement between both the

SVIA and other assessors that significant effects were possible from up to 27.9km away from the very sensitive viewpoint at Caldey Island.

Rampion

3.44. Rampion offshore wind farm was given development consent in July 2014. The development control order (DCO) specified that no turbine would exceed 210m above LAT or exceed a rotor diameter of 172m. The number of turbines was not specified but the extent of the wind farm was. The final approved layout extended around 13km by 6km.

3.45. The SVIA study area was formed on the basis that the development over great distances and 35 km would be unlikely to result in a perceptible change to seascape or landscape character.

3.46. The layout of the wind farm went through a number of iterations and three options were considered in the SVIA to determine a worst-case scenario (founded upon the 'Rochdale envelope' approach). These were for 3.6MW, 4MW at close spacings and 7MW turbines at wide spacings. The worst case was considered in the SVIA to be the 3.6MW array because of it extended further than the 4MW array but formed a denser array than the 7MW option. Two options showing a reduced array were developed- Option F with 175 3.6MW and Option D with 100 7MW turbines (see extracts of photomontages in **Figure 3.3** below). Natural England's evidence initially considered that Option D would be likely to be worse than Option F but at the hearing, put under some pressure to decide by the Examining Authority panel, agreed that Option F did represent the worst case (Planning Inspectorate, 2014, 4.329). This was mainly due to the spread of turbines being considered to be more intrusive than the height. However, this spread was only apparent from the east, from the more sensitive receptors such as Cuckmere Haven where the National Park meets the Heritage Coast, rather than from the receptors to the north. Otherwise the main difference was the wider spacing between turbines of the larger turbine array, albeit with larger structures.

3.47. The effects on the coastal settlement to Brighton and Hove at around 13km were considered of major and major moderate significance but the views were considered acceptable by the panel considering the urban context.

3.48. The effects on the South Downs National Park and Heritage Coast were considered also to be significant and more problematic. Whilst the National Park Authority considered that the effects could only be mitigated by removing the array altogether Natural England indicated that effects could be mitigated by locating it at a greater distance from the more sensitive parts of the National Park and Heritage Coast to the north east. There was discussion about the term remote and Natural England stated, when pressed by the panel, that anything over 20km could be considered to be 'remote'. By way of mitigation the applicant proposed a reduced array area increasing the distance from Cuckmere Haven beach from 17.5 km to 20.2 km, from Birling Gap from 19.6 km to 22.8 km and from Beachy Head from 23.3 km to 25.8 km. The level of significant effects were agreed to remain the same. Natural England also stated that they believed that the revised array would still compromise and be in conflict with the National Park landscape/seascape objectives.

3.49. The size of array actually to be constructed is further still from the Heritage Coast and uses a relatively small turbine of 3.45 MW.

Figure 3.3 Rampion wind farm- Comparative photomontage extracts from Cuckmere Haven

Top image: Option F with 175 3.6MW turbines. Bottom image: Option D with 100 7MW turbines

Source: Rampion Offshore wind farm: Additional visualisations of the array to include structures exclusion zone, E.On, 2013

Walney Extension

3.50. The wind farm was given development consent in August 2014. It was for up to 110 x 222m high 7MW turbines amounting to 750MW running north west from existing arrays at Walney 1 and 2 and West of Duddon Sands and with other wind farms such as Ormonde and Barrow closer to the coast. In addition, the oil and gas platforms related to the Millom and Morecambe fields are in the area. The development was located 19km away from the Cumbrian coast at its nearest point and 25km to the Lake District National Park.

3.51. The SVIA considered that the individual effects on the main assessed viewpoint in the National Park at 28km (Black Combe, Bootle Fell) would be medium-low magnitude resulting in a major/moderate to moderate significance effect. Overall, the effects on the National Park were considered negligible. With regard to combined cumulative effects, the effect on Black Coombe was considered to be up to major/moderate, depending on the scenario. The effect on the National Park was considered to remain negligible.

3.52. The Examining Authority panel visited the area including Black Combe when visibility was good to variable. Their experiences serve to underline the influence of meteorological and atmospheric conditions in limiting visibility. They were in general agreement with the SVIA's predicted magnitude of impact on considered that the experience on Black Combe would be unlikely to diminish due to the development.

Navitus Bay

3.53. Navitus Bay wind farm was refused consent in June 2015. The application layout was for 194 X 5MW 165m high turbines or 121 x 8MW 200m high turbines. This represented a reduction in size from the West of Wight Round 3 zone and the original layout option considered.

3.54. The SVIA study area was for up to 45 km from the array. The SVIA was prepared on the basis that the 8MW turbine option was the worst case due to the greatest theoretical extent of visibility. These were reduced to a 'turbine area mitigation option' (TAMO) of a maximum 105 turbines (if 6MW) during the course of the Examination period (The Planning Inspectorate, 2015, 7.4.5). The TAMO layout extended around 12.5km by 9.5km at its widest points.

3.55. There were a large number of national designations intervisible with the proposal in these were regarded by the Examining Authority panel as fundamental to the balance of judgement. They focused their attention on the receptors held to contribute to the qualities for which the AONBs or National Park designations were founded (The Planning Inspectorate, 2015, 7.3.8).

3.56. The TAMO increased the distance from these designated areas. These included the Dorset AONB and Purbeck Heritage Coast at Durlston Head from 14.3km to 18.8 km to the north west and St Adhelm's Head from 19km to 23.2 km; the Isle of Wight AONB and Heritage Coast: Tennyson Coast at The Needles from 17.6 km to 21.9km to the north east; and the New Forest National Park at Hurst Castle from 22.9km to 27.1 km to the north east.

3.57. Picking up from the Rampion Examination, the applicant claimed that anything over 20 km could be classed as 'remote' and that significant impacts on receptors would not occur at this distance or above. The panel disagreed with both points in relation to the Navitus Bay proposal as each case had to be looked at its own merits and the context of the project was considered to be different from Rampion.

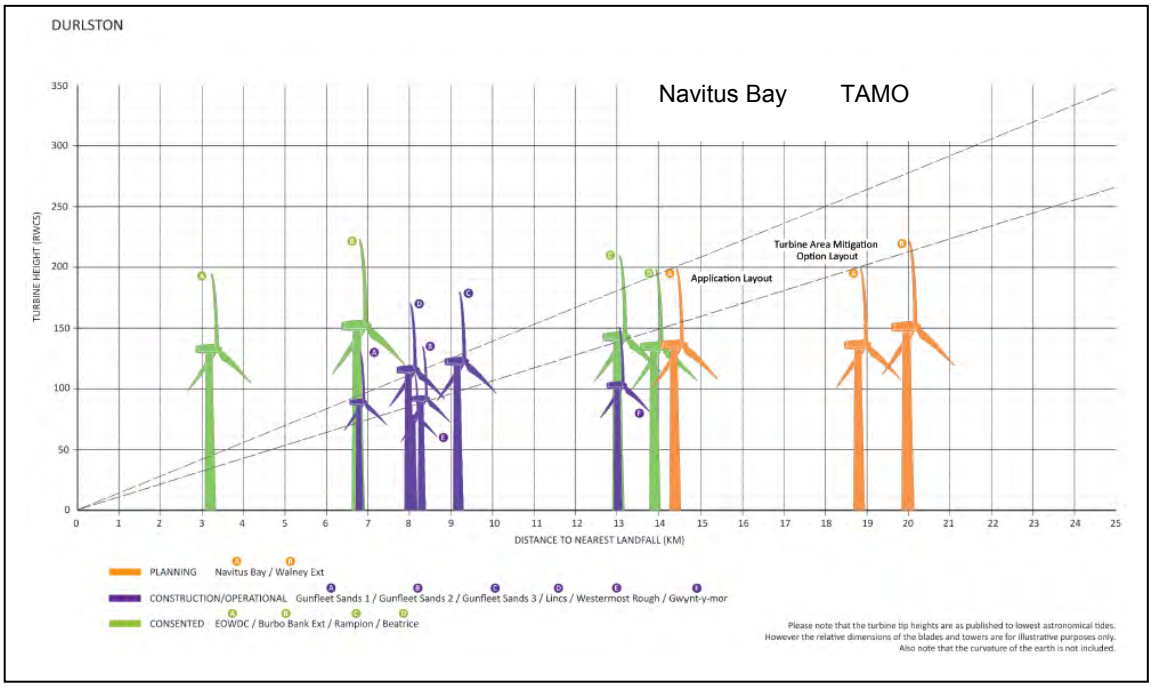
3.58. The appellant produced a number of diagrams comparing the height of turbines at various distances of the nearest turbine in the application layout, the TAMO and operational or consented turbines elsewhere which were closer e.g. EOWDC and Burbo Bank Extension (see **Figure 3.4** below). The diagrams did not state if any of the other wind farms affected national designated landscapes/coasts or make clear that EOWDC was a demonstration project. The approach did not appear to influence the panel's views and reinforces the need to consider the effects of proposals on their own merits.

3.59. In relation to visual effects the panel disagreed with the appellant's assessment to an extent considering that there were more significant effects (see **Appendix B** for detailed comparison). In addition, the panel considered that the array had a significant effect on a view from Hurst Castle in the New Forest at a distance of 27km as it interfered with the view of the Needles.

3.60. In respect of effects on the Dorset AONB and related Heritage Coast the panel considered that the proposal would be an imposing feature affecting key qualities of tranquillity, remoteness and uninterrupted panoramic views. It would maintain a continuous presence in views along the exceptional undeveloped coastline (including views from 19-23.5 km) and cause significant harm to the core qualities of the AONB and the Heritage Coast and the way they are experienced (7.4.38).

3.61. In respect of the Isle of Wight AONB and related Tennyson Heritage Coast, the panel considered that significant harm would be largely confined to sub-area A1 of the AONB. However because of the relative proximity to distinctive features such as The Needles (22km) and Tennyson Monument (23km) and Down and the role they play in the wider visual experience of the AONB, the qualities of the designations would be unacceptably and significantly harmed.

Figure 3.4 Navitus Bay- Comparing turbine heights and distance offshore with other schemes



Source: LDA, 2015, Navitus Bay, Response to Deadline V, Appendix 11 Update Turbine Height and Distance from Shore Comparison.

3.62. In respect of the New Forest National Park the panel felt that there was a significant effect on the view from Hurst Castle at 27 km towards the Needles. However, other views along the Solent Way were not considered significant and effects on the qualities of the National Park as a whole would not be significantly affected. This was agreed with Natural England. This is not surprising as Hurst Castle is at the most southerly point of the Park and the majority of the Park is inland and relatively flat, with the coast orientated south-east towards the Solent.

3.63. It should be noted that the effects on the Dorset and East Devon World Heritage Site (WHS) also contributed to the overall decision. Whilst this is a heritage designation with a different method of assessment of effects, there are overlaps with seascape and visual considerations. WHSs are experienced by people who enjoy views and their setting and they can also contribute to overall coastal seascape character. The Examining Authority noted that the management plan indicated that the experience of the site and its immediate setting, including views, contribute to the site's importance. They considered that the experiential aspects of the WHS could not be disassociated from the special qualities of the AONB (9.3.20) and were valid as a proxy for it. Overall they concluded that the harm caused to the setting of the Site, the 'less than substantial harm' to its significance and the harm to its Outstanding Universal Value carried significant weight against the decision to make the order (21.2.33). This conclusion also extended to the TAMO.

Burbo Bank Extension

3.64. The wind farm was given development consent in August 2015. This was for 36 x up to 223m high 7.5MW turbines which ran west from an existing array. 8MW turbines 187m high were installed. The development was located 15km away from the northern edge of the Clwydian Range AONB at its nearest point. The AONB itself extends south beyond the 40km SVIA study area boundary.

3.65. The SVIA considered that the individual and combined cumulative effects on the nearest assessed viewpoint in the AONB at 18.43km (Craig Fawr) would be medium magnitude resulting in a major/moderate significance effect. The other viewpoint assessed, Moel

Famau at 34.5km, was considered to undergo negligible effects. Overall, the effects on the AONB were considered negligible.

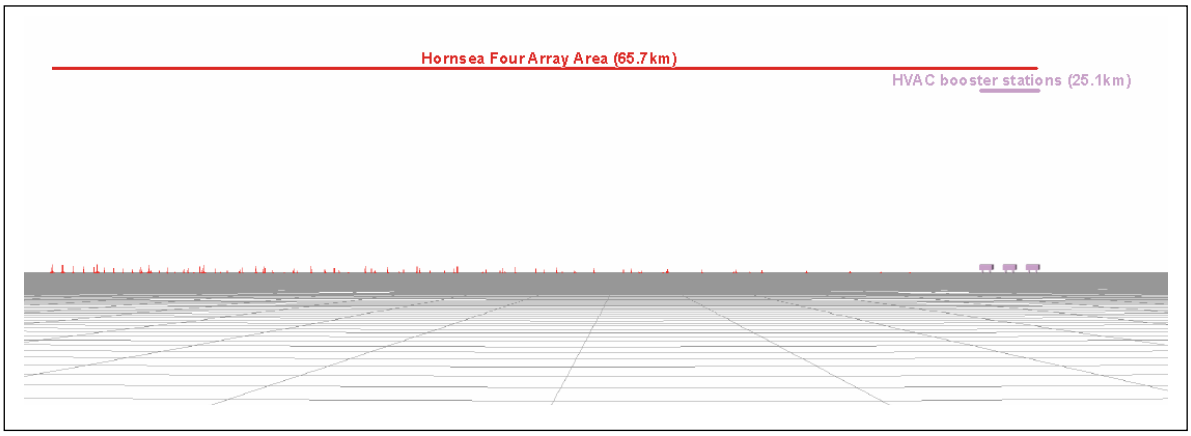
3.66. No specific instances of harm to the values of the AONB were raised in representations or evidence at the inquiry. The Inspector commented that he was satisfied that the proposal would be viewed from the northernmost extent of the AONB inland from Prestatyn and from upland outlooks in the Clwydian Range (4.133). However, these locations also provided views to other offshore wind farm developments and to substantial industrial and port development in Merseyside, Deeside and Cheshire. He considered that large areas of the AONB were affected by the application proposal to only the most minimal extent or not at all. In this context, he found that the purposes of the AONB designation would not be compromised by the application proposal.

CONSIDERATION OF ISSUES RELATING TO WIND FARMS LONG DISTANCES OFFSHORE

3.67. With increasing scales of wind farm development and distances offshore the study area limit for assessment of seascape/landscape and visual effects is increasing. The limits are defined at scoping stage as the distance beyond which it is considered that significant effects are unlikely to occur. As well as the size of wind farms and wind turbines other factors include visibility, meteorological conditions, the curvature of the Earth and visual acuity. In the past many offshore wind farms SVIAs have set a study area of 40km from the edge of development e.g. Greater Gabbard with 170m to blade tip turbines. This is increasing with increasing turbine height e.g. 45km for Thanet extension with 250m high turbines. East Anglia TWO wind farm used a study area of 50km for 300m high turbines, agreed with the Planning Inspectorate at scoping stage. The latter development's Preliminary Environmental Information Report (PEIR) discusses visibility and meteorological data in some depth (PEIR Appendix 28.7). This argues that there is a limit to visibility and likely significance of effect even for larger developments due to a range of factors. This issue relates to the limit of visual significance which will be discussed in Part 2 of this report.

3.68. Offshore wind farms require voltage to be stepped up by transformers in substations for transmission on shore. Wind farms at considerable distances offshore may require booster stations closer to shore. An example is Hornsea 4 where potentially three offshore high voltage alternating current (HVAC) booster stations up to 100m high are proposed at around 25km offshore compared to the 65km + of the wind farm offshore (see **Figure 3.5** below). If a DC export current type is used the substations will not be necessary. The HVAC substations have the potential to have a larger visual effect than the wind farm itself and would certainly be visible on a larger number of days due to visibility considerations e.g. haze etc (discussed in Part 2 of the report). The degree of significance of effect would be a matter for assessment on an individual basis. As the structures are relatively small in number and are substantially lower than the wind turbines they serve, they are not factored into the buffer distances for offshore wind farms in this report. They may only become a notable factor if there are cumulative effects with other substations or wind farms closer to shore. This should be monitored and considered in future OESEA reports.

Figure 3.5 HVAC booster substations in relation to offshore wind farm



Source: Hornsea Project Four: PEIR Volume 5, Annex 11.2: Seascape, Landscape and Visual Resources Visualisations. Viewpoint 1 Flamborough Head. (OPEN for Orsted).

Summary

3.69. Since 2009 there has been a very substantial increase in the number of turbines consented and implemented. The majority have been in the North Sea with the larger schemes long distances offshore. However, some demonstration schemes with large turbines have been consented close to shore. The average size of wind farm has increased and the consented/operational turbines capacities now range from 3.6MW through to 12.5MW. Elsewhere, developers have opted to implement schemes with smaller turbines, although they have a consent option to use larger turbines.

3.70. The first floating turbine wind farm used for deep water is now operational in Scotland- Hywind. The implication is that deeper waters off England and Wales may also now be considered for future search areas. These would include seas off the western seaboard peninsulas as well as parts of the North Sea off the coast of north east England. However, in the immediate future, the Crown Estate have launched Offshore Wind Leasing Round 4 for new seabed rights in four broad areas up to 60m water depth- Dogger Bank, Eastern Regions, the South East and Northern Wales and Irish Sea.

3.71. In the case studies, the following conclusions may be drawn:

- Medium magnitude of effects leading to major/moderate significant effects were accepted as significant by Examining Authority panels and inspectors.
- One significant visual effect on a visual receptor within a designated area does not necessarily mean that the effect on the area as a whole is significant or sufficient to withhold consent (e.g. Lake District/Walney).
- Where a designated area and its special qualities are entirely land based (as opposed to coastal) and where there is minimal relationship between the designation and the coast/sea then the effects are not likely to be significant (e.g. Clwydian Hills/Burbo Bank extension).
- Where other significant developments are located on the coast such power stations or larger urban areas the effects of offshore wind farms is reduced (e.g. Lake District/Walney, Clwydian Hills/Burbo Bank extension).
- Where there are existing offshore wind farms, inspectors tend to use this as a justification for allowing further development (e.g. Lake District/Walney, Clwydian Hills/Burbo Bank extension).
- Many proposals took the 'Rochdale Envelope' approach with options of smaller turbines covering a greater extent or larger turbines covering a more limited area. In some cases the former was considered the option having a greater effect.

- Where a proposed offshore wind farm is located along the coast from a designated area only allowing oblique views at more than 20km, effects were considered insufficient to withhold consent (Rampion).
- Where a designated area and its special qualities are related to the coast it is likely to be more sensitive to offshore wind energy (Dorset Coast, Isle of Wight AONB/Navitus).
- The combination of National Park or AONB, coinciding with Heritage Coast, appears to be considered as particularly sensitive (Dorset AONB and related Heritage Coast, Isle of Wight AONB and Tennyson Heritage Coast/Navitus).
- Where there are several designated areas directly overlooking an area of sea and affected by an offshore wind farm there is more likelihood of significant effects which are sufficient to withhold consent (Navitus).
- The maximum distance of a significant effect on a viewpoint influencing a refusal is 27km, with several other viewpoints with significant effects of over 23km being recorded (Navitus).
- It is clear that Examining Authorities and Inspectors take the view that each case is considered on its own merit.

4. Planning context and policy basis

4.1. Legislation formalising a marine spatial planning process has been established in the UK for more than ten years and policy is also being developed and implemented by agencies at a devolved regional level. In addition, terrestrial polices relevant to seascape and offshore wind farms have become established in England and Wales, such as National Policy Statements for nationally significant infrastructure projects. Policies may change in the light of the Climate Emergency declared by the UK Parliament on 1 May 2019.

4.2. This chapter concerns the legislation and polices which relate primarily to England's waters, although reference is made to other devolved administrations.

UK WIDE CONTEXT

Planning Act 2008

4.3. The Planning Act 2008 brought in a number of measures including National Policy Statements (NPSs) and the concept of Nationally Significant Infrastructure Projects (NSIPs). In respect of marine issues this was amended by the 2009 Act below.

Marine and Coastal Access Act 2009

4.4. The UK Government introduced eight key measures to help ensure 'clean, healthy, safe, productive and biologically diverse oceans and seas'. The measures included the introduction of a marine planning system and the setting up of the Marine Management Organisation (MMO) delivering marine functions in English territorial waters and UK offshore waters for matters that are not devolved. The Act requires that all public authorities should undertake planning decisions should do so in accordance with the Marine Planning Statement.

UK Marine Policy Statement

4.5. The Marine Policy Statement (MPS) was published in 2011 and acts as the policy framework for preparing marine plans throughout the UK. The UK vision for the marine environment is for *'clean, healthy, safe, productive and biologically diverse oceans and seas'* (2.1.1). The high level objectives (page 11, Box 1) include:

'….Ensuring a strong, healthy and just society:

- *People appreciate the diversity of the marine environment, **its seascapes**, its natural and cultural heritage and its resources and act responsibly…..' (my bold)*

4.6. The statement indicates that there is no legal definition of seascape but reiterates the European Landscape Convention (ELC) definition of *'an area, as perceived by people, whose character is a result of the action and interaction of natural and/or human factors'* (2.6.5.1). The text states that references to seascapes should be taken as meaning *'landscapes with views of the coast or seas, and coasts and the adjacent marine environment with cultural, historical and archaeological links with each other'*.

4.7. When considering the impact of an activity the marine plan authority (MPA) '*should take into account existing character and quality, how highly it is valued and its capacity to accommodate change...'(2.6.5.3)*. For any development relatively close to nationally designated areas such as National Parks, AONBs and Heritage Coasts, the MPA should have regard to the specific statutory purposes. Design should be taken into account as an aid to mitigation.

England-planning context

4.8. Four of the ten marine plans (South and East inshore and offshore) have been completed. The others are out to statutory consultation (the North West, North East, South West and

South East marine plan areas) (see **Figure 4.1**). The outstanding plans are to be adopted by 2021. The completed plans are discussed below. A significant proportion of the content of the early marine plans is inherited from existing approaches.

4.9. The **East Inshore and East Offshore Marine Plans** were the first two to be completed, in April 2014. The inshore area extends out from the mean high water mark to the territorial limit. The offshore area extends from the territorial limit to the boundary of the Exclusive Economic Zone. As part of the baseline, a seascape character assessment (MMO, 2012) was carried out identifying ten seascape character areas (SCAs). Policy SOC3 (page 58) states that proposals should demonstrate, in order of preference:

A) that they will not adversely impact the terrestrial and marine character of an area

B) how, if there are adverse impacts, they will minimise them

C) how, if they cannot be minimised, they will be mitigated against

D) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts

4.10. The Plans support offshore wind farms including Round 3 zones in Policy WIND2 (page 121).

4.11. The Seascape Character Assessment published in October 2012 was used as a pilot study to test the NECR105 approach to seascape assessment and formed the basis of NECR106. The report defines the boundaries of areas and describes their key characteristics, physical influences, cultural influences and aesthetic and perceptual qualities (see **Figure 4.2**). There is no assessment of sensitivity so the assessment is limited in use at assisting in determining buffers at an SEA level. Clearly it is useful for informing regional policies and SVIAs.

4.12. The South Marine Plan for the **South Inshore and South Offshore areas** was adopted in July 2018. Objective 9 is to consider seascape and its constituent marine character and visual resource, recognising the links with the adjacent landscapes. The contextual text specifically mentions designated landscapes.

4.13. The effects of development including offshore wind farms on seascape and landscape should be considered. This is stated as not only important for individual character areas, but also often for the contributions they make to nationally designated areas, and their setting (481).

4.14. The same test/policy wording for seascape (Objective 9, Policy S-SCP-1) is followed as for the East MPA Policy SOC-3, set out above.

4.15. The plan is supported by a seascape assessment (MMO Project Number – MMO1037 dated June 2014). This identified 14 marine character areas- three offshore and eleven roughly following the inshore boundary and apparently primarily defined by changes in the coastal character (see **Figure 4.2)**. Each area is described in an overview, with key characteristics, natural influences, cultural/social influences, aesthetic and perceptual qualities.

4.16. The intervisibility of the land and sea i.e. the degree of land with sea views and sea viewed from land are mapped. There is a concise description of the areas with the highest visibility. This work refines and builds on similar intervisibility mapping exercises carried out in Wales in previous studies in the early 2000s. MMO and NRW commissioned an expansion of the mapping to cover all of England's and Wales' territorial waters to produce a comprehensive and compatible dataset (see **Figures 4.3 - 4.5)**.

4.17. Overall, it is considered that the datasets help inform the relationship between land and sea and the description of seascape/marine character areas. High intervisibility may also be an indicator of sensitivity, especially where this occurs in a designated area. However, this is not necessarily the main determinant of sensitivity or importance and therefore has

to be treated with caution. Overall, this dataset is not considered to help determine potential visual buffers for offshore wind farms at a strategic level.

4.18. The national seascape assessment for England was published in September 2018. This included the remaining marine character assessments for the North West, North East, South West and South East marine plan areas. These are consistent in content with the South MPA.

Wales Planning context

4.19. The Welsh National Marine Plan has recently been published. The Wales Act 2017 means that consent for wind farms below 350MW is devolved to Welsh Ministers but those above are a matter for the UK government and remain of relevance to OESEA4. It is likely that the large-scale offshore developments associated with future developments will exceed the 350MW threshold.

National infrastructure planning- England and Wales

4.20. Since the Planning Act 2008 (as amended by the Localism Act 2011) responsibility for development consent applications for nationally significant infrastructure projects (NSIPs) has been passed to the Planning Inspectorate (PINS). PINS examine the applications and make recommendations to the Secretary of State at BEIS. Usually a panel of 3 or 4 inspectors make up the PINS 'Examining Authority'. Offshore wind farms with a capacity above 100MW are NSIPs.

4.21. National Policy Statements (NPSs) for energy were approved in July 2011. The NPSs applying to offshore wind farms are EN – 1 Overarching Energy and EN – 3 Renewable Energy Infrastructure. These are important as they set the framework within which PINS examine the landscape and visual impact of the proposed developments. (Seascape is taken to be within the meaning of landscape.) It should be noted that the NPSs have not been updated, for example to reflect devolution settlements.

EN-1

4.22. EN-1 states that the landscape and visual impact assessment (LVIA) should reference any landscape character assessments and associated studies and the 'visibility and conspicuousness' of the project and potential impact on views and visual amenity (5.9.7).

4.23. In terms of decision making, landscape effects will depend on the existing character of the local landscape, its current quality, how high it is valued and its capacity to accommodate change. The point is made that virtually all NSIPs will have effects on the landscape. Having regard to operational and other constraints, the aim should be to minimise harm to the landscape providing reasonable mitigation where possible and appropriate (5.9.8).

4.24. Nationally designated landscapes are confirmed as having the highest status of protection in relation to landscape and scenic beauty and their statutory purposes should be taken into consideration. The statement refers to development within these landscapes but also outside where they may be affected. The aim should be to avoid compromising the purposes of designations and such projects should be designed sensitively. However, the fact that a proposed project will be visible from within a designated area should not in itself be a reason for refusing consent (5.9.13). Some designated areas on the coast were specifically designated due to the land's relationship with the sea e.g. Pembrokeshire Coast National Park and Gower AONB. Others, which may run close to the coast but are designated for different reasons, may be considered to be less likely to be compromised.

4.25. Outside nationally designated areas, local landscape designations should not be used in themselves to refuse consent as this may unduly restrict acceptable development. The test is that the Examining Authority should judge whether any adverse impact on the landscape would be so damaging that it is not offset by the benefits of the project

(5.9.15). The reversibility of the development needs to be considered, as well as if the project has been designed carefully to minimise harm to the landscape.

4.26. The effects on sensitive receptors such as residents or visitors have to be assessed to establish if they outweigh the benefits of the project (5.9.18). Coastal areas are stated as being particularly vulnerable to visual intrusion because of potentially high visibility, effect on the skyline and on stretches of undeveloped coast. Examples of existing similar infrastructure should be used to assist decision-makers.

4.27. Reducing the scale of the project is cited as an option only in exceptional circumstances where mitigation could have a very significant benefit.

EN-3

4.28. EN - 3 specifically addresses offshore wind farms' seascape and visual effects. Seascape is stated as important resource and an economic asset in coastal landscapes which are often recognised through statutory landscape designations. The three principal considerations determining the likely effect of offshore wind farms are stated as:

- limit of visual perception from the coast;
- individual characteristics of the coast which may affect its capacity to absorb development; and
- how people perceive and interact with the seascape.

4.29. The assessment should be carried out in line with the DTI (2005) guidance. Where appropriate, cumulative SVIAs should be undertaken.

4.30. In terms of decision-making, consent should not be refused for development solely on the ground of an adverse effect on seascape or visual amenity unless:

- An alternative layout would minimise any harm;
- Taking account of the sensitivity of the receptors, the harmful effects are considered to outweigh the benefits of the proposed scheme.

4.31. It is expected that a reduction in scale of the wind farm is unlikely to be feasible due to the reduction in electricity generating capacity so, instead, the layout of the turbines should be designed appropriately to minimise harm (2.6.210).

4.32. For smaller projects (below 100 MW) the Marine and Coastal Access Act (2009) indicates that decisions are made by the Marine Plan Authority (MPA) – in the case of England, the Marine Management Organisation (MMO). When considering the impact of an activity it states that the MPA should take into account existing character and quality, how highly it is valued and its capacity to accommodate change (2.6.5.3).

Advice Note 9- Using the 'Rochdale Envelope (Version 3, July 2018)

4.33. When applying for a Development Consent Order (DCO) under the 2008 Planning Act, the developers will know the overall capacity of a wind farm but are unlikely to have decided on the turbine to be used. The choice of turbine influences the individual capacity, its height and rotor diameter, the resultant turbine spacing and foundation type, and the overall numbers of turbines. The 'Rochdale Envelope' approach is identified in EN-1 and EN-3 as a way of defining the worst case parameters in the DCO to allow flexibility. These parameters should identify the maximum and minimum likely number of turbines, the maximum and minimum hub and blade tip height and minimum separation distances to achieve a given maximum overall capacity within a defined area. The final implemented scheme may either have fewer larger turbines or a greater number of smaller turbines (but within the parameters set). As part of the process for assessing the likely seascape and visual effects, a range of possible options should be explored to a sufficient detail. These options should be consulted on allowing sufficient flexibility for changes to be

made. A cautious worst-case should be identified in order to feed in mitigation and to optimise the effects of the development on the environment.

4.34. The relevance to this study is that the worst-case scenarios in terms of seascape and visual effects differ in different developments. In some, larger turbines options are considered to be the worst case while in others a larger number of smaller turbines (e.g. 3.6 MW) at close spacings and/or a wider spread is considered worse than a smaller number of larger turbines with larger spacings (e.g. 7 MW). In the latter case it is not clear in some SVIAs what the likely effect of the larger turbines is. It also means that, using some SVIA evidence, it is possibly misleading to define different buffers for different sizes of turbines.

Consideration of designations

4.35. National Parks and Areas of Outstanding Natural Beauty (AONBs) originated under the National Parks and Access to the Countryside Act 1949 as amended by subsequent legislation including the Environment Act 1995 and Countryside and Rights of Way Act 2000 (CROW Act).

4.36. The designations were subject to a Landscapes Review published in 2019 (DEFRA). This made a series of recommendations including strong support for natural beauty, stronger purposes in law for national landscapes overall, renaming AONBs as 'National Landscapes' and giving them greater status in the planning system as statutory consultees, upgrading some larger AONBs to National Park status (including Dorset and East Devon), the formation of a new National Landscapes Service, updating the NPPF to reflect these changes and securing additional funding. The panel heard arguments in favour of further protection in relation to marine and coastal areas but did not include these in the final recommendations/proposals. Overall, this document's recommendations seek to strengthen these national designations.

4.37. The current statutory purposes of National Parks are to conserve and enhance the natural beauty, wildlife and cultural heritage of an area and to promote opportunities for the understanding and enjoyment of the special qualities of an area by the public. National Parks which reach the coast include Exmoor, Lake District, North York Moors, South Downs, New Forest and the Broads. These are illustrated in **Figures 3.1-3.2.**

4.38. The current statutory purpose of AONBs is to conserve and enhance natural beauty. AONBs on the coast are numerous and include North Norfolk Coast, Suffolk Coast and Heaths, Kent Downs, High Weald, Chichester Harbour, Isle of Wight, Dorset, East Devon, South Devon, Tamar Valley, Cornwall, North Devon, Quantock Hills, and Arnside and Silverside. These are also illustrated in **Figures 3.1-3.2.**

4.39. Where the reason for designation and the special qualities of the designations include the coast and/or seascape, the sensitivity of an area is increased and may merit increased buffers.

4.40. As part of the Round 4 regions refinement process, Crown Estate consultants undertook mapping of visibility from landscape designations for turbine tip heights of 250m above sea level (The Crown Estate, 2019 (1) and (2)). The designations included National Parks, AONBs, Heritage Coasts and World Heritage Sites. The mapping was intended to inform visual sensitivity and explored the degree of intervisibility of the sea from the designations (see **Figure 4.6**). However a number of limitations were identified with this approach as a proxy for sensitivity. Firstly, the shape of the designation influenced visibility, with Heritage Coasts as narrow strips of coastline and headlands giving a lower intensity of intervisibility than embayed areas. Second, there was insufficient assessment of sensitivity of each landscape designation to views. Finally, the complexity of the mapping was considered difficult to convert into buffers. Therefore, the mapping was given limited weight in the constraint analysis. Heritage Coasts were established to conserve the best stretches of undeveloped coast in England. These are non-statutory

landscape definitions agreed between Natural England and the relevant maritime authorities. They comprise of areas of coast more than 1 mile in length. Their purpose is to conserve, protect and enhance the natural beauty of the coastline and related flora and fauna and heritage features. They often overlap with National Parks and AONBs, reinforcing the importance of these coasts. They also occur in their own right where the hinterland does not have national landscape status. Examples of this include Lundy, the Durham Heritage Coast, Spurn Head and Flamborough Headland. Here they are important considerations and may merit an enhanced buffer depending on the reasons for their designation. Some may be more sensitive than others.

4.41. World Heritage Sites are designated by UNESCO according to their natural (physical, biological, geological) or cultural (historic, aesthetic, archaeological monuments and structures) attributes and should be considered to be of 'outstanding universal value'. Coastal related sites include the Dorset and East Devon Coast (Jurassic Coast) and Cornwall and West Devon Mining Landscape. It is suggested that these should be considered in two separate ways. Those that are large scale and/or substantially natural should merit buffers as for AONBs. Smaller sites can also merit buffers where the landscape/seascape setting and important views along the coast or offshore are stated as contributing to the site's designation. This may also apply where the site contributes to seascape character and the wider sensitivity of a seascape. These may merit an intermediate buffer depending on the reasons for designation.

4.42. The use of 'blanket' buffers on land outside a designation, such as National Park and AONB, is not normally supported by government planning decisions although the effects on statutory designations are considered important as indicated above. This approach may be justifiable onshore where there is potential for development to be screened by intervening landform or landcover. Offshore, there is no such screening from the coast outwards so buffers may have more justification. In cases where there is virtually no intervisibility, there may be a case for no buffers over and above that for medium sensitivity coastline. Areas such as The Broads may come into this category.

4.43. It is worth restating that buffers are a strategic level tool to identify where effects are likely and do not necessarily suggest no-go areas for development. These areas would need to be subject to careful further assessment should development be proposed within them.

4.44. There is an important distinction to be made between the contribution different sorts of designations make to a 'value' of a given seascape character area and the consideration of strategic buffers around individual designations. The purpose of this study is to consider the latter.

4.45. The effect of designations on potential buffers is dependent on the statutory importance of the designation in question. The only national statutory landscape designations in England and Wales are National Parks and AONBs. These merit large buffers as high sensitivity landscapes.

4.46. Local landscape designations may be related to the special qualities of the coast or seascape. However, they are considered to be too inconsistent to merit blanket treatment as high sensitivity receptors and though locally important do not justify buffers in their own right.

4.47. The presence of a National Trail should be considered as an indicator of sensitivity and buffers greater than that already provided by non-designated areas may be justifiable. However, there is a completed coast path around Wales and a coast path around England is scheduled to be completed in 2020. This does not mean that the entire coastline has equal sensitivity, potentially with more recent stretches having a lower sensitivity than established routes such as the South West Coast Path. The coast paths will pass through a variety of areas with different associated value and sensitivities and the sensitivity of

walkers is likely to generally reflect the area they are passing through. However, the fact that more people have access and are walking on these paths to enjoy views of the seascape is an important consideration.

4.48. Weighting of different designations for buffers in their own right was considered as part of the OESEA3 background report (White Consultants) as follows in **Table 4.1.**

Table 4.1 – Buffers in relation to Designations

Designation	Value to seascape	Effect on Buffer size
National Parks	Very High	large
AONBs	Very High	large
World Heritage Sites (*Landscape* size- e.g. Dorset and East Devon Coast)	Very High	large
Heritage Coasts	High	medium-large
National Trails (established paths prior to full Coast Path implementation e.g. South West Coast Path)	High	medium-large
World Heritage Sites (e.g. coastal castles, forts and ancient sites)	Medium- high	Contribute to capacity of marine character area
Large scheduled monuments	Medium- high	"
Historic Parks and Gardens	Medium- high	"
Local landscape designations	Medium- high	"

4.49. The OESEA3 background report (White Consultants) also suggested that overlapping of designations could be handled by applying the highest weighting. A key overlap was considered to be Heritage Coasts and AONBs/National Parks.

4.50. The OESEA3 White background report brought together buffers in a simplified form for small and medium – large offshore wind farms respectively. This concentrated on the 30 km buffer around National Parks or AONB's combined with Heritage Coasts with a lower distance buffer for medium sensitivity coasts. The intermediate buffers for single landscape designations were not illustrated. It was noted that the simple consideration of even distance buffers might not identify all areas which could be sensitive. These areas could include the Bristol Channel near to Lundy. Similarly, developments directly offshore from the most sensitive coasts may not be appropriate beyond 30km but maybe appropriate along the coast of medium sensitivity coastlines at lower distances. The main OESEA3 report simplified the reporting to include all National Parks, AONBs, Heritage Coasts and World Heritage Sites as high sensitivity receptors with other receptors as medium.

Summary

4.51. The Marine and Coastal Access Act 2009 introduced a system of formal marine planning in the UK. The UK Marine Policy Statement sets out the overall framework. A significant proportion of the content of marine plans, particularly the early plans, is inherited.

4.52. Seascape is a consideration and marine plan authorities should take into account existing character and quality, how highly it is valued and its capacity to accommodate change. Two Marine Plans in England have been completed with the rest at having completed

preliminary consultation stages. All associated national level seascape character assessments have been undertaken. These do not evaluate the sensitivity of seascapes and therefore cannot be factored into potential buffers at the SEA level.

4.53. The Welsh National Marine Plan has recently been published. The Wales Act 2017 means that consent for wind farms below 350MW is devolved to Welsh Ministers but those above are a matter for the UK government. It is likely that the large-scale offshore developments will exceed the threshold.

4.54. National Policy Statements EN-1 and EN-3 address national infrastructure planning in relation to renewable energy including offshore wind farms with a capacity above 100MW (or 350MW in Welsh waters). Nationally designated landscapes are confirmed as having the highest status of protection and their statutory purposes should be taken into consideration. Outside nationally designated areas, local landscape designations should not be used in themselves to refuse consent. The 'Rochdale Envelope' is a pragmatic approach to define the maximum parameters of a wind farm and constituent turbines as part of the consenting process. It illustrates that a range of sizes and numbers of turbines can be consented, although the worst case scenario is assessed within SVIAs.

4.55. National Parks, AONBs, Heritage Coasts and landscape-scale World Heritage Sites are the key designations relevant to consideration of wider visual buffers.

4.56. Policies may change in the light of the Climate Emergency declared by the UK Parliament on 1 May 2019.

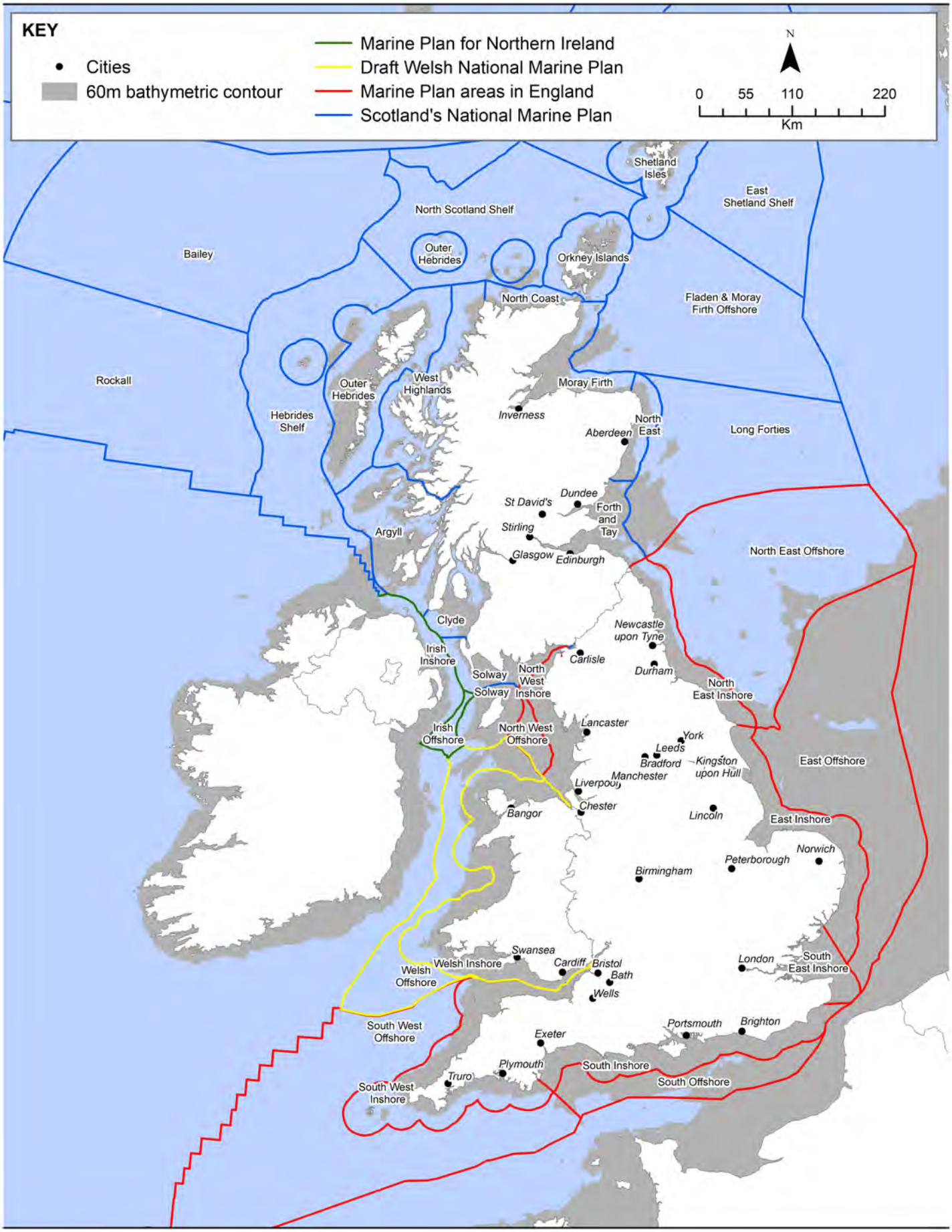


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Figure 4.1
Marine Plan Areas

28/09/19 | v1 | Drawn: HK | Checked SW

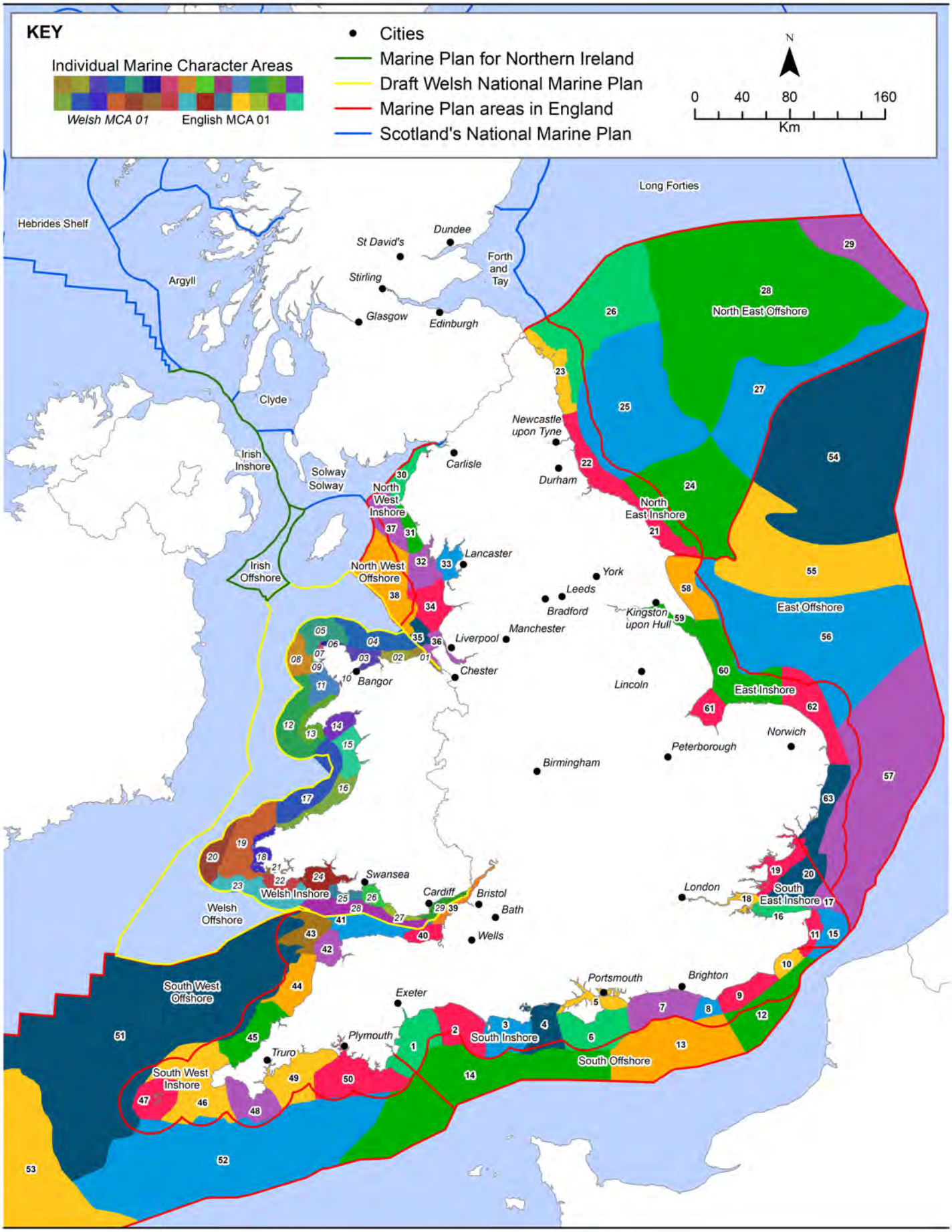

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Figure 4.2
Marine plan areas - Marine character areas

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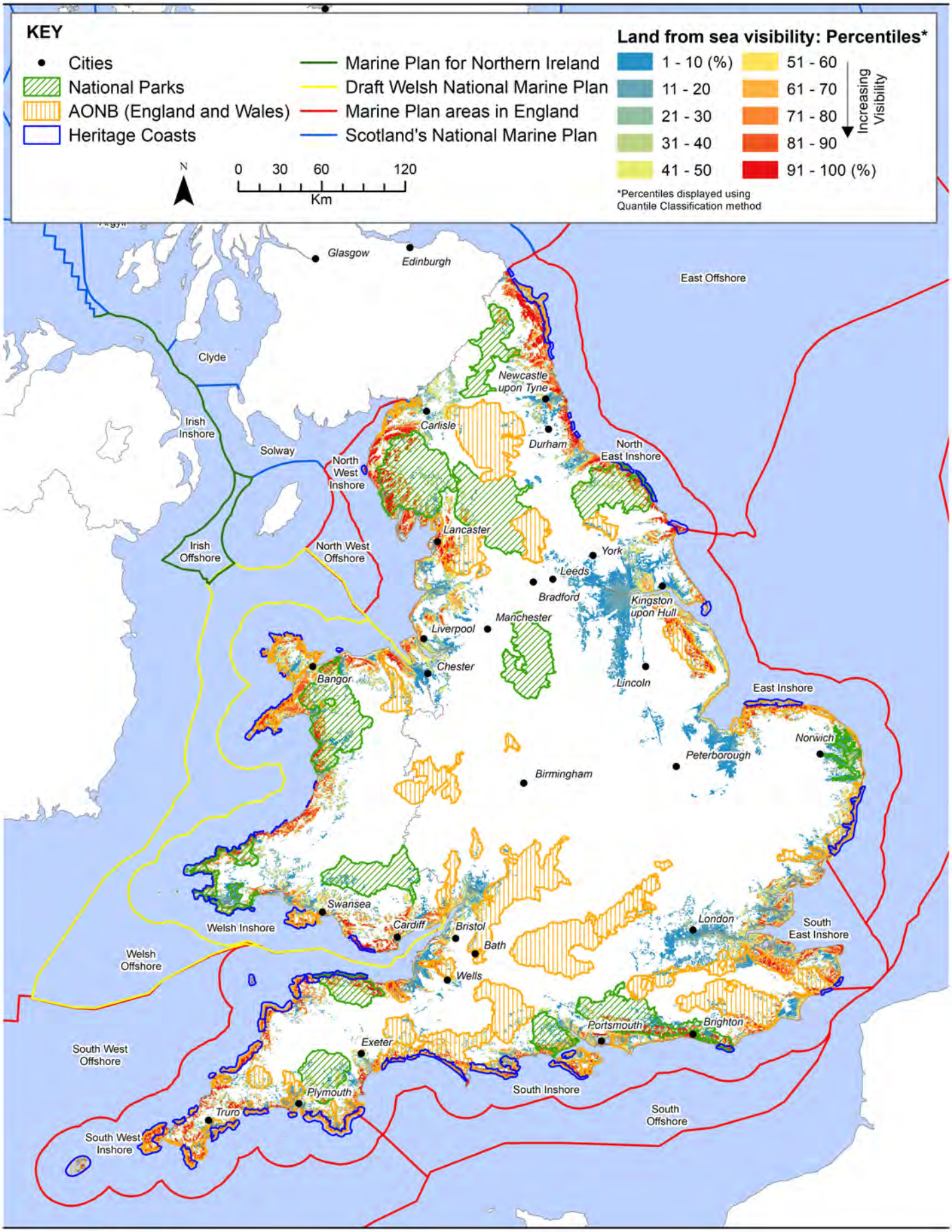

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Figure 4.3
Viewshed intervisibility of land from the sea

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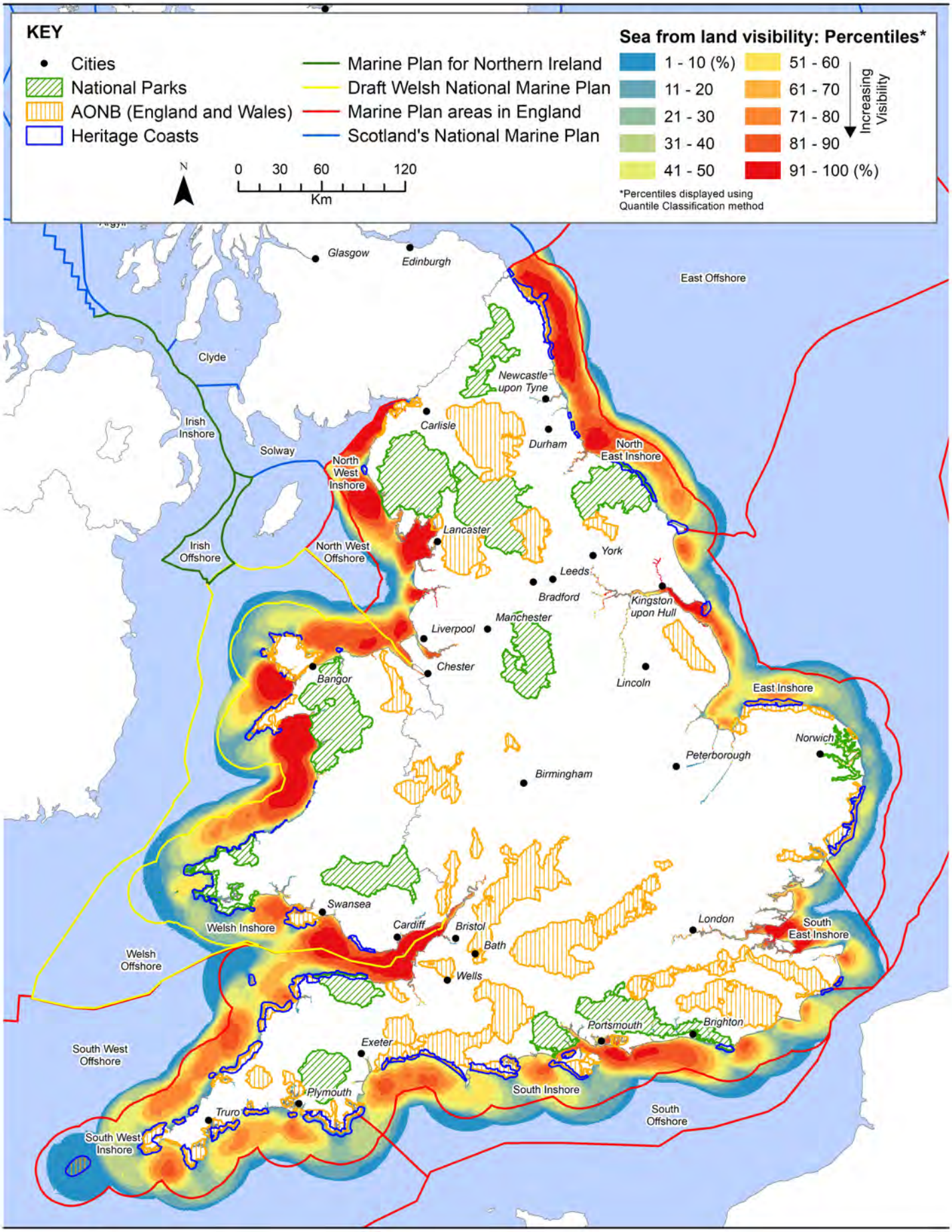

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Figure 4.4
Viewshed intervisibility of the sea from land

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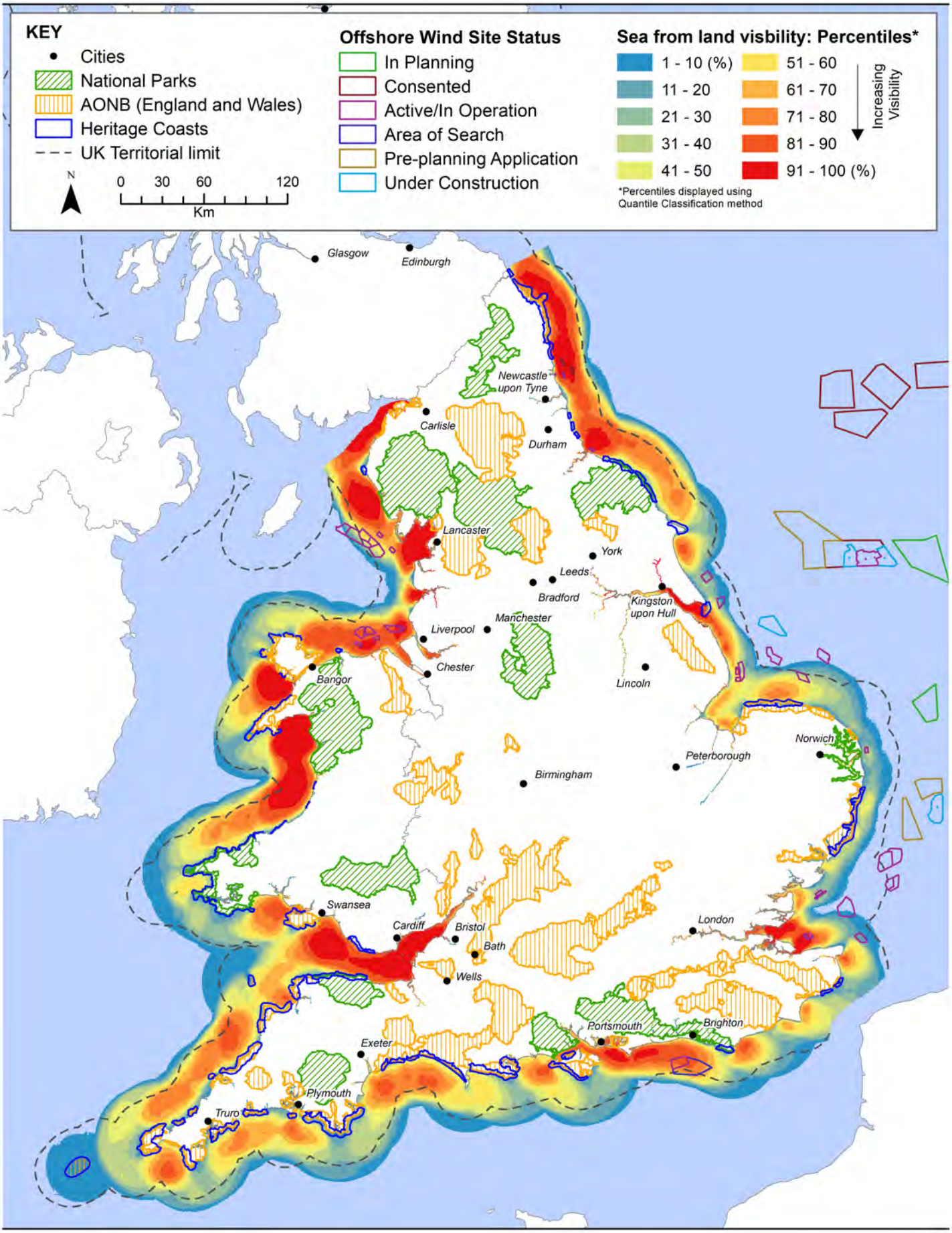

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Figure 4.5
Intervisibility of the sea from land

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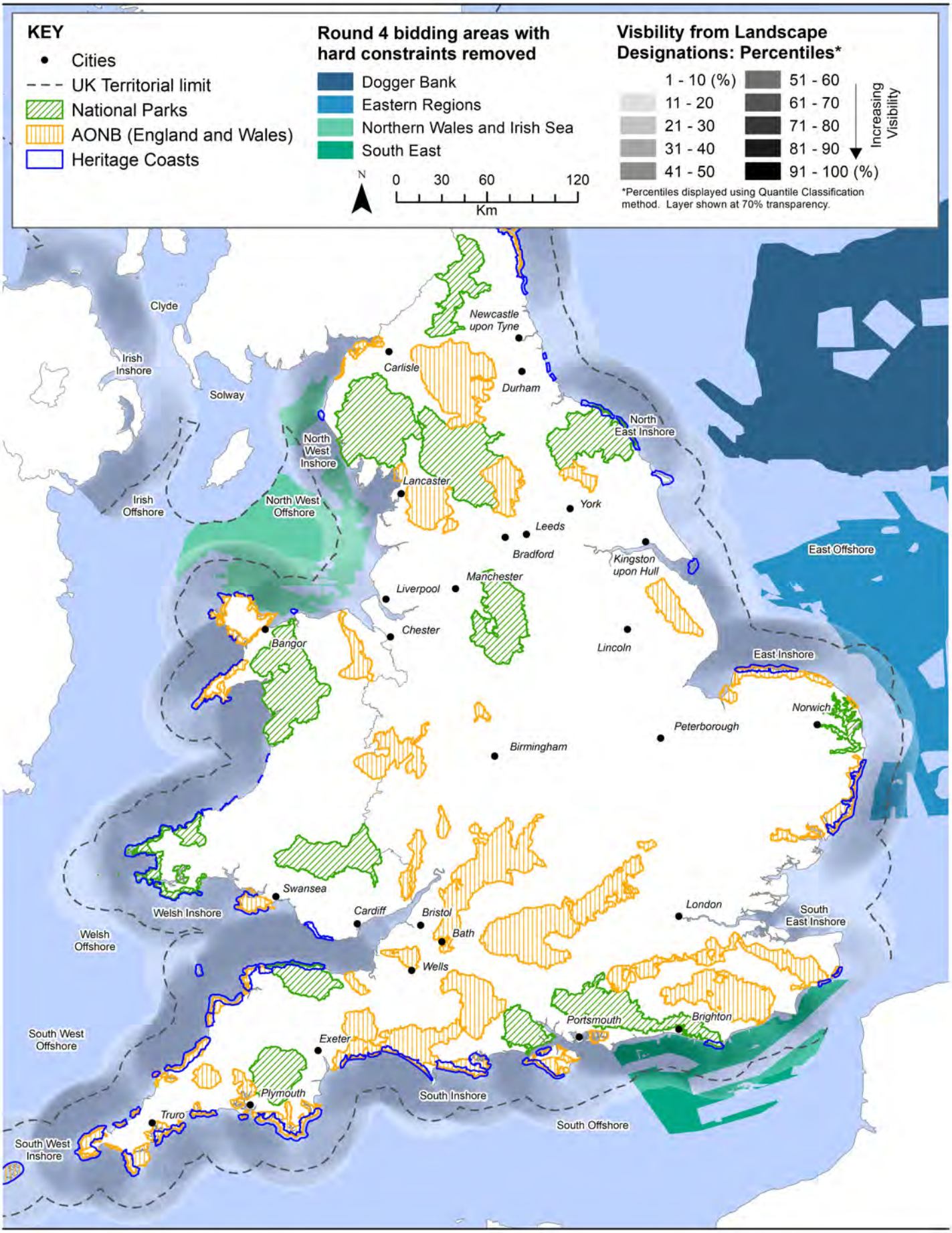

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17/02/20 | v3 | Drawn: HK | Checked SW

Figure 4.6
Round 4 offshore windfarm zones, with visbility from landscape designations model

5. Seascape and visual impact guidance

5.1. There are a number of guidance documents which are used to assess the seascape and visual impact of offshore wind farms. Some guidance has been used for some time whilst others have been updated since 2016. Most SVIAs refer to a number of documents to derive their project specific methods. The key guidance relevant to offshore wind farms is set out below.

Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report, (DTI, 2005)

5.2. This document is referred to specifically in relation to offshore wind farms in EN-3. The purpose of the seascape assessment method is to inform environmental impact assessment and therefore focuses at a detailed level. The document covers the recommended process of assessment, baseline studies required, sensitivity, predicting impacts and their magnitude, assessing significance and cumulative impacts.

5.3. Definition of a seascape unit is based broadly on the CCW Hill et al (2001) approach for a regional scale unit which is considered appropriate for assessing offshore wind farms. Whilst this is still used in Scotland, in England and Wales this has been replaced by the NECR 105 approach which defines marine character areas. This is discussed in a separate section below.

5.4. A fieldwork stage is regarded as essential for this level of assessment. Principles of visual perception are discussed including clarity, harmony, current contrast, and scalability. Key views are regarded as an essential component of data collected using a 35km seaward limit of visual significance.

5.5. The sensitivity of a seascape unit is defined as following the SNH (2005) study. However, this is not entirely transferable to England and Wales due to the NECR105 method on seascape character. However, the latter does not give guidance on this issue and so until more guidance is given (see MMO reference below) the principles are relevant.

5.6. Consideration of magnitude of change identifies quantifiable parameters which include distance, number and proportion of turbines visible, proportion of field of view and navigational lighting. Less quantifiable parameters include arrangement of turbines, background, aspect and weather and prominence of other built features in the view.

5.7. The report cites the Round 2 SEA Study (2003) in terms of thresholds for significance but states that a proposal for 100 turbine wind farm with 150m high turbines will have a different limit of visual significance to a proposal for 30 turbines 100m high. In order to inform decisions on magnitude of effect, it lists a series of factors (Figure 25, p75). These include:

Table 5.1 – Factors that tend to decrease or increase apparent magnitude

Factors that tend to decrease apparent magnitude (*sample*):	Factors that tend to increase apparent magnitude (*sample*):
Long-distances;	Short distances;
Small proportion of horizon occupied;	Large proportion of horizon occupied;
Small percentage of development visible;	Large percentage of development visible;
Integration through siting;	Strong contrast due to poor siting or layout;
Skylining;	Backgrounding;
Low visibility;	High visibility;
Absence of visual clues;	Visual clues;

Wind farm not focal point; Complex scene; Low contrast; and High elevation.	Wind farm is focal point; Simple scene; High contrast; Low elevation; and Night-time lighting.

5.8. Useful definitions of magnitude of change are set out to assist consistency of approach in **Table 5.2.** These are derived originally from the University of Newcastle Study (2002).

Table 5.2 – Magnitude of change: names, descriptors and definitions

Magnitude/ size class	Other terms used	Name	Descriptors – appearance in central vision field	Definition
Very Large	High, very high substantial, very substantial,	Dominant	Commanding, controlling the view, foremost feature, prevailing, overriding	Proposed offshore wind farm causes very large alteration to key elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is a fundamental change.
Large	Medium- high, moderate - substantial	Prominent	Standing out, striking, sharp, unmistakeable, easily seen	Proposed offshore wind farm causes large alteration to key elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is an unmistakeable change.
Moderate	Medium	Conspic-uous	Noticeable, distinct, catching the eye or attention, clearly visible, well defined	Proposed offshore wind farm causes moderate alteration to elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is a distinct change.
Small	Low, slight, minor	Apparent	Visible, evident, obvious, perceptible, discernible, recognisable	Proposed offshore wind farm causes small loss or alteration to elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is a perceptible change.
Very Small	Low, slight or minor-negligible	Inconspic-uous	Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite, subtle	Proposed offshore wind farm causes very small loss or alteration to elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is a distinguishable change.
Negligible		Faint	Weak, not legible, near limit of acuity of human eye	Proposed offshore wind farm causes negligible loss or alteration to elements / features / characteristics of the baseline seascape or visual conditions (pre-development) such that there is no legible change.

5.9. These terms are considered to remain valid and are used frequently in SVIAs. They are also used in the wireline analysis in this study.

5.10. Significance is derived from combining the sensitivity of a receptor and the magnitude of change. **Table 5.3** sets out how this is suggested in the guidance:

Table 5.3 - Significance of effects

Landscape and visual sensitivity	Magnitude of change				
	Very large	**Large**	**Moderate**	**Small**	**Very small**
Very high	Major	Major	Major	Major/ moderate	Moderate
High	Major	Major	Major/ moderate	Moderate	Moderate/ minor
Medium	Major	Major/ moderate	Moderate	Moderate/ minor	Minor
Low	Major/ moderate	Moderate	Moderate/ minor	Minor	Minor/none
Very low	Moderate	Moderate/ minor	Minor	Minor/none	None

Note: Those boxes of significance of effects shaded orange are considered to be significant effects, those shaded yellow may be significant. Those which are not shaded are considered not to be significant.

5.11. This indicates that major and major/moderate effects are significant. It is stated that effects of moderate significance are most likely to be not significant, but it is feasible that they could be judged as significant, depending on the particular circumstances arising.

5.12. Navigation lighting is considered very much a secondary visual effect due to the curvature of the earth, association with shipping and the presence of few receptors at night. The report does not, however, address aviation lighting.

5.13. Climatic and atmospheric conditions are said to affect visibility particularly in coastal situations. Data should be obtained as part of the baseline for a seascape area including visibility over a 10 year period, using a visiometer. It should be used to influence the magnitude of visual change.

Guidelines for Landscape and Visual Impact Assessment (GLVIA3)

5.14. The Guidelines for Landscape and Visual Impact Assessment were revised in a 3rd edition in 2013 (Landscape Institute, 2013). The guidance defines seascape as per the UK Marine Policy Statement and states that any assessment should carefully consider the relationship between land and sea in coastal areas and also take account of possible requirements to consider the open sea (2.9). Methods to assess the character of seascapes are being developed and the latest available guidance should be referred to. The guidance text does not refer to the DTI (2005) guidance for assessing offshore wind farms. As such it is not considered to supersede it and both documents are relevant in the context of other emerging guidance and studies. A review of SVIAs for individual wind farms bears out this approach (e.g. Navitus, Rampion, Burbo Bank Extension).

5.15. The principle of determining **significance** of effect is through combining the consideration of the sensitivity of receptor with the magnitude of effect. Landscape/ seascape **sensitivity** is explicitly derived from combining the **susceptibility** of the receptor to a

type and scale of development with the **value** of an area. The latter is divided into international, national, local or community value.

5.16. The **magnitude** of seascape or visual effect (6.38-6.41) is stated as combining consideration of the *scale or size of effect* with the *extent* of the area affected and *duration/reversibility* of that effect. The size or scale of effect includes consideration of:

- the scale of change in the view including the proportion of the view occupied by the proposed development
- the degree of contrast or integration
- the nature of the view in terms of the relative amount of time over which it will be experienced on whether views will be full, partial or glimpses.

5.17. The geographical extent of the visual effect is likely to reflect:

- the angle of view in relation to the main activity receptor,
- the distance of the viewpoint from the proposed development
- the extent of the area over which the change would be visible (combining a number of viewpoints such as on a coastal footpath or over a designated area).

5.18. The duration and reversibility of visual effects considers the amount of time that the development is likely to be present and whether it can be removed at the end of that period. Offshore wind farm would normally be in position for 25 years + (within up to a 60 year lease period) and so this can be considered to be long term but reversible.

5.19. The first two factors of scale of change and extent overlap. For instance, the distance of a viewpoint from the proposed development will determine the scale of change in the view.

5.20. The relative weighting of the three main factors are not specifically discussed in the guidance. There are some practitioners who give them equal or almost equal weight. This means that there is potential for the overall magnitude of effect to be less than the scale of effect alone. However, others give most weight to the scale of effect and extent (in terms of distance). As offshore wind farms are long-term, the overall magnitude of effect is therefore often at the same level as the scale of effect. For a study of this nature, it is sensible to take the precautionary approach and consider that the scale of effect is likely to be at a similar level to the magnitude of effect.

5.21. The GLVIA discusses cumulative effects, setting out the alternative approaches of assessing the combined effects of existing and proposed developments or just the additional cumulative effects of a given development. Neither approach is given more weight than the other. It is considered that the combined effects of developments is the most important concern at a strategic level.

NECR105 An Approach to Seascape Character Assessment

5.22. NECR105 was published by Natural England in 2012. It is a very concise document which defines terms, sets out five principles of seascape character assessment (SCA) and carries out an overview of process and capacities. There is no detailed guidance on how to carry out a seascape character assessment. The principles are:

- Landscape is everywhere and all landscape and seascape has character
- Seascape occurs at all scales and the process of seascape character assessment can be undertaken at any scale.
- SCA should involve an understanding of how seascape is perceived and experienced by people.

- SCA provides an evidence base to inform a range of decisions and applications.
- SCA can provide an integrating spatial framework.

5.23. The process for SCA is stated as similar to landscape assessment resulting in the definition and description of Seascape Character Areas and Types with the coastal boundary being the High or Low Water Mark. The output provides a seascape character baseline from which the assessment of the effects of different types of development can be built using other guidance. Guidance on determining the sensitivity of an area is not given.

5.24. All the regional seascape character studies carried out for MMO and Natural England have followed this guidance. These have already been discussed in Chapter 4.

Seascape and visual sensitivity to offshore wind farms in Wales (NRW)

5.25. In 2019 NRW published a strategic assessment and guidance for seascape and visual sensitivity to offshore wind farms in Wales' draft Marine Plan areas. The purpose of the project was to influence and guide the siting of wind farms as part of the Crown Estate Round 4 process. Whilst this report only applies to Welsh waters it is relevant to this report.

5.26. The report is in three parts:

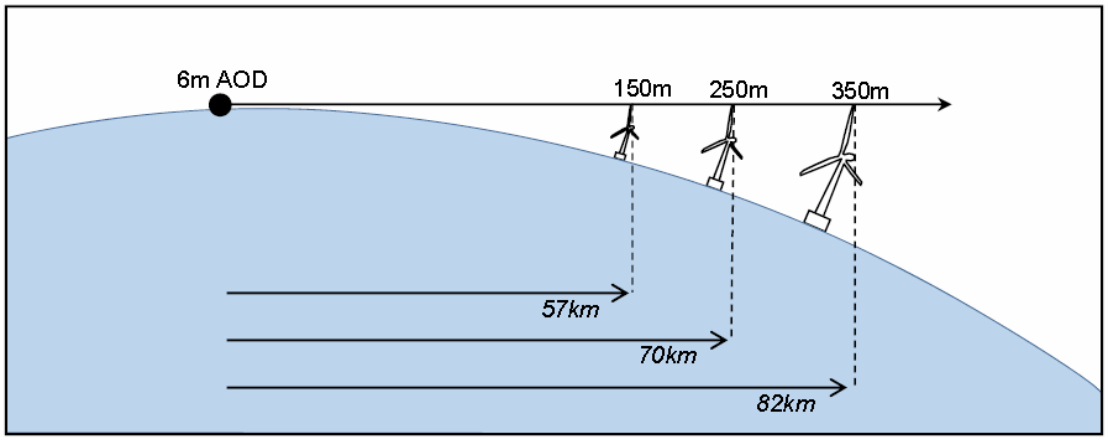
1. A visual effects ready reckoner showing the recommended distances from National Parks and Areas of Outstanding Natural Beauty (AONBs) in relation to different turbine heights up to 350m.
2. A guidance note setting out what offshore wind farm developers need to know in relation to seascape and visual effects at their site search stage.
3. A seascape sensitivity assessment for offshore wind farms in Wales' Marine plan area.

5.27. The most relevant to this study are Parts 1 and 3.

5.28. Part 1 researches and maps buffers for different heights of turbines required to avoid significant adverse effects on high sensitivity coastal visual receptors. The primary analysis reflects and builds on that carried out for the OESEA3 background study (White Consultants, 2016).

5.29. A series of factors are taken into account including physical factors such as curvature of the earth for a range of turbine sizes (see **Figure 5.1**). This indicates that large turbines can theoretically be seen above the horizon for long distances even when viewed from close to sea level.

Figure 5.1 Effect of curvature of the earth on visibility of turbine (Source: NRW (2019))



5.30. The SVIAs of 23 suitable offshore wind farms with turbines of different height are analysed. These are proposed or located in England's, Wales' and Scotland's waters. The ranges considered are low and medium magnitudes of effect. Combined with a high sensitivity receptor, a low magnitude of effect is likely to result in an effect of 'moderate' significance. A medium magnitude of effect is likely to result in an effect of 'major-moderate' significance. It is noted that that a moderate effect can potentially be significant, and that major-moderate is classified as significant in the vast majority of SVIAs. Both the average and maximum distance for low and medium magnitude of effect are recorded. Cumulative effects have also been noted and used where a wind farm is an extension to an existing large array.

5.31. The SVIA analysis only considers the effects of turbines up to 300m high due to the limited number of suitable SVIAs available during the research period. Therefore a wireline analysis for 350m high turbines is carried out. The wireline scenarios show an array of 350m high wind turbines in juxtaposition with arrays of 145m and 225m turbines where they all appear the same height. In theory, this means that the 350m high turbines at the located distance would potentially have a similar visual effect notwithstanding variable factors that affect visibility over distance such as haze.

5.32. The combined findings of the SVIA and wireline analysis are as follows:

Table 5.4 Summary of NRW SVIA analysis findings

Range of turbine heights to blade tip (m)	Low magnitude of effect *		Medium magnitude of effect	
	Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
107-145	22.6	27.3	14.0	15.0
146-175	24.4	26.5	18.8	20.8
176-225	28.5	32.0	22.0	26.7
226- 300	41.6	52.7	27.9	31.4
301-350	44.0	-	32.8	-

*Low magnitude of effect also includes equivalent effect of slight or minor

5.33. The report notes that a very approximate rule of thumb ratio between turbine height and distance for an average low magnitude of effect is 1:133 and 1:100 for average medium magnitude of effect.

5.34. The Part 3 report refines the spatial analysis by zoning Wales' waters into zones with different sensitivity to offshore wind farms.The fifteen zones are defined on the basis of:

- The extent of visual buffers relating to designated landscape areas (National Parks and AONBs) - these inform the distances of the zones away from the coast.
- The presence or otherwise of existing wind farms, which affects seascape character.
- The geometry of the Welsh coastline, taking account of major headlands, major bays and the character of the coast.

5.35. The sensitivity of a zone to offshore wind farms is based on a series of criteria which are consistent with the guidance prepared in the Part 2 report. The criteria group the factors into value, seascape susceptibility and visual susceptibility. A summary of the sensitivity of each zone is provided, in relation to offshore wind farm development, and includes recommendations to minimise their visual effects.

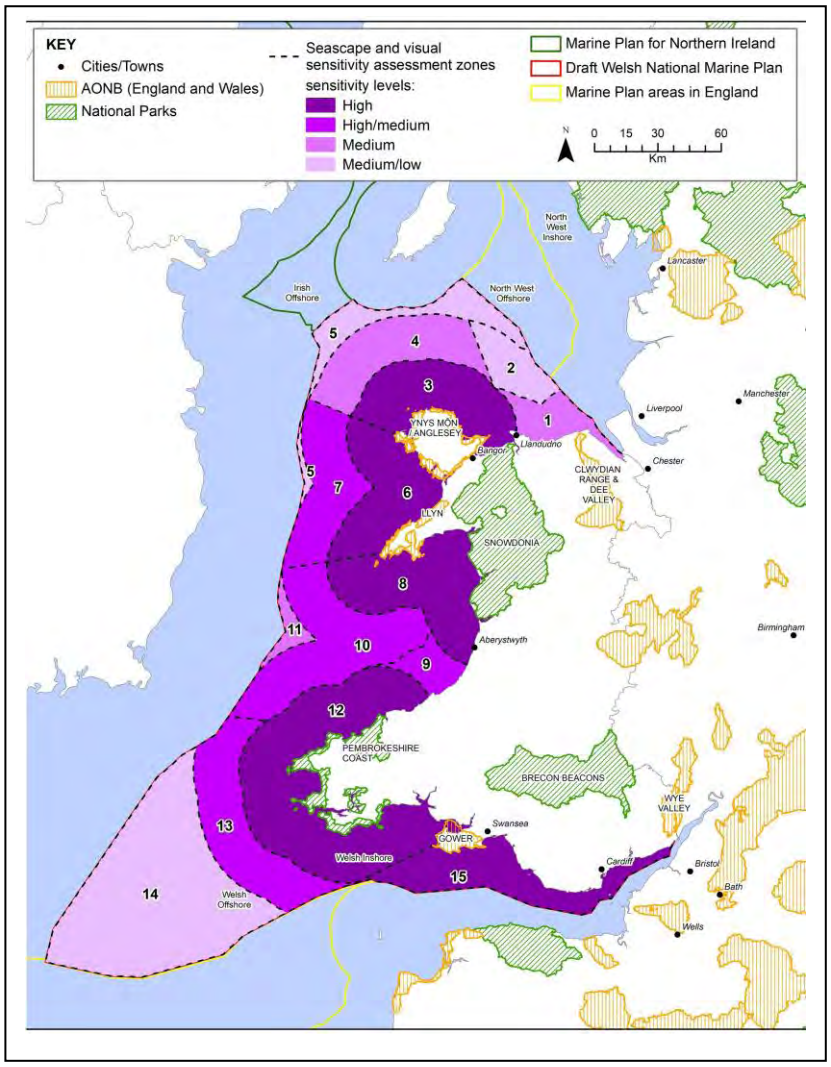
5.36. The zones are considered in groups of up to 22.6km, 22.6–44km and beyond 44km from the coast are shown in **Figure 5.1** below:

- **Up to 22.6km** from shore the sensitivity of seascape is generally considered to be high

for wind farm development except for the north east coast (**Zone 1**) which already has existing wind farm development. Here, some small extension of wind farms may be possible but scope is limited.

- **Between 22.6km and 44km** from shore the potential location for wind energy is dependent on the height of turbine and the likely extent of the overall wind farm. In **Zone 4** well-designed development may be possible and in **Zone 2** development beyond Gwynt y Môr would be tend to limit harm. In some areas, such as off the Pembrokeshire and Llŷn Coasts, it is considered harmful to have development in these zones (**7, 10 and 13**) as development would be visible and would adversely affect the special qualities, including setting, tranquillity and apparent wildness of these remote western coasts.
- **Beyond 44km** from shore the effects of most sizes of wind turbines would be limited although they may be visible in certain light and weather conditions. Development in **Zone 5** could be possible especially to the north east. Development in **Zone 11** may be possible although potential effects on Bardsey Island and the end of the Llŷn peninsula would need to be considered very carefully. Development in the majority of **Zone 14** would be likely to be possible although larger turbines in the areas closest to the Pembrokeshire coast and its islands may cause harm, again due to visibility in certain light and weather conditions.

Figure 5.2 Welsh designated landscapes, their seascape settings and their sensitivity to offshore wind farms



Source: Extract from Figure 7 Wales seascape sensitivity report, NRW, 2019

Approach to seascape sensitivity assessment (MMO1204)

5.37. MMO have recently published an approach to seascape sensitivity assessment (2019) which addresses the MPS statement *'In considering the impact of an activity or development on seascape, the marine plan authority should take into account existing character and quality, how highly it is valued and its capacity to accommodate change specific to any development.'* (Defra, 2011, Section 2.6.5.3).

5.38. The previous MMO seascape project, MMO1134, along with the Seascape Characterisation for the Marine Plan Areas 3 and 4, 2011, have fulfilled the initial part of the MPS seascape requirements, namely 'existing character'. This project therefore considers quality, value and capacity to accommodate change.

5.39. The document sets out a process which is complementary to Natural England's (2019) approach to landscape sensitivity. Sensitivity is derived from a combination of the seascape character and visual susceptibility of a defined seascape marine character area/seascape character area to a given type and scale of development, combined with the value of the area. To achieve this, the process indicates that a development type should be described, and then judgements made against relevant criteria and associated indicators which contribute to making an area more or less susceptible. The method is intended to be tested and then could be used to inform strategic seascape sensitivity assessments and the sensitivity element of SVIAs. There are no current plans for undertaking sensitivity assessments in the waters around England.

5.40. The relevance to this study is that MMO recognise seascape character as a factor to be considered alongside visual considerations such as buffers in influencing the location and design of offshore wind farms and other marine developments.

SUMMARY

5.41. The publication 'Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report' (DTI 2005) remains as key guidance in assessing the effects of offshore wind farms. Its consideration of magnitude of change identifies quantifiable parameters which include distance, number and proportion of turbines visible, proportion of field of view and navigational lighting. Less quantifiable parameters include arrangement of turbines, background, aspect and weather and prominence of other built features in the view.

5.42. GLVIA3 (LI, 2013) provides general guidance on landscape and visual impact assessment. This considers the factors influencing sensitivity and magnitude of effect. The three main factors affecting visual magnitude of effect are defined as scale of effect, extent and duration but their relative weighting is not specifically discussed. Scale of effect and extent overlap to an extent and as offshore wind farms are long-term, the overall magnitude of effect is therefore often at the same level as the scale of effect. For a study of this nature, it is sensible to take the precautionary approach and consider that the scale of effect is likely to be at a similar level to the magnitude of effect.

5.43. NECR105 defines the approach to seascape character assessment in England and Wales. It is a very concise document which gives no detailed guidance. The marine character areas now completed for all the Marine plan areas are derived from this approach but do not include an evaluation of sensitivity and so have limited value for strategic level assessment although inform more detailed assessments. Strategic sensitivity assessments using MMO1204 in English waters would be helpful although none are planned.

5.44. The Welsh seascape sensitivity study specifically considered buffers to offshore wind farms with wind turbines up to 350m high to blade tip. This built on previous OESEA seascape studies and its findings are of interest and relevance.

5.45. Our interpretation of the threshold of no significance remains the same as for the previous studies (White Consultants, May 2009 and 2016). It is derived from a 'worst case' scenario in the DTI (2005) seascape and visual impact assessment guidance which states that effects of moderate adverse significance could be judged as significant (although it is most likely they are not). Taking a precautionary approach our research defines the point where the visual effect of an offshore wind farm development changes from one of moderate significance to minor-moderate significance. In practice it is difficult to be precise because effects change depending on the size of the wind farm, the viewpoint, the viewer, and weather conditions. Beyond this threshold, wind farms are still likely to be visible in clear conditions. The method, variable factors and findings are discussed in more detail in the report.

6. An updated International perspective

EXTENT OF RESEARCH AND OVERVIEW

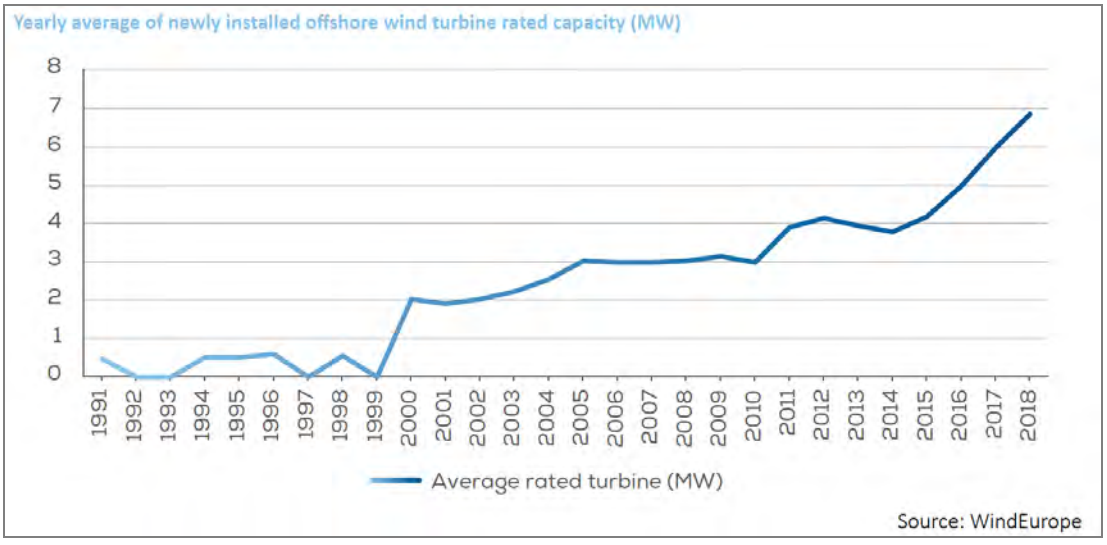
6.1. Research has been carried out in 2008, 2016 and 2019 into how European countries, USA and other countries are approaching offshore wind farms. The study has been limited to information that has been available in English or Dutch. As such, information on trends, implemented schemes and overall capacity has been easier to ascertain than how visual impact and seascape have been considered as part of the strategic environmental assessment or policy. The information provided can therefore not be considered comprehensive. Rather, the chapter provides a snapshot of current international practice.

6.2. A useful overview of current trends is provided by the European Wind Energy Association (EWEA) (2018) in its annual review[3]. It states that whilst new offshore installations were 16% down on 2017 (a record year), wind power increased more than any other form of energy generation. Offshore wind represented 23% of the gross annual installation in Europe, with 2.65GW of new capacity connected to the grid in 2018, and total offshore wind capacity of 18.5GW.

6.3. The Walney 3 Extension offshore wind farm was the largest operational offshore wind farm in the world in 2018, with 87 turbines and a capacity of 657 MW. In the UK,18% of annual electricity demand was from wind power with about half of this from offshore installations.

6.4. In 2018 the average rated capacity of newly installed offshore turbines in Europe was 6.8MW, 15% larger than in 2017.

Figure 6.1: Increase in the average capacity of installed offshore wind turbine.



Source: Wind Europe, 2018.

6.5. Globally, installed capacity by the end of 2022 is estimated[4] at over 46GW, mainly in China, the UK and Germany. The trend towards larger turbines is evident, as these decrease operational expenditure and have other advantages such as generally improved load factors from tall structures.

[3] Offshore Wind in Europe: Key trends and statistics 2018, Wind Europe

[4] Global Offshore Wind Market Report, Norwegian Energy Partners 2018

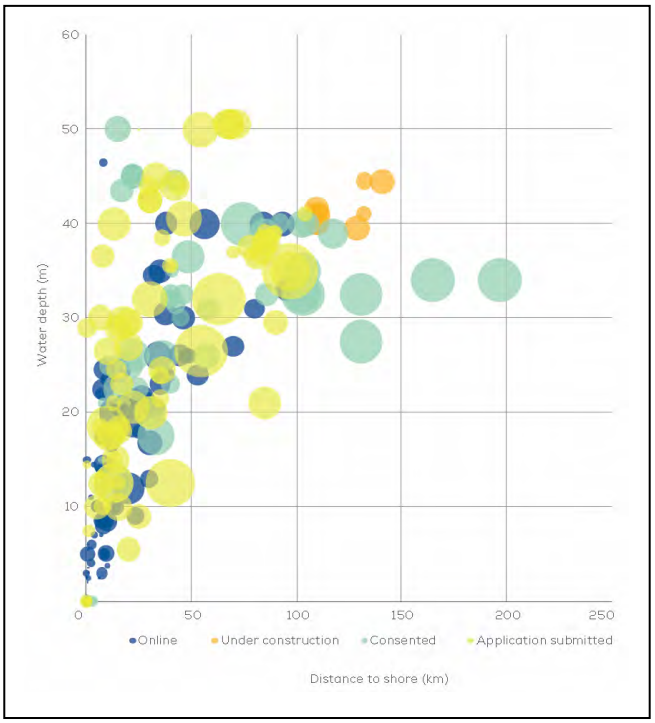
6.6. In 2018[5], for the first time, China installed more offshore capacity than any other country (1.6GW), followed by the United Kingdom (1.3GW) and Germany (0.9GW). New growth markets for offshore wind are emerging in the US, Chinese Taipei and Japan.

6.7. The richest offshore wind resource is located in deep waters, where attaching turbines to the seabed is not practical. Floating offshore foundations, offer the potential for less foundation material, simplified installation and decommissioning, and additional wind resource at water depths exceeding 60m.

6.8. There is variation in the distance that new offshore wind farms in Europe are located from the shore. German schemes consented but not yet operational are at an average of 52km offshore, whilst average of operational schemes is 55km. There is an increase in Belgium from operational at 36km to consented at 46km. However, a new wave of consented schemes in Sweden average 17km offshore, and in France proposed schemes with large turbines to 8.4MW are proposed at an average of 16km offshore. It is not clear whether the reason for this is that the space available to construct economically advantageous schemes is limited or due to the consenting regime.

6.9. The average distance offshore has very slightly reduced in recent years. At the end of 2017[6], the average distance of grid-connected wind farms offshore was 41km and the average water depth was 27.5m. The equivalent figures for 2015 were 43.3km and 27.1m respectively. This pattern of development is diagrammatically illustrated in **Figure 6.2.**

Figure 6.2 Average distance offshore and water depths of bottom-fixed turbines with grid connections



Note: capacity of wind farm indicated by size of bubble

Source: WindEurope, EWEA, 2017, Figure 25.

6.10. **Table 6.1** shows current offshore wind farms in Europe.

[5] From IEA.org website

[6] Offshore Wind in Europe: Key trends and statistics 2017, Wind Europe

Table 6.1 – Wind farms at construction or operational stages in Europe excluding the UK (current at August 2019)

Country	Name of Wind Farm	Turbine Size (MW)	No. Turbines	Distance from shore (km)
Denmark	Anholt	3.6	111	15
	Frederikshavn	2.3	4	3.2
	Horns Rev 1	2	80	18
	Horns Rev 2	2.3	91	32
	Horns Rev 3	8.3	49	30
	Tunø Knob	0.5	10	6
	Middelgrunden	2	20	2
	Nysted	2.3	72	10
	Samsø	2.3	10	3.5
	Sprogo	3	7	10.6
	Rodsand 2	2.3	90	9
	Rønland	2.3	8	0.1
	Avedøre Holm	3.6	3	0.5
	Nissum Bredning Vind	7	4	2
	Krieger's Flak	8.4	72	15
Germany	Aplha Ventus	5	12	43
	Amrumbank West	3.8	80	36
	BARD Offshore I	5	80	89
	Borkum Riffgrund 1	4	78	34
	Borkum Riffgrund 2	8.3	56	50
	Dan Tysk	3.6	80	70
	Global Tech I	5	80	115
	EnBW Baltic 1	2.3	21	16
	EnBW Baltic 2	3.6	80	90
	Nordsee Ost	6.15	48	57
	Meerwind Sud/Ost	3.6	80	23
	Sandbank 24	4	72	90
	Riffgat	3.6	30	15
	Butendiek	3.6	80	32
	Trianel Windpark Borkum 1	5	40	45
	Gode Wind 1 and 2	6.2	97	40
	Nordergründe	6.15	18	15
	Merkur	6	66	45
	Noordsee One	6.15	54	40
	Veja Mate	6	67	95
	Arkona	6.4	60	35
	Wikinger	5	70	35
	Deutsche Bucht	8.4	31	100
	Hohe See	7	71	95
	Trianel Windpark Borkum II	6.3	32	45
	Albatros	7	16	90
Belgium	Thornton Bank phase 1	5	6	27-30
	Thornton Bank phase 2	6.15	30	30
	Thornton Bank phase 3	6.15	18	30
	Northwind	3	72	37
	Belwind	3	55	46
	Rentel	7	42	33
	Nobelwind	3.3	50	45
	Norther	8.4	44	22
	Northwester 2	9.5	23	50

Country	Name of Wind Farm	Turbine Size (MW)	No. Turbines	Distance from shore (km)
Netherlands	Egmond aan Zee	3	36	10-18
	Prinses Amalia (Q7)	2	60	23
	Luchterduinen	3	43	23
	Gemini	4	150	57
	Irene Vorrink	0.6	28	<1
	Westermeerwind	3	48	<1
Sweden	Lillgrund	2.3	48	10
	Bockstigen	0.66	5	3
	Karehamn	3	16	7
	Vindpark Vänern	3	10	3
	SeaTwirl S1	0.3	1	<1
Rep. Ireland	Arklow Bank Phase 1	3.6	7	7
Spain	PLOCAN (Plataforma Oceanica de Canarias) - phase 1 demo	10	5	<3
	ELISA/ELICAN - Mario Luis Romero Torrent (PLOCAN site)	5	1	<1
	W2Power WIP10+ - 1:6 Scale prototype - PLOCAN	0.1	2	<1
France	Floatgen Project	2	1	19
Norway	UNITECH Zefyros demo	2.3	1	10
	Makani floating demo	4	2-4	6
	Karmoy fixed demo	6.2		<1
	Karmoy floating demo	4	2-4	9

Notes:

- Updates from 4COffshore and thewindpower.net, and other sources such as developers' websites.
- Only showing offshore schemes that are operational or under construction.
- Grey background = in construction

6.11. When all wind farms in **Table 6.1** are considered, the following data can be abstracted:

Table 6.2 – Turbine size, development size and distance offshore for operational European wind farms

Turbine Size	Average No. of Turbines	Average Distance Offshore km
0.5MW – 2MW	34	8.8
2.1MW – 3MW	37	14.1
3.1MW – 6.15MW	52	41.4
6.2MW - 10MW	33	41.5

6.12. **Table 6.1** shows that many developments are significant distances offshore, especially those in German waters, and this is confirmed in **Table 6.2**. Thus highlights the correlation between larger schemes with larger turbines and the distance offshore, with an average distance of just over 40km from the shore for turbines up to 10MW.

6.13. **Table 6.3** indicates that there are a large number of offshore wind farms at the stage of having received planning consent, or are under construction, especially in Germany.

France is also a new entrant to the offshore development with a number of consented schemes.

Table 6.3 -Wind farms with planning consent or pre-construction in Europe (August 2019)

Country	Name of Wind Farm	Turbine Size (MW)	No. Turbines	Distance from Shore km
Belgium	Seamade (Seastar)	8.4	30	40
	Seamade (Mermaid)	8.4	28	52
Denmark	All consented schemes are onshore / sea edge			
Germany	Sandbank 1	4	72	90
	GICON Schwimmendes pilot	2.3	1	19
	Arcadis Ost 1	12	58	20
	Baltic Eagle	9.5	52	30
	Deutsche Bucht Pilot Park	8.4	2	87
	Borkum Riffgrund West 1	6	45	53
	Gode Wind 3	15	8	35
	Borkum Riffgrund West 2	15	18	53
	Gennaker	8	103	15
	EnBW He Dreiht	10	90	85
	EnBW Hohe See	6	80	90
	Gode Wind 4	15	10	42
	Kaskasi	9	38	48
	OWP West	15	18	58
Rep. Ireland	Arklow Bank Phase 2	10	100	10
	Codling Wind Park	5	220	13
Sweden	Kattegat	6	47	9
	Kriegers Flak 2	20	80	32
	Stora Middelgrund	8	108	25
	Storegrundet	6	70	11
	Taggen	8	83	19
	Stenkalles grund	5	20	
Netherlands	Hollandse Kust Zuid Holland I and II - Chinook	10	76	26
	Windpark Fryslân	4.3	89	6
	Borssele I/II	8	94	22
	Borssele III/IV	9.5	77	32
	Borssele Site V -Leeghwater demo	9.5	2	36
France	Parc éolien en mer de Dieppe - Le Tréport	8	62	15
	Parc éolien en mer de Fécamp	7	83	15
	Eoliennes Offshore du Calvados	7	75	15
	Baie de Saint-Brieuc	8	62	18
	Saint-Nazaire	6	80	12
	Iles d'Yeu et de Noirmoutier	8	62	21
	Les éoliennes flottantes de Groix & Belle-Île	6	4	18
	Provence Grand Large	8.4	3	16

Notes:

Updates from 4COffshore and thewindpower.net, and other sources such as developers' websites.

Only showing offshore schemes that have been consented.

6.14. **Table 6.3** shows that many developments are still significant distances offshore, especially those in German waters, followed by Belgium and the Netherlands. However, new entrants France and Ireland and, to a lesser extent Sweden, are bringing down the average distances, as illustrated in **Table 6.4** with an average distance of just over 26km for 6.1-9.9MW turbines and 40km from the shore for 10-15MW turbines. As mentioned above, the reasons for this disparity are not clear.

Table 6.4 – Turbine size, development size and distance offshore for consented European wind farms

Turbine Size	Average No. of Turbines	Average Distance Offshore km
2MW – 6MW	66	32.1
6.1MW – 9.9MW	68	26.2
10MW- 15MW	51	40.1

APPROACHES- NATION BY NATION

6.15. In order to give a fuller picture, the research report text from the White Consultants 2016 study has been combined with an update for each country.

6.16. In Europe, the EU ratified the Protocol on Strategic Environmental Assessment on 21 November 2008. The SEA Directive (Directive 2001/42/EC) transposes the Protocol in the EU legislation. This applies to plans for energy such as offshore wind. SEAs have been researched where available in English.

Denmark

6.17. During the period 1999–2006 a comprehensive environmental monitoring programme was carried out in order to evaluate the environmental impact of two of the then biggest offshore wind farms in the world: the Horns Rev Offshore Wind Farm and the Nysted Offshore Wind Farm. The general conclusion from the environmental programme of Horns Rev and Nysted is that offshore wind power can be designed in an environmentally sustainable manner that does not lead to significant adverse impacts. The follow-up programme 2009- 2012 does not consider visual buffers further. The guidance document on environmental impact assessment (DEA, 2013) does not mention seascape or visual issues at all.

6.18. The EIA assessment of Horns Rev concluded that visual impacts would be minimal given the scale of the project and the fact that the wind farm was 15-20km offshore. At Nysted, where the wind farm can be found at a much closer distance to the coastline of Lolland-Folster, the EIA recognised that the turbine array is a 'significant element in the coastal landscape'.

6.19. A study by Soerensen et al (2002) which looked at lessons learnt from Middelgrunden Wind Farm stated that:

'It is concluded that although active public involvement is a time and resource requiring challenge, it is to be recommended as it may lead to mitigation of general protests, blocking or delaying projects, and increase future confidence, acceptance and support in relation to the coming offshore wind farms in Europe.'

6.20. Middelgrunden wind farm received very little opposition considering the visual impact of 102m high turbines just 2-3.5km away from a very popular recreational area near Copenhagen harbour. The reason is believed to be the strong public involvement, both

financially and in the planning phase, as well as refinement of the design of the scheme. This was modified from three lines of turbines to a smaller number of turbines in a single curving line on the approach to harbour.

6.21. Research into the Danish Energy Agency (DEA) and Danish Forest and Nature Agency (DFNA) on seascape and visual assessments reveals that though seascape and visual impacts are considered within the environmental process, there does not appear to be as much emphasis on a suggested buffer distance other than the limitations of the territorial boundaries.

6.22. The 'Future Offshore Wind Power Sites – 2025' (DEA, 2005) publication stated that 'It is estimated that depending on visibility conditions large scale offshore wind farms will be visible from a distance of 20km for 125m high turbines and 34km for 260m high turbines. Thus, turbine height greatly affects visibility. In calm conditions visibility across the sea is extremely good, but due to changing weather conditions visibility will be partially or substantially reduced most days of the year; there are only few days each year when visibility exceeds 19km'.

6.23. Since 2009, four new wind farms have been established: Sprogo, east of the island of Sjaelland (Copenhagen is on the east of this island), 10.5 km from the shore and comprising 7 3MW turbines, Anholt, with 111 3.6MW turbines 15km off the north west coast of Midtjylland, Rodsand 2, with 90 2.3MW turbines 9km offshore and Horns Rev 3 with 49 8.3MW turbines 25-40km offshore. In addition, 350MW of coastal wind farms and 50MW of test schemes will be connected in 2020.

6.24. A number of additional schemes are now in the early stages of planning and these are fairly close inshore on the north and west side of the mainland.

Germany

6.25. Guidance provided by the Bundesamt Für Seeschifffahrt und Hydrographie called 'Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment' (StUK 3, 2007) suggests that a photorealistic simulation (text and visualisation) of the landscape affected by the wind farm in question must be presented, unless the project is located further than 50km from the nearest point on the coastline.

6.26. Future areas of wind farm developments in the North Sea and Baltic Sea are predominantly located in areas outside of the territorial limit. Nearly all German projects are planned for areas that are much more than 30km from the coast and in waters 20-25m in depth. This is a consequence of the heavy use of the German coastal waters for shipping, gravel extraction and military use. But in addition, most planners voluntarily keep to a minimum distance of 30km from the shore, as a result the wind farms become hardly visible from land or from the German Islands (German Energy Agency website).

6.27. Since 2009 there has been a significant increase in schemes in German waters. 5 new schemes with a total of 350 turbines, of 3.5 to 5MW capacity, are located between 15 and 45km off shore. In 2015 alone, wind turbines with a total capacity of 2282 megawatts went on grid. This brings Germany's total offshore contribution to 3.3 GW.

6.28. Germany now has 26 operational schemes, with 5 in construction, comprising large sites of up to 97 turbines at 7MW capacity, at an average distance of 55km offshore. Another 14 schemes are consented, and generally comprise a large number (average 42) of large turbines (5 to 20MW), on average lying 52km offshore. These proposed sites tend to be grouped close to other sites, and in many cases stacked in a linear arrangement (such as Gode Wind to Borkum lying east-west in the Helgolander Bucht) or in blocks further into the North Sea, and some schemes in the Baltic Sea.

6.29. The German market[7] regulation changed with the introduction of the WindSeeG (Offshore Wind Act) which became law on 1 January 2017. The WindSeeG introduces a centralised planning approach, which involves an Area Development Plan. This outlines the location and construction schedule of future transmission assets, currently out to 2025.

6.30. The majority of new areas coming forward are 115km or more offshore in the North Sea. In the Baltic, the areas defined are extensions of existing wind farms at the outer edge of the German exclusive economic zone (above 25 km from the coast). The draft environmental report of the draft Site Development Plan for the North Sea (BSH (1), 2019) indicates that there is a limit of a height of 125m wind turbines within sight of the coast and islands (2.15, page 148). It is considered that platforms and offshore wind farms at a distance of at least 30km from the coast would not cause much impact on the landscape as perceived from the land. The expected effect of the allocated areas is likely to be quite low (3.14, page 159). The equivalent report for the Baltic Sea (BSH (2), 2019) concurs with the North Sea findings with the expected extensions also to have a low visual effect with the installation is only being visible to a very limited extent from the land in good visibility conditions (4.10, page 217).

Figure 6.3 German Offshore wind farm development plan- North Sea

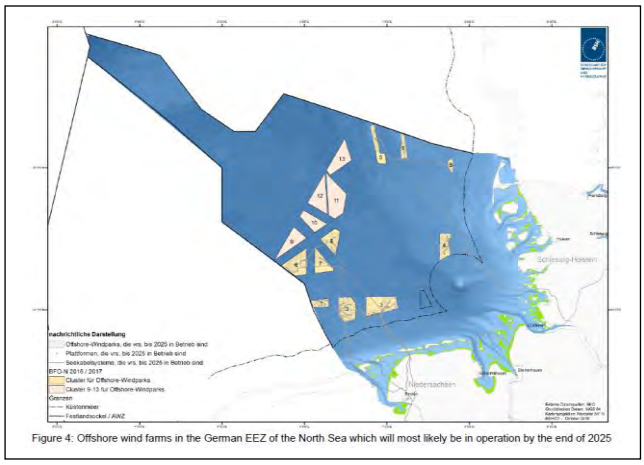


Figure 4: Offshore wind farms in the German EEZ of the North Sea which will most likely be in operation by the end of 2025

Source: Draft site development plan 2019 for the North and Baltic Sea (*English translation*), (German) Federal Maritime and Hydrographic Agency, Hamburg, October 2018.

Belgium

6.31. Belgium has only 67 kilometres of coastline. It has proved difficult to find information relating to strategic environmental assessment and visual effects but the pattern of development appears to take this factor into account.

6.32. The Electrabel development 12.5km off the coast at Knocke was granted a concession in March 2002. This was subsequently withdrawn by the Government due to local opposition. Following this, subsequent applications for other wind farms between 5km and 16.5km offshore were also rejected.

6.33. In June 2004 an offshore wind farm zone was defined by the Government running from just inside the 22km territorial waters out to sea. The approach was to site wind farms at distances considered too far for visual intrusion, stacking wind farms in line extending further and further offshore (see the eastern block in **Figure 6.4**).

6.34. The earliest wind farms applications were Thornton Bank, Bank zonder Naam (Eldepasco) 38km off shore and Bligh Bank (Belwind) 42km offshore. The Thornton Bank visual impact assessment stated that as the wind farm will be at 27km from the coast, the visibility of the wind turbines will be very limited and heavily dependent on the weather. The effect

[7] From Global Offshore Wind Market Report, Norwegian Energy Partners 2018

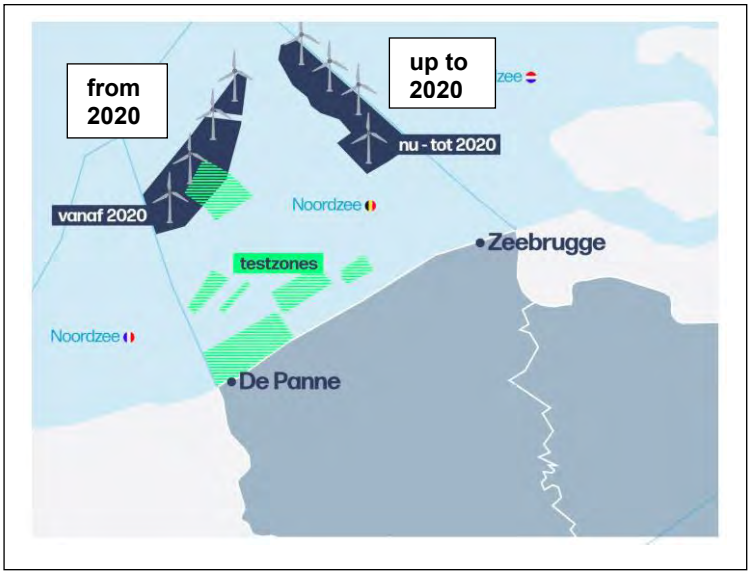
of the wind farm is judged to be slightly negative to non-existing. The inauguration of the 325MW project in the 2014 lifted Belgium's installed offshore capacity to 495MW. However, the closest wind farm is the 360MW Norther, between Thornton Bank and the coast, at 22km distance. This uses 8.4MW turbines. The rest are beyond Thornton Bank, including the 216MW Northwind, 165MW Belwind and 218MW Northwester (in construction) projects.

6.35. Currently there are 9 operational schemes, on average at 36km offshore, with turbines ranging from 3-9.5MW capacity. Two further consented schemes are located at 40 and 52 km offshore with between 28-30 turbines of 8.4MW capacity. All these are in a linear pattern stacked away from the coast.

6.36. Beyond 2020 a new wind farm zone of 1,750MW has been established to the south west running more parallel to the shore. This is around 35-55km offshore with a target completion date of 2025.

6.37. Experimental test zones for various energy uses such as wave energy are proposed further inshore.

Figure 6.4 Belgium offshore zones



Source: Regering zet in op groene Noordzeestroom: dubbel zoveel windmolens op zee, VRTNWS, 2018 *based on* Marien Ruimtelijk Plan 2020-2026 (MRP).

Netherlands

6.38. The Netherlands established a 'Near Shore Wind farm' demonstration project at Egmond aan Zee in 2007 to gain knowledge and experience to use further offshore. This temporary project is 8km from the shore in territorial waters.

6.39. The 'Offshore Wind Energy Act' in the Netherlands, 2015, simplified the decision-making process for the realisation of offshore wind projects, in an effort to achieve the Dutch renewable energy targets for 2020, a goal of 16% sustainable energy in 2023, and to expedite the permit and subsidy procedures. Under this legislation the government took responsibility in relation to the designation of zones, as indicated in the Dutch National Water Plan (Nationaal Waterplan).

6.40. A partial review was carried out of the National Water Plan in light of the designation of the Holland Coast area and the area north of the Wadden Islands for offshore wind energy (Netherlands Government, 2015). This indicated that wind turbines were to be located at least 22km from the shore off the Holland Coast. Generally speaking, the maximum distance at which wind turbines were theoretically visible was 35km, assuming a turbine tip height of 150m. Coastal weather conditions indicated that a turbine located 22km

from the shore would be visible on 19 % of days. During the summer, such a turbine would be visible on roughly 31% of days. For the Holland Coast area, the impact of an array 22km from the coast was assessed as negative in terms of visibility and the impact graded as negative in terms of dominance. However, the designated area north of the Wadden Islands roughly 60 km from the shore was not considered to be visible from the islands. Hence, the impact was assessed as neutral in terms of both visibility and dominance. All developments within the zones are required to go through regulatory processes so not all may be developed.

6.41. Subsequently, the Offshore Wind Energy Roadmap 2030, issued in 2018, calls for an additional 7GW of capacity. The location of these development zones, such as Hollandse Kust (west) and Ijmuiden Ver, are around planned 60km from the shore at their closest points, beyond the existing and other wind farms to be implemented beforehand (see figure below).

6.42. Currently, there are 6 operational schemes at distances of 22-50 km offshore, with an average of 38 turbines ranging from 3 to 9.5 MW capacity. There are three further schemes consented including a smaller schemes 6km from the shore with 4.3 MW turbines, and two at 26 and 36 km using 9.5 or 10MW turbines.

Figure 6.5: Offshore wind energy strategy for Netherlands

Source: Offshore Wind Energy Roadmap 2030, Dutch Ministry for the Economy and Climate, 2018.

Ireland

6.43. Overall there has been limited activity in the offshore sector, with only one operational scheme of seven 3.6 MW turbines at Arklow Bank, 7 km off the east coast south of Dublin.

6.44. In 2014, the Irish government published its Offshore Renewable Energy Development Plan setting targets for offshore wind development for 2030. Following the plan, Ireland would install a minimum of 800MW of capacity, with medium and high scenarios of 2.3GW and 4.5GW also envisioned by 2030.

6.45. The Energy White Paper entitled 'Ireland's Transition to a Low Carbon Energy Future 2015-2030', 2015, identified that 24% of Ireland's entire electricity usage was met by indigenous wind energy. However, offshore wind installation was considered significantly more expensive than onshore, and so the latter was intended to be used to meet short term targets.

6.46. The Climate Action Plan 2019 now indicates that previous targets will not meet the 2030 emissions reduction targets. As such, a major step up in ambition is required to produce 70% of electricity from renewable sources by 2030 which includes increasing offshore wind energy capacity to 3.5GW. A 'top team' is intended to be set up to drive this forward (page 59).

6.47. The Ireland Offshore Renewable Energy Development Plan SEA, 2010, relied on the DTI, 2005 report in terms of the likely visual buffers i.e. a 35km seaward limit. The visual significance of a wind device beyond this distance was assumed to be negligible in most cases as the changes to the seascape will be very minor or imperceptible to the human eye (page 76). Visibility may extend over longer distances in seascapes associated with high cliffs or steep hinterland. A study for Northern Ireland is referred to in terms of defining the magnitude of effects of 5-7MW turbines (page 77). These findings were verified as part of the Irish SEA study and were:

- Large: 0-15km from the coast-notable change
- Medium: 15-24km – moderate change
- Small: 24–35km – minor change
- Negligible: 35km – no discernible change

6.48. The report goes on to state that it is not possible to determine effects at a strategic level due to the variation in receptors (page 78). Designated coastal landscapes are discussed and are considered to be sensitive (e.g. page 209).

6.49. Several further wind farm schemes have now been consented including a major extension of Arklow Bank with a scheme of 100 10MW turbines, and Codling scheme of 220 5MW turbines. These two new schemes are just 10 and 13km offshore respectively.

Poland

6.50. Whilst Poland has identified a number of large potential sites for offshore wind development in the Baltic, none are yet consented. The three sites which appear to be the likely first schemes, are Baltica 1 at 85km offshore, and Baltica 2 and 3, lying at approximately 30km offshore. These three alone may create 3 GW of capacity. Other license applications are evident which would further extend this cluster significantly.

Estonia

6.51. Estonia has a target within its National Renewable Energy Action Plan to install up to 500MW of offshore wind capacity by 2018, although this has not been met.

Finland

6.52. There are three demonstration offshore wind farms operating in Finland, with a total capacity of 32MW. In 2017, the 42MW Tahkoluoto demonstration scheme was commissioned 1.2km offshore. The wind farm uses technology designed specifically for icy weather conditions.

Norway

6.53. To date, Norway has 2MW of offshore wind capacity installed at the Hywind floating demonstrator project. The Norwegian Ministry of Petroleum and Energy has been pursuing the potential for offshore wind. An SEA of 15 offshore wind zones has been published and

this has been consulted on. This is in Norwegian so the contents are not known. These vary from around a few km from shore for demonstration projects to over 100km offshore. In 2019 Utsira Nord, Sandskallen – Sørøya Nord and Sørlige Nordsjø II were further consulted on. Also in 2019, Government subsidies have been agreed (by Enova for Equinor) for the construction of 11 8MW floating wind turbines to supply power to North Sea oil platforms. This builds on Equinor's experimental Hywind scheme.

United States of America (USA)

6.54. In the USA, environmental impacts must be assessed in order to meet the National Environmental Protection Act (1970) and the National Historic Preservation Act (1966). The Bureau of Ocean Energy Management (BOEM) manage the process of assessing, selecting and leasing federal areas offshore on the USA outer continental shelf to 200 miles. An environmental assessment is carried out as part of the selection process and stakeholders views are taken before areas are allocated. The National Park Service are consulted to identify potentially sensitive visual settings and concerns which can influence the identification of potential projects areas (National Park Service, 2014, 2.3, page 10).

6.55. The National Park Service have guidelines to evaluate visual impacts of proposals coming forward within the lease areas (National Park Service, 2014). This guidance sets out eight factors influencing visibility which include lighting, atmospheric conditions, distance and the characteristics of the object e.g. motion and backcloth (page 42). The guidance refers to Sullivan et al, 2013, whose research suggests that an appropriate area of impact analysis based on turbine heights up to 500 feet (152m) would be 25 miles (40km). Taller turbines might be visible for longer distances and could require a larger area of analysis (page 55).

6.56. The first offshore wind farm in the USA was completed in December 2016 and is located 5km south east of Block Island, Rhode Island. This has five turbines totalling 30MW of capacity. As of June 2018, BOEM has issued 13 commercial wind energy leases off the coasts of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, and Virginia, totalling over 1.3 million acres (BOEM, 2018).

Canada

6.57. Currently, Canada has no installed offshore wind capacity. In 2016 the government of Ontario, where the majority of Canadian projects are planned to be located, announced it is to keep a moratorium on offshore wind projects until potential environmental impacts are fully understood.

Australia

6.58. Before 2015, the Government did not support development of an offshore wind industry. The current Australian Government is more favourable towards an offshore wind industry and in 2015, Australia's Clean Energy Innovation Fund was established to provide AUD $1 billion to support offshore technologies (including offshore wind) from demonstration to commercial-scale deployment.

Asia

6.59. In Asia[8], governments are committing to decarbonise their energy systems but some are at an early stage of market growth in terms of offshore energy.

[8] From Global Offshore Wind Market Report, Norwegian Energy Partners 2018

6.60. The region is faced with difficult weather conditions typhoons and sea bed earthquakes in parts of China and Taiwan), river delta sea bed sediments (China), and deep water (Japan and South Korea).

6.61. In China, there are many projects under construction or pre-construction which are up to and around around 20km offshore. Deepwater development zones such as Guandong are around 55km + offshore.

6.62. Chinese Taipei completed an auction for 5.5 GW of offshore wind capacity, and utilities have already signed power purchase agreements for 1GW. Most of the earlier development zones/pre-construction sites e.g. Formosa1 are near shore with some extending further offshore, beyond/behind other developments e.g. Greater Changhua 1.

6.63. Vietnam has almost 100MW of capacity installed in the Bac Lieu offshore wind farm, installed in phases between 2013 and 2015. This is near shore- within 1km. A further 100MW is currently under construction at the first phase of the Khai Long project, with the potential for an additional 200MW to be development at the site. Again, this is very close to the shore. Longer term projects such as Than Long are 14km + offshore.

6.64. In Japan, the parliament has approved a new law to define project development zones. This new law is expected to facilitate deployment of large-scale projects.

India

6.65. In 2015, the Indian Ministry of New and Renewable Energy (MNRE) announced a National Offshore Wind Energy Policy, allowing areas within India's EEZ for offshore wind farm development. These are focussed in two near shore development zones off Gujarat.

Summary

6.66. Overall, European nations tend to start with developments closer to shore and then place larger arrays with larger turbines significantly further offshore, sometimes stacking beyond nearer existing arrays. In the USA, the earliest wind farm at Cape Wind has been subject to prolonged objection, partly on visual setting grounds. Elsewhere, there is no clear indication of how the visual impacts influence decision making- in Asia there are many near shore wind farms but the quality of coastal landscape or designations nearby are not known.

6.67. Denmark has identified a number of offshore 'wind park' locations to meet offshore renewable energy targets. The DEA and DFNA have both recognised the importance of visual assessments in the planning process as recognised in published documents; however, evidence suggests from previous EIA work in Denmark that public interaction at an early stage is more beneficial than setting offshore limits.

6.68. In Germany, planners and developers have favoured a 30km minimum distance offshore to deter any refusals based on the visual and noise impacts. Not only does this assist in planning consent, but it also prevents any conflicts with other nautical activities around the coastline. The trend in the Netherlands and Belgium appears to be to allocate areas at least 22km from the coast, with larger zones significantly further offshore (35-60km).

6.69. There has been a substantial increase in the numbers of turbines constructed in the EU in the last 6 years. Leaving aside the contribution of the UK, Germany has seen the most significant growth in this sector, with many new schemes and many other projects in the pipeline, which may reach a combined 4GW by 2017. Belgium also has expanded its capacity considerably, with a view to providing 2.5GW capacity by 2022. The Netherlands has been slower but has ambitious plans to 2030. Denmark, which was the early pioneer of offshore wind, is less ambitious but may see its current capacity double by 2020, to around 2.3GW. Ireland's offshore industry has developed slowly but the Climate Action Plan 2019 indicates an acceleration of deployment to meet the 2030 targets.

6.70. The trend in the most recent and larger planned schemes, is for larger turbines, in significant numbers, and further offshore for the more experienced nations. However, the average distances offshore are reducing due to late entrants Ireland, France and Sweden who are starting their offshore development closer to shore. Wind farms tend to be stacked behind each other where there is limited coastal extent with some gaps between development zones. Arrays further offshore are arranged more parallel to the coast as visual intrusion is considered less problematic.

7. Analysis of offshore wind farm seascape and visual impact assessments

7.1. This chapter considers all available offshore wind farm SVIAs including those for Round 1 to 3 zones, project extensions, demonstration projects and STW wind farm developments. **Figures 3.1 and 3.2** shows the location of the zones and proposals respectively.

7.2. The main objective for analysing the Seascape, Landscape and Visual Impact Assessments (SVIAs) of individual offshore wind farms is to establish a pattern of the limits of visual significance. The relevant guidance has been discussed in Chapter 5 and it has been established that DTI (2005) guidance remains relevant and so the approach taken in the White Consultants 2009 and 2016 studies also remains relevant. This chapter therefore combines the analysis of 'smaller' wind turbine sizes from the 2009 and 2016 reports with additional analysis of the most recent wind farms SVIAs with larger turbine sizes.

7.3. The DTI guidance (2005) states that '*A viewpoint assessment should be carried out to identify and evaluate the potential effects on available views and visual amenity arising from the proposed offshore wind farm at specific representative locations in the study area*'. The conclusions on the degree of effect on these viewpoints will also inform the expected effect on seascape units. In order to meet the EIA requirements, the choice of viewpoints must go through consultation with the local authority and key stakeholders whilst also taking into consideration comments made during public consultation.

7.4. Predicting the likely significance of visual impacts (i.e. comparing the development against the original baseline) for each viewpoint is achieved by combining the *sensitivity* of the receptor or seascape unit that the viewpoint is located within and the *magnitude* of change. For the purposes of the brief, the magnitude of change is the key determinant as the sensitivity of receptors will vary across Round 4 areas.

Sensitivity

7.5. The sensitivity criteria used for each seascape character area are currently derived (with minor modification) from the University of Newcastle Study (2002) as set out in **Chapter 5** although GLVIA3 indicates that value is also an important component.

7.6. The sensitivity of a visual receptor combines the judgement of the susceptibility of the receptor (or person) to the specific type of change or development proposed and the value related to the view such as through planning designations or attached to the view by the receptor. These judgements will be dependent on the location and context of a viewpoint, the expectations, occupation and activity of receptors and the importance of the view.

Magnitude of Change

7.7. The magnitude of change to receptors is broadly assessed in a standardised way based on DTI (2005) and other guidance such as GLVIA3 and involve consideration of the *scale or size of effect* with the *extent* of the area affected and *duration/reversibility* of that effect. Factors that influence the scale of effect include the size and character of development, the distance of development from a viewpoint, the degree of change in a view, the degree of contrast or integration and the angle of view of a receptor.

7.8. Inevitably there is some variation in how the magnitude of change is defined in the SVIAs reviewed. The majority tend to follow the definitions as suggested by the GLVIA (2002 and 2013) and SNH (2005) as set out in **Table 5.2**. Assessments may use other terms for magnitude. Our interpretation of these definitions is set out below in **Table 7.1**.

Table 7.1 - Terms for Magnitude

Magnitude/size class	Other terms used for magnitude
Very Large	Very high or very substantial, high or substantial. (Assessments may not differentiate between very large and large)
Large	High or substantial, medium- high or moderate – substantial. (Assessments may not differentiate between very large and large)
Moderate	Medium
Small	Low, slight, minor, (also including medium-low).
Very Small	Low (slight or minor)-negligible

7.9. For wind farms which are some distance offshore some assessments of magnitude consider the worst-case effect assuming weather conditions of very good or excellent visibility which allow clear views of the development. Other assessments factor in that very good or excellent visibility occur on only a small proportion of days in the year with resulting reduction in visibility of the development and the corresponding assessed magnitude of effect. It is considered that these approaches are averaged out in the overall findings.

7.10. The assessed wind farms include those which are considered alone and also against a baseline including other offshore wind farms. Here, there is effectively an assessment of additional effect. This now reflects the situation in many parts of English waters. Additional effects are highly likely to be of lower magnitude than if the wind farm was viewed in isolation because of the perception of less change from the baseline view/situation. This factor tends to reduce the distance at which potentially significant effects apparently occur and so these buffers may be conservative for areas where there is no existing development, such as the south west. Some wind farms are extensions to existing wind farms and so here the influence of existing development is particularly marked. Because of this we also comment on the average thresholds of effect excluding analysis of the three main extensions (at Walney 3, Burbo Bank and Thanet).

Significance

7.11. Significance is derived from combining the sensitivity of a receptor and the magnitude of change. **Table 5.3** sets out how this is suggested in seascape guidance (DTI (2005)). For individual viewpoints in certain SVIAs the assessor may have decided that Table 5.3 does not apply and the effect may be considered significant or not significant depending on particular conditions.

7.12. For the purposes of this study it is considered sufficient to look at the magnitude of effect only for each viewpoint so that the sensitivity of individual receptors does not confuse the findings. The range considered for the purposes of the brief is low (including moderate/low) and moderate magnitudes of effect which combined with high and medium sensitivity of receptors respectively result in effects of moderate significance. Combined with a high sensitivity receptor, a medium magnitude of effect is likely to result in an effect of 'major-moderate' significance. A major-moderate is classified as significant in the vast majority of SVIAs and so this effect should be avoided if possible. Therefore off sensitive coasts this should not be used as the buffer distance as it builds in likely significant effects, particularly if an average of SVIA findings is used. Receptors of low sensitivity exist on the coast, mainly in industrial or urbanised areas. However, the extent of these areas tends to be limited and adjacent receptors in rural areas adjacent are likely to be of at least moderate/medium sensitivity. It is highly unlikely that there

will be any locations where large offshore wind farms will only be subject to views from low sensitivity receptors. Therefore to avoid any significant effects, moderate adverse magnitude of effects is used as the closest range of distances advisable off coasts without high sensitivity receptors. Both the average and maximum distance for low and medium magnitude of effect are recorded. Cumulative effects have also been noted and used where a wind farm is an extension to an existing large array.

Structure of analysis

7.13. The offshore wind farms used in the 2009 and 2016 SVIA analyses are listed first. The additional wind farms and their SVIAs considered in this study are then described. All relevant SVIA findings are summarised and set out in **Tables 7.2 and 7.3**. The findings of the analyses are then discussed. The individual SVIA analyses are shown in **Appendix D**.

7.14. An average 'average distance' and an average 'maximum distance' of moderate or low adverse effects have been extracted from the relevant viewpoints in each assessment. Analysis of the results have been separated for different sizes of turbines rather than in MW capacity used in previous OESEA reports. It is considered that it is now most helpful to concentrate on ranges of turbine heights, as this is a determining factor of magnitude of effect. This approach was also used in the NRW, 2019 report, so consistency of approach is beneficial. However, as the size of array, i.e. the number of turbines, is generally increasing, a further analysis of the same wind farms in size (number of turbines) order has been carried out. This is discussed after the main analysis with information in **Appendix G.**

Reliability of SVIA evidence

7.15. The SVIAs had been carried out by a range of consultancies and individuals with a range of experience in judging effects of wind turbines offshore, and also over a range of time-over ten years. Experience in this field is growing but no third-party reviews of the SVIAs have been made available or studied. The study team have not verified the accuracy of judgments by on-site visits. Therefore the results derived from this exercise have to be considered with some caution.

SVIAS REVIEWED IN 2009

7.16. Ten SVIAs were reviewed in 2009 to establish if there was consistent and usable data on visual impacts from viewpoints at various distances. Nine were taken forward. Lincs wind farm was identified as an anomaly to the rest of the SVIAs for Round 2 wind farms with a much lower set of distances for the magnitudes of change. This was because two Round 1 wind farms lying between Lincs and the coast had been included within the baseline assessment and so the degree of change was considered as much less by the assessor. Therefore, this assessment was excluded to avoid distortion of the results.

7.17. The SVIAs contributing to the overall analysis were:

Round 1 SVIAs

- Kentish Flats
- North Hoyle

Round 2 SVIAs

- Gunfleet Sands 2
- London Array
- Thanet
- Walney

- West of Duddon Sands
- Gwynt y Môr
- Beatrice Demonstration Project

SVIAS REVIEWED IN 2016

7.18. Fourteen SVIAs of schemes coming forward between 2009 and 2016 were reviewed. Data from nine schemes were taken forward to analysis. Four schemes offered incomplete data, and one, Gunfleet Sands, was not included as it consisted of only a two turbine extension and would have distorted the data significantly.

7.19. The SVIAs contributing to the overall analysis were:

- Westermost Rough A
- Hywind Scotland Pilot Park
- Docking Shoal
- Navitus Bay
- Burbo Bank Extension
- Beatrice Offshore
- Rampion
- Neart na Gaoithe
- Walney Extension

Key issues arising from 2009 and 2016 studies

7.20. There was a distinct difference between the findings of the 2009 study and the 2016 study in respect of the SVIA thresholds of visual impact. The later study indicated higher threshold distances. The average size of wind farm in 2009 was 85 turbines and in the 2016 analysis, 122 turbines. However, this is slightly misleading with the first group including the very large Gwynt y Môr scheme and a number of smaller schemes at 20-40 turbines. The developments between 2009 and 2016 were consistently larger between 110-207 turbines. This may explain the difference in the thresholds of effect as the spread of turbines is one of the key determinants.

SVIAS REVIEWED IN 2019

7.21. Thirteen SVIAs of schemes coming forward between 2016 and 2019 were reviewed. Data from nine schemes were taken forward to analysis. Four schemes were too far offshore to provide data for effects on coastal receptors.

East Anglia ONE North

7.22. This proposed scheme is located approximately 36km from its nearest point onshore, close to Lowestoft. It comprises up to 67 turbines, of up to 19 MW power capacity, with tip height up to 300m, with a total capacity of 800MW. Further refinement of the project design and the EIA will be based on consultation responses.

7.23. 9 viewpoints were considered to have potential for significant effects, ranging from 38.8 to 42.7 km distance. A further 8 viewpoints were considered to have no potential for significant effect.

7.24. There may be cumulative seascape, landscape and visual impacts taking into account the East Anglia ONE, East Anglia THREE, Norfolk Vanguard and Norfolk Boreas offshore wind farms.

7.25. The sources of information are the Preliminary Environmental Information Scoping Report, Volume 1 2015, and Chapter 28 Offshore Seascape, Landscape and Visual Amenity.

East Anglia TWO

7.26. The scheme lies 31km from the Lowestoft. The Suffolk Coast and Heaths AONB and The Suffolk Heritage Coast is located approximately 29.7km from the wind farm site.

7.27. Up to 75 turbines with 900 MW capacity are proposed, with an individual turbine capacity of up to 19 MW and a tip height up to 300m. The realistic worst case layout assessed as the project design envelope for the SLVIA is a 60 x 300m wind turbine layout.

7.28. There may be cumulative seascape, landscape and visual impacts taking into account the East Anglia ONE, East Anglia THREE, Norfolk Vanguard and Norfolk Boreas offshore wind farms.

7.29. 20 viewpoints were identified for detailed assessment ranging from 30.5 to 47.7km distance.

7.30. The sources of information are the Scoping Report by Scottish Renewables, November 2017, Appendix 4.1 and 28.7 Offshore Wind farm Visibility, the Planning Inspectorate and 4COffshore.

Norfolk Vanguard

7.31. The scheme covers two areas which are, at their closest, 47km from the shore. Up to 180 turbines with a total capacity of 1800 MW are proposed, with a tip height up to 350m.

7.32. Due to the distance offshore, the ES states that 'potential impacts during the operational and maintenance phase would largely be limited to the presence of the above ground onshore infrastructure and its influence on landscape and visual receptors', i.e. no impact is assessed for the offshore turbines. The scheme is therefore excluded from analysis.

7.33. The sources of information are ES Chapter 5 Project Description and Chapter 29 Landscape and Visual Impact Assessment, June 2018.

Norfolk Boreas

7.34. The scheme lies 72 km offshore. Between 90-200 turbines with a total capacity of 1800MW are proposed, using 9-20MW turbines.

7.35. Due to the distance offshore the ES states, as with Vanguard, that the potential impacts during the operational and maintenance phase would largely be limited to the presence of the above ground onshore infrastructure and its influence on landscape and visual receptors. Therefore no impact is assessed for the offshore turbines. The scheme is therefore also excluded from analysis.

7.36. The sources of information are ES Chapter 5 Project Description and Chapter 29 Landscape and Visual Impact Assessment, June 2019.

Thanet Extension

7.37. The scheme is located 8 km from the coast. The proposals are for up to 34 turbines, with a total capacity of 340 MW, with turbines of 8-12 MW capacity and tip heights up to 250m.

7.38. A 45km radius study area was selected. 29 viewpoints were assessed as visual receptors, at distances ranging from 8.7km to 34.7 km.

7.39. The sources of information are Environmental Statement Volume 2 Chapter 1: Project Description (Offshore) June 2018; and Environmental Statement Volume 2 Chapter 12: Seascape, Landscape and Visual Impact Assessment.

Wave Hub

7.40. In 2006 a scheme was consented for wave energy converters (WECs) situated 16km out to sea off St Ives Head, a 1km x 3km deployment area. It planned a maximum capacity of 20MW.

7.41. In 2018 a subsequent application was made for the proposed deployment of either up to four floating wind turbines with blade tip to a maximum of 220m, in place of the WECs, or a combination of the two technologies which may include up to three hybrid wind and wave platforms, totalling a maximum generating capacity of 40 MW.

7.42. Four onshore viewpoints were assessed for visual impact ranging from 17.5 to 20.5 km. The scheme is not taken forward for analysis as 3-4 wind turbines are not representative of larger offshore wind farm developments which are the focus of this report. Though two other demonstration projects are included in the analysis it is considered that a third smaller scheme (Wave Hub) would begin to potentially distort the findings.

7.43. The sources of information are South West of England Regional Development Agency Wave Hub Environmental Statement June 2006 (see p 202 Landscape and Views); Wave Hub Floating Wind Consent Application ES 2018; and the Seascape, Landscape and Visual Impact Assessment Chapter 8, August 2018, and Addendum January 2019.

Neart na Gaoithe

7.44. This scheme is located 15.5 km offshore from the Fife Ness. It was consented in November 2017, and comprises of up to 54 turbines with a total power capacity of 450MW, with turbines up to 208m high.

7.45. The Seascape and Landscape Visual Impact Assessment found that there was a 'significant' effect on the character of East Fife and north-east Lothian. 21 viewpoints were assessed for visual impact, at distances ranging from 15.5 to 49 km. Cumulative impacts will be experienced in the context of The Inch Cape wind farm and proposed wind farms at Seagreen.

7.46. The sources of information are Neart na Gaoithe Offshore Wind farm (Revised Design) – EIA Non-Technical Summary March 2018; see Chapter 14 of the EIA Report.

Inch Cape

7.47. The scheme is located 15km off the coast of East Lothian near Arbroath. It was consented in 2014, but subject to legal challenge. The scheme now has a reduced number of turbines (by more than a third), to a maximum of between 40-72 turbines up to a height of 291m. The total power capacity is 784 MW.

7.48. Significant effects are predicted for recreational users of coastal facilities at distances of up to approximately 20 km distance from the wind farm and potentially up to 35 km distance for high sensitivity receptors. 26 viewpoints were selected ranging from 18.5 to 52km distance.

7.49. The sources of information are Inch Cape Wind Farm Environmental Impact Assessment Report 2018, Non-Technical Summary, and Volume 12B (Viewpoints chapter 12C).

Seagreen

7.50. This scheme lies at its closest 27km from the shore on the Angus coastline. It was consented in 2014, but has since been updated with improved designs. The new 'optimised' project is in two parts, Alpha and Bravo, each with up to 75 turbines or a combined maximum of 120, with blade tip height up to 280m, with a total capacity of 1500MW.

7.51. Eight viewpoints used within the SLVIA for the originally consented project are utilised in the revised SLVIA, plus a further six, at distances of between 30-73km.

7.52. The SLVIA states that the optimised Seagreen wind turbines will also be seen in the same context as consented projects at Inch Cape and Neart na Gaoithe. This will bring about a range of potential cumulative effects. However, as the viewpoint assessment has also concluded, the potential contribution that the optimised Seagreen Project will make to the cumulative effects is not considered to be the significant factor.

7.53. The sources of information are Seagreen Wind Farm Environmental Impact Assessment Report 2018, Non-Technical Summary, and Chapter 13 Seascape, Landscape and Visual Amenity.

Moray East

7.54. This proposal supersedes the consented Telford, Stevenson and MacColl wind farms. At its closest it is 22km from the coast in the Outer Moray Firth. The consented scheme comprises 137 turbines of 8.1-15 MW with maximum tip heights to 280m, and the overall generation capacity of 1,116 MW. Construction of the wind farm using turbines with a blade tip height of 204m has started.

7.55. The original application included the assessment of 7 viewpoints between 22-34 km distance. The threshold at which significant impacts diminish was considered to be in the region of 30–35 km. The revised application included 22 viewpoints between 23-49km.

7.56. Sources of information are Moray East Offshore Wind farm Alternative Design Parameters Scoping Report March 2017 and Chapter 9 Seascape, landscape and visual assessment.

Moray West

7.57. This proposed scheme lies 22.5 km from the shore in the Outer Moray Firth lying adjacent to Moray East. It comprises 62-85 turbines with blade tip heights from 199 to 285m. Capacities are not stated in the EIA. The SLVIA assessment is based on the largest turbines.

7.58. 26 viewpoints were assessed, at distances of between 23 and 53km, and 10 are considered to have potentially significant effects.

7.59. The Development was also considered cumulatively with the Moray East Offshore Wind Farm and 25 onshore wind farms (consented or in-application).

7.60. Sources of information are The Moray West Offshore EIA report, Volume 1 Non-Technical Summary and Chapter 14: Seascape, Landscape and Visual Impact Assessment (SVIA p49).

Kincardine Offshore

7.61. The proposed scheme is located south-east of Aberdeen approximately 15km from the Scottish coastline. It is considered a commercial demonstrator site, which will utilise floating foundation technology, and will be one of the world's first arrays of floating wind turbines alongside Hywind. It comprises eight 6MW turbines, with a later variation to six 8.4 MW (tip height 191m) and one 2MW turbines (tip height 106m).

7.62. 23 viewpoints were assessed in the 2016 ES, at 15–36 km distance.

7.63. Sources of information are The Kincardine Offshore Wind farm Project Design Statement 2018, and Section 36C Variation ES 2017 (revised viewpoint analysis), and original 2016 ES (see p488, 501).

Hornsea Four

7.64. This scheme lies 65 km from the shore at East Riding of Yorkshire. It comprises of up to 180 turbines up to 370m high with a total capacity of 1000 MW.

7.65. The EIA scoping report (October 2018) states that Hornsea Four will have similarities to the existing Hornsea projects both in terms of the nature of the project and its location. As a result, the ES will take into account the results of EIAs for the existing Hornsea projects in order to avoid duplication of assessment. The scoping report states that given their proposed distances from the nearest shore it is likely that these effects can be scoped out on the basis that they are likely to be close to or below the horizon at the distances from shore which are proposed.

7.66. The scheme includes up to three HVAC booster stations lying closer to the shore, at a minimum distance of 25km. The Preliminary Environmental Information Report (PEIR) July 2019 indicates that despite these booster stations the scheme will have no significant effects on seascape and visual resources.

7.67. This scheme is not carried forward to analysis due to its distance offshore.

OVERALL COMBINED ANALYSIS

7.68. A summary of the visual impact analysis for all the 28 schemes are shown in **Tables 7.2 and 7.3** and illustrated in **Figures 7.1 and 7.2.**

Table 7.2 Summary analysis of SVIA visual effects of offshore wind farms based on turbine height

Wind farm	Round	Status	Turbine capacity in MW*	Maximum turbine height to blade tip (m)**	Max no. of turbines**	Maximum wind farm capacity (MW)**	Nearest coast km	Existing wind farms in baseline?	No. of SVIA viewpoints	Low magnitude of effect***		Medium magnitude of effect	
										Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
North Hoyle	1	Implemented	2	107	30	60	7.5	n	12	18.3	21.8	11.2	13.5
Gunfleet Sands 2	1	Implemented	3.6	128	22	173	8.5	y	8	12.1	19.6		
Kentish Flats	1	Implemented	3	140 (115)	30	90	8	n	13	21.1	26.9	11.2	12.1
Gwynt y Môr	2	Implemented	3.6	140	160	576	18	y	36	22.3	35.8	14.3	15.3
Docking Shoal	2	Withdrawn	3-6	145	177	540	14	y	8	22.3	26.3	19.1	19.1
									Averages	**19.2**	**26.1**	**14.0**	**15.0**
Thanet Sands	2	Implemented	3	150 (115)	100	300	11	n	10	21.8	27.7	17.5	17.5
West of Duddon Sands	2	Implemented	3.6	150	139	389	14	y	17	23.3	26.3	11.0	14.6
Greater Gabbard	2	Implemented	3.6	170 (131)	141	504	23	n	6				
Sheringham Shoal	2	Implemented	3.6	172 (135)	88	317	17	n	26	23.5	25.0	19.2	21.0
Westermost Rough A	2	Implemented	6	172 (177)	110	210	8	n	9	18.9	32.6	15.3	17.5
London Array	2	Implemented	3.6	175 (147)	271	630	21	y	18	21.0	21.0		
									Averages	**21.7**	**26.5**	**15.8**	**17.7**
Kincardine	SFD	Construction	7 (8.4)	176	7	50	15	n	23	23.2	36.0	19.6	35.0
Hywind	Demo	Implemented	6	178	5	30	23	n	7	25.9	29.0		
Atlantic Array	3	Withdrawn	5	180	278	1390	14	n	37	28.4	37.5	20.9	27.5
Neart na Gaoithe	Sco 1	Consented	8-10	197 (208)	128	448	15	y	18	32.9	39.0	28.0	28.0
Beatrice Offshore	Sco 1	Construction	7	198	142	588	22	n	16	29.7	33.1	22.2	25.6
Navitus Bay	3	Refused	8	200	121	970	14	n	12	24.9	28.2	19.5	23.1
Walney 1	2	Implemented	3.6	202 (137)	93	186	15	y	17	23.2	23.4	16.5	18.8
Rampion	3	Construction	3.6-7 (3.45)	210 (140)	175	400	13	n	29	26.4	29.5	19.9	30.0
Walney Extension		Implemented	8.25	222	207	659	19	y	17	25.6	32.3		
Burbo Bank Extension		Implemented	3.6	223 (187)	36	254	7	y	18	21.7	30.6	15.1	22.0
									Averages	**26.2**	**31.9**	**20.2**	**26.3**
Thanet Extension		Submitted	8-12	250	34	340	8	y	18	26.3	44.1	16.1	19.9
Seagreen	3	Consented	12.5	280	120	1500	27	y	13	35.3	38.0	32.0	32.0
Moray East	3	Construction	9.5	280	137	1116	22	n	22	42.0	49.0	27.0	34.0
Moray West	3	Consented	10-12	285	85	1116	22	y	25	40.8	53.0	25.8	28.0
Inch Cape	Sco 1	Consented	9.5	291	72	1000	15	y	26	42.0	52.5	29.7	34.8
East Anglia ONE North	3	Submitted	12-19	300	53	800	36	n	17	42.9	48.8		
East Anglia TWO	3	Submitted	12-19	300	60	900	31	n	22	40.6	47.7	34.2	37.6
									Averages	**38.6**	**47.6**	**27.5**	**31.1**

* Shows as assessed in SVIA (implemented capacity in brackets) ** in SVIA (implemented height or number in brackets). Note: *** Low magnitude category includes equivalent of low and medium/low

Table 7.3 Summary of SVIA visual effects of offshore wind farms

Offshore wind farm SVIAs	Low magnitude of effect		Medium magnitude of effect	
Heights of turbine to blade tip (m)	Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
107-145	**19.2**	26.1	**14.0**	15.0
150-175	**21.7**	26.5	**15.8**	17.7
176-223	**26.2**	31.9	**20.2**	26.3
250-300	**38.6**	47.6	**27.5**	31.1

Figure 7.1 Low magnitude of effect for different height turbines- average SVIA distances

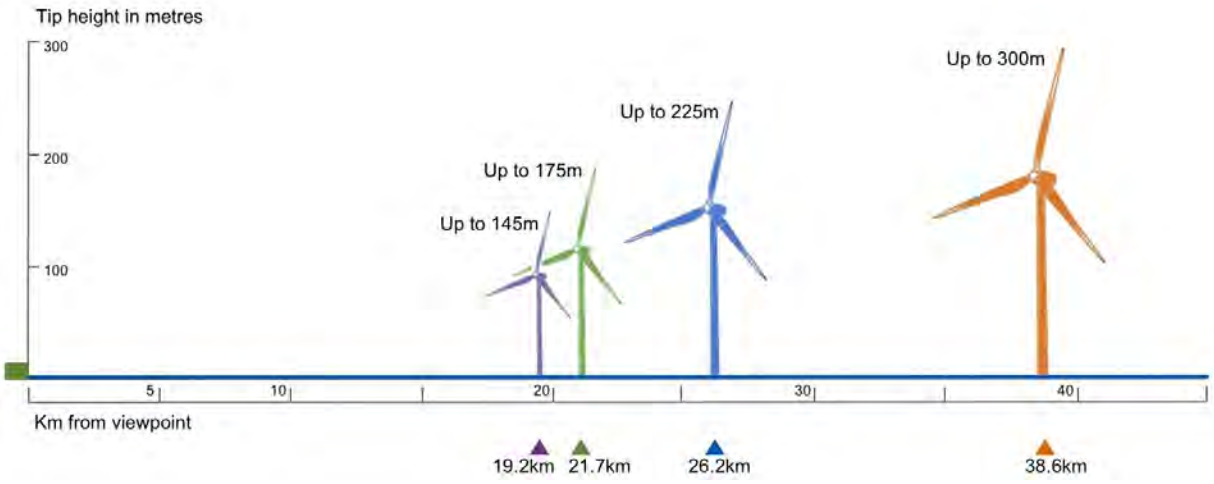
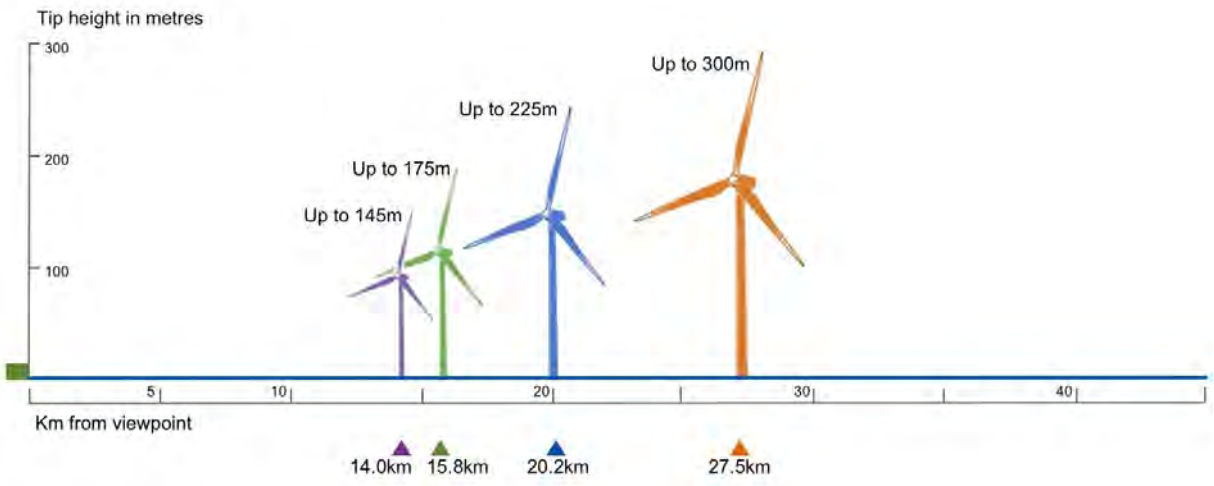


Figure 7.2 Medium magnitude of effect for different height turbines- average SVIA distances



7.69. It should be noted that the Greater Gabbard SVIA does not contribute to the analysis because all the visual effects are greater than medium. The SVIA found that visual effects on receptors were substantial up to 29km and moderate-substantial up to 33.5km. This reinforces the need for a precautionary approach when using the summary thresholds.

Analysis excluding wind farm extensions

7.70. As previously mentioned, the extensions of wind farms at Walney, Burbo Bank and Thanet are likely to be assessed as having lower additional visual effects as additional elements to the adjacent existing wind farm baseline. This has the effect of reducing the threshold distances. If the analysis of these wind farm extensions is excluded the following thresholds shown in **Figure 7.4** would apply. This indicates that the threshold distances for the two larger size ranges of turbines are increased between 0.6-2.2km.

Table 7.4 Summary of SVIA visual effects of offshore wind farms excluding extensions

Offshore wind farm SVIAs	Low magnitude of effect		Medium magnitude of effect	
Heights of turbine to blade tip (m)	Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
107-145	**19.2**	26.1	**14.0**	15.0
150-175	**21.7**	26.5	**15.8**	17.7
176-223	**26.8**	32	**20.9**	26.9
250-300	**40.6**	48.2	**29.7**	33.3

Analysis based on number of turbines in array

7.71. A visual impact analysis for all the 28 schemes based on the number of turbines within each is set out in **Appendix F**. This indicates that there is no strong correlation between the number of turbines in an array and the expected magnitude of effect.

7.72. North Hoyle, as a small array of 30 turbines, does have the shortest average and maximum distance for low magnitude of effect. Kentish Flats, also with 30 turbines, also has the smallest distance for maximum medium magnitude of effect. However, West of Duddon Sands, which is relatively large with 139 turbines, has the smallest average distance for medium magnitude of effect. North Hoyle has the smallest wind turbines assessed at 107 m to blade tip.

7.73. East Anglia One North, with 53 turbines, has the largest average and maximum distance for low magnitude of effect. Inch Cape, with 72 turbines, has the largest distance for average and maximum magnitude of effect. These two wind farms also have the largest turbines- 291m and 300m to blade tip.

7.74. It is possible that some of the results could be explained by a correlation between the size of wind turbine and the spacing of turbines which means that the larger the turbine, the larger the array. The analysis does not include the physical dimensions of the arrays or their juxtaposition with viewpoints.

7.75. It is also possible that some variation can be put down to the different approach of assessors as well as other factors such as other wind farms as part of the baseline.

SUMMARY AND DISCUSSION

7.76. SVIAs for 28 wind farms from Rounds 1, 2, 3, STW and wind farm extensions have been analysed. The distances at which both low and medium magnitude of visual effect have been extracted for four ranges of turbine sizes.

7.77. Including all wind farms analysed, the range at which low magnitude of effect occurs is from average 19.2km for turbines up to 145m height to blade tip to average 38.6km for turbines up to 300 m high. A low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a coastal National Park or AONB, or a visitor to a World Heritage Site.

7.78. The range at which medium magnitude of effect occurs is from average 14km for turbines up to 145m height to blade tip to average 27.5km for turbines up to 300m high. A medium magnitude of effects may have a significant effect on medium or medium to high sensitivity receptors.

7.79. The thresholds of effects derived from these analyses are lower than both the OESEA3 background report (2016) and NRW studies (2019). This is likely to be due to the following combination of factors:

- This analysis includes judgements of medium-low in the range of low magnitudes of effects- this influences the thresholds of low effect in all turbine height ranges.
- There are a greater number of assessments informing the analysis of wind farms, including those with higher turbines, but also smaller demonstration wind farms like Kincardine and wind farm extensions are included.
- The grouping of different heights/sizes of turbines is slightly different between this analysis and OESEA3 background report, and so the two are not directly comparable. The latter groups turbines of 3-6MW together i.e. up to around 180m high.

7.80. The distances set out in **Table 7.4** are considered to be preferred as possible buffer distances than **Table 7.3,** albeit the differences are small. This is because the SVIAs judgement of effects of wind farm extensions is likely to be less because the existing wind turbines are taken into consideration as part of the baseline. The latter distances have still been used in diagrams as these include all wind farms analysed.

7.81. The visual impact analysis of schemes based on the number of turbines does not indicate that there is a strong correlation between the number in an array and the expected magnitude of effect. This does not therefore contribute to the findings taken forward.

7.82. The thresholds for average low magnitude effects in this report are considered to be indicators for minimum thresholds as it is considered likely that effects on high sensitivity receptors could be significant around these distances. They may understate buffer thresholds in areas with highly sensitive individual or combined receptors (such as national landscape designations with strong coastal/seascape special qualities) and no existing development. The NRW (2019) reports which have larger buffer distances are considered to remain a valid expression of the analysis carried out on a slightly different basis and with slightly fewer wind farms considered. These should continue to form a basis for consideration within Welsh waters but the updated findings of this SEA can also inform these discussions.

8. Offshore wind farm scenarios wireline analysis

Introduction

8.1. While some conclusions can be drawn from SVIAs of Round 1- 3 and STW wind farms it is considered important for the study to understand the impacts of larger turbines which are likely to come forward in the future. The SVIAs analysed consider turbines up to 300m high to blade tip. Some wind farms further offshore are now considering wind turbines up to 370m high to blade tip e.g. Hornsea 4. Wirelines are used in this report to explore the potential visual effects of wind turbines 350m and 400m high to blade tip. The size of array, heights of viewpoints and distances of arrays offshore are considered to be representative of typical situations and wind farms in the UK which may have effects on coastal receptors.

Method

8.2. Wireline scenarios have been prepared for the two different heights of turbines in two different sizes of arrays either on their own or in a cumulative impact situation with existing wind farms.

8.3. For larger turbines in deeper water at +40m depth the use of jacket foundations is now often used. This has been applied to the 350m/400m turbines whilst the standard monopile design is used for the 3.6MW turbines in the cumulative scenarios.

8.4. The larger turbines are set out in an offset grid, in accordance with spacings in consented large turbine wind farms i.e. 6x7.5 turbine rotor diameter (Rampion). This is a moderate size spacing rather than a compact spacing. Smaller turbines are placed in an offset grid with spacing in accordance with outline findings of a BWEA offshore report (BWEA, 2008).

8.5. A basic scenario of a 500MW wind farm (around 25 turbines) with either 350m high turbines or 400m high turbines is set out in a virtual seascape with no other features. The arrays are placed at 13km, 18km, 24km and 35km from the coast to represent a realistic range to explore the magnitude of effects. For each layout, wireline views on the coast have been derived at viewing heights of 22m AOD. These simulate views respectively from low-lying hills such as found in eastern England and from lower cliffs found in other parts of England.

8.6. A second set of wirelines sets out 350m or 400m high turbines in a large array (around 80 turbines) consistent with those coming forward. These are viewed at different distances and at different viewing heights AOD. The distances are 13km, 24km, 35km and 44km at viewing heights of 6m, 22m and 100m AOD. These simulate views respectively from promenades, low-lying hills such as found in eastern England and from cliffs and coastal hills elsewhere.

8.7. Three cumulative scenarios are illustrated to show arrays of larger turbine sizes at distance seen against smaller turbines closer inshore. These are:

- 350m high turbine array at 24km, 220m high turbine array at 13km and 147 m high turbine array at 7km
- 350m high turbine array at 35km, 220m high turbine array at 13km and 147 m high turbine array at 7km
- 350m high turbine array at 24km, 350m high turbine array at 13km and 147 m high turbine array at 7km

8.8. A similar exercise was carried out for smaller turbines in the 2009 and 2016 OESEA background reports. It should be noted that there are limitations with this wireline

method of visualisation. The turbines are rendered dark grey rather than the white or very light grey and yellow of actual turbines. The effect of the atmosphere with its associated visibility modifiers such as haze or mist also cannot be taken into consideration. Overall, this may mean the wirelines exaggerate the contrast of the turbines with their background and show a worst case visibility scenario. This is more marked for turbines at a greater distance away from the viewer.

8.1. The wirelines have been prepared to be consistent with the 2009 and 2016 studies wirelines. Cylindrical rather than planar projection is used. The latest Landscape Institute visual representation guidelines (2019) have therefore not been followed partly as the final version of the guidance was published after the assessment was carried out and partly as using wirelines prepared to a different method might change the perceived magnitude of effect, although unlikely.

8.2. The wirelines were constructed using a virtual 50mm lens field of view (as for a 35mm camera) with a viewing distance of around 33-51cm for an A3 sheet depending on the single wind farm scenario and 51cm for an A1 sheet for the cumulative scenario. This produces a geometrically accurate image. However, the human eye records more detail in this than can be captured by a 2D image and so turbines are likely to appear larger in reality. The DTI (2005) guidance refers to this (p68, 69) and recommends that wirelines or photomontages should be taken on site to viewpoints so judgements can be made in the field with the actual scale of the seascape apparent. SNH (2017) guidance on wind farm visualisations recommends that photomontages should be viewed at a comfortable arm's length (104) and wirelines at an A1 paper width (820mm) (157). This is mainly to ensure that members of the public can appreciate the likely size of development rather than for professional use. In this case, the wirelines were printed for professional assessment and assessed at A3 for single wind farm scenarios and A1 for cumulative scenarios. Two chartered landscape architects (A and B) with experience in assessing wind farm development assessed the magnitude of effects of the wirelines separately using the definitions set out in DTI (2005) (see **Table 5.2**). Both assessments are shown.

8.3. For our exercise we have undertaken only a desk study assessment of scale/size of effect. This possibly balances the apparently reduced size of the wireline image with the effect of visibility modifiers reducing contrast of the turbines with their background. It is accepted the latter are likely to be more significant with increasing distance (to be considered in detail in Part 2 of the report). As a simple image the wireline also excludes the potential effect of intervening coastline or features which may increase the apparent magnitude of effect by giving scale to the proposals. Sample wireline extracts are shown in **Figures 8.1 and 8.2.**

Figure 8.1 Wireline Sample 1- 350m high wind turbines at 13km viewed at 22m AOD

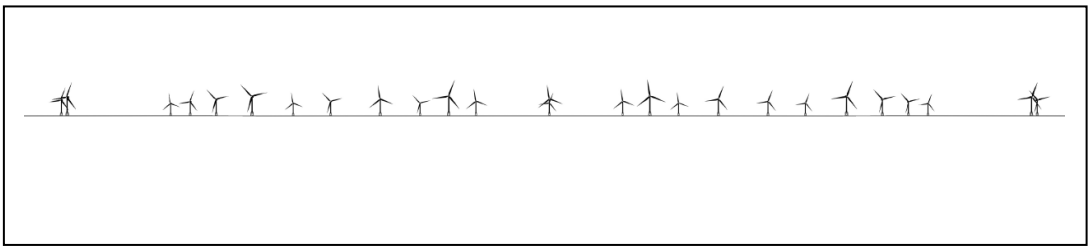
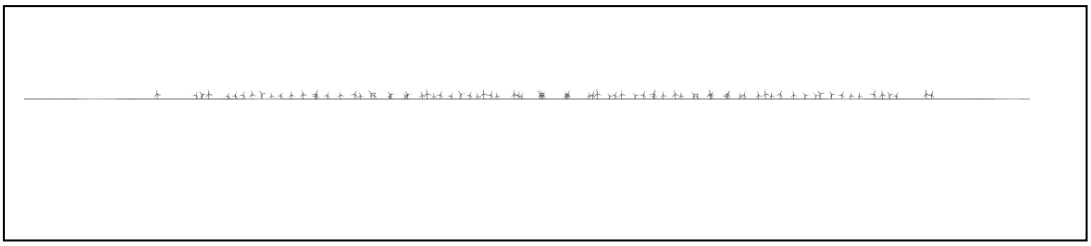


Figure 8.2 Wireline Sample 2- 400m wind turbines at 44km viewed at 22m AOD



Analysis

8.4. The assessment for each 500MW scenario derived from assessments carried out in 2009 and 2016 and for this study (see **Appendix E1**) is set out in **Table 8.1** below. The wireline views are shown in **Appendix E3** and underpinning scenario plans in **Appendix E2**.

Table 8.1 – View of potential magnitude of effects for each 500MW offshore wind farm scenario viewed at 22m AOD

Turbine height m /capacity (MW)	Distance from shore/viewpoint			
	13km	18km	24km	35km
137 (3.6)	Moderate and moderate/large	Small and small/ moderate	Small	n/a
175 (5)	Moderate and Large	Moderate and moderate/ large	Small and small/moderate	n/a
190 (7/8)	Moderate and Large	Moderate and Large	Small	Very small
220 (10)	Large	Moderate and Large	Small and small/moderate	Very small
250 (15)	Large	Moderate/ large and large	Moderate	Very small
350 (20)	Large and Very Large	Large	Moderate	Small
400 (20+)	Large and Very Large	Large and Very Large	Moderate and Large	Small and Moderate

8.5. Based on the above for 500MW wind farms, for **high sensitivity** receptors (where a small (or low) magnitude of effect is found at the following maximum thresholds):

- For 137m/3.6MW turbines the threshold of no significance is *beyond* 24km.
- For 175m/5MW turbines the threshold of no significance is *beyond* 24km.
- For 190m/7-8MW turbines the threshold of no significance is *beyond* 24km (because there is a small assessed effect at 24km and so the threshold for small is at or just beyond 24km but less than 35km where a very small effect is expected).
- For 220m/10MW turbines the threshold of no significance is *well beyond* 24km but less than 35km (because there is a small and small/moderate assessed effects at 24km and so the threshold for small is well beyond this distance but less than 35km where a very small effect is expected).
- For 250m/15MW turbines the threshold of no significance is *well beyond* 24km but less than 35km.
- For 350m/20MW turbines the threshold of no significance is *beyond* 35km.
- For 400m/20MW+ turbines the threshold of no significance is *well beyond* 35km.

8.6. For **medium sensitivity** receptors (where a medium magnitude of effect is found at the following maximum thresholds):

- For 137m/3.6MW turbines the threshold of no significance is *between 13*-18km.
- For 175m/5MW turbines the threshold of no significance is *between 18*-24km.
- For 190m/7-8MW turbines the threshold of no significance is *between 18*-24km.
- For 220m/10MW turbines the threshold of no significance is *between 18*-24km.
- For 250m/15MW turbines the threshold of no significance is *beyond* 24km.
- For 350m/20MW turbines the threshold of no significance is *beyond* 24km.
- For 400m/20MW+ turbines the threshold of no significance is around 35km.

8.7. The assessment for the large wind farm scenario derived from assessments carried out for this study is set out in **Table 8.2** below (see **Appendix E4** for second set of wirelines and **Appendix E2** for the scenario plan).

Table 8.2 – View of potential magnitude of effects for a large offshore wind farm scenario viewed at 6m, 22m and 100m AOD

Turbine ht m /capacity (MW)	Distance from shore/viewpoint			
	13km	24km	35km	44km
350 (20)	Very large/large and Very Large	Moderate	Small	Very small
400 (20+)	Very large/large and Very Large	Moderate	Small	Very small

8.8. In relation to viewing 350m and 400m high turbine wind farms from different heights (6m, 22m and 100m AOD) the assessors found that the level of effects were the same at each height. This finding coincides with the 2009 and 2016 studies as set out in Chapter 2 and **Appendix E1**. Wind farms appear more coherent and potentially slightly smaller in scale

when viewed from higher viewpoints. This is because their bases, towers and layout can be seen in the context of a wider sea view. The effect is most apparent in the closest wireline scenario of 13km reducing significantly for further scenarios. This difference in perception is not sufficiently substantial to merit a different evaluation of scale of effect. At longer distances more of the turbines can be seen above the horizon from higher viewpoints. Again, for the size of turbine and the distances assessed, there is not sufficient difference to arrive at a different scale of effect.

8.9. For the large wind farm scenario, for **high sensitivity** receptors (where a low or small magnitude of effect is found at the following maximum thresholds):

- For 350m/20MW turbines the threshold of no significance is *beyond* 35km.
- For 400m/20MW+ turbines the threshold of no significance is *beyond* 35km.

8.10. For **medium sensitivity** receptors (where a medium magnitude of effect is found at the following maximum thresholds):

- For 350m/20MW turbines the threshold of no significance is *beyond* 24km.
- For 400m/20MW+ turbines the threshold of no significance is *beyond* 24km.

8.11. It is noted that the judgements of effect by one assessor of the 400m turbine at 24km and 35km are, contrary to expectation, less for the larger wind farm scenario (**Table 8.2**) than the 500MW scenario (Table 8.1). The wireframe scenarios had different viewing distances and this may have underplayed the visual effects of the larger wind farm. Nevertheless overall trends can be discerned.

SUMMARY

8.12. Wirelines are used in this report to explore the potential visual effects of wind turbines 350m and 400m high to blade tip. The ranges of size of array, heights of viewpoints (6m, 22m and 100m AOD) and distances of arrays offshore (13km, 18km, 24km, 35km and 44km) are considered to be representative of typical situations and wind farms in the UK which may have effects on coastal receptors.

8.13. For a sample 500MW wind farm, a small (or low) magnitude of effect was found beyond 24km for 137m high turbines and well beyond 35km for 350m or 400m high turbines. A low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a National Park or AONB.

8.14. For the same sample 500MW wind farm, a medium magnitude of effect was found between 13-18km for 137m high turbines and around 35km for 350m or 400m high turbines. A medium magnitude of effects may have a significant effect on medium or medium to high sensitivity receptors.

8.1. For the large wind farm scenario, a small (or low) magnitude of effect was found beyond 35km for 350m or 400m high turbines. As above, a low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a National Park or AONB.

8.2. For the large wind farm scenario, a medium magnitude of effect was found beyond 24km for 350m or 400m high turbines. As above, a medium magnitude of effect may have a significant effect on medium or medium to high sensitivity receptors.

8.3. In relation to viewing wind farms from different heights (6m, 22m and 100m AOD) the assessors found that the level of effects were the same at each height.

9. Marine Visibility Modifiers

Introduction – Range of Modifiers

9.1. Offshore meteorological conditions can greatly affect the distance that wind farms can be seen. Seasonal and diurnal patterns of visibility for coastal environments are significantly different to onshore sites and generally visibility is higher (Lawrence, 1976). This is largely to do with meteorological effects associated with coastal regions.

9.2. This chapter will look at the influence of marine visibility modifiers on the visible offshore distance. Various studies on general visibility and the visibility of offshore wind farms in particular are explored.

9.3. DTI (2005) recommends the use of Met Office weather data for SVIAs to assess trends in conditions over a 10 year period for stations located landward of proposed wind farm sites. For this level of research a full range of data would prove extremely expensive and therefore the data used has been limited to representative locations and broad factors at a regional level.

9.4. Detailed visibility data has been obtained from the Met Office for eight coastal weather stations around English and Welsh coastlines. Broad sunshine and rainfall data are also discussed. In addition, seasonal trends and variations are briefly explored for some coastal stations based on data collected for the 2009 OESEA study (see **Appendix G**).

REVIEW OF GUIDANCE AND ASSESSMENTS

SNH (2005): An assessment of the sensitivity and capacity of the Scottish seascape in relation to wind farms

9.5. The SNH report refers to the meteorological effects on visibility in Scotland. Key conclusions with regard to coastal weather patterns are that:

- The visual range for Scotland is significantly higher than that for England and Wales and visual range on the north west of Scotland is consistently high.
- Highest values of visibility tend to occur in the afternoon whilst poor visibility builds up during the night. Clear views of turbines at sunset are more likely than at sunrise, making seascapes with aspects towards sunset slightly more sensitive in this respect.
- In Britain, excellent visibility is associated with unstable polar airstreams, particularly if these come directly from more northern latitudes and across sea tracks rather than urban areas.
- Haar (sea fret) is a phenomenon which occurs on the east coast of the UK north of The Wash. In late spring/early summer a light easterly wind is driven across the North Sea due to high pressure in Scandinavia. This air is cooled by the sea and leads to large scale condensation, so forming sea fog and low stratus cloud across the coast. Unlike other fogs, haar can exist in wind speeds up to 9 miles an hour. The most affected area is the strip from the Humber to the Tweed.
- Windows of exceptional visibility exist just after rain and before evaporation occurs, in Scotland, these windows are likely to occur more frequently.

Bishop & Miller (2006) Visual Assessment of offshore wind turbines: The influence of distance, contrast, movement and social variables

9.6. This report sets out research and analysis on the parameters which determine the visual impact of offshore wind turbines. The key conclusions relating to the effects of meteorology on visibility are:

- Distance remains clearly important in determining the visual magnitude of developments, however, contrast between the turbines and their background of sky is also important and needs to be quantified. In the northern hemisphere a wind farm off a south-facing coast will typically have full sun on the exposed side of the turbines much less than a farm off a north facing coast.
- Although different parties are not going to agree on impacts, application of an impact estimation process based on empirical research at least forces the factors to be considered into the open and makes the parameters explicit. This provides something concrete which can be argued over rather than poorly defined personal concepts of visual impact without substantiation.

Husar and Husar (1998): Global Distribution of Continental Haziness, Washington University

9.7. Visibility is a standard meteorological variable recorded globally at all synoptic weather stations. The visual range, or visibility, is the maximum distance at which an observer can discern the outline of an object. The visual range in the atmosphere is reduced mainly by the presence of aerosol particles. These can be either hydrometeors or haze particles. Hydrometeors are large droplets or crystals of water (>5μm) and can occur as rain, fog, clouds and snow. Haze is used as a generic term that includes smoke, dust, sea spray, as well as marine and continental haze.

9.8. Husar & Husar present the following formula for calculating the maximum distance at which an observer can discern the outline of an object (as modified below in SNH 2005).

$$V = \frac{C}{E}$$

V = Visual Range

C = Constant determined by the threshold sensitivity of the human eye and the assumed contrast of visible objects against their background.

E = Extinction coefficient–a measure of how much haze is in the air.

9.9. **Table 9.1** indicates the maximum likely viewable distance at which the outline of an object can be made out given a range of UK specific coefficients.

Table 9.1 The influence of haze on viewable distance

Applicable Area and Season	Haze Coefficient (E)	Viewable Distance (V)
Northern Scotland	0.1	39km
Wales (Spring and Summer). Central and Southern Scotland (Summer to Winter)	0.15	26km
Central & Southern England (Spring). Central England, north & south Wales (winter). Parts of south & NE England (summer)	0.2	19.5km
Southern England (winter)	0.25	15.6km

(Source: Husar & Husar, 1998 – Assumes a 'C' value of 3.9 as noted as generally used in SNH (2005) p159

9.10. The viewable distance represented in the table above does not include the impact of meteorological phenomena hydrometeors (e.g. rain, snow).

Taylor (2004): How do weather conditions affect visual impact of an Off Shore Wind Farm?

9.11. Taylor (2004) investigated the visual impact of North Hoyle offshore wind farms in relation to weather conditions in order to try and understand their connection. The study was a student essay and used secondary amateur weather data recorded daily from a weather station located at Llysfaen on the North Wales coast. Whilst the study stated that whole year's sampling would be ideal, the survey was undertaken over 11 mornings over a period of just over two weeks in July 2004. Seven sites in all were visited on each morning with a period of five minutes allowed for each site. A data sheet was filled out, an estimate of visibility was made and a typical visibility score attributed. A basic system of scoring visibility from 0-10 (where 0 is obscured and 10 is an obvious visual 'intrusion') was used following consultation with CCW. A photograph was then taken during the typical conditions prevailing during the five-minute period.

9.12. The results of the study showed that on 54% of the days measurements were taken, the visual impact of the wind farm was at best (or worst) negligible due to weather conditions.

9.13. The report concluded that the extent to which weather conditions control visibility is such that in some conditions, even 'distant' viewpoints can have unpredicted and unusually high scores.

9.14. "*Visibility seems not to decrease exponentially…instead it seems to reduce as the distance increases, until around 18-20km it falls drastically and then levels out…from this drop out point the visual impacts are not at all intrusive on the seascape and it often becomes completely obscured.*"

9.15. It should be noted that terms such as 'intrusive' are used by a layman rather than a professional but the study is considered as a useful and carefully worked through contribution giving a snapshot of an existing wind farm's visibility.

Met Office visibility definitions

9.16. The Met Office sets out definitions for the different ranges of visibility ranging from 'very poor' to 'excellent' as follows:

- Very poor visibility - range is less than 1 km;
- Poor visibility - range is 1 to 4 km;
- Moderate visibility - range is 4 to 10 km;
- Good visibility - range is 10 to 20 km;
- Very good visibility - range is 20 - 40 km; and
- Excellent visibility - range is over 40 km.

9.17. In the PIER SLVIA (2011) for East Anglia TWO, they note that:

'It is reasonable to conclude that the prevailing visibility and weather conditions combine to reduce the duration and potential for significant effects to periods when clear views of the (East Anglia TWO) wind farm site are available…. Whilst this 'visibility' analysis is a useful indicator other factors such as contrast (largely influenced by lighting by the sun) scale, orientation and movement of the structures also need to be considered when determining the likely impact of optimum visibility at a certain range.'

9.18. Commentary: Both the frequency of visibility and the other factors mentioned are valid considerations in helping to consider the likelihood of significant effects. However, SLVIAs should note the worst case situation in excellent visibility and then make a judgement taking into account the other factors.

9.19. The SLVIA (2019) scoping for East Anglia TWO justifies a study area of 50km, based on SNH (2017) guidance and an analysis of Met Office Data from Weybourne and Shoeburyness. This stated that visibility over 50km was only possible for 9% of the time in the 10 year period 2007-2017. It was concluded that visual effects beyond 50km were unlikely to be significant. This was agreed in consultation and the Planning Inspectorate's scoping opinion (section 4.24) stated that effects beyond 50km could be scoped out. The SLVIA goes onto state that significant effects are most likely in the closer areas and less likely in the outer edges of the study area.

Other research findings taking weather conditions into account

9.20. An online search for research on the visibility of offshore wind turbines has yielded two studies with relevant findings.

9.21. Research was undertaken in 2012 led by Argonne National Laboratory based in the USA[9]. This was based on fieldwork and reporting of observations carried out in the UK in relation to a number of offshore wind farms located in the Irish Sea and the English Channel.

9.22. The objectives included identifying the maximum distances that wind farms could be seen in both daytime and night-time views and assessing the effect of distance on visual contrasts associated with the structures.

9.23. The eleven wind farms assessed included Rhyl Flats, North Hoyle and Walney 1 to the west and Greater Gabbard and Thanet to the east. These use mainly 3.0MW and 3.6MW turbines up to 150m high (Walney) with arrays from 25 turbines (Rhyl Flats) up to 140 (Great Gabbard).

9.24. The visibility assessments consisted of numeric ratings on a scale of 1 to 6, scored on the visibility of a wind farm within its landscape/seascape setting and for the weather and lighting conditions at the time of the observation. These are summarised as:

- Visibility Level 1- Visible only after extended, close viewing; otherwise invisible.
- Visibility Level 2- Visible when scanning in the general direction of the study subject; otherwise likely to be missed by casual observers.
- Visibility Level 3- Visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.
- Visibility Level 4- Plainly visible, so could not be missed by casual observers, but does not strongly attract visual attention or dominate the view because of its apparent size, for views in the general direction of the study subject.
- Visibility Level 5- Strongly attracts the visual attention of views in the general direction of the study subject. Attention may be drawn by the strong contrast in form, line, color, or texture, luminance, or motion.

[9] Sullivan, R., Kirchler, L., Cothren, J., & Winters, S. (2013). RESEARCH ARTICLE: Offshore Wind Turbine Visibility and Visual Impact Threshold Distances. *Environmental Practice, 15*(1), 33-49. doi:10.1017/S1466046612000464

- Visibility Level 6- Dominates the view because the study subject fills most of the visual field for views in its general direction. Strong contrasts in form, line, colour, texture, luminance, or motion may contribute to view dominance.

9.25. In total there were 49 daytime observations of 11 wind farms from 29 onshore locations, with six additional observations at night. Three observers were involved- a landscape architect, a geospatial visualization developer, and an archaeologist. Most days were partly to mostly cloudy and two days were sunny without fog. In general, visibility was judged to be good, although many observations included low contrast levels between shaded wind turbines and cloudy sky backdrops.

9.26. The results were that small to moderately-sized wind farms were visible to the unaided eye at distances greater than 42km with turbine blade movement visible up to 39km. At night, aerial hazard navigation lighting was visible at distances greater than 39km. The observed wind farms were judged to be a major focus of visual attention at distances up to 16km, were noticeable to casual observers at distances of almost 29km, and were visible with extended or concentrated viewing at distances beyond 40km.

9.27. The conclusions were that:

'even small offshore wind facilities of a few dozen turbines can be seen easily at distances exceeding 25km and that moderately sized facilities of 100 turbines are seen easily at distances of 35km or even farther, in a variety of weather and lighting conditions. At distances of 14km or less, even isolated, small facilities will likely be a major focus of visual attention in seaward views, again in a variety of weather and lighting conditions.'

9.28. Commentary: Overall, at this time there was a greater separation between a series of smaller wind farms than is now the case and so the likely levels of effect may be correspondingly less than the same view now. The weather/visibility was also not very good or excellent so the findings reflect normal scenarios, not worst case. This independent study is representative with a large number of observations during the day and night. Its objective judgements are helpful as a check relative to SVIAs with qualified professionals' judgements. Unfortunately it uses scales which do not correspond to those commonly used in the UK as measures of magnitude of effect but there are parallels to the descriptors devised in SNH (2005). For instance, the term 'noticeable' at distances up to 29km is an indicator of moderate magnitude which is likely to have a significant effect on sensitive receptors.

9.29. A further, more limited, study by a team from New York State in 2017[10] considered weather patterns around New York and photorealistic visual simulations of arrays of 8MW wind turbines 187m to blade tip.

9.30. It was concluded that beyond 32km (20 miles) from shore, turbines would become difficult or impossible to see in the majority of conditions. During around 77% of the daylight hours in a given year in New York, turbines placed 32km from the viewer would be very difficult to discern or invisible due to atmospheric conditions.

9.31. Offshore turbines would be possibly most visible in the morning, before 10 a.m., when colour contrast is highest with clear skies. The data showed this condition had the potential to occur only during approximately 8% of daylight hours of a typical year in New York.

[10] Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C December 2017 **Visibility Threshold Study** conducted by the State of New York

9.32. At a distance of 40km (25 miles), under even clear or partly cloudy skies, it was concluded that it was likely that a viewer would not notice the above-horizon portions of 187m high turbines unprompted, but rather would have to know they are there and actively look for them. The exception to this would likely occur under very specific lighting conditions involving a dark cloudy horizon and intense morning or evening sunlight at a low-angle illuminating the light grey turbines. Blade movement, although nearly impossible to discern at 40km, might draw the viewer's eye under specific particularly clear conditions.

9.33. An additional factor in some weather conditions would be sea spray which could serve to scatter and diffuse light—and therefore visibility—thus reducing the effective visibility range.

9.34. The study noted that there were numerous climate variables and that viewer experience was a much more complicated metric, as it is influenced by visual acuity, viewer activity, and a variety of environmental factors.

9.35. Commentary: This study is very limited and relates only to New York weather conditions. In the context of the buffers being considered in this study (Section 13) it is interesting that the thresholds of 32km and 40km are mentioned when considering turbines of 187m height.

VISIBILITY DATA FOR COASTAL STATIONS IN ENGLAND

Data Examined

9.36. In order to explore the variation of weather conditions off the English coast to the south, east and west, visibility data for eight coastal stations was acquired from the Met Office. In a clockwise direction- Boulmer (north east), Weybourne (east), Manston (south east), Hurn (south), Culdrose (south west), St Athan (south Wales), Rhyl (north Wales) and St Bees Head no 2 (north west) (see **Figure 9.2**). The data represents 10 years of hourly data on a monthly spread. To produce the data, automated recordings of visibility are carried out by determining the concentration of aerosols from a captured sample of air between two lasers. This is equated to a distance from which a distinct object or skyline can be viewed. This data does not take account of varying conditions that may exist at certain distances offshore and may therefore provide a distorted picture of the actual visibility. The individual and combined visibility of the stations is set out in **Table 9.2**.

Table 9.2 Visibility Distances for Coastal Stations over a 10 year period (2008-2017)

Weather Stations	Visibility Distance (km)							
	0-5	6-10	11-15	16-20	21-25	26-30	35	40+
Boulmer % days visibility	10.9%	12.7%	12.4%	16.3%	13.9%	12.7%	4.6%	16.5%
cumulative totals	100.%	89.1%	76.4%	64.0%	47.7%	33.8%	21.1%	16.5%
Weybourne % days visibility	9.9%	13.0%	13.5%	11.1%	9.8%	14.1%	6.0%	22.6%
cumulative totals	100%	90.1%	77.1%	63.6%	52.5%	42.7%	28.6%	22.6%
Manston % days visibility	10.7%	13.2%	12.7%	13.1%	12.8%	17.0%	6.7%	13.7%
cumulative totals	100%	89.3%	76.1%	63.3%	50.2%	37.4%	20.5%	13.7%
Hurn % days visibility	11.0%	13.1%	13.8%	19.7%	15.1%	20.3%	3.7%	3.1%
cumulative totals	100%	89.0%	75.8%	62.1%	42.3%	27.2%	6.8%	3.1%
Culdrose % days visibility	19.9%	16.1%	17.5%	28.7%	11.8%	4.6%	0.7%	0.7%
cumulative totals	100%	80.1%	64.0%	46.5%	17.8%	6.0%	1.4%	0.7%
St Athan % days visibility	6.5%	9.6%	10.7%	14.3%	14.7%	22.9%	9.2%	12.0%
cumulative totals	100%	93.5%	83.8%	73.1%	58.8%	44.1%	21.2%	12.0%
Rhyl % days visibility	5.4%	7.4%	11.5%	14.0%	13.8%	20.1%	8.8%	19.1%
cumulative totals	100%	94.6%	87.2%	75.7%	61.7%	47.9%	27.9%	19.1%
St Bees Head % days visibility	13.5%	12.7%	17.5%	21.8%	18.3%	10.3%	1.8%	4.0%
cumulative totals	100%	86.5%	73.8%	56.3%	34.5%	16.2%	5.8%	4.0%
Average % days visibility	11%	12.2%	13.7%	17.4%	13.8%	15.2%	5.2%	11.5%
Avg. cumulative totals	100%	89.0%	76.8%	63.1%	45.7%	31.9%	16.7%	11.5%

Figure 9.1 Average visibility distances related to % days per annum (2008-2017)

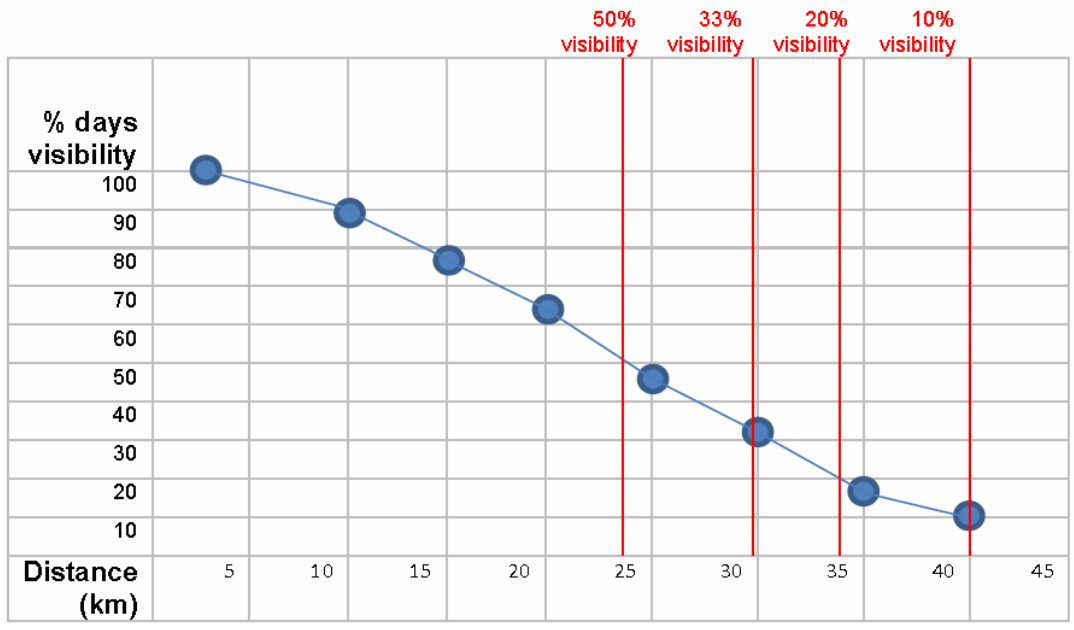
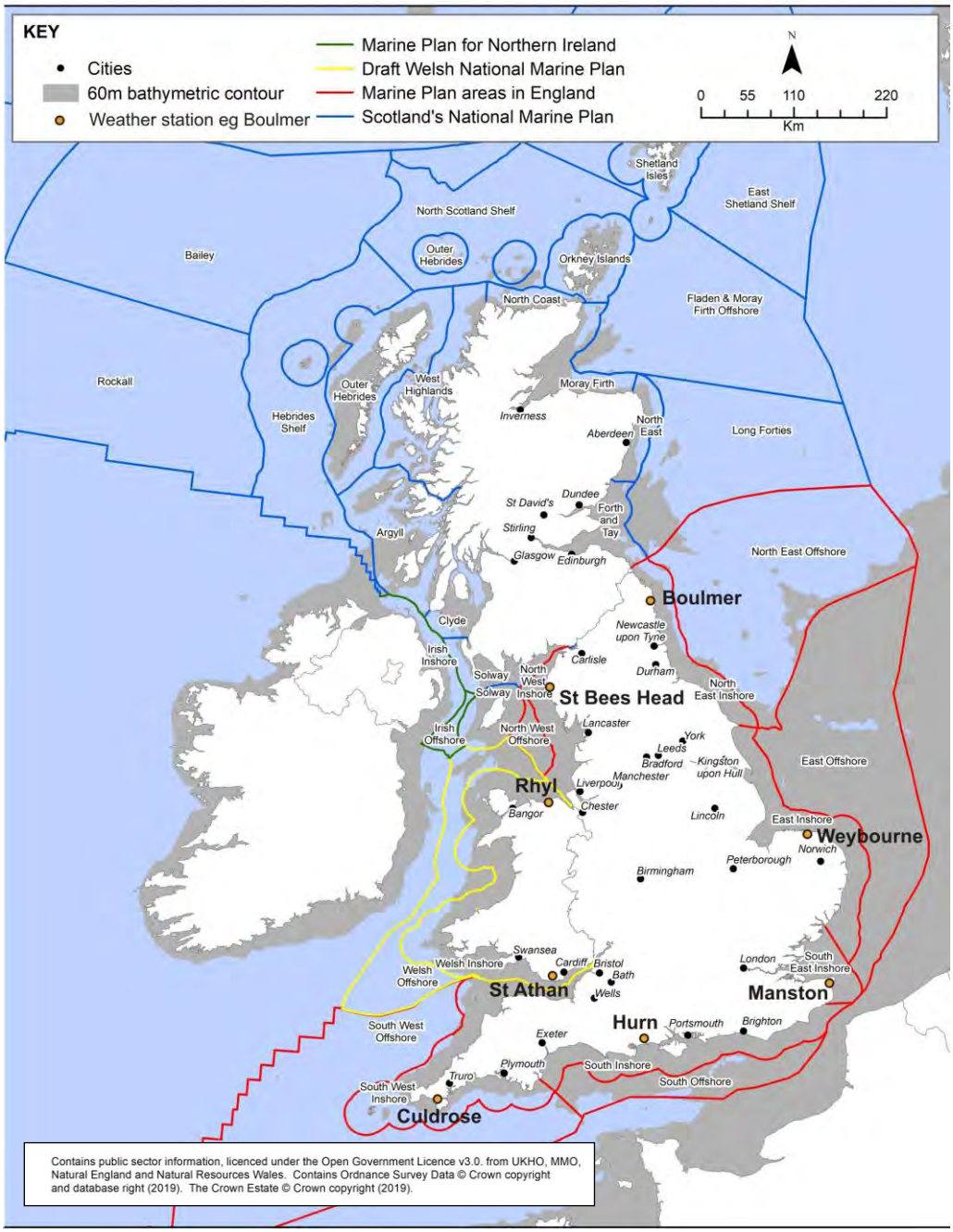


Figure 9.2 - Weather Station Locations



Observations

9.37. The main observations and comparisons from the Met Office data are summarised below:

- Averaging all coastal stations, the visual range recorded was just under 24km around 50% of the time, just under 30km 33% of the time, around 34km for 20% of the time, and 40km 10% of the time (see **Figure 8.1**).
- There is variability at different locations, with clearer visibility in eastern England and Wales and less in the coastal stations to the south and west of England.
- For Boulmer, Weybourne and Manston to the east around half the number of days have visibility at distances above 21km. Visibility above 35 km ranges between 20.5% of days (Manston) to 28.6% (Weybourne).

- For Wales, Rhyl and St Athan, half the days have visibility at the upper end of the 21-25km range. Visibility above 35km ranges between only 21.2% of days (St Athan) to 27.9% (Rhyl).
- For the southern and western England coastal stations of Hurn, Culdrose and St Bees Head half the days have visibility over the 16 to 20 km range. Visibility above 35km dips to between only 1.4% of days (Culdrose) to 6.8% (Hurn).
- The most frequent visibility at Boulmer (to the north east) and Weybourne (to the east) is over 40km, whilst at the other end of the scale, Culdrose (to the west) and St Bees Head (to the north west) it is most frequently between 16-20km. Hurn, St Athan and Rhyl's most frequent visibility range is 26-30km (around 20% of days).
- The dataset used is not large so these results may not be entirely indicative of all areas in the intervening coast and marine areas. The Culdrose statistics appear to be particularly at one end of the scale.

9.38. Data analysed in the OESEA 2009 report on patterns of seasonal variations on visibility are set out in **Appendix G**. These illustrate a clear pattern within the visual ranges on a monthly basis. The summer months (June–September) experience a much larger 'maximum percentage' visual range in comparison to the winter months (November–February) which experience a much lower visual range. It is likely that more people will be viewing the seascape in the summer, and for more prolonged periods, due to holidays and weekend trips, and more equable weather conditions. There is a case that this should be weighted in consideration of % of days visibility.

SUNSHINE AND RAINFALL DATA FOR UK COASTAL STATIONS (1981-2010)

9.39. Sunshine can affect visibility of wind farms by highlighting turbines when reflected off their surface. This is most likely to occur, with the sun behind the viewer, on north facing coasts followed by east or west facing coasts. Turbines can also be seen in silhouette, particularly at sunrise on east facing coasts or at sunset on west facing coasts with the latter being more sensitive as more receptors are likely to see this juxtaposition. Rainfall significantly reduces visibility of turbines. The areas with more days of rainfall are therefore potentially less likely to be a sensitive to wind farm development.

9.40. Met Office historical data on sunshine and rainfall was obtained for the recording stations located close to the stations selected for the visibility data.

Sunshine (Hours)

9.41. As shown in **Table 9.8**, average monthly sunshine hours throughout the year is in the range between 116 & 150 hours per month. This figure fluctuates depending on the month; however, sunshine hours in summer are generally much higher as would be expected.

Table 9.8 – Average monthly sunshine (hours) in England and Wales (1981-2010)

Helen's Bay (N Ireland)	St Athan (S Wales)	Hurn (S England)	Manston (SE England)	Boulmer (NE England)
116.4	139.4	147.2	150.2	128.9

(Source https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/*)*

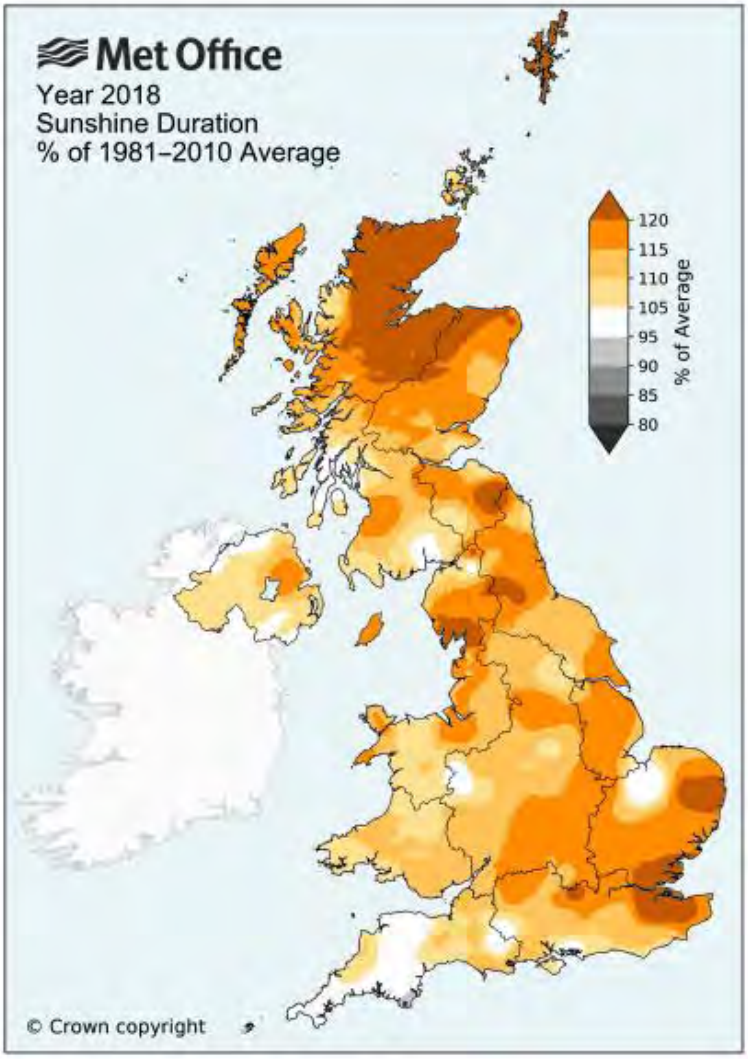
9.42. **Figure 9.3** shows the average annual sunshine amount for the UK (1981-2010). There are patches of higher than average sunshine in the far north of Scotland and Morecambe Bay

as well as in Norfolk and around the Thames Estuary. In general it is evident that there is generally more sunshine on the east coast than the west.

9.43. Subsidence associated with high pressure reduces cloud cover and in spring and summer, when the sea is cool relative to the land, there is little convective cloud over the sea. Coastal areas are then favoured by high sunshine amounts, whereas convective cloud often forms inland (Met Office).

9.44. Overall, it can be concluded that southern and eastern areas are sunnier and are likely to have clearer and more frequent visibility of wind farms than the west.

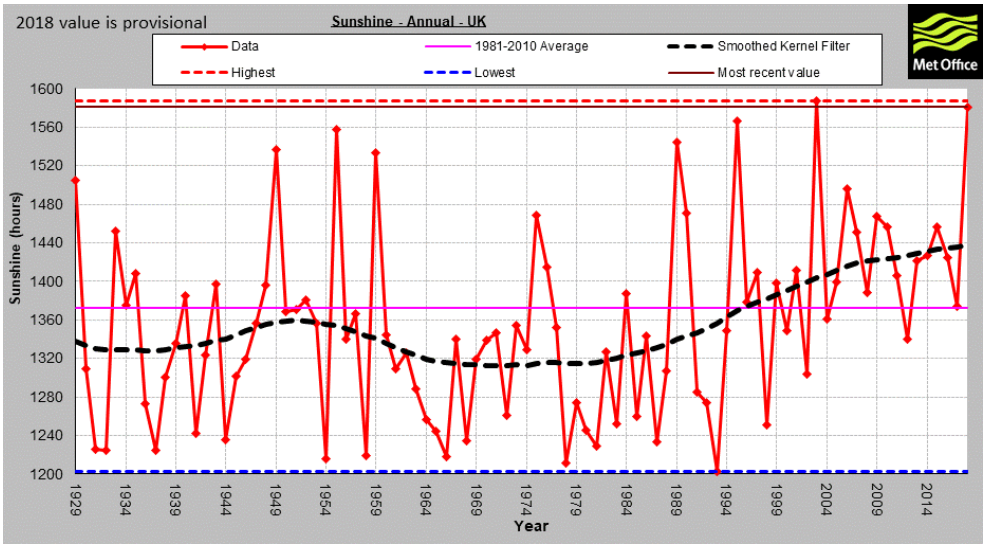
Figure 9.3 Average annual sunshine amount for the UK (1981-2010)



(*Source: Met Office*)

9.45. The trend over the past few years is for more sunshine, as indicated in the following graph from Met Office records:

Figure 9.4 Sunshine trend for the UK (1981-2010)



https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-temperature-rainfall-and-sunshine-time-series

Rainfall (mm)

9.46. As shown in **Table 9.9**, average rainfall and days with rain appears to be higher in Wales. Throughout Wales, the months from October to January are significantly wetter than those between February and September, unlike places in eastern England where July and August are often the wettest months of the year. This seasonal pattern is a reflection of the high frequency of winter Atlantic depressions and the relatively low frequency of summer thunderstorms (Met Office).

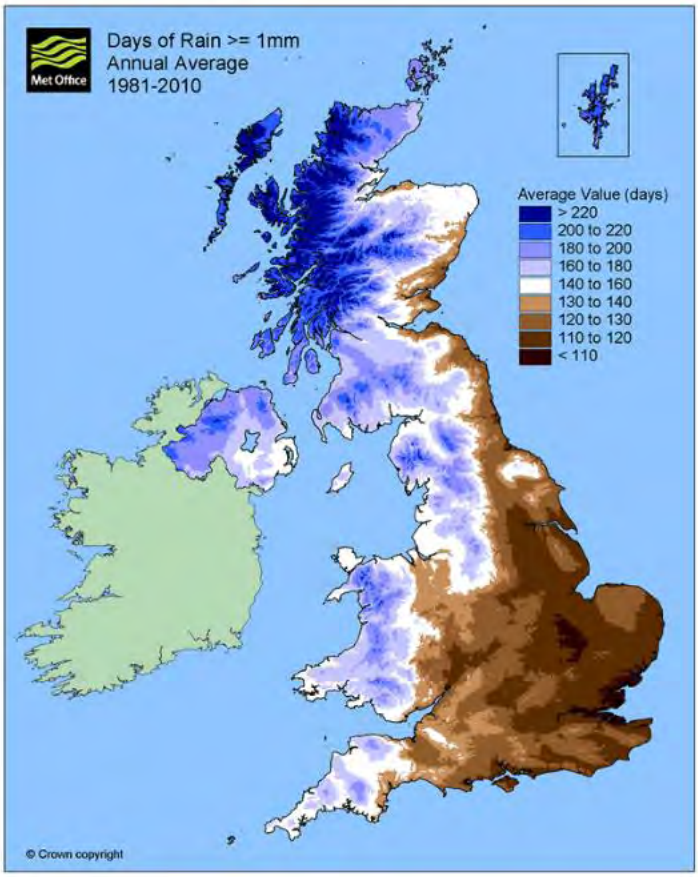
Table 9.9 – Average monthly rainfall (mm) in England and Wales (1981-2010)

Variable	Helen's Bay (N Ireland)	St Athan (S Wales)	Hurn (S England)	Manston (SE England)	Boulmer (NE England)
Average Rainfall (mm)	77.5	83.2	69.6	49.4	57.4
Days of Rain (>=1mm)	12.4	12.1	10.0	8.8	10.2

(Source https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/

9.47. **Figure 9.5** shows the average annual rainfall amount for the UK (>=1mm) (1981-2010). Overall it's clear that the east is drier than the west and there appears to be a fairly strong correlation between sunshine and rainfall. Whilst western Scotland has the highest rainfall in the UK, much of eastern Scotland is sheltered from the rain-bearing westerly winds. This shelter reaches its greatest potential along the coasts of East Lothian, Fife and the Moray Firth and these areas receive less than 700 mm of rainfall in an average year. Much of Southern England is relatively distant from the route of many Atlantic depressions and towards the Thames Estuary there is increasing shelter from rain-bearing SW winds. Overall, it can be concluded that southern and eastern areas are drier and are likely to have clearer and more frequent visibility of wind farms than the far north and west.

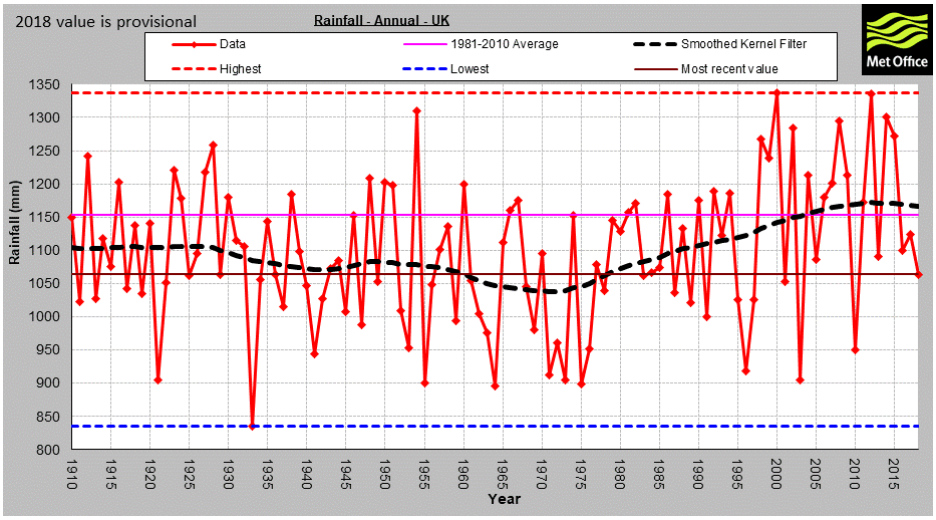
Figure 9.5 Average annual rainfall amount for the UK (>=1mm) (1981-2010)



(*Source: Met Office*)

9.48. Met Office data indicates a fluctuation of rainfall over the last 15 years as follows:

Figure 9.6 Rainfall trend for the UK (1981-2010)



https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-temperature-rainfall-and-sunshine-time-series

State of the UK Climate 2018

9.49. The report by the International Journal of Climatology 'State of the UK Climate 2018' provides a summary of the UK weather and climate through the calendar year 2018, alongside the historical context for a number of essential climate variables.

9.50. It notes the following:

- In 2018 rainfall for the UK overall was 92% of the 1981–2010 average and 96% of the 1961–1990 average.
- The most recent decade (2009–2018) has been on average 1% wetter than 1981–2010 and 5% wetter than 1961–1990 for the UK overall.
- In 2018, sunshine for the UK overall was 114% of the 1981–2010 average and the third sunniest year in a series from 1929.
- The UK's summer in 2018 was much warmer, drier and sunnier than average.
- For the most recent decade (2009–2018) the UK has had, on average, 4% more hours of bright sunshine than the 1981–2010 average and 7% more than the 1961–1990 average.

9.51. All this indicates that the extremes of weather (rain and sun) are increasing with potential for longer periods of both. These factors may balance each other out in terms of their effect on the frequency of visibility of offshore wind farms.

Summary and discussion

9.52. Some cautious conclusions can be drawn from the coastal weather station data. Averaging all coastal stations, the visual range recorded was just under 24km around 50% of the time, just under 30km for 33% of the time, around 34km for 20% of the time and 40km for 10% of the time.

9.53. To the east of England, visibility lies above 21km for more than half the time and above 35km for more than 20% of the time. The coast of Wales enjoys visibility at the upper end of the 21-25km range for half the time and above 35km around 21-28% of the time. To the south and west England, visibility appears to be less, lying above 16-20km for more than half the time but at 30km+ there appears to be a distinct cut-off point- visibility above 35km is between 1.4% and 6.8% of the time.

9.54. Uncertainties derived from the methodology used to collect some meteorological data and therefore subsequent interpretations introduce some concern about its use to inform wind farm buffers.

9.55. Although it has not been possible to obtain more detailed attributes of sunshine and rainfall, the number of days of sunshine and rain gives an initial idea of which areas could potentially experience higher visibility throughout the year. Overall, it can be concluded generally that southern and eastern areas are drier and sunnier and eastern areas are likely to have clearer and more frequent visibility of wind farms located some distance offshore than the west of England. This reinforces the visibility data. North-facing coasts will experience views of wind farms highlighted by the sun most frequently.

9.56. Whilst haar (sea fret) is noted on the east coast of the UK north of the Wash, no observations about fog have been included in the data. Other variables that help decipher the presence of fog including relative humidity and dew point (when compared to temperature) were also unobtainable for this study. If contained within a measured sample (at the coastal station) it would be recorded as restricting visibility and so forms part of the overall visibility dataset summarised in **Table 10.2**.However, if it occurred offshore this would not be included.

9.57. The team's experience of long views being regularly possible such as along the Severn Estuary (35km+) or across to Ireland from Wales remind us that visibility at long distances is regularly possible. The site visit in October 2019 to the east coast (discussed elsewhere in this report) also indicates that wind farms 33km offshore were visible to the human eye even in low contrast weather conditions (Great Gabbard and Dudgeon). However, as

discussed by Taylor (2004), visual impact is not solely based on visibility. Wind turbines also may be more or less visible depending on various other factors such as sun and cloud.

9.58. The influence of weather data, particularly relating to visibility, depends on what assessors, decision-makers and ultimately, society, considers is a significant and acceptable percentage of time that an offshore wind farm is likely to be visible or has a worst case significant adverse effect. Whilst the Culdrose coastal station to the west, away from current Round 4 bidding areas, has very limited or negligible frequency of visibility above 35 km, other coastal stations near relevant Round 4 areas record potential visibility above 35 km between 20-28% of days. 30km is the overall average threshold for visibility for around 30% days per year and is a distinct cut off point to the west of England but less so to the east of England and Wales. This data will be relevant to other potential areas for development coming forward in future.

9.59. Ultimately, the influence of marine visibility modifiers should be determined by examination of detailed data on a site by site basis. The UK coastline experiences a varied climate with variable visibility and weather that can change in minutes.

10. Review of Lighting Effects

10.1. This chapter briefly considers the requirements for lighting, discusses SVIAs assessments of the impact of lighting and reviews existing developments.

LIGHTING REQUIREMENTS

Navigational lighting

10.2. The requirements for navigational lighting are set out in the IALA Recommendation O-139 on 'The Marking of Man-Made Offshore Structures' Edition 2, December 2013. This notes that lights:

- Are located not less than 6 metres and not more than 30m above Highest Astronomical Tide (HAT);
- Have a minimum nominal range of 10 Nautical Miles (18.5km), taking background lighting into account;
- Are synchronized with a flash character according to Mo (U) W ≤15s;
- Have a vertical divergence of the projected beam such that the light will be visible from the immediate vicinity of the structure to the maximum luminous range of the light.

10.3. Specifically in relation to offshore wind farms, structures should be painted yellow all around from the level of HAT up to 15 metres. On a case-by-case assessment alternative marking, where applicable, may include horizontal yellow bands of not less than 2 metres in height and separation. The addition of retro-reflective material may be considered.

Aviation lighting

10.4. The Civil Aviation Authority (CAA) is the statutory body that sets out requirements for the lighting of en-route obstacles (i.e. those away from the vicinity of a licensed aerodrome) are set out in Article 222 of the UK Air Navigation Order (ANO) 2016.2.

10.5. This Article requires medium intensity (2000 candela) steady red aviation warning lights to be mounted as close as possible to the top of all structures at or above 150 metres above ground level (AGL).

10.6. In terms of requirement for lighting wind turbines generators in accordance with the ANO, the CAA considers the top of a wind turbine generator to be the maximum blade tip height. In terms of positioning of aviation obstruction lighting on wind turbine generators with a maximum height of 150m AGL or above onshore3, the CAA interprets 'as close as possible to the top of the obstacle' as the fitting of lights on the top of the supporting structure (the nacelle) rather than the blade tips.

10.7. Additionally, at least three (to provide 360 degree coverage) low-intensity Type B6 lights (32 candela) lights should be provided at an intermediate level of half the nacelle height.

10.8. CAA policy CAP 764, 2016, also requires some downward spillage of light. The article also allows for the CAA to permit that only turbines on the periphery of any wind farm need to be equipped with aviation warning lighting. Such lighting, where achievable, shall be spaced at longitudinal intervals not exceeding 900m.

10.9. The need for lighting within a wind farm is typically decided during the consultation stage of a planning application, based on views from the CAA, Ministry of Defence (MOD) and local aerodromes. Turbines below 150m are not routinely lit, but where lighting is required, wind farm developers usually seek to agree on the use of Infra-Red lighting in the interests of public amenity, this being barely perceptible to the human eye.

DTI SVIA guidance (2005)

10.10. The guidance only considers marine navigational lighting (6.3.4) stating that locating the development as far away from the coastline as possible will be the best method of mitigating the effects with the curvature of the Earth eventually obscuring lights. When viewed from just AOD, lights located on turbine towers 15m AOD would not be visible beyond 20km (Table 4 p73). In any case, the guidance indicates that navigation lighting at night is considered very much a secondary visual effect and should be dealt with as such in the SVIA. If the visual impact of an offshore wind farm is not significant during the day then it is considered very unlikely that it will be unacceptable at night (p80). The guidance does not consider aviation lighting.

EXAMPLES OF IMPACT ASSESSMENT FROM RECENT OFFSHORE WIND FARM SVIAS

10.11. A selection of some more recent offshore wind farms (2018/2019) have been reviewed in terms of their approach to the effects of lighting.

Inch Cape

10.12. The assessment has assumed a worst case scenario of 40 turbines up to 291m to blade tip height and clear visibility. All peripheral turbines were assumed to be lit with 2000 candela aviation lighting at nacelle level. Infra-red lighting does not appear to be considered as part of the SVIA.

10.13. Significant night time effects were predicted from the aviation lighting seen in addition to either the other wind farm lit turbines, based on interpolation from the four viewpoints assessed in the same seascape character areas as those for which significant day time effects were predicted. Additionally, localised significant night time effects were predicted. All were at distances of less than 30km from the nearest peripheral lit Inch Cape wind turbine. It was noted that the distances at which navigational and aviation lighting is predicted to be visible, vary depending on the atmospheric conditions.

Moray Offshore Wind farm (West)

10.14. A night time visual assessment was carried out at four viewpoints (SVIA p134). Effects were noted as follows:

- Viewpoint 3 (32km): The red turbine lights on the hubs of the perimeter turbines of the Development would be visible in the view. Although the lighting introduces lights into a section of dark seascape, the lights were not considered to be obtrusive and due to their relatively low position on the distant skyline, do not impede the view of the night sky. The magnitude of change was considered *low*.
- Viewpoint 9a (24.8km): The red turbine lights would be substantially diminished due to the distance of the Development offshore. The magnitude of change was considered *medium*.
- Viewpoint 12 (32.8 km): The lighting would be seen as an extension of the Beatrice offshore wind farm and in front of the lighting on the hubs of the Beatrice demonstrator turbines and oil platforms further offshore covering a wider proportion of the skyline. The magnitude of change was considered *medium*. (It should be noted that Beatrice demonstrator is due to be decommissioned imminently).
- Viewpoint 16 (31.7 km): The red turbine lights on the hubs of the perimeter turbines of the development would be visible in the view. The magnitude of change was considered *medium- low*.

Seagreen

10.15. The closest wind turbines of the optimised Seagreen Project would be in excess of 30km from the nearest land-based receptors. The SVIA (Sept 2018) states that, as set out in the IALA standards, the wind turbine lighting will consist of flashing lights which will be visible to at least 5 (sic) nautical miles (approximately 9km) (SLVIA 13.423). Aviation lighting on the wind turbines and meteorological masts was likely to be red or infra-red and was considered to be unlikely to be visible from land-based receptors.

10.16. With regards to the SLVIA viewpoints, even allowing for the possibility of some lighting being discernible over extended distances, the magnitude of change was judged unlikely to ever be more than medium-low if viewed from a remote location with no adjacent development. When combined with the considered low sensitivity of these receptors at night time the effect was considered no more than minor and therefore not significant in SLVIA terms (SLVIA 13.426).

Walney extension

10.17. The night time lighting from aviation (73 turbines) and navigational (29 turbines) lighting was considered to be readily discernible only from the closest coastal viewpoint-around 20km. (Other viewpoints ranged upto 39km away from the nearest turbines.) The lit development would be seen in the context of much closer wind farms and the effect was not considered significant (SVIA 19.9.3.10).

Summary

10.18. The above SVIA conclusions vary from expectations that effects would not be greater than 20km to assessments which considered effects at 33km could have medium magnitude of effect.

SITE VISITS

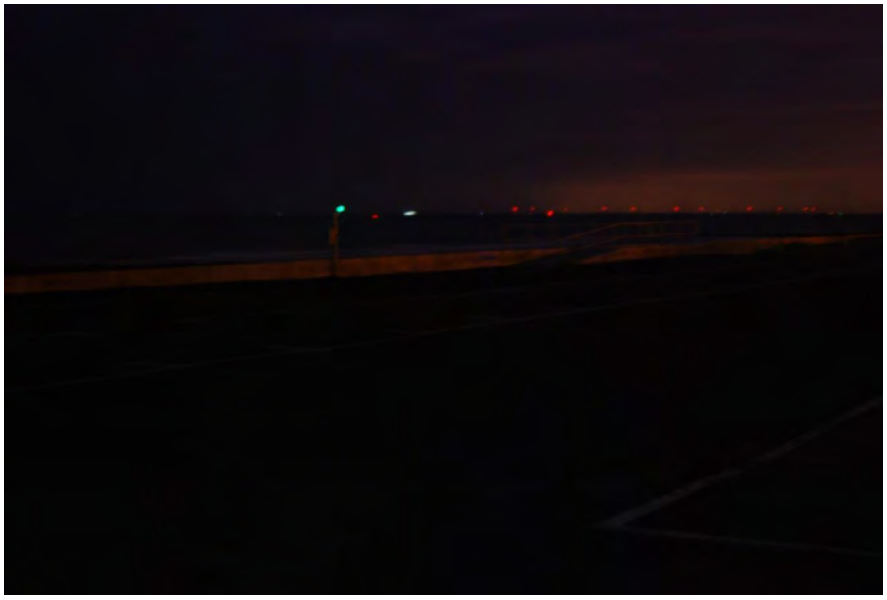
10.19. Site visits to assess existing wind farms, including night time assessments, have been carried out over a number of years- 2008, 2016 and 2019.

North Wales Coast: 2008 review

10.20. The North Wales coast was visited over a period of two days in December 2008 (see **Appendix H**). At night, the marine navigational lighting was only just perceptible at 10km but not at 21km and could be confused for other lighting such as navigation buoys and vessels.

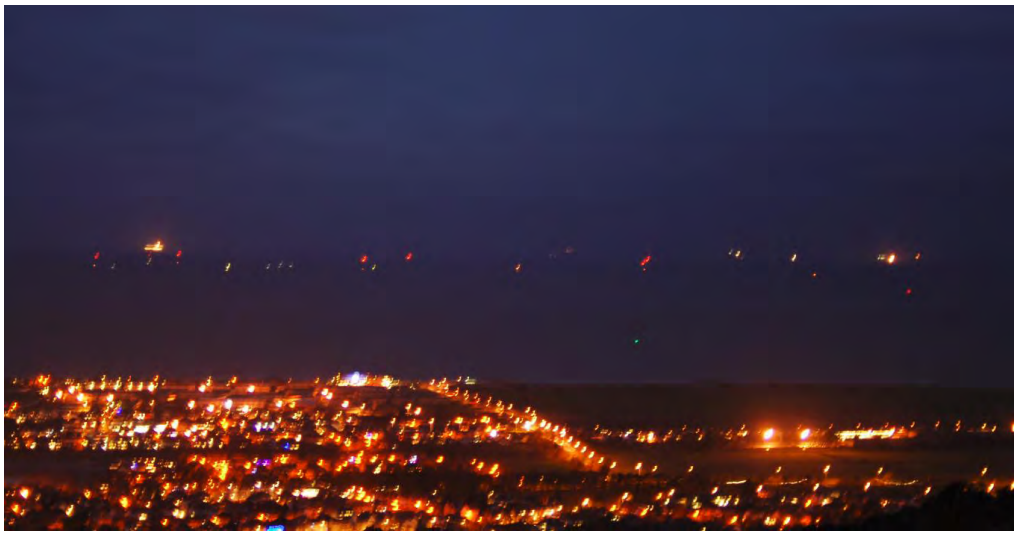
10.21. The red aviation lighting was significantly more noticeable and could be seen for long distances even in moderate visibility conditions. The furthest observed was Burbo Bank at a distance of 21km. Its sporadic flashing resulted in a restless image and appeared to ‘industrialise’ the seascape. It was considered that the lighting was likely to be more visible in a variety of weather conditions than the turbines in daylight based on several observations. **Figure 10.1** shows a photograph of lights of Burbo Bank from 21km.

Figure 10.1 Burbo Bank at night from 20km (Prestatyn)



10.22. North Hoyle wind farm's six red aviation lights appeared to flash in a gentler and less sporadic fashion than Burbo Bank when observed at a distance of 7.5km and 10km. It is assumed that this was a function of the blades passing in front of the lights although this cannot be confirmed. Due to the lights' high location on top of the turbine hubs they could not be mistaken for any other sort of marine lighting. As the North Hoyle lights were well spaced and less numerous than the turbines their visual impact was considered less than the turbines viewed in daylight in clear visibility conditions. The 54m high Douglas Oil and Gas platform at around 24km was visible on the horizon. This is shown in **Figure 10.2** to left of, and behind the wind farm.

Figure 10.2 North Hoyle at night from 10km (above Prestatyn)



10.23. Overall, it was considered that lighting was not a major issue in the North East Wales seascape where there is already a significant amount of lighting such as from oil rigs such as the Douglas rig as well as the onshore lighting such as Prestatyn above. However, the Burbo Bank apparently flashing aviation lighting was a cause for concern. It is considered that in more remote, wild seascapes with limited or no other marine lighting that the

aviation lighting could be a significantly 'industrialising' influence even at long distances offshore.

North Wales Coast: 2016 review

10.24. This assessment considered the Gwynt y Môr Round 2 wind farm which had been constructed since the 2008/9 study, along with the other constructed developments. The overall review is included in **Appendix H**. To get a sense of the effect of lighting, one viewpoint was visited at night in January 2016- Llandudno promenade, War Memorial.

10.25. The impression gained from the site visit was that navigational lighting on each turbine was highly apparent at at least a distance of 16km in the case of Gwynt y Môr. Rhyl Flats was more apparent at 11km. The red aviation lighting was brighter but less numerous as it lay on the edges of arrays and could be seen for long distances in good visibility conditions e.g. Gwynt y Môr from 16-23km. The actual turbines structures themselves could not be seen. Therefore, at night, Gwynt y Môr and Rhyl Flats appeared as if they were another coastline with a large industrial installation with tall structures. This effect was considered to be significantly adverse at a distance of 16km.

East of England Coast: 2019 review

10.26. The area was visited on two days in late October 2019 primarily to assess wind farms during the day (see **Appendix I**). Overall, the visibility ranged from poor through to good and very good visibility. However, a photograph from one viewpoint, from a building in street behind Aldeburgh seafront, was taken at night.

10.27. In this location, the weather cleared sufficiently to deliver very good weather conditions. Greater Gabbard/Galloper wind farm was 33km offshore.Navigation lighting on each turbine was not visible but some flashing red aviation lighting was just visible on the horizon. As an isolated group on the horizon this was not a significant effect in the visibility conditions. The photograph below in **Figure 10.3** picks up the central most light as a very small red dot near the centre of the image. As an image it understates what could be seen by the eye which picked up the flashing lights.

Figure 10.3 Greater Gabbard/Galloper wind farms at night from 33km

SUMMARY AND CONCLUSIONS

10.28. DTI guidance (2005) indicates that marine navigation lighting is a secondary impact and is very unlikely to be greater than the visual effects of a wind farm during the day.

10.29. Marine navigational lighting has an intensity which is expected to be visible for up to 18.5km (10 nautical miles) and is located at a level at which it is unlikely to be visible over longer distances due to the curvature of the Earth. It is therefore not considered to be a significant factor in determining buffer distances.

10.30. Aviation lighting is red, more intense, and located on the turbine nacelle. Due to the action of the turbine blades passing in front of the lights they appear to flash when viewed from upwind. Turbine lighting is visible over long distances, with over 30km recorded. However, effects tend to be more important at closer distances, with Gwynt y Môr 16-23km being an example. The spread of turbines across the horizon is also a factor. If a wind farm is a well contained cluster, effects are less. If the development covers the majority, or all of the horizon, effects are likely to be much greater. It may not be a significant factor where there is already marine lighting, particularly of an industrial nature such as oil rigs and numerous large vessels. However, in wild and remote seascapes and areas adjacent to certain designated landscapes where tranquillity is a special quality, it may be considered a relevant contributory factor in the siting of offshore wind farms. Cumulative effects are considered in the next chapter.

11. Consideration of cumulative effects

11.1. More than one offshore wind farm seen together will give rise to cumulative seascape and visual effects. Information from SVIAs is analysed with indicative buffers set out. However, the limitations of this approach are also discussed. The cumulative extent of skyline covered and the spacing between developments is explored and the extent to which this is should influence consideration of visual buffers is discussed.

Definitions and approaches

11.2. There are a number of definitions of cumulative effects. GLVIA3 says that it is not appropriate to prescribe the approach since issues related to cumulative effects depend on the specific characteristics of both the development proposal and the location. However, it lists different types of effect including extension of existing developments, additional development intensifying effects and incremental change as a result of successive individual developments.

11.3. SNH guidance (2012) relating to onshore wind farms defines cumulative impacts as:

'*the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together.*' (Paragraph 7).

11.4. Whilst many SVIAs concentrate on the additional effects of a given development, at a strategic level, it is the combined effect of a set of developments that is important, as this is what the viewer will experience. The guidance states that strategic planning should determine where the most suitable locations for development are and determine the thresholds of acceptable change (SNH, 2012, Paragraph 18).

11.5. The DTI (2005) report provides guidance on the process of cumulative SVIA, mainly based on previous GLVIA and SNH guidance, but is still relevant. It states that:

'when assessing significance of cumulative effects, consideration should be given to whether the proposed wind farm crosses the threshold of acceptability for the total number of wind farms in a seascape'.

11.6. It also recognises that there is no existing methodology for identifying when a seascape has reached its limit of capacity and therefore developers should be referring back to any strategic policies or locational guidance documents which identify the landscape objectives and policies for the area.

11.7. A report relating to the impact of onshore cumulative assessments, Entec (2008), concludes on issues particularly relevant to offshore wind developments, in particular, the potential development of the wind farm landscape. The report suggests that providing there is sufficient space or undeveloped skyline between each development or the overlapping of several schemes is not too dense; the developments would appear as a series of wind farms within the landscape and therefore does not become the dominant or defining characteristic of the landscape.

11.8. The report also concludes that where the wind farm element is the dominant and defining characteristic of the landscape i.e. a wind farm landscape, this could influence the quality of the landscape. However, this form of scenario is not deemed unacceptable if this is part of the wider planning system that has already taken account of the value and capacity of that particular landscape resource.

11.9. The approach of defining acceptable wind farm objectives for different landscapes has subsequently been applied in many parts of the UK. The objectives range from 'landscapes with no wind energy development' through to 'wind farm landscapes'.

11.10. Natural England's approach to landscape sensitivity assessment, June 2019,states that landscape capacity is taken as the amount of development or change which a particular landscape and the associated visual resource is able to accommodate without undue negative effects on its character and qualities. However, this concept is considered in the Approach to be possibly too simplistic and other non-landscape factors which influence capacity are mentioned. As such, unlike Topic Paper 6 which it supersedes, the document does not address this further. The way in which forthcoming complementary guidance on seascape sensitivity from MMO tackles cumulative effects is likely to be more relevant than Natural England guidance.

11.11. For offshore wind, wind farm seascapes have not been defined, although seas off parts of the east coast and north Wales could be construed as such. Their capacity for further development, and what form that development should take is an issue. For example, the NRW 2019 study indicates that any extension to the north east Wales arrays should be further offshore, rather than along the coast, mainly due to potential effects on Snowdonia National Park and the Isle of Anglesey AONB. In addition, lateral extension would cover large proportions of the horizon which could contribute substantially to combined cumulative effects on some receptors.

11.12. Equally, parts of the western seaboard could be defined as seascapes currently with no wind energy development. The desirability of this remaining the case (in seascape terms) will be based on consideration of the qualities and sensitivity of the seascape, and intervisibility with sensitive seascape and visual receptors. The only nationally consistent information available to this study which contributes to this is on designations and the NRW 2019 study which applies only to Welsh waters.

Analysis of SVIAs

11.13. It is recognised that many SVIAs concentrate on assessing the additional effects of a given development rather than the combined effect of all developments. This makes the data abstracted from them less helpful in a strategic assessment.

11.14. 14 out of 27 SVIAs have measurable cumulative effects assessments from viewpoints. The assessments are located in **Appendix D** and are brought together in **Table 11.2**. The summary derived from this is set out in **Table 11.1**.

Table 11.1 Summary of SVIA cumulative visual effects of offshore wind farms

Offshore wind farm SVIAs	Cumulative low magnitude of effect ***		Cumulative medium magnitude of effect	
Heights of turbine to blade tip (m)	Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
107-145	**24.0**	24.7	**9.2**	10.8
150-175	**21.6**	27.7	**14.9**	27.7
176-223	**24.5**	26.4	**24.0**	27.1
250-300	**36.1**	41.8	**36.1**	39.4

.

Table 11.2 Analysis of Offshore Wind Farms: Cumulative Visual Impact Assessment

Scheme	Round	Status	Turbine capacity in MW*	Max. turbine height to blade tip (m)**	Max no. of turbines**	Maximum wind farm capacity (MW)**	Nearest coast km	Existing wind farms in baseline?	No. of SVIA viewpoints for cum. effect	Cumulative low magnitude of effect***		Cumulative medium magnitude of effect	
										Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
North Hoyle	1	Implemented	2	107	30	60	7.5	n	12	18.3	20.4	9.2	10.8
Gunfleet Sands 2	1	Implemented	3.6	128	22	173	8.5	y					
Kentish Flats	1	Implemented	3	140	30	90	8	n	1	30.9	30.9		
Gwynt y Môr	2	Implemented	3.6	140	160	576	18	y					
Docking Shoal	2	Withdrawn	3-6	145	177	540	14	y	3	22.9	22.9		
									Averages	**24.0**	**24.7**	**9.2**	**10.8**
Thanet Sands	2	Implemented	3	150 (115)	100	300	11	n	4	21.6	27.7	14.9	27.7
West of Duddon Sands	2	Implemented	3.6	150	139	389	14	y					
Gabbard	2	Implemented	3.6	170 (131)	141	504	23	n					
Sheringham Shoal	2	Implemented	3.6	172 (135)	88	317	17	n					
Westermost Rough A	2	Implemented	6	172 (177)	110	210	8	n					
London Array	2	Implemented	3.6	175 (147)	271	630	21	y					
									Averages	**21.6**	**27.7**	**14.9**	**27.7**
Kincardine	SFD	Construction	7 (8.4)	176	7	50	15	n					
Hywind	Demo	Implemented	6	178	5	30	23	n					
Atlantic Array	3	Withdrawn	5	180	278	1390	14	n					
Neart na Gaoithe	Sco 1	Consented	8-10	197 (208)	128	448	15	y					
Beatrice Offshore	Sco 1	Construction	7	198	142	588	22	n	14	24.8	33.1	21.2	25.6
Navitus Bay	3	Refused	8	200	121	970	14	n				28.0	28.2
Walney 1	2	Implemented	3.6	202 (137)	93	186	15	y	17	26.5	27.6	27.6	35.2
Rampion	3	Construction	3.6-7 (3.45)	210 (140)	175	400	13	n	3	24.1	24.1	22.8	24.0
Walney Extn		Implemented	8.25	222	207	659	19	y	17	20.8	20.8	29.5	31.3
Burbo Bank Etxn		Implemented	3.6	223 (187)	36	254	7	y	5	26.4	26.4	14.8	18.4
									Averages	**24.5**	**26.4**	**24.0**	**27.1**
Thanet Extn		Submitted	8-12	250	34	340	8	y	4	18.5	22.8		
Seagreen	3	Consented	12.5	280	120	1500	27	y					
Moray East	3	Construction	9.5	280	137	1116	22	n	22	37.6	46.0	33.7	36.0
Moray West	3	Consented	10-12	285	85	1116	22	y	25	40.5	50.0	25.6	28.0
Inch Cape	Sco 1	Consented	9.5	291	72	1000	15	y					
E Anglia ONE north	3	Submitted	12-19	300	53	800	36	n	17	41.8	42.7	49.9	55.8
E Anglia TWO	3	Submitted	12-19	300	60	900	31	n	22	42.3	47.7	35.3	37.6
									Averages	**36.1**	**41.8**	**36.1**	**39.4**

Notes
Where wind farm has no figures, no cumulative assessment was carried out or the assessment is not available (e.g. Gwynt y Môr)
* Shows as assessed in SVIA (implemented capacity in brackets)
** in SVIA (as implemented in brackets)
*** Low category includes variations on low and medium/low effects

11.15. The findings indicate an inconsistent pattern of effects when compared to the effects of wind farms assessed predominantly on their own.

11.16. The distance at which average cumulative low magnitude of effect of 107-145m high turbine arrays at 24km is greater than the individual arrays magnitude of effect, as might be expected. However, the distance is lower for the other three size ranges ranging from 21.6km for 150-175m turbines to 36.1km for 250-300m turbine arrays.

11.17. The distance at which average cumulative medium magnitude of effect of 107-145m and 150-175m high turbine arrays at 9.2 km and 14.9 km respectively is lower than the individual arrays magnitude of effect. However, the distance is higher for the upper two size ranges ranging from 24km for 176-223m turbines to 36.1km for 250-300m turbine arrays. The latter is the same as the average cumulative low magnitude of effect.

11.18. Overall, these findings should be considered with caution. As discussed earlier, the reason for the lower values and variation is likely to be that many of the cumulative effects assessed are the additional effects that proposals may have as part of overall cumulative effects rather than the combined/overall cumulative effects themselves.

Wireline analysis

11.19. The 2009 White Consultants report analysed a number of scenarios. The first was for a 4.5GW wind farm 24km from the coast consisting of 5 MW turbines. The wind farm was split into 9 clusters separated by 5km of clear water. It was considered that the magnitude of effect would be moderate due to the extent of the horizon covered.

11.20. A second scenario considered the above wind farm with a Round 1 wind farm of 30 3.6MW turbines 137m high to blade tip in one cluster a minimum of 7km offshore and a Round 2 wind farm of 98 5MW turbines 175m high to blade tip 13km offshore. Overall, it was considered that that there would be a large change due to the extent of horizon covered, the size of the nearer clusters and the visual confusion between the wind farm clusters through overlapping of turbines.

11.21. For the 2016 study, four scenarios were explored using different sizes of turbines, the concentrating on the potential effects of larger turbines i.e. 10MW and 15MW. All scenarios combined wind farms at 7km, 30km and 24km. The findings are shown in **Table 11.3.**

Table 11.3 - View of potential magnitude of effects for cumulative scenarios including 10MW/220m and 15MW/300m turbines viewed at 22m AOD

Cumulative Wireline Scenarios	Scale of effect
10MW Scenario- three wind farms at 7km+13km+24km	Large and very large
15MW Scenario- three wind farms at 7km+13km+24km	Large/very large
Mixed Scenario- three wind farms with different turbine sizes (in brackets)- 7km (3.6MW) + 13km (15MW) + 24km (15MW)	Large and very large
Mixed Scenario- three wind farms with different turbine sizes (in brackets)- 7km(3.6MW) + 13km(10MW) + 24km (15MW)	Large and very large

11.22. For this study, three scenarios have been explored using different sizes of turbines, the concentrating on the potential effects of larger turbines 350m high i.e. 20MW, in conjunction with 220m/10MW and 137m/3.6MW turbine arrays. All scenarios combined wind farms at 7km, 13km, 24km and 35km. The findings are shown in **Table 11.4.**

Table 11.4 – View of potential magnitude of effects for cumulative scenarios including 20MW/350m,10MW/220m and 3.6MW/137m turbines viewed at 22m AOD

Cumulative Wireframe Scenarios	Scale of effect
Cumulative scenarios	
20MW/350m (24km), 10MW/220m (13km) and 3.6MW/137m (7km) turbine arrays	Large and very large
20MW/350m (35km), 10MW/220m (13km) and 3.6MW/137m (7km) turbine arrays	Moderate and very large
20MW/350m (at 24km and 13km) and 3.6MW/137m (7km) turbine arrays	Large and very large

11.23. All the wirelines reflect a worst case visibility situation depending on excellent visibility of all arrays and good light. In these conditions it is considered that that there would be adverse change due to the extent of horizon covered, the size of the nearer clusters and a very confused and unbalanced composition with turbines becoming the dominant seascape characteristic. Whereas the 2016 study considered the effect to be large to very large, these scenarios were considered to range from moderate to very large. The scenario with the greatest impact was considered to be where 350m high turbines were used in two arrays, 13km and 24km offshore, in conjunction with 137m turbines 7km from shore. The least impact is where the furthest array of 350m turbines is 35km offshore. More information on the method, analyses and scenarios is set out in Appendices E1, E5 and E6.

Summary

11.24. Most of the SVIAs analysed concentrate on the additional cumulative effects of a given development, rather than the combined cumulative effect, and so the findings need to be treated with caution. Nevertheless there is an increase in the cumulative effect of arrays in line with increasing size of turbines. For example, larger turbines 250-300m high have both medium and low average cumulative effects around 36km from shore.

11.25. In terms of wireline analysis this also needs to be treated with caution as it illustrates a worst case scenario with excellent visibility covering all assessed arrays which is likely to be a rare occurrence. Of multiple wind farms from 7km to 35km from shore, it is considered that that there would be a moderate to very large change due to the extent of horizon covered, the size of the nearer clusters and the visual confusion between the wind farm clusters through overlapping of turbines and different sizes of turbines. The worst scenario is considered to one where large turbines 350m high are in arrays 13km as well as 24km offshore. The best scenario is where the furthest array of 350m turbines is 35km offshore.

11.26. It is the combined cumulative effect of a set of developments that is important at a strategic level to understanding the overall visual effects on people and associated effects on seascape character.

11.27. Seascape sensitivity studies should help inform the most suitable locations for development and explore the thresholds of acceptable change taking combined

cumulative impact into account. This would be helpful at a strategic level now that MMO guidance has been issued. Studies should be based on further consideration of marine character areas or similar units, proximity to statutory and key designations and related intervisibility. This is outwith the scope of this report.

11.28. Within areas considered to be suitable for offshore wind farms, array design should be a key consideration to optimise the pattern of development. This should include the relationship between arrays including the distance between them, open gaps to the horizon (or far offshore arrays) and the compatibility of the arrays' size of turbines and arrangement. This is also outwith the scope of this report.

12. Findings of site visits

Introduction

12.1. In order to assess the actual visibility and visual effects of implemented offshore wind farms a series of visits have been made to a number of coastal locations. This also has allowed comparison with the relevant SVIA findings for specific viewpoints and review of photomontages/visualisations where these have been available.

12.2. To inform the OESEA 2016 study a site visit was made to the North Wales coast in March 2016 to assess the effects of Gwynt y Môr, Rhyl Flats and North Hoyle wind farms.

12.3. For this study, the east of England coast was visited in October 2019. The main objective here was to look at the visibility of wind turbines further offshore and the juxtaposition with nearer arrays. Two main groups were assessed:

- Off the north Norfolk coast: Race Bank, Sheringham Shoal and Dudgeon wind farms
- Off the Suffolk and Essex coast: Greater Gabbard/Galloper, London Array, East Anglia 1 and Gunfleet arrays.

12.4. In addition, the Scottish coast between Aberdeen and Peterhead was visited in July 2019 to assess EOWDC and Hywind wind farms.

Method

12.5. The method for the 2016 and 2019 assessments are explained in the **Appendices H and I.** The assessment structure differs slightly inasmuch as the former in North Wales is based on specific viewpoints viewing three wind farms from different directions and distances. The 2019 analysis, covering three different main locations and sets of wind farms on the East Coast, is structured on wind farms themselves, with associated viewpoints. The observations made are structured in a similar way.

12.6. Photos were taken as an aide memoire but written observations were based on what was seen on site. The digital SLR photographs make the wind farm look smaller than when viewed in real life.

12.7. Visibility definitions for weather are as follows based on Met Office weather records:

Table 12.1 Visibility definitions

Description	Range
Unknown	-
Very poor	Less than 1 km
Poor	Between 1-4 km
Moderate	Between 4-10 km
Good	Between 10-20 km
Very good	Between 20-40 km
Excellent	More than 40 km

North Wales observations and conclusions

12.8. For North Wales, a series of observations were made (see **Appendix H**).

12.9. As the study period was in the winter months starting in January 2016 it was difficult to find days when the visibility is sufficient to assess the effects of Gwynt y Môr and the other wind farms. This reinforces the statistics of the

relatively limited number of days that wind farms further offshore are easily visible and/or may have a significant visual impact.

12.10. Different weather conditions had significant effects on the visibility of turbines on the site visits. When sunlight was on turbines, especially when behind the viewer, they were highly visible from long distances e.g. Gwynt y Môr from 16-28km. Conversely, in overcast and hazy conditions turbines at 8km were difficult to see and could be barely perceptible at around 14km. It was observed that there were variations across the wind farms in variable conditions with some turbines in shade beneath cloud, while others were in sun. Therefore, the wind farm turbines did not appear to be as a strong coherent group in these variable conditions. The closer the wind farm, the less this effect changed the perception of the wind farm e.g. 8-10km compared to 13-20km.

12.11. From the higher viewpoints, the wind farms looked more coherent as the whole of the wind farm and their layout could be seen clearly against the darker sea area. The difference in scale and detail between different wind farms could also be compared e.g. Gwynt y Môr and Rhyl Flats wind farms from Great Orme (see **Figure 12.1**).

Figure 12.1 View of Gwynt y Môr (and part of Rhyl Flats) from Great Orme

12.12. From the lower viewpoints, the wind farms looked further away on the horizon, although the turbines were still prominent when sunlit but were often seen against a lighter sky which reduced their effect. The layout of the wind farm was less easy to comprehend than when viewed from higher viewpoints.

12.13. The Gwynt y Môr photomontages showed a different layout to that that was implemented. They also appeared to make turbines smaller than they appeared in real life even though they were for 5MW turbines and those implemented were 3.6MW turbines. Where tested, the photomontage designed to illustrate a view from a viewing distance of around 400mm had to be held at about 200mm to achieve a similar effect to that seen on site.

12.14. The three Round 1 wind farms are spaced such that they are well separated and sit within an overall seascape as prominent elements but without dominating it apart from adjacent short stretches of coast. While the North Hoyle layout is organised and coherent allowing views to the horizon, there is blade overlapping. It is very clear that the grid is rectilinear and at right angles to the

coast. This gives it a semi-industrial appearance. The Burbo Bank layout appears as a well separated 'drift' of turbines when viewed from along the coast in Wales. The Rhyl Flats wind farm is the least successful with rows parallel, and centrally placed, to the concave part of the coast. This makes the layout appear over-regimented and forming the focus of many views. The juxtaposition of the three different layouts is disruptive to the composition of the seascape.

12.15. The Round 2 Gwynt y Môr wind farm is larger, extending further along the coast and is further out to sea than the Round 1 wind farms. It is therefore visible in good visibility at all the viewpoints. The distance of the wind farm away from the coast and its spread means that much of the array did not appear to be in regimented rows for the most part, although this was apparent in places. In many cases, though, there was overlapping between the turbines of the various wind farms which led to a confused image in clear conditions.

12.16. At night, navigational lighting on each turbine was highly apparent at at least a distance of 16km in the case of Gwynt y Môr. Rhyl Flats was more apparent at 11km. The red aviation lighting was brighter but less numerous as it lies on the edges of arrays and could be seen for long distances in good visibility conditions e.g. Gwynt y Môr from 16-23km. The actual turbines structures themselves could not be seen. Therefore, at night, Gwynt y Môr and Rhyl Flats look like another coastline with a large industrial installation with tall structures. This effect was significantly adverse at a distance of 16km.

12.17. The four existing wind farms off the Welsh Coast combined with the Burbo Bank wind farm to the east create a wind farm seascape with wind turbines as the dominant element in views out to sea along the coast in many places between the Great Orme and the Point of Ayr. This does not mean that offshore wind farm development is inappropriate for the majority of this stretch of coastline due to its particular characteristics. However, it raises the issue of the suitability of this approach in other seascapes and the capacity of this seascape to absorb more or larger development. The spread of Gwynt y Môr and Rhyl Flats combined taking the majority of the horizon in the framed view from Llandudno promenade is not a desirable precedent. The Burbo Bank extension with significantly larger turbines relatively close inshore (implemented subsequent to the site visit) has exacerbated the effect on the eastern stretch of the coast. This will be an issue to consider in the likely proposed extent of the Gwynt y Môr extension.

English east coast observations and conclusions

12.18. For the East coast, a series of further observations were made (see **Appendix I**). Many observations reinforced the findings, such as the effect of distance on atmospheric modifiers, the variation of visibility across an entire array and increased coherence of turbine layouts seen from higher viewpoints.

12.19. The assessment during late October with visibility conditions only good and very good at best and little sun meant that the wind farms were not viewed in the worst case situation. Different weather conditions had significant effects on the visibility of turbines on the site visits. When sunlight was on individual turbines, especially when behind the viewer, they were visible from long distances e.g. 33km at Dudgeon. Conversely, in overcast and misty conditions turbines at 17km were difficult to see. It was observed that there were variations across the wind farms in variable conditions with some turbines in shade beneath or within cloud, while others were in very limited sun. Therefore, the wind farm turbines did not appear to be as a strong coherent group in these variable conditions. The closer the wind farm, the less this effect changed the perception of the wind farm e.g. 9km and 17km compared to 24-33km.

12.20. Comparing the apparent size of turbines in two different arrays in the same view from Beeston Bump/Hill (63m AOD), those at Dudgeon (187m at 33km) appeared to be around two thirds the height of Sheringham Shoal (135m at 17km). Therefore, 300m turbines 33km offshore would appear to be of similar size to 135m turbines 17km offshore from this height of viewpoint. 350-400m turbines 33km offshore would be likely to appear larger. However, the turbines further away were observed to be less distinct and more likely to disappear from view in the weather and visibility conditions. Therefore, from observation, the effects of turbines further away would be tempered by atmospheric interference and the frequency of view, requiring very good or excellent visibility conditions. The latter factors therefore become increasingly important determinants of the significance of effects further offshore.

12.21. As in North Wales, the juxtaposition of close inshore and offshore wind farms is visually disruptive although it is clear that they are physically separated.

12.22. Combined cumulative effects were not addressed in the SVIAs for the intervisible Gunfleet Sands (I, II and III) and London Array so the overall effects of wind farms taken together have not been assessed.

12.23. Currently there is visual separation between wind farms on the north coast of Norfolk so they appear as separate coherent groups. This is a positive feature.

12.24. At night, in very good weather conditions, navigational lighting on each turbine was just visible on the horizon at 33km in the case of Greater Gabbard/Galloper. As an isolated group on the horizon this was not considered to be a significant effect.

Scottish east coast observations and conclusions

12.25. The brief site visit to the Scottish east coast to view demonstration and pilot projects reinforced some of the findings from the other site visits but also revealed other properties (see **Appendix I**).

12.26. EOWDC, with eleven 202m high turbines located close inshore, had very large effects on coastal receptors. The full detail and colour of the wind turbines and their yellow steel jacket bases were revealed. This is not an issue for turbines located over 24km offshore as the base would be below the horizon for observers at sea level. The size of the structures was demonstrated by the fact that they remained as large structures within the landscape rather than receding at a rate that might have been expected when travelling along the adjacent coastal road for a significant distance.

12.27. The five floating 178m high turbines of Hywind appeared as very small objects at around 26km. This may have been because they were viewed in conjunction with much closer port and industrial structures, they were not illuminated by sun, or because the size of the array was small. However, at this distance they did not appear to have a significant effect.

Summary and conclusions

12.28. The key points arising from the site visits are discussed below.

12.29. In very good visibility and with sun on turbines, especially behind the viewer, 187m high turbines can be picked out at distances of 33km, but this size of turbine appears very small.

12.30. Even if in shadow with a light horizon behind, 187m high turbines at 33km can just be discerned if searched for.

12.31. Atmospheric interference such as haze, mist and cloud and sunless conditions can obscure or reduce the contrast between light grey turbines and their backcloth meaning that they can be difficult to discern from 8 to 33km.

12.32. When viewed at sea level, the top of the tower, hub and blades of 131m high turbines are still visible at 29km. Therefore, the effect of curvature of the earth on reducing effects, particularly on larger turbines, should not be overstated.

12.33. At lower levels, wind farm layouts can appear less coherent than when viewed from higher viewpoints (e.g. 60m AOD+). Therefore, wind farms do not necessarily have less effect on receptors on low lying coasts themselves (although effects further inland, if flat, are likely to be negligible).

12.34. Wind farm seascapes with overlapping views of arrays have been created off the North Wales coast east of the Great Orme, are nearing this condition in the Thames estuary and may reach this state further up the east coast if extensions reduce or remove visual separation of arrays.

12.35. At night, aviation warning lighting can be significant at 16+km especially with a large spread across the horizon, but not at 33km with a limited spread. Overall, it appears to be less important as a factor than daytime views of the whole turbine.

12.36. In relation to SVIAs, some underestimate effects whilst others appear to be accurate in terms of worst case. Most do not address combined cumulative effects and so the 'cumulative effects' assessments underestimate or minimise the actual overall effects of implemented wind farms on receptors. It is considered that cumulative impact assessments should cover the *combined* effect of all existing and consented wind farms along with the proposal as well as an assessment of the *additional* effects of the proposal above the baseline. This is a particular consideration for extensions. There may also be a situation where other wind farms in the consenting process have to be taken into account as a further scenario. However, this should not substitute for both the *combined* and *additional* cumulative assessments.

13. Summary and findings

13.1. The objective of the study is to provide strategic guidance to developers and regulators on the likely limits of significant effect on seascape in English waters from further offshore wind development, including potential cumulative effects with existing operational, consented or in planning developments.

13.2. The study builds on the findings of previous OESEA background papers in 2009 and 2016.

13.3. The published OESEA3 Environmental Report (March 2016) stated as part of Recommendation 1 that developments (individually or cumulatively) should aim to avoid causing significant detriment to amenity and well-being as a consequence of deterioration in valued attributes such as landscape, tranquillity and other factors. In the discussion on visual buffers (derived from White Consultants (2016)) the report states:

'Further conclusions of the work were that for high value and high sensitivity coastlines, a distance of 30km from the coast (the limit of visual acuity) could be attributable to developments for a range of sizes (e.g. 3.6MW to 15MW), whereas distances for areas of medium value and sensitivity may be in the order of 13km (3.6MW turbines), 20km (4-8MW turbines) or 20+km (10-15MW turbines).' (p291).

13.4. This report seeks to update consideration of these distances. It considers the latest UK policies, guidance and baseline seascape information, and the latest offshore wind farms SVIAs and PEIRs. It also considers the potential effects of future larger wind turbine sizes through preparation of wireline scenarios and assessment. The study goes on to explore the influence of marine visibility modifiers e.g. haze and other weather conditions, considers the influence of lighting on potential effects, reviews other nations' approaches to buffers/siting wind farms offshore, evaluates cumulative effects of existing and proposed developments and summarises the findings of site visits to assess implemented offshore wind farms. It brings together these considerations to come to overall conclusions on the likely limits of significant visual effects contributing to seascape in this chapter.

13.5. The focus of the previous OESEA background studies has been on visual effects on coastal receptors and potential visual buffers, particularly associated with national landscape designations of National Parks and AONBs. This study acknowledges that consideration of seascape character is also a factor as a comprehensive national baseline for this has now been completed. However, the current absence of sensitivity assessments to offshore wind development for the majority of the English seascape remains an issue. Wales now has such an assessment which uses visual buffers from national landscape designations as a significant component in deriving boundaries of units and attributing sensitivity. As such, the findings of this report should be helpful in assisting in deriving sensitivity to wind farms in English waters at a broad brush scale along with a range of other factors.

13.6. Our interpretation of the threshold of no significance is derived from a 'worst case' scenario in the DTI (2005) seascape and visual impact assessment guidance which states that moderate significance adverse effects could be judged as significant (although it is most likely they are not). Taking a precautionary approach our research defines the point where the visual effect of an offshore wind farm development changes from one of moderate adverse significance to minor-moderate significance. Different magnitudes of effect are acceptable depending on the sensitivities of seascape or receptors.

13.7. In practice it is difficult to be precise about buffer distances because effects change depending on the size of the wind farm, the potential influence of other wind farms, the sensitivity of the viewpoint and the viewer and prevailing visibility and weather conditions. Beyond any given threshold of 'no significance', wind farms are still likely to be visible in clear weather conditions.

13.8. In order to analyse a range of data we have separated the magnitude of effect of wind farms from the sensitivity of receptor. This is to understand the 'pure' visual effects of development at different distances.

13.9. The study is concerned with all potential future offshore wind farm development and is not limited to Round 4 zones.

13.10. The summaries for each report chapter are set out below followed by a section bringing the evidence together in tabular form.

Wind farm development since 2009

13.11. Since 2009 there has been a very substantial increase in the number of turbines consented and implemented. The majority have been in the North Sea with the larger schemes tend to be located long distances offshore. However, some smaller schemes with large turbines have been consented close to shore e.g. EOWDC demonstration project. The average size of wind farm has increased and the consented/operational turbines capacities now range from 3.6MW through to 12.5MW. Elsewhere, developers have opted to implement schemes with smaller turbines, although they have a consent option to use larger turbines.

13.12. The first floating turbine wind farm used for deep water is now operational in Scotland- Hywind. The implication is that deeper waters off England and Wales may also now be considered for future search areas. These would include seas off the western seaboard peninsulas as well as parts of the North Sea off the coast of north east England. However, in the immediate future, the Crown Estate have launched Offshore Wind Leasing Round 4 for new seabed rights in four bidding areas up to 60m water depth- Dogger Bank, Eastern Regions, the South East and Northern Wales and Irish Sea.

13.13. In the case studies, it has been found in the decision making process that great weight is put on the effects on nationally designated landscapes and their users. Where there is more than one sensitive designation affected, this can count against a proposal. The combination of National Park or AONB, coinciding with Heritage Coast and/or World Heritage sites, appears to be considered as particularly sensitive. Much depends on the relationship of the proposal with the designations, such as whether the views are directly offshore looking at the widest part of the array, or viewing the narrower side of the array along the coast. However, each case is looked at on its own merits, with comparison with other proposals treated with caution.

13.14. In determining the worst case scenario for assessment sometimes larger numbers of smaller turbines at closer spacings, and possibly with a greater spread, have been regarded as the worst case scenario compared to larger turbines at greater spacing, with a narrower spread.

Policy considerations

13.15. The Marine and Coastal Access Act 2009 introduced the marine planning system in the UK. The UK Marine Policy Statement sets out the overall framework. Seascape is a consideration and marine plan authorities should take into account existing character and quality, how highly it is valued and its capacity to accommodate change.

13.16. Two Marine Plans in England have been completed with the rest out to consultation. All associated national level seascape character assessments have been undertaken. These do not evaluate the sensitivity of seascapes and therefore cannot be factored into potential buffers at the SEA level.

13.17. The Welsh National Marine Plan has now been adopted. The Wales Act 2017 means that consent for wind farms below 350MW is devolved to Welsh Ministers but those above are a matter for the UK government. It is likely that the large-scale offshore developments will exceed the threshold.

13.18. National Policy Statements EN-1 and EN-3 address national infrastructure planning in relation to renewable energy including offshore wind farms with a capacity above 100MW in England and 350MW in Wales. Nationally designated landscapes are confirmed as having the highest status of protection and their statutory purposes should be taken into consideration. Outside nationally designated areas, local landscape designations should not be used in themselves to refuse consent. The 'Rochdale Envelope' is a pragmatic approach to define the maximum parameters of a wind farm and constituent turbines as part of the consenting process. It illustrates that a range of sizes and numbers of turbines can be consented, although the worst case scenario is assessed within SVIAs.

13.19. National Parks, AONBs, Heritage Coasts and landscape-scale World Heritage Sites are the key designations relevant to consideration of wider visual buffers.

13.20. Policies may change in the light of the Climate Emergency declared by the UK Parliament on 1 May 2019.

International perspective

13.21. European nations within the EU operate a system of SEA some of which consider visibility/visual effects on the coast. Earlier developments for each country have tended to be located closer to shore with larger arrays with larger turbines significantly further offshore, sometimes stacking beyond nearer existing arrays. Arrays further offshore are arranged more parallel to the coast as visual intrusion is considered less problematic.

13.22. Considering the most experienced countries, planners and developers in Germany have favoured a 30km minimum distance offshore to deter any refusals based on the visual and noise impacts (based on wind turbine sizes to date). Implemented schemes average 55km offshore and consented schemes average 52km offshore. Not only does this assist in planning consent, but it also prevents any conflicts with other nautical activities around the coastline. Denmark, as an early pioneer has a wide variety of schemes very close to shore and up to 40km. The trend in the Netherlands and Belgium appears to be to allocate areas around 22km from the coast, with newer development zones significantly further offshore (35-60km).

13.23. In the USA, only one offshore wind farm has been implemented but 13 commercial wind energy leases have now been issued by the Bureau of Ocean Energy Management (BOEM) who manage the process of assessing, selecting and leasing federal areas offshore. The National Park Service (NPS) are consulted to identify potentially sensitive visual settings. NPS guidance refers to research that suggests that an appropriate area of impact analysis based on turbine heights up to 152m would be 40km. Taller turbines might be visible for longer distances and could require a larger area of analysis.

13.24. Elsewhere, there is no clear indication of how the visual impacts influence decision making- in Asia there are many near shore wind farms but the quality of coastal landscape or designations nearby are not known.

Seascape and visual impact guidance

13.25. The publication 'Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report' (DTI 2005) remains as key guidance in assessing the effects of offshore wind farms. Its consideration of magnitude of change identifies quantifiable parameters which include distance, number and proportion of turbines visible, proportion of field of view and navigational lighting. Less quantifiable parameters include arrangement of turbines, background, aspect and weather and prominence of other built features in the view. The report omits consideration of aviation lighting although marine navigation lighting is included.

13.26. GLVIA3 (LI, 2013) provides general guidance on landscape and visual impact assessment. This considers the factors influencing sensitivity and magnitude of effect. The three main factors affecting visual magnitude of effect are defined as scale of effect, extent and duration but their relative weighting is not specifically discussed. Scale of effect and extent can overlap as factors and as offshore wind farms are long-term in duration, the overall magnitude of effect combining the three factors is often the same as the scale of effect on its own. For a study of this nature, it is sensible to take the precautionary approach and consider that this is the case.

13.27. NECR105 defines the approach to seascape character assessment in England and Wales. It is a very concise document which gives no detailed guidance. The marine character areas now completed for all the Marine plan areas are derived from this approach but do not include an evaluation of sensitivity and so have limited value for strategic level assessment although act as a baseline and inform more detailed assessments.

13.28. The Welsh seascape sensitivity study specifically considered buffers to offshore wind farms with wind turbines ranging from 107m up to 350m high to blade tip. It used analysis of SVIAs in a complementary manner to the OESEA background studies.

13.29. MMO have just published guidance on assessing seascape sensitivity (MMO (2019)). It is relevant to how sensitivity to offshore wind farms could be assessed at national and regional levels as well as for SVIAs.

SVIAs analysis

13.30. SVIAs for 28 wind farms from Rounds 1, 2, 3, STW and wind farm extensions have been analysed. The distances at which both low and medium magnitude of visual effect have been extracted for four ranges of turbine sizes.

13.31. Including all wind farms analysed, the range at which low (including medium/ low) magnitude of effect occurs is from an average 19.2km for turbines up to 145m height to blade tip to an average 38.6km for turbines up to 300m high. A low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a National Park or AONB, especially if occurring in a number of related locations.

13.32. The range at which medium magnitude of effect occurs from an average 14km for turbines up to 145m height to blade tip to an average 27.5km for turbines up to 300m high. A medium magnitude of effect may have a significant effect on medium or medium to high sensitivity receptors.

13.33. The thresholds of effects derived from these analyses are lower than both the OESEA3 background report, 2016 and NRW, 2019 studies. This is likely to be due to the following combination of factors:

- This analysis includes judgements of medium-low in the range of low magnitudes of effects- this influences the thresholds of low effect in all turbine height ranges.
- There are a greater number of assessments informing the analysis of wind farms, including those with higher turbines, but also smaller demonstration wind farms like Kincardine and wind farm extensions are included.
- The grouping of different heights/sizes of turbines is slightly different between this analysis and OESEA3 background report, and so the two are not directly comparable. The latter groups turbines of 3-6MW together i.e. up to around 180m high.

Wireline analysis

13.34. Wirelines are used in this report to explore the potential visual effects of wind turbines 350m and 400m high to blade tip as these are not addressed in the SVIAs analysed. The ranges of size of array, heights of viewpoints (6m, 22m and 100m AOD) and distances of arrays offshore (13km, 18km, 24km, 35km and 44km) are considered to be representative of typical situations and wind farms in the UK which may have effects on coastal receptors.

13.35. For a sample 500MW wind farm, a small (or low) magnitude of effect was found beyond 24km for 137m high turbines and well beyond 35km for 350m or 400m high turbines. A low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a National Park or AONB.

13.36. For the same sample 500MW wind farm, a medium magnitude of effect was found between 13-18km for 137m high turbines and around 35km for 350m or 400m high turbines. A medium magnitude of effects may have a significant effect on medium or medium to high sensitivity receptors.

13.37. For the large wind farm scenario, a small (or low) magnitude of effect was found beyond 35km for 350m or 400m high turbines. As above, a low magnitude of effect may have a significant effect on a high or very high sensitivity receptor such as a National Park or AONB.

13.38. For the same large wind farm scenario, a medium magnitude of effect was found beyond 24km for 350m or 400m high turbines. As above, a medium magnitude of effect may have a significant effect on medium or medium to high sensitivity receptors.

13.39. In relation to viewing wind farms from different heights (6m, 22m and 100m AOD) the assessors found that the level of effects were the same at each height.

Visibility modifiers

13.40. The Met Office visibility data for eight coastal weather stations was analysed. Averaging all coastal stations, the visual range recorded was just under 24km around 50% of the time, just under 30km 33% of the time and around 34km for 20% of the time. The period of best visibility occurred in the summer months.

13.41. To the east of England, visibility lies above 21km for more than half the time and above 35km for more than 20% of the time. The coast of Wales enjoys visibility at the upper end of the 21-25km range for half the time and above 35km around 21-28% of the time. To the south and west England, visibility appears to be less, lying above 16-20km for more than half the time but at 30km+ there appears to be a distinct cut-off point- visibility above 35km is between 1.4% and 6.8% of the time.

13.42. Uncertainties derived from the methodology used to collect some meteorological data and therefore subsequent interpretations introduce some concern about its use to inform wind farm buffers.

13.43. Although it has not been possible to obtain more detailed attributes of sunshine and rainfall, the number of days of sunshine and rain gives an initial idea of which areas could potentially experience higher visibility throughout the year. Overall, it can be concluded generally that southern and eastern areas are drier and sunnier and eastern areas are likely to have clearer and more frequent visibility of wind farms located some distance offshore than the west of England. This reinforces the visibility data. North-facing coasts will experience views of wind farms highlighted by the sun most frequently.

13.44. No observations about fog have been included in the data so no conclusions can be drawn. Other variables that help decipher the presence of fog including relative humidity and dew point (when compared to temperature) were also unobtainable for this study. If contained within a measured sample (at the coastal station) it would be recorded as restricting visibility and so forms part of the overall visibility dataset. However, if it occurred offshore this would not be included.

13.45. The team's experience of long views being regularly possible such as along the Severn Estuary (35km+) or across to Ireland from Wales remind us that visibility at long distances is regularly possible. The site visit in October 2019 to the east coast also indicates that wind farms 29-33km offshore were visible to the human eye even in low contrast weather conditions (Great Gabbard and Dudgeon). However, as discussed by Taylor (2004), visual impact is not solely based on visibility. Wind turbines also may be more or less visible depending on various other factors such as sun and cloud.

13.46. The influence of weather data, particularly relating to visibility, depends on what assessors, decision-makers and ultimately, society, considers is a significant and acceptable percentage of time that an offshore wind farm is likely to be visible or has a worst case significant adverse effect (e.g. excellent visibility with sun on turbines and/or high contrast). Whilst the Culdrose coastal station to the west, away from current Round 4 bidding areas, has very limited or negligible frequency of visibility above 35 km, other coastal stations near relevant Round 4 areas record potential visibility above 35 km between 20-28% of days. 30km is the overall average threshold for visibility for around 30% days per year and is a distinct cut off point to the west of England but less so to the east of England and Wales.

13.47. Ultimately, the amount of variation from marine visibility modifiers is limited to the level of detail on a site by site basis. The UK coastline experiences varied weather patterns that can change in minutes.

Lighting

13.48. DTI guidance (2005) indicates that marine navigation lighting is a secondary impact and is very unlikely to be greater than the visual effects of a wind farm during the day.

13.49. Marine navigational lighting has an intensity which is expected to be visible for up to 18.5km (10 nautical miles) and is located at a level at which it is unlikely to be visible over longer distances due to the curvature of the Earth. It is therefore not considered to be a significant factor in determining buffer distances.

13.50. Aviation lighting is red, more intense, and located on the turbine nacelle. Due to the action of the turbine blades passing in front of the lights they appear to flash when viewed from upwind. Turbine lighting is visible over long distances,

with over 30km recorded. However, effects tend to be more important at closer distances, with Gwynt y Môr 16-23km being an example. The spread of turbines across the horizon is also a factor. If a wind farm is a well contained cluster, effects are less. If the development covers the majority, or all of the horizon, effects are likely to be much greater. It may not be a significant factor where there is already marine lighting, particularly of an industrial nature such as oil rigs. However, in wild and remote seascapes and areas adjacent to certain designated landscapes where tranquillity is a special quality, it may be considered a relevant contributory factor in the siting of offshore wind farms.

Cumulative issues

13.51. Most of the SVIAs analysed concentrate on the additional cumulative effects of a given development, rather than the combined cumulative effect, and so the findings need to be treated with caution. Nevertheless, there is an increase in the cumulative effect of arrays in line with increasing size of turbines. For example, larger turbines 250-300m high have both medium and low average cumulative visual magnitude of effects around 36km from shore.

13.52. The wireline analysis of cumulative scenarios also needs to be treated with caution as it illustrates a worst case scenario with excellent visibility covering all assessed arrays which is likely to be a rare occurrence. Of multiple wind farms from 7km to 35km from shore, it is considered that that there would be a moderate to very large change due to the extent of horizon covered, the size of the nearer clusters and the visual confusion between the wind farm clusters through overlapping of turbines and different sizes of turbines. The worst scenario is considered to be one where large turbines 350m high are in arrays 13km as well as 24km offshore. The best scenario is where the furthest array of 350m turbines is 35km offshore.

13.53. Overall, at a strategic level, it is the combined cumulative effect of a set of developments that is important in understanding the overall visual effects on people and associated effects on seascape character. This is also a particular consideration in the assessment of extensions.

13.54. Seascape sensitivity studies should help inform the most suitable locations for development and explore the thresholds of acceptable change taking combined cumulative impact into account. This would be helpful at a strategic level, preferably once expected MMO guidance has been issued. Studies should be based on further consideration of marine character areas or similar units, proximity to statutory and key designations and related intervisibility. This is outwith the scope of this report.

13.55. Within areas considered to be suitable for offshore wind farms, array design should be a key consideration to optimise the pattern of development. This should include the relationship between arrays including the distance between them, open gaps to the horizon (or far offshore arrays) and the compatibility of the arrays' size of turbines and arrangement. This is also outwith the scope of this report.

Site visit summary

13.56. Site visits were carried out to the north Wales coast in 2016 and the east coast of England and Scotland in 2019. The findings include the following.

13.57. In very good visibility and with sun on turbines, especially behind the viewer, 187m high turbines could be picked out at distances of 33km, but this size of turbine appears very small.

13.58. Even if in shadow with a light horizon behind, 187m high turbines at 33km can be just discerned if searched for.

13.59. Atmospheric interference such as haze, mist and cloud and sunless conditions can obscure or reduce the contrast between light grey turbines and their backcloth meaning that they can be difficult to discern at distances from 8km to 33km.

13.60. When viewed at sea level, the top of the tower, hub and blades of 131m high turbines are still visible at 29km. Therefore, the effect of curvature of the earth on reducing effects, particularly on larger turbines, should not be overstated.

13.61. At lower levels, wind farm layouts can appear less coherent than when viewed from higher viewpoints (e.g. 60m AOD+). Therefore, wind farms do not necessarily have less effect on receptors on low lying coasts themselves (although effects further inland, if flat, are likely to be negligible).

13.62. Wind farm seascapes with views of overlapping arrays have been created off the North Wales coast east of the Great Orme, are nearing this condition in the Thames estuary and may reach this state further up the east coast if extensions reduce or remove visual separation of arrays.

13.63. At night, aviation warning lighting can be significant at 16+km especially with a large spread across the horizon, but not at 33km with a limited spread. Overall, it appears to be less important as a factor than daytime views of the whole turbine.

13.64. In relation to SVIAs, some underestimate effects whilst others appear to be accurate in terms of worst case. Most do not address combined cumulative effects and so the cumulative effects assessments underestimate or minimise the actual overall effects of implemented wind farms on receptors.

Bringing the evidence together

13.65. The analyses from the SVIA and wireline analysis are brought together with part of the NRW, 2019 analysis (**Table 5.4)** in **Table 13.1** below. These reflect the suggested distances for buffers depending on the maximum turbine size (as defined by the 'Rochdale Envelope') and sensitivity of seascape or receptor.

Table 13.1 Overall analysis of the magnitude of visual effect related to distance

Offshore wind farm SVIAs	Low magnitude of effect		Medium magnitude of effect	
Heights of turbine to blade tip (m)	Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
107-145	**19.2**	26.1	**14.0**	15.0
150-175	**21.7**	26.5	**15.8**	17.7
176-223	**26.2**	31.9	**20.2**	26.3
250-300	**38.6**	47.6	**27.5**	31.1
301-350	**35-44*** **44****	-	**24-35*** **32.8****	-
351-400	**35-44***	-	**24-35***	-

*Wireline assessment ** NRW, 2019 findings

13.66. The NRW findings are based on a slightly different basis of analysis and with fewer wind farms. However, they are broadly consistent with the findings of this report.

13.67. Whilst the buffer distances above appear precise, there is in reality a continuum of gradually decreasing effects with increasing distance. The scale of effect will also be influenced by the extent of wind farm (especially width across the horizon), its arrangement and turbine spacing, and its relationship with coastal receptors e.g. angle of view and juxtaposition with other elements such as headlands and islands. In addition, at greater distances, the influence of visual acuity and visibility modifiers come into play.

13.68. In terms of visual acuity, the width of the upper part of the turbine tower provides a reasonable indicator of the distance that turbine may be visible in excellent visibility conditions (as it is likely to be seen above the horizon). The largest currently consented turbine towers have a diameter of up to 5m and so, theoretically, can be seen from 50km. Larger turbines 350-400m high are likely to have larger diameter towers and so may be able to be seen from longer distances. Therefore visual acuity is unlikely to be a limiting factor in terms of visual buffers.

13.69. In terms of visual modifiers, averaging all eight coastal stations assessed, the visual range recorded was just under 24km around 50% of the time, just under 30km for 33% of the time, around 34km for 20% of the time and 40km for 10% of the time.

13.70. This means that there is more certainty that wind farms closer to the coast will have the worst case effects expected in SVIAs and the wireline analyses. It is a matter for debate as to the percentage days that the worst case 'significant adverse' effect may be considered 'acceptable' or regarded as 'not significant'. This is a matter for assessors, decision-makers and society as a whole. Most people might consider 50% of days (24km) as being too frequent, particularly as the better visibility days tend to be in the summer. On the other hand, for very sensitive coastal receptors the frequency of visibility may be a limiting factor. 20% (34km) may be considered to be a reasonable conservative threshold limiting harm to a sensitive seascape and 10% (40km) to a very sensitive seascape. For individual wind farms, the nearest two to three weather stations visibility statistics should be reviewed to respond to the local conditions rather than relying on the national averages.

13.71. In respect of designations, Rampion (165-210m high turbines assessed) is located 16km south of the nearest part of the South Downs National Park beyond Brighton, although probably not intervisible with it. It is 20-26km south west of the area where the National Park meets the coast which is also designated Heritage Coast. From here the narrow edge of the array is visible rather than the wider edge which is visible from Brighton. The effects on this stretch of coast were given particular consideration and agreed as significant but were not considered sufficient to refuse the project.

13.72. Navitus Bay (200m high turbines) was proposed 19km from the Dorset AONB to the north west, 23.5km from the Isle of Wight AONB to the north east and 27km from the New Forest National Park at Hurst Castle, having significant visual effects on receptors in each. Both AONBs overlaid Heritage Coast designations. Parts of the coast were orientated towards the array and it interfered with highly sensitive views such as to the Needles. The combined significant effects weighed against the proposal. In addition, the harm caused to the setting of the Dorset and East Devon WHS, the 'less than substantial harm' to its significance and the harm to its outstanding universal value carried significant weight against the decision to make the order. The WHS overlapped the Dorset AONB.

13.73. The Atlantic Array (180m high turbines) was considered to potentially cause significant adverse effects on receptors in Pembrokeshire Coast National Park up to 28km away, Gower AONB at 22km, and North Devon AONB and Exmoor

National Park closer to. All the designations were overlaid with Heritage Coast designations. The balance between these and other effects and the benefits of the project were not ultimately tested as the project was withdrawn by the developer.

13.74. From these samples it appears that National Park/AONB and Heritage Coast combined is the most sensitive combination of designations. Also offshore wind farm development along the coast from these combined designations may be acceptable at a distance but not where the development is viewed directly offshore. In addition, constraints on development increase where more than one area of combined designation is potentially affected.

13.75. Undeveloped undesignated coast is an intermediate category which is taken into account but given significantly less weight than national designations. It is considered that the buffer distances for medium sensitivity coastlines applies here.

13.76. In respect of coastal urban areas, the moderately large scale arrays of Rampion and Gwynt y Môr were approved 13km away from the south coast settlements around Brighton and north coast settlements of Wales respectively. Slightly smaller arrays using larger turbines at Burbo Bank extension and Westermost Rough were approved around 8km from the flat coastal settlements of Hoylake and Withernsea respectively. These distances show that decision makers have considered that some developed flat coastlines have greater tolerance of offshore wind energy development than undeveloped coasts.

13.77. In practice, existing wind farms are used as justifications for extensions in SVIAs. It is therefore difficult to provide a different buffer distance for multiple wind farms. Rather, the ability of a given area to accommodate offshore wind farms will depend partly on the objectives for an individual seascape/marine character area e.g. no offshore wind farms, widely separated wind farms, wind farm seascape; and partly on the design of individual developments and their relationship to each other. The former will be informed by the regional or local seascape character assessments, and sensitivity assessments as these become available. It should be noted that whilst there is a sensitivity assessment for Welsh waters there are no current plans for undertaking sensitivity assessments in the waters around England.

13.78. The following tables bring together the key factors in **Tables 13.2 and 13.3**. **Table 13.4** relates the buffers to different types and sensitivities of receptors.

13.79. The suggested buffers provide a balance between a variety of factors. On the one hand, they respond to current policy where great weight is given to protecting statutory landscapes. On the other, in areas of lesser constraint, they provide lesser buffers which can thus allow offshore wind energy closer inshore. However, for wind farms proposed closer to the coast it will be important to take design into account in terms of space between different developments, and the relationship of turbine sizes and arrangements in related/intervisible arrays.

Table 13.2 – High sensitivity seascapes or receptors where a maximum small effect is desirable

	Suggested distances for buffers								
Research heading	137/145m turbine 3.6MW	175m turbine 5MW	190m turbine 7/8MW	220m turbine 10MW	250m turbine 15MW	300m turbine 15MW	350m turbine 20MW	400m turbine 20MW+	All turbine sizes
Wireline assessment (2016)	Beyond 24km	Beyond 24km	Beyond 24km	Well beyond 24km	Well beyond 24km	-	-	-	-
Wireline assessment (2019)	-	-	-	-	-	-	35-44km (39.5km average)	35-44km (39.5km average)	-
SVIAs effects (2016)	29.9km (3-6MW)		27.2km	-	-	-	-	-	28.7km
SVIAs effects (2019)	19.2km	21.7 km	26.2km			38.6km	-	-	-
Marine Visibility modifiers (2009)	-	-	-	-	-	-	-	-	30km
Marine Visibility modifiers (2019)	-	-	-	-	-	-	-	-	10-20% days visibility-34-40km

Table 13.3 – Medium sensitivity seascapes or receptors where a maximum medium effect is desirable

	Suggested distances for buffers								
Research heading	**137/145m turbine 3.6MW**	**175m turbine 5MW**	**190m turbine 7/8MW**	**220m turbine 10MW**	**250m turbine 15MW**	**300m turbine 15MW**	**350m turbine 20MW**	**400m turbine 20MW+**	**All turbine sizes**
Wireline assessment (2016)	13km-18km	18-24km	18-24km	18-24km	Beyond 24km	-	-	-	-
Wireline assessment (2019)	-	-	-	-	-	-	24-35 km (29.5km average)	24-35 km (29.5km average)	-
SVIAs effects (2016)	20.6km (3-6MW)		18.9km	-	-	-	-	-	19.9km
SVIAs effects (2019)	14km	15.8 km	20.2km			27.5km	-	-	-
Marine Visibility modifiers (2009)	-	-	-	-	-	-	-	-	30km
Marine Visibility modifiers (2019)	-	-	-	-	-	-	-	-	33-50% days visibility 24-30km

Table 13.4 – Possible range of buffers for single offshore developments

			Suggested distances for buffers						
	Value to seascape	Potential sensitivity	107-145m turbine 3.6MW	146-175m turbine 5MW	176-224m turbine 7/8MW	225-300m turbine 15MW	301-350m turbine 20MW	351-400m turbine 20MW+	Notes
National Parks and AONBs with coastal special qualities- often characterised by presence of Heritage Coast designation. Multiple statutory landscape designations.	Very High	Very High	34km	34km	34km	40km	40km	40km	Based primarily on limit of visual significance
National Parks (England and Wales) AONBs World Heritage Sites (Landscape based- e.g. Dorset and East Devon Coast)	Very High	High	19km	22km	26km	39km	40km	40km	Based primarily on SVIA 2019 analysis with wireline analysis and limit of visual significance for larger turbines
Heritage Coasts National Trails	High	Medium/ high and high	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate between high and medium sensitivity buffers
World Heritage Sites (e.g. coastal castles, forts and ancient sites) Landscapes of Outstanding and Special Historic Interest (Wales) Large SAMs Historic Parks and Gardens	Medium-high	Medium and medium/ high	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate between high and medium sensitivity buffers

Local landscape designations									
			Suggested distances for buffers						
	Value to seascape	Potential sensitivity	107- 145m turbine 3.6MW	146-175m turbine 5MW	176-224m turbine 7/8MW	225-300m turbine 15MW	301-350m turbine 20MW	351-400m turbine 20MW+	Notes
Medium sensitivity seascapes	Medium	Medium	14km	16km	20km	27.5km	30km	30km	Based primarily on SVIA 2019 analysis with wireline analysis and limit of visual significance for larger turbines

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APPENDICES

Appendix A: Abbreviations and Glossary

Abbreviations used in text

AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CLVIA	Cumulative Landscape and Visual Impact Assessment
DCO	Development Consent Order
DPO	Draft Plan Option
EIA	Environmental impact assessment
ES	Environmental statement
ExA	Examining Authority
GLVIA	Guidelines for landscape and visual impact assessment
GIS	Geographic information system
HPMCZ	Highly protected marine conservation zone
HSC	Historic Seascape Characterisation
HWM	High water mark
ICZM	Integrated Coastal Zone Management
km	Kilometres
LCA	Landscape character assessment *or* landscape character area
LDP	Local Development Plan
LVIA	Landscape and visual impact assessment
LWM	low water mark
m	metres
MCA	Marine Character Area
MPA	Marine Planning Area
MPS	Marine Policy Statement
MHW	Mean high water
nm	nautical miles
NE	Natural England
NRW	Natural Resources Wales
PEIR	Preliminary Environmental Information Report
PU	Shoreline Management Plan policy unit
RSU	Regional Seascape Unit
RHL	Registered Historic Landscape (Landscapes of outstanding or special historic interest in Wales)
SAC	Special Area of Conservation
SCA	Seascape character assessment / seascape character area
SCT	Seascape character type
SLA	Special Landscape Area
SM	Scheduled Monument
SMR	Scheduled Monument Record
SPA	Special Protection Area

SSSI	Site of Special Scientific Interest
SNH	Scottish Natural Heritage
SVIA	Seascape, (landscape) and visual impact assessment
UKCS	United Kingdom Continental Shelf
WHS	World Heritage Site
ZTV	Zone of theoretical visibility
ZVI	Zone of visual influence

Glossary

Term	*Definition*
Seascape, marine and coastal processes terms	
Abrasion	The mechanical wearing effect on rocks caused by corrosion. The abrading agent can take a variety of forms e.g. sand, pebbles or boulders moving across a rock surface.
Attrition	The mechanism by which the particle size of any material is reduced by friction during transport.
Biogenic	A feature that is created by living organisms, either animal or plant.
Characteristics	elements, features and qualities which make a particular contribution to distinctive character.
Characterisation	the process of identifying areas of similar character, classifying and mapping them and describing their character. (NECR105)
Classification	concerned with dividing the seascape into areas of distinct, recognisable and consistent common character in grouping areas of similar character together. It requires the identification of patterns in the seascape, created by the way the natural and human influences interact and are perceived and experienced to create character in the seascape. (NECR105)
Description	capturing the overall essence of the character of the seascape, with reference to geology, landform, bathymetry, habitats, use of the coast and sea, cultural associations etc, drawing out the ways in which these factors interact together and are perceived and experienced and are associated with events and people.
Demersal	In relation to marine organisms: those which flourish on the ocean floor.
Elements	individual component parts of the seascape such as beaches, cliffs, submerged reefs, sea walls, groynes and rocky outcrops.
Features	particularly prominent or eye-catching elements such as lighthouses, rock stacks and coastal cliffs.
Fetch	The distance of open water across which wind blows or over which wind generated water wave travels, unobstructed by major land obstacles. The amount of fetch helps to determine the magnitude and energy of a wave and therefore its erosional or depositional tendencies on neighbouring shorelines.
Hydraulic action	Force exerted by moving water on rocks e.g. air forced into cracks in solid rocks by breaking waves is capable of causing their disintegration by expanding the fissures.
Key characteristics	those combination of elements which help given area its distinct sense of place. They can in many cases to be 'positive' characteristics but they may also in some cases be 'negative' features which nevertheless are important to the current character of the seascape. (Natural England, 2014)
Landward limits (of a seascape character assessment)	the distance which the seascape character assessment will expand onshore and inland. Such considerations relate to the mainland, peninsulas and islands, regardless of their distance out at sea. The extent is dependent on the purpose and/or scope of the assessment being undertaken.
Littoral	Pertaining to a shoreline.
Longshore drift	A general movement of beach material along the shoreline due to the effect of waves breaking obliquely on to the beach.

Term	*Definition*
Pelagic	In relation to the environment: the open ocean as distinct from the ocean floor. In relation to marine organisms: those which flourish independent of the ocean floor and shoreline environments.
Perception	perception combines the sensory (that which we receive through our senses) with the cognitive (knowledge and understanding gained from many sources and experiences).
Reef	A line of rocks or material in the tidal zone of the coast, submerged at high water but partly uncovered at low water.
Ria	Submerged coastal valley or estuary resulting from a rise of sea level, often associated with post-glacial coasts.
Marine character area	See seascape character area. (Term used for national/regional scale units).
Saltation	Sediment transported by bouncing or hopping along a surface carried by water or wind.
Seascape	Seascape is landscapes with views of the coast or seas, and coasts and the adjacent marine environment with cultural, historical and archaeological links with each other. (MPS)
Seascape character	Seascape character is a distinct and recognisable pattern of elements in the seascape that makes one seascape different from another, rather than better or worse. (NECR105)
Seascape character assessment (SCA)	SCA is the process of identifying and describing variation in the character of the seascape, and using this information to assist in managing change in the seascape. It seeks to identify and explain the unique combination of elements and features that make seascape distinctive. (NECR105)
Seascape or marine character area	These are single unique geographical areas of a particular seascape character type. Each has its own individual character and identity, even though it shares the same generic characteristics with other seascape character areas of the same type. (NECR105)
Seascape or marine character capacity	Seascape capacity refers to the amount of specified development or change which a particular marine or local seascape character area and the associated visual resource is able to accommodate without undue negative effects on its character and qualities. (Adapted from Natural England, 2019)
Seascape or marine character sensitivity	Term applied to marine character and seascape and the associated visual resource, combining judgements of their susceptibility to a specific type of development / development scenario or other change being considered and the value(s) related to that seascape, marine character and visual resource. (Derived from Natural England, 2019)
Seascape or marine character susceptibility	The degree to which a defined seascape or marine character area and its associated visual qualities and attributes might respond to the specified types of development or change without undue negative effects on character and the visual resource. (Adapted from Natural England, 2019)
Seascape or marine character type	These are distinct types of seascape that are relatively homogeneous in character. They are generic in nature in that they may occur in different locations but wherever they occur they share broadly similar combinations of geology, bathymetry, ecology, human influences and perceptual and aesthetic attributes. (NECR105)
Seascape or marine character value	The relative value or importance attached to a seascape or marine character area, which may express national or local consensus, because of its quality, its special qualities including perceptual aspects such as scenic beauty, tranquillity and wildness, natural or historic attributes or features, cultural associations, or its relationship with designated or

	valued landscapes and coasts. (Adapted from Natural England, 2019)
Term	*Definition*
Seascape quality	The physical state of the seascape. It includes the extent to which typical character is represented in individual areas, sometimes referred to as strength of character, the intactness of the seascape from visual, functional and ecological perspectives and the condition or state of repair of individual elements of the seascape. (NECR105)
Seascape strategy	the objectives and overall vision of what the seascape should be like in the future, and what is thought to be desirable for a particular seascape character type or area, as a whole. (Natural England, 2014)
Seascape, (Landscape) and Visual Impact Assessment (SVIA)	SVIA is an established methodology which is used to assess the impact of the development or other use change on seascape, landscape and visual amenity. It includes analysis of the effects during the construction, operation and decommissioning phases of the development, including any restoration or after uses.
Seaward limits (of an SCA)	distance out to sea that the SCA will extend.
Slack	an area of almost motionless water.
Suspension	The process by which lightweight materials are transported by moving water in the zone of turbulent flow.
Swash	The movement of a turbulent layer of water up the slope of the beach as a result of the breaking of a wave. It is capable of moving beach material of substantial size and is an important element in longshore drift.
Swell	A regular movement of marine waves created by wind stress in the open ocean.
Traction	Solid load carried by water.
Other terms associated with landscape	
Amenity (Planting)	planting to provide environmental benefit such as decorative or screen planting.
Analysis	the process of dividing up the seascape/landscape into its component parts to gain a better understanding of it.
Apparent	object visible in the seascape/landscape.
Approach	the step-by-step process by which seascape/landscape assessment is undertaken.
Arable	land used for growing crops other than grass or woody species.
Aspect	in Wales, an aspect is a component of the LANDMAP information recorded, organised and evaluated into a nationally consistent spatial data set. The landscape information is divided into five aspects- geological landscape, landscape habitats, visual and sensory, historic landscape and cultural landscape.
Aspect area	areas defined in each of the LANDMAP aspect assessments which are mutually exclusive
Assessment	term to describe all the various ways of looking at, analysing, evaluating and describing the seascape/landscape or assessing impacts on seascape/landscape and visual receptors.
Biodiversity	the variety of life including all the different habitats and species in the world.

Term	*Definition*
Conservation	the protection and careful management of natural and built resources and the environment.
Complexity	(in the context of describing a skyline)how varied or complicated the skyline is from dead flat with even vegetation at one end of the scale to mountainous with varied vegetation at the other.
Consistent	relatively unchanging element or pattern across a given area of seascape/landscape.
Cultural heritage asset	see heritage asset
Cultural pattern	expression of the historic pattern of enclosure and rural settlement.
Cumulative impacts/effects	either additional changes caused by a proposed development in conjunction with similar developments or the combined effect of a set of developments, taken together
Distinctiveness	see sense of place
Diversity	(in terms of the function of an area) the variety of different functions of an area.
Dominant	main defining feature or pattern.
Effects	term used in environmental impact assessment (EIA) where effects are changes arising from the action, operation or implementation of a proposed development.
Effects, direct	where development lies within a seascape/landscape and physically removes an element or feature e.g. rocks, cliff, coastal vegetation
Effects, indirect	effects away from the development such as perceived change of character or from associated development such as transport infrastructure
Field Boundary	the defined edge of a field whether fence, hedge, bank, ditch or wall.
Field Size	Large 2 Ha Above, Medium Around 1.5 Ha, Small Less Than 1 Ha.
Geology	the study of the origin, structure, composition and history of the Earth together with the processes that have led to its present state.
Ground Type	expression of the soil forming environment and its influence in determining the surface pattern of vegetation and land use.
Hedge	fence of shrubs or low trees, living or dead, or of turf or stone. Though strictly a row of bushes forming a hedge, hedgerow has been taken to mean the same as a hedge.
Hedge bank	earth bank or mound relating to a hedge
Heritage asset	a building, monument, site, place, area or landscape positively identified as having a degree of historical significance meriting consideration in planning decisions. Designated heritage assets include world heritage sites, scheduled ancient monuments, protected wreck sites, battlefields, listed buildings and registered parks and gardens.
Horticulture	intensive form of cropping, such as vegetables or fruit.
Impact	used as part of overall term, as in EIA or LVIA, to help describe the process of assessing potentially significant effects- see effects.
Inherent	dictionary definition- ‘existing as an inseparable part’. In the context of sensitivity means the sensitivity of the seascape/landscape area itself with all its component elements and features rather than its relationship with types of development or adjacent areas.

Term	*Definition*
Integrity	unspoilt by large-scale, visually intrusive or other inharmonious development
Landcover	combinations of natural and man-made elements including vegetation that cover the land surface.
Landform	combinations of slope and elevation which combine to give shape and form to the land.
LANDMAP	*LANDMAP* is the national Geographical Information System (GIS) based information system for Wales, devised by Natural Resources Wales, for taking landscape into account in decision-making. It is a nationally consistent dataset divided into 5 aspects- geological landscapes, landscape habitats, visual and sensory, historical landscapes and cultural landscapes.
Landscape	an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors
Landscape and Visual Impact Assessment (LVIA)	A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity. (GLVIA 3)
Landscape Character	a distinct, recognisable and consistent pattern of elements, features and qualities in the landscape that makes one landscape different from another, rather than better or worse.
Landscape Character Area (LCA)	these are single unique areas which are discrete geographical areas of a particular landscape character. Each has its own individual character and identity. These areas in Wales are primarily derived from LANDMAP aspects.
Landscape Resource	the overall stock of the landscape and its component parts. (The landscape considered as a measurable finite resource like any other e.g. minerals, land, water).
Landscape value	the relative value or importance attached to a landscape (often as a basis for designation or recognition), which expresses national or local consensus, because of its quality, special qualities including perceptual aspects such as scenic beauty, tranquillity or wildness, cultural associations or other conservation issues. In Wales, value is also attributed to each LANDMAP aspect using a variety of criteria.
Magnitude of effect	degree of change
Mixed Farmland	a combination of arable and pastoral farmland
Mosaic	mix of different landcovers at a fine grain such as woodland, pasture and heath.
Objective	method of assessment in which personal feelings and opinions do not influence characterisation or judgements.
Outcrop	the area where a particular rock appears at the surface.
Pastoral	land down to grass either grazed by animals or for cutting.
Physiography	expression of the shape and structure of the land surface as influenced both by the nature of the underlying geology and the effect of geomorphological processes.
Polygon	discrete digitised area in a geographic information system(GIS).
Prominent	Highly conspicuous feature or pattern in the landscape.
Protect	to keep from harm.

Term	*Definition*
Qualities	aesthetic (objective visible patterns) or perceptual (subjective responses by the seascape/landscape assessor) attributes of the seascape such as those relating to scale or tranquillity respectively.
Receptor, visual	people in a variety of different situations who can experience views within an area and who may be affected by change or development. Receptors can include users of public footpaths, open access land, roads, rail or cycleways or urban or rural residents.
Receptor, seascape/landscape	seascape/landscape character areas, designations, elements or features which may be affected by development
Remoteness	physical isolation, removal from the presence of people, infrastructure (roads and railways, ferry and shipping routes) and settlement
Resource	see seascape/landscape resource.
Restore	repair or renew.
Riparian	vegetation associated with the water body, usually a river or stream.
Scenic quality	seascape/landscape with scenes of a picturesque quality with aesthetically pleasing elements in composition
Semi-natural vegetation	any type of vegetation that has been influenced by human activities, either directly or indirectly. The term is usually applied to areas which are reverting to nature due to lack of management.
Sense of place	the character of a place that makes it locally identifiable or distinctive i.e. different from other places. Some features or elements can evoke a strong sense of place e.g. islands, forts, vernacular architecture
Sensory	that which is received through the senses i.e. sight, hearing, smell, touch.
Setting, of a heritage asset	The surroundings in which the asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or a negative contribution to an asset, may affect the ability to appreciate that significance or may be neutral.
Settlement	all dwellings/habitations, whether single or clustered in cities, towns and villages.
Settlement Pattern	the predominant pattern of settlement in an area.
Significance	a measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic. A significant effect needs to be taken into account in decision-making.
Subjective	method of assessment in which personal views and reaction are used in the characterisation process.
Topography	term used to describe the geological features of the Earth's surface e.g. mountains, hills, valleys, plains.
Unity	consistency of pattern over a wide area i.e. the repetition of similar elements, balance and proportion, scale and enclosure.
Value	see landscape value
Vernacular	built in the local style, from local materials.
Visual Effects	effects on specific views and on the general visual amenity experienced by people.

Appendix B Navitus Bay: Comparison of visual impact between SVIA and ExA panel

Navitus Bay: comparison of visual impact between appellant assessors and ExA panel

Note: table contents extracted from Navitus Bay Wind Park Examining Authority's Report on Findings and Conclusions and Recommendation to the Secretary of State 7.4.1 onwards . (Note possible ExA confusion between scale of effect and significance of effect).

Viewpoint details			Appellant assessor (LDA) assessment			Examining authority panel view			
View-point number	Viewpoint name	Minimum distance from array (km)	Sensitivity	Magnitude of effect	Significance	Sensitivity	Magnitude of change/ scale of effect	Significance	Comments
8	St Adhelm's Head- national trail	23.5	High/medium	Medium / low	Moderate (not significant)	High	Medium	Major/ moderate	Conspicuous, eye-catching
9	Durlston Castle and Durlston Country Park	19	High	Medium	Major/ moderate	High	Medium	Major/ moderate	Conspicuous, well-defined, not fore- most predominant feature
A	Anvil Point - Durlston Castle and Durlston Country Park	19.4	High	Medium	Medium?	High?	Medium	Not stated but considered significant	Conspicuous, eye-catching. Significant as one of a sequence of medium scale of effects the effects experienced along the stretch of coast.
11	Ballard Down	22		Medium	Medium?	Not stated	Large – medium?	?	Noticeable, draw the eye.
12	Old Harry Rocks	5 km additional			Major/ moderate	Not stated	Not stated	Major/ moderate	New focal point, compete with the prominence of rocks and chalk cliffs.
B	Swanage Beach North		High/medium	Medium	Medium?	Not stated	Medium?	?	Occupy part of long distance views. Foreground features such as boats and beach related activities draw the eye away from the horizon.

Viewpoint details			Appellant assessor (LDA) assessment			Examining authority panel view			
View-point number	Viewpoint name	Minimum distance from array (km)	Sensitivity	Magnitude of effect	Significance	Sensitivity	Magnitude of change/ scale of effect	Significance	Comments
27	Hurst Castle	27	High/medium	Medium/ low	Moderate (not significant)				
28	The Needles	22.3			Major/ moderate			Major/ moderate	Noticeable but distant feature in views silhouetted between and beyond the Needles
29	Tennyson's monument	23.9	High	Medium/ low	Moderate (not significant)	High	Medium/n low	Moderate (part of a sequence of moderate impacts)	New focal point, discernible
31/32/33	Mottistone, Limerstone Down, Black Gang car park	28+						Not significant	Discernible, only minor alterations the baseline views

Appendix C Atlantic Array- comparative visual impact table

APPENDIX ?: ATLANTIC ARRAY VIEWPOINTS VISUAL EFFECTS ASSESSMENT EVALUATION COMPARISON

SVIA- final						**LUC review for Pembrokeshire Coast National Park**			**NRW** *[Evaluation on White Consultants scale]*			
SLVIA View-point refer-	*Name of viewpoint*	*Distance from nearest turbine [km]*	*Sensitivity of receptors [final ES]*	*Magnitude of change [final ES]*	*Signi-ficance [final ES]*	*Sensit-ivity of recept-ors*	*Magnitude of change*	*Signific-ance*	*Sensit-ivity of recept-ors*	*Magnitude of change*	*Signific-ance*	*Comment*
PCNP												
2	St Govan's Head	27.93	high	negligible	minor	Very high	Medium	Major/ substantial	high	moderate/ slight	moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea from a dramatic coastline but the receptors would be aware of the MOD use and structures in the vicinity.
3	Broad Haven beach, Bosherton	29.02	very high	negligible	minor	Very high	Medium	Major/ substantial	high [very]	moderate/ slight	major/ moderate	The array would be apparent in clear visibility seen in framed views from the beach beyond Church Rock which is an awkward juxtaposition. The effect is considered significant adverse.
4	Stackpole Head	28.24	very high	negligible	minor	Very high	Medium	Major/ substantial	high [very]	moderate/ slight	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea from a dramatic coastline. The 500mm viewing distance visualisation is helpful in showing the real effects of this array. The effect is considered significant adverse.
7	Manorbier	29.21	very high	negligible	minor	Very high	Medium	Major/ substantial	high	moderate/ slight	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea. The effect is considered significant adverse.
8	Lydstep	29.27	high	small	moderate [minor at night]	Very high	Medium	Major/ substantial	high	moderate/ slight	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea which includes Caldey Island, although an extensive holiday village is visible to the North with associated marine recreation activities including motorboats. The effect is considered significant adverse.
9	Caldey Island	27.5	very high	small	major [moderate at night]	Very high	Medium	Major/ substantial	high [very]	moderate	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea from a sensitive viewpoint. The effect is considered significant adverse.
11	Colby Estate	40.64	high	negligible	minor	Very high	Small /negligible	Moderate	high	negligible	negligible	The array would be a distant, barely perceptible feature only visible on the clearest days within a wide arc of view with intervening landscape and coast. The effect is not considered significant due to distance.

Key

Significant effect

Potentially significant effect

Viewpoint distance where all assessors agree there is a significant effect

SLVIA- final						LUC review for National Park			White Consultants review for NRW *[Evaluation on White Consultants scale]*			
SLVIA View-point refer-	*Name of viewpoint*	*Distance from nearest turbine [km]*	*Sensitivity of receptors [final ES]*	*Magnitude of change [final ES]*	*Signi-ficance [final ES]*				*Sensit-ivity of recept-ors*	*Magnitude of change*	*Signific-ance*	*Comment*
Gower												
18	Spaniard Rocks	27.9	very high	small	major [moderate at night]	-	-	-	high	moderate	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea beyond the highly distinctive Worms Head. This would be a very awkward juxtaposition spoiling the drama of coastline. The effect is considered significant adverse.
23a	Rhossili Downs southern end	24.61	high	medium	major [moderate at night]	-	-	-	high	moderate	major/ moderate	The array would be noticeable in clear visibility in an otherwise unspoilt vista of the sea beyond the highly distinctive Worms Head. The effect is considered significant adverse.
26	Worms Head near lookout station	23.09	very high	medium	substantial [moderate at night]	-	-	-	high [very]	substantial / moderate	major	The array would be prominent in clear visibility in an otherwise unspoilt vista of the sea beyond the highly distinctive Worms Head. The effect is considered significant adverse.
29	Port Eynon Point	23.74	very high	medium	substantial [moderate at night]	-	-	-	high	substantial /moderate	major	The array would be prominent in clear visibility in an otherwise unspoilt vista of the sea beyond the highly distinctive Worms Head. The effect is considered significant adverse.
34	Reynolds-town, Cefn Bryn	29.9	high	small	moderate [minor at night]	-	-	-	high	slight	moderate	The array would be perceptible in clear visibility within a wide arc of view with intervening landscape and coast. The effect is not considered significant due to the intervening landscape, highly textured with woodland and other vegetation, which assists in drawing the eye from the array, which appears as a distant forest of turbines.
35	Three Cliffs Bay	31.32	very high	negligible	minor	-	-	-	high [very]	moderate/ slight	major/ moderate	The array would be apparent in clear visibility in an otherwise unspoilt vista of the sea beyond the highly distinctive and scenic bay. The effect is considered significant adverse on balance due to its juxtaposition with the bay although it is at a distance.
36	Pwlldu Head	32.41	very high	small	major [moderate at night]	-	-	-	high	moderate/ slight	major/ moderate	The array would be just apparent in clear visibility in an otherwise unspoilt vista of the sea. The effect is considered significant adverse on balance.
37	Mumbles Head	37.12	high	negligible	minor	-	-	-	high	negligible	negligible	The array would be barely perceptible even in clear visibility due to distance. The effect is not considered significant.

Key

Significant effect

Potentially significant effect

Viewpoint distance where all assessors agree there is a significant effect

Appendix D SVIA analysis- individual wind farms

Scheme name	Atlantic Array			
Document	Atlantic Array Offshore Wind Farm Draft ES Volume 1 Chapter 12			
Data source	RWE npower renewables			
Status	Withdrawn			

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW		1390	
No. of turbines		278	approx turbine capacity from interpolation : 5 MW
Turbine blade tip height (m)		180	
Distance from nearest coast km		14	

Effect Note: only land-based viewpoints with small or medium MoE listed

No other windfarms present or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of proposed change)	Significance of effect (daytime)
9 Caldey Island	27.5	High	Medium	Minor-moderate
18 Spaniard Rocks	28.0	High	Small	Minor
2 St Govan's head	28.0	Very high	Small	Moderate
23a Rhossili Downs	25.0	High	Medium	Moderate-major
26 Worms Head	23.5	Very high	Medium	Major-substantial
29 Port Eynon	24.0	High	Medium	Minor-moderate
3 Broad Haven	29.0	High	Small	Minor
34 Cefn Bryn	30.0	High	Small	Minor
35 Three Cliffs Bay	31.5	High	Small	Minor
36 Pwlldu Head	32.5	High	Small	Minor
37 Mumbles Head	37.5	High	Small	Minor
4 Stackpole Head	28.5	High	Small	Minor
54 Highveer Point	31.0	High	Small	Minor
55 Silkenworthy Knap	30.0	High	Small	Minor
56 Holdstone Down	28.0	High	Small	Minor
58 Little Hangman	24.5	Very high	Small	Minor
64 Capstone Point	19.0	High	Medium	Minor-moderate
66 Higher Slade	17.5	High	Medium	Minor-moderate
67 Lee Bay	16.5	High	Small	Minor
68 Bull Point	15.0	High	Medium	Minor-moderate
69 NW of Mortehoe	15.0	High	Medium	Minor-moderate
7 Manorbier	29.0	High	Small	Minor
70a Potters Hill	16.5	High	Small	Minor
71 Putsborough Sand	17.5	Very high	Medium	Moderate
72 Baggy Point	16.0	High	Medium	Minor-moderate
73 Saunton Down	19.5	High	Medium	Minor-moderate
74 Braunton Burrows	22.5	High	Small	Minor
75a Westward Ho	26.5	High	Small	Minor
77 Peppercombe	30.0	High	Small	Minor
78 Buck's Mills	30.0	High	Small	Minor
79 Clovelly Harbour	28.5	Very high	Small	Minor
8 Lydstep point	29.0	High	Small	Minor
82 Windbury Head	26.5	High	Medium	Minor-moderate
83 West Titchbury	25.5	High	Medium	Minor-moderate
90a Blegberry	27.5	Medium	Small	Minor
92 Bursdon Moor	33.0	High	Small	Minor
93 Embury Beacon	34.5	High	Small	Minor

Analysis	km	
Max. distance where Low MoE occurred	37.5	Low = Small only
Av. Distance where Low MoE occurred	28.4	Low = Small only
Max. distance where Medium MoE occurred	27.5	Medium only
Av. distance where Medium MoE occurred	20.9	Medium only

Cumulative Effect No other windfarms present or planned

Scheme name	Beatrice		
Document	E S Section 14 Wind Farm Seascape, Landscape and Visual April 2012		
Data source	http://www.marinedataexchange.co.uk		
Status	Under construction		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	588		
No. of turbines	83	142	7 MW
Turbine blade tip height (m)		198	
Distance from nearest coast km	22		

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect	Significance of effect
1 Duncansby Head	36.74	High	Low to negligible	Moderate to negligible
2 Keiss Pier	27.35	High medium to low	Low to negligible	Moderate to negligible (residents)
3 Sortat	32.49	High	Negligible to none	Negligible to none
4 Wick Bay	18.04	High	Medium	Major to Moderate
5 Sarclet	13.93	High (residents)	High	Major (Residents)
6 Hill O Many Stanes	16.78	High to medium	High	Major to major-moderate
7 Lybster	19.27	High	High to medium	Major to major-moderate
8 Latheron A9	22.98	Medium to low	Medium	Moderate to moderate-minor
9 Dunbeath	25.62	High (residents)	Medium	Major to moderate (residents)
10 Whailgoe Steps	33.06	High (residents)	High	Major (residents)
11 Scaraben	33.06	High	Low	Moderate
12 Navidale	38.05	High medium to low	Low to negligible	Moderate-minor
13 Catchory	29.48	High medium (residents)	Negligible	Negligible
14 Minor Rd Stemster Hill	26.28	Medium to low	Medium to low	Moderate to minor
15 Aberdeen-Orkney Ferry route	19.73	Medium to low	Low to none	Moderate-minor
16 Aberdeen-Orkney Ferry route	29.74	Medium to low	Low to none	Moderate-minor

Analysis	km	
Max. distance where Low MoE occurred	33.1	Low + Medium to low
Av. Distance where Low MoE occurred	29.7	Low + Medium to low
Max. distance where Medium MoE occurred	25.6	Medium only
Av. distance where Medium MoE occurred	22.2	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
1 Duncansby Head	36.74	High	Negligible	Negligible
2 Keiss Pier	27.35	High medium to low	Low to negligible	Moderate to negligible (residents)
3 Sortat	32.49	High	Negligible to none	Negligible to none
4 Wick Bay	18.04	High	None	None
5 Sarclet	13.93	High (residents)	Low	Moderate
6 Hill O Many Stanes	16.78	High to medium	Medium	Major to Moderate
7 Lybster	19.27	High	Low	Moderate
8 Latheron A9	22.98	Medium to low	Low	Moderate-minor to minor
9 Dunbeath	25.62	High (residents)	Medium	Major-moderate (residents)
10 Whailgoe Steps	33.06	High (residents)	Low	Moderate (residents)
11 Scaraben	33.06	High	Low	Moderate to moderate-minor
12 Navidale	38.05	High medium to low	Low to negligible	Moderate to negligible (residents)
13 Catchory	29.48	High medium (residents)	High-Medium	Negligible
14 Minor Rd Stemster Hill	26.28	Medium to low	Medium to low	Moderate to minor

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	33.1	Low + medium to low
Av. Distance where Low MoE occurred	24.8	Low + medium to low
Max. distance where Medium MoE occurred	25.6	Medium only
Av. distance where Medium MoE occurred	21.2	Medium only

Scheme name	Burbo Bank Extension		
Document	ES Volume 2 - Chapter 20: Seascape, Landscape and Visual Impact Assessment March 2013 p 49-71		
Data source	http://infrastructure.planninginspectorate.gov.uk/projects/north-west/burbo-bank-extension-offshore-wind-farm/		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	254		
No. of turbines	32	36	3.6 MW
Turbine blade tip height (m)	187	141-223	
Distance from nearest coast km	7		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect	Significance of effect
1 Leasowe Common	7.91	High	High-medium	Major-moderate
2 Hoylake, Near Hilbre Point	8.41	High	High-medium	Major-moderate
3 Crosby Coastguard Station	9.85	High (residents & visitors)	Low	Moderate
4 Fort Perch Rock, New Brighton	11.01	Medium (visitors)	Medium	Moderate
5 Formby – Beach	11.18	High	Medium	Moderate
6 Point of Ayr	12.25	High	High-medium	Major-moderate
7 Thurstaston Common	13.36	High	Medium	Moderate
8 Gwespyr	14.41	High	Medium	Major-moderate
9 Prestatyn (near Nova Centre)	15.33	Medium	Medium	Moderate
10 Craig Fawr, Clywdian Range	18.43	High	Medium	Major-moderate
11 Clieves Hill	20.31	High (residents & visitors)	Low	Moderate
12 Southport Pier	21.99	High (visitors)	Medium	Moderate
13 Pensarn/ Abergele	26.40	Medium (visitors)	Low	Moderate-minor
14 Moelfre Isaf	30.06	High (walkers)	Low	Moderate
15 St Anne's Pier	30.22	Medium (visitors)	Low-negligible	Negligible
16 Starr Gate, Blackpool	32.68	High (residents)	Low-negligible	Negligible
17 Moel Famau, Clwydian Range	24.53	High (walkers)	Negligible	Negligible
18 Great Ormes Head	37.80	High (visitors)	Negligible	Negligible

Analysis	km	
Max. distance where Low MoE occurred	30.6	Low only
Av. Distance where Low MoE occurred	21.7	Low only
Max. distance where Medium MoE occurred	22.0	Medium only
Av. distance where Medium MoE occurred	15.1	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of change)	Significance of effect (Predicted impact)
5 Formby – Beach	11.18	High	Medium	Moderate
6 Point of Ayr	12.25	High	High-medium	Major-moderate
10 Craig Fawr, Clywdian Range	18.43	High	Medium	Major-moderate
13 Pensarn/ Abergele	26.40	Medium (visitors)	Low	Moderate-minor
17 Moel Famau, Clwydian Range	24.53	High (walkers)	Negligible	Negligible

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	26.4	Low only
Av. Distance where Low MoE occurred	26.4	Low only
Max. distance where Medium MoE occurred	18.4	Medium only
Av. distance where Medium MoE occurred	14.8	Medium only

Scheme name	Docking Shoal			
Document	Seascape and Visual Assessment October 2007 p 51+			
Data source	http://www.marinedataexchange.co.uk			
Status	Withdrawn			

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	540		
No. of turbines		177 (worst case)	3-6 MW
Turbine blade tip height (m)		145	
Distance from nearest coast km	14		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (sensitivity to change)	Magnitude of effect (Magnitude of operational visual effect)	Significance of effect (Effect significance)
1 Chapel St Leonards	22.90	medium to low	Low	minor to moderate
2 Skegness	20.30	low to medium	Low to medium	minor to moderate
3 Gibraltar Point	22.10	medium to low	Low	minor to moderate
4 Candlebury Hill	31.60	low	Negligible	negligible
5 St Edmunds Point	24.80	medium to low	Low to medium	moderate to minor
6 Brancaster Bay	19.10	medium	Medium	moderate
7 Blakeney Point	17.60	medium to high	Medium to low	moderate
8 Docking	26.30	low to medium	Low	minor

Analysis	km	
Max. distance where Low MoE occurred	26.3	Low + Low to medium + Medium to low
Av. Distance where Low MoE occurred	22.3	Low + Low to medium + Medium to low
Max. distance where Medium MoE occurred	19.1	Medium only
Av. distance where Medium MoE occurred	19.1	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (magnitude of cumualtive effects)	Significance of effect (Significance of impact)
1 Chapel St Leonards	22.90	medium to low	low	minor
6 Brancaster Bay	19.10	medium	medium to high, to low	Moderate to major, to minor or negligible
7 Blakeney Point	17.60	medium to high	medium to high, to low	Moderate to major, to minor or negligible

Analysis (cumulative)	km
Max. distance where Low MoE occurred	22.9
Av. Distance where Low MoE occurred	22.9
Max. distance where Medium MoE occurred	n/a
Av. distance where Medium MoE occurred	n/a

Scheme name	West of Duddon Sands		
Document			
Data source			
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	389		
No. of turbines	108	139	3.6 MW
Turbine blade tip height (m)	150	150	
Distance from nearest coast km	14		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
Seascale Beach	41.1	High (Residents)	Negligible	Negligible / Nil
Bootle Fell	32.5	Medium	Very Small	Minor / Negligible
Black Combe	26.3	High	Small	Moderate / Minor
Coastal Path Haverigg	20.2	High	Small	Moderate / Minor
A593 Broughton in Furness	35.9	Medium	Negligible	Nil
A595 Kirkby in Furness	25.4	Moderate	Very Small	Minor / Negligible
Hoad Monument Ulverston	30.8	High	Very Small	Minor
High Haume Farm	23.5	High	Small	Moderate / Minor
BiggarBank, Walney	14.6	High (residents)	Medium	Moderate
South Walney Nature Reserve	7.5	High	Medium	Moderate
Birkrigg Fell	27.1	High	Very Small	Minor
Humphrey Head	35.7	High	Very Small / Negligible	Minor / Negligible
Morecombe Stone Pier	35.1	High	Negligible	Negligible / Nil
St Patrick's Chapel	32.6	High	Very Small	Minor
Rossall Point, Fleetwood	23	High	Small	Moderate / Minor
Blackpool Tower	27.9	High	Very Small	Minor
St Annes Pier	33.8	High	Negligible	Negligible / Nil

Analysis	km	
Max. distance where Low MoE occurred	26.3	Low = 'Small'
Av. Distance where Low MoE occurred	23.3	Low = 'Small'
Max. distance where Medium MoE occurred	14.6	Medium only
Av. distance where Medium MoE occurred	11.0	Medium only

Cumulative Effect

see Walney 1

Scheme name	East Anglia ONE North		
Document	Prelim. Environmental Information Ch. 28 Offshore Seascape, Landscape and Visual Amenity		
Data source	www.scottishpowerrenewables.com		
Status	Application submitted		

Windfarm details	as built or consented	as assessed in ES/SLVIA (worst case)	Notes eg turbine types
Total turbine capacity MW		800	
No. of turbines		53	12-19 MW
Turbine blade tip height (m)		300	
Distance from nearest coast km		36	

Effect

No other windfarms taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change, worst case)	Magnitude of effect (Magnitude of change)	Significance of effect
Lowestoft	38.8	Medium-high	Medium-low	Not significant
Kessingland Beach	39.7	Medium-high	Medium-low	Not significant
Covehithe	41.6	High	Low	Not significant
Southwold	43.9	High	Low	Not significant
Gun Hill Southwold	44.4	High	Low	Not significant
Walberswick	45.6	High	Low	Not significant
Dunwich	48.8	High	Low	Not significant
Dunwich Heath and Beach	50.2	scoped out		
Minsmere Nature Reserve	50.9	scoped out		
Sizewell Beach	52.4	scoped out		
Suffolk Coastal Path, Thorpeness - S	53.0	scoped out		
Thorpeness	53.9	scoped out		
Aldeburgh	55.8	scoped out		
Hopton-on-sea	40.9	Medium-high	Low	Not significant
Gorleston-on-sea	42.7	Medium-high	Low	Not significant
Great Yarmouth, South Beach	44.0	scoped out		
Caister-on-sea	46.4	scoped out		

Analysis	km	
Max. distance where Low MoE occurred	48.8	Low + medium low
Av. Distance where Low MoE occurred	42.9	Low + medium low
Max. distance where Medium MoE occurred		No data
Av. distance where Medium MoE occurred		No data

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change, worst case)	Magnitude of effect (Magnitude of change)	Significance of effect
Lowestoft	38.8	Medium-high	Medium	Significant
Kessingland Beach	39.7	Medium-high	Medium-high	Significant
Covehithe	41.6	High	Medium-high	Significant
Southwold	43.9	High	Medium-high	Significant
Gun Hill Southwold	44.4	High	Medium-high	Significant
Walberswick	45.6	High	Medium	Significant
Dunwich	48.8	High	Medium	Significant
Dunwich Heath and Beach	50.2	Medium-high	Medium	Significant
Minsmere Nature Reserve	50.9	Medium-high	Medium	Significant
Sizewell Beach	52.4	Medium	Medium	Not significant
Suffolk Coastal Path, Thorpeness - S	53.0	Medium-high	Medium	Significant
Thorpeness	53.9	High	Medium	Significant
Aldeburgh	55.8	High	Medium	Significant
Hopton-on-sea	40.9	Medium-high	Medium-low	Not significant
Gorleston-on-sea	42.7	Medium-high	Medium-low	Not significant
Great Yarmouth, South Beach	44.0	scoped out		
Caister-on-sea	46.4	scoped out		

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	42.70	Low + medium low
Av. Distance where Low MoE occurred	41.80	Low + medium low
Max. distance where Medium MoE occurred	55.8	Medium only
Av. distance where Medium MoE occurred	49.9	Medium only

Note in ES: Significant seascape / landscape and visual effects are scoped out beyond 50km

Scheme name	East Anglia Two		
Document	Prelim. Environmental Information Vol 3 Ch.28.7 Ch.28 Offshore Seascape, Landscape and Visual		
Data source	www.scottishpowerrenewables.com		
Status	Application submitted		

Windfarm details	as built or consented	as assessed in ES/SLVIA (worst case)	Notes eg turbine types
Total turbine capacity MW		900	
No. of turbines		60	12-19 MW
Turbine blade tip height (m)		300	
Distance from nearest coast km		31	

Effect

No other windfarms taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change, worst case)	Magnitude of effect (Magnitude of change)	Significance of effect
1 Lowestoft	32.1	Medium-high	Medium-low	Not significant
2 Kessingland Beach	30.5	Medium-high	Medium	Not significant
3 Covehithe	30.6	High	Medium	Significant
4 Southwold	31.5	High	Medium	Significant
5 Gun Hill Southwold	31.7	High	Medium	Significant
6 Walberswick	32.7	High	Medium	Significant
7 Dunwich	35.0	High	Medium	Significant
8 Dunwich Heath and Beach	35.7	High	Medium	Significant
9 Minsmere Nature Reserve	36.2	Medium-high	Medium	Significant
10 Sizewell Beach	35.6	Medium	Medium	Not significant
11 Suffolk Coastal Path, Thorpeness	35.5	Medium-high	Medium	Significant
12 Thorpeness	35.8	Medium-high	Medium	Significant
13 Aldeburgh	36.4	High	Medium	Significant
14 Orford Castle	40.6	Medium-high	Medium-low	Not significant
15 Shingle Street	46.0	High	Low	Not significant
16 Bawdsey	47.7	Medium	Low	Not significant
17 Old Felixstowe	52.4	scoped out		
18 Orford Ness (Lighthouse)	37.6	Medium-high	Medium	Significant
19 Hopton-on-sea	37.3	Medium-high	Low	Not significant
20 Gorleston-on-sea	40.1	Medium-high	Low	Not significant
21 Great Yarmouth, South Beach	42.9	scoped out		
22 Caister-on-sea	46.6	scoped out		

Analysis	km	
Max. distance where Low MoE occurred	47.7	Low + medium low
Av. Distance where Low MoE occurred	40.6	Low + medium low
Max. distance where Medium MoE occurred	37.6	Medium only
Av. distance where Medium MoE occurred	34.2	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change, worst case)	Magnitude of effect (Magnitude of change)	Significance of effect
Lowestoft	32.1	Medium-high	Medium	Not significant
Kessingland Beach	30.5	Medium-high	Medium-high	Significant
Covehithe	30.6	High	Medium-high	Significant
Southwold	31.5	High	Medium-high	Significant
Gun Hill Southwold	31.7	High	Medium-high	Significant
Walberswick	32.7	High	Medium	Significant
Dunwich	35.0	High	Medium	Significant
Dunwich Heath and Beach	35.7	High	Medium	Significant
Minsmere Nature Reserve	36.2	Medium-high	Medium	Significant
Sizewell Beach	35.6	Medium	Medium	Not significant
Suffolk Coastal Path, Thorpeness - S	35.5	Medium-high	Medium	Significant
Thorpeness	35.8	Medium-high	Medium	Significant
Aldeburgh	36.4	High	Medium	Significant
Orford Castle	40.6	Medium-high	Medium-low	Not significant
Shingle Street	46.0	High	Low	Not significant
Bawdsey	47.7	Medium	Low	Not significant
Old Felixstowe	52.4	scoped out		
Orford Ness (Lighthouse)	37.6	Medium-high	Medium	Significant
Hopton-on-sea	37.3	Medium-high	Medium-low	Not significant
Gorleston-on-sea	40.1	Medium-high	Medium-low	Not significant
Great Yarmouth, South Beach	42.9	scoped out		
Caister-on-sea	46.6	scoped out		

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	47.7	Low + medium low
Av. Distance where Low MoE occurred	42.3	Low + medium low
Max. distance where Medium MoE occurred	37.6	Medium only
Av. distance where Medium MoE occurred	35.3	Medium only

Note in ES: Significant seascape / landscape and visual effects are scoped out beyond 50km

Scheme name	Greater Gabbard		
Document	Greater Gabbard Offshore Wind Farm ES - SLVIA Chapter 10.3		
Data source	https://tethys.pnnl.gov/publications/greater-gabbard-offshore-wind-farm-environmental-statement, 4COffshore		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	504		
No. of turbines	140	141	3.6 MW
Turbine blade tip height (m)	131	170	
Distance from nearest coast km	23		

Effect

No other windfarms taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of change - worst case of excellent visibility)	Significance of effect (Significance of impact)
VP1 Orford Castle	28.00	High	Moderate-substantial	Not significant
VP2 Old Felixstowe Seafront	33.50	High	Moderate-substantial	Not significant
VP3 Aldeburgh seafront	29.00	High	Substantial	Not significant
VP4 North of Alderton	32.50	Moderate	Moderate-substantial	Not significant
VP5 Orford Ness nr lighthouse	25.00	High	Substantial	Not significant
VP6 Shingle Street	30.50	High	Moderate-substantial	Not significant

Analysis	km	
Max. distance where Low MoE occurred		no data
Av. Distance where Low MoE occurred		no data
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Cumulative Effect Chapter 10.5 indicates very limited effects, minor or none

Scheme name	Gunfleet Sands 2		
Document	Gunfleet Sands 2 Offshore Wind Farm Environmental Statement 2007 Section 12		
Data source	https://tethys.pnnl.gov, 4COffshore		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	173		
No. of turbines	48	22	3.6 MW turbines
Turbine blade tip height (m)	128		
Distance from nearest coast km	8.5		

Effect

Other windfarms present or planned are taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change)	Magnitude of effect (Magnitude of change)	Significance of effect
Cliff top, The Naze	13	Medium - low	Medium - low	Moderate - Minor
Greensward, Frinton-on-Sea	9.5	Medium - low	Medium - low	Moderate - Minor
Public Footpath, Great Holland	10	Medium - low	Medium - low	Moderate - Minor
Radar Tower, Holland Haven	8.3	Medium - low	Medium - low	Moderate - Minor
Seafront Promenade, Clacton-on-Sea	8.9	Low	Low	Minor
Sea Defence, Seawick	10.1	Low	Low	Minor
Beach at West Mersea	19.6	Medium - low	Low	Minor
Bradwell Bird Observatory	17.5	Medium	Low	Minor - Moderate

Analysis	km	
Max. distance where Low MoE occurred	19.6	Low + Medium-low
Av. Distance where Low MoE occurred	12.1	Low + Medium-low
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Cumulative Effect

No viewpoint data

12.7.9

The cumulative magnitude of effect of the Round 1 offshore wind farms with the GS2 development is therefore considered to be Low. When combined with a generally Low - Medium sensitivity to change to the GS2 development the significance of cumulative effect is considered to be Minor with the generally open exposed and remote foreshore areas providing some capacity for change. The cumulative impact is then generally reduced further inland and to the north.'

Scheme name	Gwynt y Mor		
Document	Gwynt y Môr Offshore Wind Farm Environmental Statement Chapter 10		
Data source	https://tethys.pnnl.gov/		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	576		
No. of turbines	160		3.6 MW
Turbine blade tip height (m)	140		
Distance from nearest coast km	18		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
Bull Bay	42.3	Moderate	Negligible	Insignificant
Point Lynas	37.1	Moderate to High	Negligible	Slight
Mynydd Eilian	38	Moderate to High	Negligible	Slight
Moelfre Headland	35	Moderate to High	Negligible	Slight
Red Wharf Bay	35.9	Moderate to High	Negligible	Slight
Bwrdd Arthur	30.9	Moderate to High	Small	Slight to Moderate
Penmon Point	28	Moderate to High	Small	Slight to Moderate
Beaumaris	32.2	Moderate	Small	Slight
Bangor Pier	35.8	Low to Moderate	Small	Insignificant
Carnedd Llywelyn	36.7	High	Negligible	Slight
Llanfairfechan	27.8	Moderate	Negligible	Insignificant
Conwy Mountain	21.4	Moderate to High	Small to Medium	Moderate
Great Orme Summit	16.2	Moderate to High	Small to Medium	Moderate
Great Orme Summit	15.8	Moderate to High	Small to Medium	Moderate
Great Orme Rest and Be Thankful	16	Moderate to High	Small to Medium	Moderate
Llandudno Promenade monument	16.2	Moderate	Medium to Large	Moderate to Substantial
Llandudno Promenade conf centre	16.2	Moderate	Medium to Large	Moderate to Substantial
Landudno Promenade Paddling Pool	15.7	Low to Moderate	Medium to Large	Moderate
Rhos-on-Sea	14.3	Low to Moderate	Medium	Slight to Moderate
Bryn Euryn	15.7	Moderate	Small to Medium	Slight to Moderate
Mynydd Marian	15.3	Low to Moderate	Medium	Slight
Abergale (Pensarn Station)	13.9	Low	Medium to Large	Slight to Moderate
Rhyl Aquarium	13.1	Low	Medium to Large	Slight to Moderate
Graig Fawr	15.9	Moderate to High	Small to Medium	Moderate
Prestatyn Nova Centre	12.7	Low	Medium	Slight
Gwaenysgor	14.9	Low to Moderate	Medium	Slight to Moderate
Point of Ayr	14.6	Moderate	Small to Medium	Slight to Moderate
Thurstaston Common	24.5	Moderate to High	Small	Slight to Moderate
Grange Hill	21.1	Moderate	Small	Slight
Hilbre Point	19.1	Moderate	Small to Medium	Slight to Moderate
New Brighton	25.7	Low	Small	Insignificant
Crosby	28	Low	Small	Insignificant
Formby Point	26.4	Moderate to High	Small	Slight to Moderate
Southport Pier	37	Low	Negligible	Insignificant
Snowdon Summit	54.9	High	Negligible	Insignificant
Blackpool Tower	47.7	Low	Negligible	Insignficant

Analysis	km	
Max. distance where Low MoE occurred	35.8	Low = 'Small' + Small to medium
Av. Distance where Low MoE occurred	22.3	Low = 'Small' + Small to medium
Max. distance where Medium MoE occurred	15.3	Medium only
Av. distance where Medium MoE occurred	14.3	Medium only

Cumulative Effect

Chapter 12.6 16 not found online

Scheme name	Hywind Scotland Pilot Park		
Document	Hywind Scotland Pilot Park Environmental Statement -SLVIA March 2015 Statoil		
Data source	http://www.statoil.com/en/EnvironmentSociety/Environment/impactassessments/NewEnergy/IntWind/Pages/HywindScotland		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	30		
No. of turbines	5	5	6 MW
Turbine blade tip height (m)	159-178		
Distance from nearest coast km	23		

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (senitivity of viewpoint)	Magnitude of effect	Significance of effect (level of impact)
1 Scotstown Head	26.0	High	Minor	Minor
2 Gable Braes, Peterhead	23.0	High	Minor	Minor
3 Slains Castle Car Park	26.0	Medium	Minor	Minor
4 Near A950 Thunderton	29.0	Medium	Minor	Minor
5 Peterhead Bay	25.4	Medium/high	Minor	Minor
6 Reform Tower	25.6	Medium/high	Minor	Minor
7 Stirling Hill	26.2	Medium/high	Minor	Minor

Analysis	km	
Max. distance where Low MoE occurred	29.0	Low = 'Minor' only
Av. Distance where Low MoE occurred	25.9	Low = 'Minor' only
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Cumulative Effect no data found

In ES:

Subject to the exact extent and configuration of the ZTVs for these developments, a degree of cumulative and in combination impact may potentially occur relating to simultaneous or successive visibility. However, due to the low magnitude of change relating to any visibility should it occur, deriving from the very long separation distances both between the developments under consideration, and between each development and the receptors being assessed, it is not considered that any of these would result in a significant effect.

Scheme name	Inch Cape (updated 2019)			
Document	EIA 2018, Non Technical Summary, and Volume 12B (Viewpoints chapter 12C).			
Data source	Marine Scotland			
Status	Consented			

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	784	1000	
No. of turbines		40 - 72	min 9.5 MW
Turbine blade tip height (m)		291	
Distance from nearest coast km	15		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity of visual receptor)	Magnitude of effect (Magnitude of change)	Significance of effect (Effect on visual amenity)
1 Garron Point	43.7	High	Low	Minor/moderate
5 Montrose	20.0	High	High	Major
6 Braehead of Lunan	19.5	High	High	Major
9 Minor Road S of Cairnconon Hill	27.0	Moderate	High	Moderate/major
10 Clifftop Path N of Victoria Park	18.6	High	High	Moderate/major
11 Arbroath Signal Tower	19.7	High	High	Moderate/major
4 Cairn o' Mount	42.9	High	Low	Minor/moderate
8 White Caterthun Hill Fort	38.8	High	Low	Moderate
13 Dodd Hill	38.0	High	Low	Minor/moderate
15 Dundee Law	43.7	High	Low	Moderate
17 Strathkinness	39.4	High to moderate	Low	Minor/moderate
19 Largo Law	48.4	High	Low	Minor/moderate
20 B9131 South of Dunino	36.2	Moderate	Low	Minor/moderate
22 Anstruther Easter	36.4	High	Low	Moderate
26 North Berwick Law	52.50	High	Low	Moderate/major
2 A92, North of Inverbervie	30.0	High to moderate	Medium	Moderate/major
3 Beach Road, Kirkton	24.1	High	Moderate	Moderate/major
12 A92 East of Muirdrum	25.2	High to moderate	Moderate	Moderate/major
14 Carnoustie	26.7	High	Moderate	Moderate
16 Tentsmuir	33.4	High	Moderate	Moderate/major
18 St Andrews, East Scores	34.8	High	Moderate	Moderate/major
21 Kingsbarns	30.6	Moderate	Moderate	Moderate
23 Fife Ness, Lochaber Rock	28.32	High	Moderate	Moderate/major
24 Isle of May	34.40	High	Moderate	Moderate/major
7 Brechin	31.7	Moderate	Negligible	Negligible
25 Dunbar	51.00	High	Negligible	Minor/moderate

Analysis	km	
Max. distance where Low MoE occurred	52.5	Low only
Av. Distance where Low MoE occurred	42.0	Low only
Max. distance where Medium MoE occurred	34.8	Includes Medium and Moderate
Av. distance where Medium MoE occurred	29.7	Includes Medium and Moderate

Cumulative Effect

There are no parts of the study area where the Inch Cape WTGs will be visible only with these two application and scoping stage wind farms, which would only be seen in the south west part of the study area. In this context and particularly given the considerable distance between these two proposed wind farms, it is considered that the effects of the Inch Cape WTGs and OSPs with the baseline of operational and consented wind farms and these two proposed wind farms, would be no greater than the effects assessed for Inch Cape with the operational and consented developments included in the assessment. '

Scheme name	Kentish Flats		
Document	Kentish Flats Environmental Statement 8.5.10		
Data source	GREP UK		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	90		Note extn 2015 49.5 MW 15x3.3 MW
No. of turbines	30		3 MW
Turbine blade tip height (m)	115	140	
Distance from nearest coast km	8		

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of change)
1 St Peters Chapel	30.9		Negligible	Moderate/Minor
2 Pier at Southend-on-Sea	23.7		Slight	Moderate/Minor
3 Warden	12.1		Moderate	Moderate
4 Whitstable (Tankerton)	9.6		Substantial	Major/Moderate
5 Whitstable (Bayview Hill)	12		Moderate	Moderate
6 Herne Bay Museum	8.7		Substantial	Major/Moderate
7 Margate	18.8		Slight	Moderate/Minor
8 North Downs Way	26.9		Slight	Moderate/Minor
9 Shoeburyness	19		Slight	Moderate/Minor
10 Thanet, A256 neat Westwood	20.6		Slight	Minor
11 Reculver / Saxon Shore Way	9.5		Moderate	Major/Moderate
12 Sheerness	20.5		Slight	Moderate/Minor
13 Faversham	18.5		Slight	Minor

Analysis	km	
Max. distance where Low MoE occurred	26.9	Low = 'Slight'
Av. Distance where Low MoE occurred	21.1	Low = 'Slight'
Max. distance where Medium MoE occurred	12.1	Medium = "Moderate'
Av. distance where Medium MoE occurred	11.2	Medium = "Moderate'

Cumulative Effect p 100

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of cumulative change)	Significance of effect (Cumulative effects)
1 St Peters Chapel	30.9	High	Slight	Moderate/minor

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	30.90	Low = 'Slight'
Av. Distance where Low MoE occurred	30.90	Low = 'Slight'
Max. distance where Medium MoE occurred	n/a	
Av. distance where Medium MoE occurred	n/a	

Scheme name	Kincardine Offshore		
Document	ES March 2016 and Section 36C Variation ES 2017 (revised layout)		
Data source	Marine Scotland		
Status	Under construction		

Windfarm details	as built or consented	as assessed in ES/SLVIA (2017 update)	Notes eg turbine types
Total turbine capacity MW		50	
No. of turbines		7	Six up to 8.4 MW and one 2 MW
Turbine blade tip height (m)		upto 176	
Distance from nearest coast km	15		

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity of receptors)	Magnitude of effect	Significance of effect (Significance of impact)
Newburgh (carpark to links)	35.0	Low	Moderate	Minor-moderate
Balmedie	29.0	Low	Moderate	Minor-moderate
Regular ferry routes	19.0	Moderate	Low	Minor-moderate
Eastern Boulevard Aberdeen	21.0	Moderate-high	Low	Minor-moderate
East side of Castlehill	20.0	Moderate-high	Moderate-high	Minor-moderate
Torry Battery/Girdleness Point	18.0	Moderate-high	Low	Minor-moderate
Doonies Farm	17.0	Moderate-high	Moderate	Minor-moderate
Coastal path - Finhon	15.0	High	Moderate	Moderate-major
Portlethen	16.0	Moderate-low	Moderate	Moderate
Downies	15.0	High-moderate	Moderate	Moderate-major
Cookney	20.0	Low	Moderate	Minor-moderate
Newtonhill	16.0	Moderate	Moderate	Moderate
Muchalls	17.0	Moderate-low	Moderate	Moderate
Railway (bridge of Muchalls)	18.0	Moderate-low	Moderate	Moderate
A90 Trunk Road	18.3	Moderate-low	Moderate	Moderate
Stonehaven Golf Course	19.0	Moderate-high	Moderate	Moderate-major
Stonehaven Harbour	20.0	High	Low	Minor-moderate
Stonehaven War Memorial	20.0	High	Low	Moderate
Dunnottar Castle car park	21.0	High	Low	Moderate
Dunnottar Castle (coastal path)	22.0	High	Low	Moderate
Catterline (south)	24.0	High	Low	Moderate
Gourdon(eastern end of village)	31.0	Moderate-low	Low	Minor-moderate
Johnshaven (beach)	36.0	Moderate-low	Low	Minor-moderate

Analysis	km	
Max. distance where Low MoE occurred	36.0	Low only
Av. Distance where Low MoE occurred	23.2	Low only
Max. distance where Medium MoE occurred	35.0	defined as Moderate
Av. distance where Medium MoE occurred	19.6	defined as Moderate

Cumulative Effect

P 521 of ES states:
The EOWDC has been considered as part of the assessment due to its proximity to this project (17km), and therefore mutual viewpoints were assessed where necessary to the north of Aberdeen. As the additional windfarms in the table below are >35km, no further cumulative impact is deemed necessary as part of this assessment as they do not share any mutual viewpoints. Additionally, there are no known windfarms in planning phase to be considered.

Scheme name	London Array Offshore Phase 1		
Document	ES Landscape Seascape and Visual Assessment Appendix 5.1		
Data source	http://marinedataexchange.co.uk		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	630		
No. of turbines	175	up to 271	3.6 MW
Turbine blade tip height (m)	147	175	
Distance from nearest coast km	21		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
Deal	40	High	None	None
North Foreland	22	High	Low to Negligible	Negligible
Margate - Cliftonville/Palm Bay	21	High	Low	Slight Adverse
Margate - Walpole Bay	21	High	Low	Slight Adverse
Chislet / West Thanet	27	Low	Low to Negligible	Negligible
Reculver	27	High	Low to Negligible	Negligible
Herne Bay	31	High	Negligible	Negligible
Whitstable	34	Medium	Negligible	Negligible
Swale	44	High	None	None
Shoeburyness	40	Medium	Negligible	Negligible
Shoebury Ness	36	Medium	Negligible	Negligible
Burnham on Crouch	40	Medium	Negligible	Negligible
Blackwater Estuary	40	Medium	Negligible	Negligible
Clacton-on-Sea	24	Medium	Low to Negligible	Negligible
Holland-on-Sea	24	Medium	Low to Negligible	Negligible
Naze Tower	24	Medium	Low to Negligible	Negligible
Harwich Seafront	31	Medium	Negligible	Negligible
Felixstow Seafront	31	Medium	Negligible	Negligible

Analysis	km	
Max. distance where Low MoE occurred	21.0	Low only
Av. Distance where Low MoE occurred	21.0	Low only
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Cumulative Effect no data found

ES ordered from marine data exchange but download failed

Scheme name	Navitus Bay	
Document	Environmental Statement Volume C Chapter 13 Seascape Landscape and Visual p224+	
Data source	http://infrastructure.planningportal.gov.uk/projects/south-east/navitus-bay-wind-park	
Status	Refused on grounds of visual and cumulative impact.	

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW		970	
No. of turbines		121 (up to 194)	8 MW
Turbine blade tip height (m)		200	
Distance from nearest coast km	14		

During planning application process scheme was changed under a TAMO to 105 turbines of 6.5 MW at min distance of 19km.

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude)	Significance of effect (Significance of impact)
6 - Whiteways, Povington Hill	28.2	High	Low	Moderate
7 Swyre Head	23.1	High	Medium	Major-moderate
8 St Aldhelm's Head	19.0	High-medium	Medium	Major-moderate
9 Duriston Castle	14.4	High-medium	High-medium	Major-moderate
12 Old Harry Rocks	16.3	High	Medium	Major-moderate
16 Constitution Hill	25.6	High	Very low	Negligible
20 Hengisbury Head	20.4	High	Medium-low	Moderate
27 Hurst Castle	23.0	High-medium	High	Major
28 The Needles	17.7	High	High	Major
29 Tennyson's monument	19.5	High	Medium	Major-moderate
32 Limerstone Down	26.1	High	Medium-low	Moderate
33 Blackgang Car Park	27.8	High	Low-very low	Minor

Analysis	km	
Max. distance where Low MoE occurred	28.2	Low + Medium-low
Av. Distance where Low MoE occurred	24.9	Low + Medium-low
Max. distance where Medium MoE occurred	23.1	Medium only
Av. distance where Medium MoE occurred	19.5	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect	Significance of effect (Significance of impact)
6 - Whiteways, Povington Hill	28.2	High	Medium	Major-moderate
33 Blackgang Car PArk	27.8	High	Medium	Major-moderate

Analysis (cumulative)	km	
Max. distance where Low MoE occurred		no data
Av. Distance where Low MoE occurred		no data
Max. distance where Medium MoE occurred	28.2	
Av. distance where Medium MoE occurred	28.0	

Scheme name	Neart na Gaoithe			
Document	ES - Chapter 21 Seascape, Landscape and Visual Impacts			
Data source	http://www.neartnagaoithe.com/environmental-statement1.asp			
Status	Consented			

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	448		
No. of turbines	45-54	64 -128	8-10 MW
Turbine blade tip height (m)	208	175 to 197	
Distance from nearest coast km	15		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect	Significance of effect (Significance of impact)
2 Beach Road, Kirkton, St Cyrus	49.00	High	Negligible	None
5 Dodd Hill	43.90	Medium	Negligible	None
6 Braehead of Lunan	39.00	High	Low	Moderate-minor
7 Arbroath	30.8	High	Medium-low	Moderate
8 Carnoustie	31.70	Medium	Medium-low	Moderate
9 Dunedee Law	44.90	Medium	Negligible	None
10 Tentsmuir	31.80	High	Medium-low	Moderate
11 Strathkinness	33.10	High	Low-negligible	Minor
12 St Andrews, East Scores	28.20	High	Low	Moderate
13 Fife Ness, Lochaber Rock	15.50	High	High	Major
14 Anstruther Easter	21.80	High	High	Major
15 Largo Law	36.80	Medium	Negligible	None
16 Isle of May	16.30	High	High	Major
17 North Berwick Law	33.00	High	Low	Moderate
18 Dunbar	28.00	High	Medium	Major-moderate
19 West Steel	34.90	Medium	Low	Minor
20 Coldingham Moor	32.80	Medium	Medium-low	Minor
21 St Abb's Head	33.00	High	Medium-low	Moderate

Analysis	km	
Max. distance where Low MoE occurred	39.0	Low + medium low
Av. Distance where Low MoE occurred	32.9	Low + medium low
Max. distance where Medium MoE occurred	28.0	Medium only
Av. distance where Medium MoE occurred	28.0	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of impact)	Significance of effect (Cumulative impact significance - additional impact of Neart na Gaoithe in addition to all other cumulative wind farms)
2 Beach Road, Kirkton, St Cyrus	49.00	High	no info	Minor
5 Dodd Hill	43.90	Medium	no info	Minor
6 Braehead of Lunan	39.00	High	no info	Moderate-minor
7 Arbroath	30.8	High	no info	Moderate-minor
8 Carnoustie	31.70	Medium	no info	Moderate-minor
9 Dunedee Law	44.90	Medium	no info	Minor
10 Tentsmuir	31.80	High	no info	Major-moderate
11 Strathkinness	33.10	High	no info	Moderate-minor
12 St Andrews, East Scores	28.20	High	no info	Major-moderate
13 Fife Ness, Lochaber Rock	15.50	High	no info	Major
14 Anstruther Easter	21.80	High	no info	Major-moderate
15 Largo Law	36.80	Medium	no info	Minor
16 Isle of May	16.30	High	no info	Major
17 North Berwick Law	33.00	High	no info	Moderate-minor
18 Dunbar	28.00	High	no info	Moderate
19 West Steel	34.90	Medium	no info	Minor
20 Coldingham Moor	32.80	Medium	no info	Moderate-minor
21 St Abb's Head	33.00	High	no info	Moderate-minor

Analysis (cumulative)	km	
Max. distance where Low MoE occurred		no data
Av. Distance where Low MoE occurred		no data
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Scheme name	North Hoyle		
Document	North Hoyle Offshore Wind Farm Environmental Statement Chapter 5.3		
Data source	https://infrastructure.planninginspectorate.gov.uk		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	60		
No. of turbines	30		2 MW
Turbine blade tip height (m)	107		
Distance from nearest coast km	7.5		

Effect

No other windfarms present appear to be taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change)	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of effects)
1 Thos-on-Sea	20.4	Moderate	Low	Low to Moderate
2 Bryn Euryn	21.8	Moderate	Low	Low to Moderate
3 Mynydd Marian	18.7	Low to Moderate	Low	Low
4 Abergale / Pensam Station	14.2	Moderate	Low	Low to Moderate
5 Rhyl Aquarium	9.2	Low	Moderate	Low to Moderate
6 Graig Fawr	10.8	Moderate	Moderate	Moderate
7 Marian Ffrith	13.5	High	Moderate	Moderate to High
8 Prestatyn - Nova Centre	7.5	Low	High	Moderate
9 Point of Ayr	9.5	High	High	High
10 Bryn-Ilwyn - Viewpoint	9.6	Moderate	High	Moderate to High
11 Thurstaston Common	19.8	High	Low	Low to Moderate
12 Hilbre Point	14.8	Moderate to High	Low	Moderate

Analysis	km	
Max. distance where Low MoE occurred	21.8	Low only
Av. Distance where Low MoE occurred	18.3	Low only
Max. distance where Medium MoE occurred	13.5	Medium only (=Moderate)
Av. distance where Medium MoE occurred	11.2	Medium only (=Moderate)

Cumulative Effect see p52 (terminology in brackets if different in document)

Cumulative effect with other proposed windfarms, at Rhyl Flats and Burbo

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect	Significance of effect
1 Thos-on-Sea	20.4	Moderate	Low	
11 Thurstaston Common	19.8	High	Low	
3 Mynydd Marian	18.7	Low to Moderate	Low	
2 Bryn Euryn	21.8	Moderate	Low	
4 Abergale / Pensam Station	14.2	Moderate	Low	
12 Hilbre Point	14.8	Moderate to High	Low to moderate	
5 Rhyl Aquarium	9.2	Low	Moderate	
8 Prestatyn - Nova Centre	7.5	Low	Moderate	
6 Graig Fawr	10.8	Moderate	Moderate	
7 Marian Ffrith	13.5	High	Moderate to High	
10 Bryn-Ilwyn - Viewpoint	9.6	Moderate	Moderate to high	
9 Point of Ayr	9.5	High	High	

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	20.4	Low + Low to moderate
Av. Distance where Low MoE occurred	18.3	Low + Low to moderate
Max. distance where Medium MoE occurred	10.8	Medium only (=Moderate)
Av. distance where Medium MoE occurred	9.2	Medium only (=Moderate)

Scheme name	Moray East (updated 2019)			
Document	ES Scoping Report March 2017, Chapter 9 Seascape, landscape and visual assessment.			
Data source	Marine Scotland			
Status	Consented	Construction has started		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	950	1116	
No. of turbines	100	137	9.5 MW
Turbine blade tip height (m)	to 280		
Distance from nearest coast km	22		

Effect

No other windfarms present (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of residual effects)
1 Duncansby Head	42.00	Medium-high	Low	Not significant
2 Keiss Pier	35.00	Medium-high	Low	Not significant
3 Sortat	40.00	Medium-low	Low-negligible	Not significant
4 Wick Bay	26.00	Medium-high	Medium	Significant
5 Sarclet	23.00	Medium	Medium	Significant
6 Hill O' Many Stanes	24.00	Medium-high	Medium	Significant
7 Lybster (end of Main Street)	27.00	Medium-high	Medium	Significant
8 Latheron (A9)	31.00	Medium-high	Medium	Significant
9 Dunbeath (nr Heritage Centre)	34.00	Medium-high	Medium	Significant
10 Berriedale (A9)	36.00	Medium-high	Medium-low	Not significant
11 Morven	49.00	Medium-high	Low	Not significant
12 Navidale	45.00	Medium-high	Medium-low	Not significant
13 Catchory	39.00	Medium	Low	Not significant
14 Minor Rd, S side Stemster Hill	34.00	Medium-low	Medium-low	Not significant
15 Whaligoe Steps	23.00	Medium-high	Medium	Significant
16 Lossiemouth Harbour	46.00	Medium	Low	Not significant
17 Buckie, Cliff Terrace	44.00	Medium-low	Low	Not significant
18 Portnockie - Bow Fiddle Rock	41.00	Medium-high	Low	Not significant
19 Cullen, Viaduct & cycle path	43.00	Medium-high	Low	Not significant
20 Bin Hill	46.00	Medium	Low	Not significant
21 Findlater Castle	43.00	Medium-high	Low	Not significant
22 Portsoy	45.00	Medium-high	Low	Not significant

Analysis	km	
Max. distance where Low MoE occurred	49.0	Low + medium low
Av. Distance where Low MoE occurred	42.0	Low + medium low
Max. distance where Medium MoE occurred	34.0	Medium only
Av. distance where Medium MoE occurred	27.0	Medium only

Cumulative Effect see Chapter 15.4

Cumulative effect with other windfarms, existing, consented or applied for - worst case

(terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of impact)
1 Duncansby Head	42.00	Medium-high	Low	Not significant
2 Keiss Pier	35.00	Medium-high	Medium-low	Not significant
3 Sortat	40.00	Medium-low	Low	Not significant
4 Wick Bay	26.00	Medium-high	Medium-low	Not significant
5 Sarclet	23.00	Medium	Low	Not significant
6 Hill O' Many Stanes	24.00	Medium-high	Medium-low	Not significant
7 Lybster (end of Main Street)	27.00	Medium-high	Medium-low	Not significant
8 Latheron (A9)	31.00	Medium-high	Medium	Significant
9 Dunbeath (nr Heritage Centre)	34.00	Medium-high	Low	Not significant
10 Berriedale (A9)	36.00	Medium-high	Medium	Significant
11 Morven	49.00	Medium-high	Medium-low	Not significant
12 Navidale	45.00	Medium-high	Medium-low	Not significant
13 Catchory	39.00	Medium	Low	Not significant
14 Minor Rd, S side Stemster Hill	34.00	Medium-low	Medium	Not significant
15 Whaligoe Steps	23.00	Medium-high	Low	Not significant
16 Lossiemouth Harbour	46.00	Medium	Low	Not significant
17 Buckie, Cliff Terrace	44.00	Medium-low	Low	Not significant
18 Portnockie - Bow Fiddle Rock	41.00	Medium-high	Low	Not significant
19 Cullen, Viaduct & cycle path	43.00	Medium-high	Low	Not significant
20 Bin Hill	46.00	Medium	Low	Not significant
21 Findlater Castle	43.00	Medium-high	Low	Not significant
22 Portsoy	45.00	Medium-high	Low	Not significant

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	46.0	Low +medium low
Av. Distance where Low MoE occurred	37.6	Low +medium low
Max. distance where Medium MoE occurred	36.0	Medium only
Av. distance where Medium MoE occurred	33.7	Medium only

Scheme name	Moray West (updated 2019)		
Document	EIA Report 2018, Non Technical Summary, and Chapter 14		
Data source	Marine Scotland		
Status	Application consented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	850	1116	
No. of turbines		72-85	10 to 12 MW
Turbine blade tip height (m)		to 285m	
Distance from nearest coast km	22		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Impact Magnitude)	Significance of effect (Effect Significance)
1: Duncansby Head	53	Medium-high	Low	Not-significant
2: Keiss	43	Medium-high	Negligible	Not-significant
3: Wick	32	Medium-high	Medium-low	Significant
4: Sarclet	26	Medium-high	Medium	Significant
5: Whaligoe Steps	26	Medium-high	Medium	Significant
6: Minor Road (SE of Osclay)	28	Medium	Medium	Significant
7: Lybster	25	Medium-high	Medium	Significant
8: Latheron	25	Medium-high	Medium	Significant
9a: Dunbeath	25	Medium-high	Medium	Significant
9b: Dunbeath	24	Medium-high	Medium-high	Significant
10: Morven	35	Medium-high	Medium-low	Not-significant
11: Berriedale (A9)	23	Medium-high	Medium	Significant
12: Navidale	28	Medium-high	Medium	Significant
13a: Brora	37	Medium-high	Medium-low	Not-significant
13b: Dornoch	49	Medium-high	Low	Not-significant
14: Tarbat Ness Lighthouse	37	Medium-high	Medium-low	Not-significant
15: Burghead Visitor Centre	38	Medium-high	Medium-low	Not-significant
16: Lossiemouth Harbour	32	Medium-high	Medium-low	Not-significant
17: Buckie	40	Medium-high	Medium-low	Not-significant
18: Bin Hill	43	Medium	Low	Not-significant
19 Portnockie	39	Medium-high	Medium-low	Not-significant
20: Cullen	41	Medium-high	Medium-low	Not-significant
21: Findlater Castle	42	Medium-high	Medium-low	Not-significant
22: Sandend	44	Medium-high	Low	Not-significant
23: Portsoy	50	Medium-high	Medium-low	Not-significant

Analysis	km	
Max. distance where Low MoE occurred	53.0	Low + medium low
Av. Distance where Low MoE occurred	40.8	Low + medium low
Max. distance where Medium MoE occurred	28.0	Medium only
Av. distance where Medium MoE occurred	25.8	Medium only

Cumulative Effect

Cumulative effect with other consented windfarms (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Cumualive Magnitude of change)	Significance of effect (Significance of Cumulative Effect)
4: Sarclet	26	Medium-high	Medium	Significant
5: Whaligoe Steps	26	Medium-high	Medium	Significant
6: Minor Road (SE of Osclay)	28	Medium	Medium	Significant
7: Lybster	25	Medium-high	Medium	Significant
8: Latheron	25	Medium-high	Medium	Significant
9a: Dunbeath	25	Medium-high	Medium	Significant
9b: Dunbeath	24	Medium-high	Medium	Significant
10: Morven	35	Medium-high	Medium-low	Significant
11: Berriedale (A9)	23	Medium-high	Medium	Significant
12: Navidale	28	Medium-high	Medium	Significant
13a: Brora	37	Medium-high	Low	Not significant
13b: Dornoch	49	Medium-high	Low	Not significant
14: Tarbat Ness Lighthouse	37	Medium-high	Low	Not significant
15: Burghead Visitor Centre	38	Medium-high	Low	Not significant
16: Lossiemouth Harbour	32	Medium-high	Low	Not significant
17: Buckie	40	Medium-high	Medium-low	Significant
18: Bin Hill	43	Medium	Medium-low	Not significant
19 Portnockie	39	Medium-high	Medium-low	Significant
20: Cullen	41	Medium-high	Medium-low	Significant
21: Findlater Castle	42	Medium-high	Medium-low	Significant
22: Sandend	44	Medium-high	Low	Not significant
23: Portsoy	50	Medium-high	Medium-low	Not significant

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	50.0	Low + medium low
Av. Distance where Low MoE occurred	40.5	Low + medium low
Max. distance where Medium MoE occurred	28.0	Medium only
Av. distance where Medium MoE occurred	25.6	Medium only

Scheme name	Rampion		
Document	ES Section 12 – Seascape, Landscape & Visual Impact Assessment Dec 2012 p71+		
Data source	http://infrastructure.planninginspectorate.gov.uk		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	400		note Option F modelled in ES
No. of turbines	116	100-175 (worst case)	3.45 MW (3.6 to 7 in EA)
Turbine blade tip height (m)	140	165-210	
Distance from nearest coast km	13		

Effect

No other windfarms present (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (magnitude of predicted visual change)	Significance of effect (level of predicted visual effect)
1 Beachy Head cliff top	22.50	Very high	Medium	Major
2 Birling Gap cliff top	19.60	Very high	Medium	Major
3 Birling Gap beach	19.60	Very high	Medium	Major
4 Seven Sisters C Park cliff top	17.80	Very high	Medium	Major
5 Seven Sisters Cuckmere Haven	18.70	Very high	Very small	Moderate
6 Seaford Head cliff top	15.70	Very high	Medium	Major
7 Seaford sea front promenade	15.50	High	Medium	Major-moderate
8 Newhaven Coastguard cliff top	14.60	Medium	Medium	Moderate
9 Peacehaven cliff top	13.90	High	Large	Major
10 Beacon Hill, Rottingdean	14.10	High	Large	Major
11 Brighton parade	14.20	High	Large	Major
12 Brighton sea front promenade	14.10	High	Large	Major
13 Shoreham/A259 coastal road	14.20	High	Medium	Major-moderate
14 Worthing sea front promenade	13.40	High	Large	Major
15 Littlehampton sea front	17.80	High	Medium	Major-moderate
16 Bognor Regis sea front	23.90	High	Small	Moderate
17 Pagham beach	28.20	High	Small	Moderate
18 Selsey sea front promenade	29.50	High	Small	Moderate
19 Willingdon Hill	24.00	High	Medium	Major-moderate
20 Firle Beacon	21.60	Very high	Medium	Major
21 Saxon Down	24.10	High	Small	Moderate
22 Hollingbury Golf Course	18.10	Very high	Medium	Major
23 Ditchling Beacon ridge	23.60	High	Medium	Major-moderate
24 Devil's Dyke	19.60	Very high	Large	Major
25 Upper Beeding	19.80	Medium	Very small	Minor-negligible
26 Cissbury Ring	18.90	Very high	Medium	Major
27 Highdown Hill	16.80	High	Large	Major
28 Springhead Hill	25.40	High	Medium	Major-moderate
29 Bignor Hill	30.00	Very high	Medium	Major-moderate

Analysis	km	
Max. distance where Low MoE occurred	29.5	Low = 'Small' only
Av. Distance where Low MoE occurred	26.4	Low = 'Small' only
Max. distance where Medium MoE occurred	30.0	Medium only
Av. distance where Medium MoE occurred	19.9	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (cumulative magnitude of visual change)	Significance of effect (level and significance of cumulative visual effect)
19 Willingdon Hill	24.00	High	Medium (no effect)	Major-moderate (no effect)
20 Firle Beacon	21.60	Very high	Medium (no effect)	Major (no effect)
21 Saxon Down	24.10	High	Small (no effect)	Moderate (no effect)

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	24.10	Low = Small
Av. Distance where Low MoE occurred	24.10	Low = Small
Max. distance where Medium MoE occurred	24.00	
Av. distance where Medium MoE occurred	22.80	

Scheme name	Seagreen Alpha and Bravo			
Document	EIA 2018, Non Technical Summary, and Chapter 13 Seascape, Landscape and Visual Amenity.			
Data source	Marine Scotland			
Status	Consented			

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW		1500 MW	
No. of turbines		up to 120	estimate from capacity/no: 12.5 MW
Turbine blade tip height (m)		280	
Distance from nearest coast km		27	

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
1 Garron Point	38	Medium	Low-medium	Moderate-minor
2 Beach Road, Kirkton	32	High-medium	Medium	Major-moderate
3 White Caterthun Hill Fort	52	High	Low-very low	Moderate-minor
4 Montrose	33	High-medium	Low-medium	Moderate
5 Braehead of Lunan	35	High-medium	Medium-low	Major-moderate
6 Arbroath Signal Tower	40	High	Low-very low	Moderate-minor
7 Carnoustie	49	High-medium	Low-very low	Minor
8 Fife Ness, Lochaber Rock	50	High	Very low	Minor-negligible
9 North Berwick Law	73	High	Very low	Minor-negligible
10 Pinderachy	61	High	Low-very low	Moderate-minor
11 The Geot/Ben Tirran	71	High	Low-very low	Moderate-minor
12 Isle of May	55	High-medium	Very low	Minor-negligible
13 Bell Rock Lighthouse	30	High	Low-very low	Moderate-minor

Analysis	km	
Max. distance where Low MoE occurred	38.0	Low + Low-medium
Av. Distance where Low MoE occurred	35.3	Low + Low-medium and Medium-low
Max. distance where Medium MoE occurred	32.0	Medium only
Av. distance where Medium MoE occurred	32.0	Medium only

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of impact)	Significance of effect (Impact Significance)
1 Garron Point	38	Medium		Minor
2 Beach Road, Kirkton	32	High-medium		Moderate
3 White Caterthun Hill Fort	52	High		Minor
4 Montrose	33	High-medium		Moderate-minor
5 Braehead of Lunan	35	High-medium		Moderate
6 Arbroath Signal Tower	40	High		Minor
7 Carnoustie	49	High-medium		Minor
8 Fife Ness, Lochaber Rock	50	High		Minor-negligible
9 North Berwick Law	73	High		Minor-negligible
10 Pinderachy	61	High		Moderate-minor
11 The Geot/Ben Tirran	71	High		Moderate-minor
12 Isle of May	55	High-medium		Minor-negligible
13 Bell Rock Lighthouse	30	High		Moderate-minor

Analysis (cumulative)	km	
Max. distance where Low MoE occurred		No data
Av. Distance where Low MoE occurred		No data
Max. distance where Medium MoE occurred		No data
Av. distance where Medium MoE occurred		No data

Scheme name	Sheringham Shoal		
Document	ES May 2006		
Data source	http://sheringhamshoal.co.uk		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	317		
No. of turbines	88		3.6 MW
Turbine blade tip height (m)	135	117, 142 and 172	note they consider visual effect similar
Distance from nearest coast km	17		

Effect

No other windfarms taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
1 Cromer Pier	19.00	High	Medium	Moderate
2 Wells-Next-The Sea	25.00	High	Low	Minor
3 Beeston Hill	17.00	High	High	Major
4 Viewpoint in Oak Wood	19.00	High	Medium	Moderate
5 Cley Marshes Nature Reserve	18.00	High	High	Major
6 Overstrand, car park	21.00	High	Medium	Moderate
7 Incleborough Hill	18.50	High	Medium	Moderate
8 Sheringham, Peddars Way	17.00	High	High	Major
9 Sheringham Coast Watch – hut	17.00	Medium	High	Moderate
10 Weybourne, Peddars Way	17.00	High	Medium	Moderate
11 Holgate Hill	19.00	Medium	Medium	Moderate
12 A148, crossroads near Bale	27.50	Medium	n/a	Negliglible
13 Blakeney, car park	19.50	High	Medium	Moderate
14 Morston – car park	21.00	High	Medium	Moderate
15 Stiffkey Salt Marshes	22.00	High	Low	Minor
16 A149 St Withburga Church	27.50	Medium	n/a	Negliglible
17 Beeston Regis Heath	19.00	Medium	Medium	Minor
18 Dead Man's Hill	17.00	Medium	High	Moderate
19 Muckleburgh Hill	18.00	Medium	High	Moderate
20 Holt, church	23.00	High	n/a	Negliglible
21 West Beckham	21.50	Low	n/a	Negliglible
22 A148	25.00	Medium	n/a	Negliglible
23 Holkham Park	28.00	High	n/a	Negliglible
24 Beacon Hill Road	32.00	High	n/a	Negliglible
25 Gibraltar Point Viewpoint	35.00	High	n/a	Negliglible
26 Passenger Ferry	5.00	m	High	Moderate

Analysis	km	
Max. distance where Low MoE occurred	25.0	Low only
Av. Distance where Low MoE occurred	23.5	Low only
Max. distance where Medium MoE occurred	21.0	Medium only
Av. distance where Medium MoE occurred	19.2	Medium only

Cumulative Effect

Incl proposed schemes at Cromer and Docking Shoal/Race Bank (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
1 Cromer Pier	19.00	High	not defined	Moderate
2 Wells-Next-The Sea	25.00	High	not defined	Minor
18 Dead Man's Hill	17.00	Medium	not defined	Moderate

Analysis (cumulative)	km	
Max. distance where Low MoE occurred		no data
Av. Distance where Low MoE occurred		no data
Max. distance where Medium MoE occurred		no data
Av. distance where Medium MoE occurred		no data

Scheme name	Thanet		
Document	Thanet Offshore Wind Farm ES Chapter 13.6		
Data source			
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	300		
No. of turbines	100	60-100	3 MW
Turbine blade tip height (m)	115	150	
Distance from nearest coast km	11		

Effect

Other windfarms present or planned are not taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
Reculver Country Park	27.7	Low to Medium	Low	Minor
West Brook POS / Coastal Path	17.5	Medium	Medium	Moderate
Margate Harbour Wall	15.4	Medium	Low	Minor
Kingsgate / North Foreland	12.3	High	Medium to High	Moderate
Broadstairs Promenade	14.2	Medium to High	Medium to High	Moderate
Wellington Crescent, Ramsgate	16.6	Medium	Medium to Low	Minor to Moderate
Richborough Castle	24.5	Medium to Low	Negligible	Negligible
Kings Avenue / Princes Drive	23.5	Medium	Low to Medium	Minor to Moderate
Deal Pier / Promenade	25.6	Medium	Low to Medium	Minor to Moderate
St Margaret's at Cliffe	33	High	Low to Negligible	Minor

Analysis	km	
Max. distance where Low MoE occurred	27.7	Low + Low to medium +Medium to low
Av. Distance where Low MoE occurred	21.8	Low + Low to medium +Medium to low
Max. distance where Medium MoE occurred	17.5	Medium only
Av. distance where Medium MoE occurred	17.5	Medium only

Combined Cumulative Effect

Cumulative effect with other windfarms (Kentish Flats) (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of cumulaitve impact)	Significance of effect (Impact significance)
Reculver Country Park	27.7	Low to Medium	Minor	Minor to moderate
West Brook POS / Coastal Path	17.5	Medium	Medium	Moderate
Margate Harbour Wall	15.4	Medium	Minor	Minor to moderate
Kingsgate / North Foreland	12.3	High	Medium	Moderate

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	27.7	Low = 'Minor'
Av. Distance where Low MoE occurred	21.6	Low = 'Minor'
Max. distance where Medium MoE occurred	27.7	Medium only
Av. distance where Medium MoE occurred	14.9	Medium only

Scheme name	Thanet extension		
Document	ES Vol 2 Chapter 1: Project Description (Offshore) 2018 and Vol 2 Chapter 12: SLVIA		
Data source	National Infrastructure Planning		
Status	Application submitted		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW		340	
No. of turbines		34	8-12 MW, possibly larger
Turbine blade tip height (m)		upto 250	
Distance from nearest coast km		8	

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity to change)	Magnitude of effect (Magnitude of change)	Significance of effect (Significant effects)
Reculver Country Park, Thanet Coastal Path	24.7	Medium-high	Medium-low	Not significant
West Brook POS (Margate)/Thanet Coastal P	14.2	Medium	Medium-high	Significant
Margate Harbour Wall (Turner Arts Gallery)	12.2	Medium	Medium	Not significant
Kingsgate/North Foreland, Coastal Path	8.7	High	High	Significant
Broadstairs Promenade	10.5	High	High	Significant
Wellington Crescent, Ramsgate	13.3	Medium	Medium-high	Significant
King's Avenue/Princes Drive, Sandwich Bay	19.9	Medium-high	Medium	Significant
Richborough Castle	22.8	Medium-high	Medium-low	Not significant
Joss Bay/North Foreland	8.7	High	High	Significant
Stone Bay	9.8	High	High	Significant
Foreness Point/Palm Bay	9.1	High	High	Significant
Walpole Bay (Margate)	11.5	Medium-high	Medium-high	Significant
Birchington-on-Sea	17.8	Medium-high	Medium	Significant
Manston Road, Isle of Thanet	14.6	Medium-high	Medium	Significant
Broadstairs, Dumpton Gap	11.1	High	High	Significant
England Coastal Path, Sandwich Flats	18.0	Medium	Medium-low	Not significant
St Peter's Church, Sandwich	21.9	Medium-high	Medium-low	Not significant
Leysdown-on-Sea	44.1	Medium	Low	Not significant

Analysis	km	
Max. distance where Low MoE occurred	44.1	Low + medium low
Av. Distance where Low MoE occurred	26.3	Low + medium low
Max. distance where Medium MoE occurred	19.9	Medium only
Av. distance where Medium MoE occurred	16.1	Medium only

Cumulative Effect

Cumulative effect with other projects (not windfarms), either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of impact)
Reculver Country Park, Thanet Coastal Path	24.7	Medium-high		No visibility of cumulative projects
West Brook POS (Margate)/Thanet Coastal P	14.2	Medium		No visibility of cumulative projects
Margate Harbour Wall (Turner Arts Gallery)	12.2	Medium		No visibility of cumulative projects
Kingsgate/North Foreland, Coastal Path	8.7	High		No visibility of cumulative projects
Broadstairs Promenade	10.5	High		No visibility of cumulative projects
Wellington Crescent, Ramsgate	13.3	Medium	Low	Not significant
King's Avenue/Princes Drive, Sandwich Bay	19.9	Medium-high	Low	Not significant
Richborough Castle	22.8	Medium-high	Medium-low	Not significant
Joss Bay/North Foreland	8.7	High		No visibility of cumulative projects
Stone Bay	9.8	High		No visibility of cumulative projects
Foreness Point/Palm Bay	9.1	High		No visibility of cumulative projects
Walpole Bay (Margate)	11.5	Medium-high		No visibility of cumulative projects
Birchington-on-Sea	17.8	Medium-high		No visibility of cumulative projects
Manston Road, Isle of Thanet	14.6	Medium-high		No visibility of cumulative projects
Broadstairs, Dumpton Gap	11.1	High		No visibility of cumulative projects
England Coastal Path, Sandwich Flats	18.0	Medium	Low	Not significant
St Peter's Church, Sandwich	21.9	Medium-high	Medium-low	Not significant
Leysdown-on-Sea	44.1	Medium		No visibility of cumulative projects

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	22.8	Low + medium low
Av. Distance where Low MoE occurred	18.5	Low + medium low
Max. distance where Medium MoE occurred		No data
Av. distance where Medium MoE occurred		No data

Scheme name	Walney Phase 1		
Document	Walney Offshore Windfarm ES Part 2		
Data source			
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	186		
No. of turbines	51	93	3.6 MW
Turbine blade tip height (m)	137	202	
Distance from nearest coast km	15		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
St Bees Head	42.6	High	Negligible	Negligible/Nil
Seascale Beach	31.3	High (Residents)	Very Small	Minor
Bootle Fell	27.6	Medium	Very Small	Minor/Negligible
Black Combe	23.4	High	Small	Moderate/Minor
Coastal Path, Haverigg	18.8	High	Medium	Moderate/Minor
A593 Broughton in Furness	36.4	Medium	Negligible	Nil
A595 Kirkby in Furness	25.1	Medium	Very Small	Minor/Negligible
Hoad Monument, Ulverston	30.5	High	Negligible	Negligible/Nil
High Haume Farm	23	High	Small	Moderate/Minor
Biggar Bank, Walney	14.4	High (Residents)	Medium	Moderate
South WalneyNature Reserve	16.2	High	Medium	Moderate
Birkrigg Fell	26.8	High	Very Small	Minor
Humphrey Head	36.4	High	Negligible	Negligible/Nil
Morecambe Stone Pier	37.7	High	Negligible	Negligible/Nil
Heysham Head	35.6	High	Negligible	Negligible/Nil
Rossall Point, Fleetwood	28.9	High	Very Small	Minor
Blackpool Tower	35.2	High	Negligible	Negligible/Nil

Analysis	km	
Max. distance where Low MoE occurred	23.4	Low = 'Small'
Av. Distance where Low MoE occurred	23.2	Low = 'Small'
Max. distance where Medium MoE occurred	18.8	Medium only
Av. distance where Medium MoE occurred	16.5	Medium only

Cumulative Effect

In Walney ES 1.0 notes that:
Walney and West of Duddon Sands are assessed as a single entity,
and assessed in context of several other proposed windfarms on the Eastern Irish Sea.

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of change)	Significance of effect (Significance of visual effect)
St Bees Head	42.6	High	Negligible	Negligible
Coastal Path, Haverigg	18.8	High	Large	Major
South WalneyNature Reserve	16.2	High	Large	Major
Biggar Bank, Walney	14.4	High (Residents)	Major	Major- moderate
Black Combe	23.4	High	Medium	Moderate
High Haume Farm	23	High	Medium	Moderate
Rossall Point, Fleetwood	28.9	High	Medium	Moderate
Blackpool Tower	35.2	High	Medium	Moderate
Bootle Fell	27.6	Medium	Small	Minor
A595 Kirkby in Furness	25.1	Medium	Small	Minor
Birkrigg Fell	26.8	High	Small	Moderate -minor
Seascale Beach	31.3	High (Residents)	Very small	Minor
A593 Broughton in Furness	36.4	Medium	Very small	Minor
Hoad Monument, Ulverston	30.5	High	Very small	Minor
Humphrey Head	36.4	High	Very small	Minor - negligible
Morecambe Stone Pier	37.7	High	Very small	Minor - negligible
Heysham Head	35.6	High	Very small	Minor - negligible

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	27.6	Low = 'Small'
Av. Distance where Low MoE occurred	26.5	Low = 'Small'
Max. distance where Medium MoE occurred	35.2	Medium only
Av. distance where Medium MoE occurred	27.6	Medium only

Scheme name	Walney Extension		
Document	Environmental Statement Volume 1 Chapter 19 Seascape, landscape and visual impact assessment June 2013 p.69+		
Data source	http://infrastructure.planninginspectorate.gov.uk/projects/north-west/walney-extension-offshor		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	659		
No. of turbines	87	93-207	8.25 MW
Turbine blade tip height (m)	222	142-222	
Distance from nearest coast km	19		

Effect

Additional effect to other existing windfarms as part of baseline (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (Magnitude of impact)	Significance of effect
1 St Bees head	39.56	High	Low-negligible	Minor
2 Thornhill	39.15	Low	Low-negligible	Negligible
3 Seascale beachfront	33.78	High-medium	Low-negligible	Minor
4 Seafront at Ravenglass	32.33	High	Low	Moderate
5 Black Combe, Bootle fell	27.79	High	Medium-low	Major-moderate to moderate
6 Coastal path Silecroft	24.29	High	Low	Moderate
7 Public footpath NW Milcom	28.18	High	Low-negligible	Minor
8 Askam in Furness	29.06	High	Negligible	Negligible
9 Biggar Bank Rd Walney Island	20.75	High	Low	Moderate
10 South End Haws Walney Island	22.69	High	Low	Moderate
11 Morecambe Stone Pier	44.06	High	None	None
12 Rossal Point Fleetwood	34.46	Medium	Negligible	Negligible
13 Blackpool promenade	38.98	High	Negligible-none	Negligible-none
14 Douglas Head Isle of Man	35.94	High	Negligible	Negligible
15 Loch promenade Douglas	36.66	High-medium	Negligible	Negligible
16 Snaefell Isel of Man	38.28	High	Negligible	Negligible
17 Maughold, Isle of Man	31.29	High	Low-negligible	Negligible

Analysis	km	
Max. distance where Low MoE occurred	32.3	Low + Medium-low
Av. Distance where Low MoE occurred	25.6	Low + Medium-low
Max. distance where Medium MoE occurred		Medium only - no data
Av. distance where Medium MoE occurred		Medium only - no data

Cumulative Effect

Cumulative effect with other windfarms, either existing or proposed (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor	Magnitude of effect (combined effect offshore)	Significance of effect
3 Seascale beachfront	33.78	High-medium	Low-negligible	Minor
5 Black Combe, Bootle fell	27.79	High	Medium	Major-moderate
9 Biggar Bank Rd Walney Island	20.75	High	Low	Moderate
12 Rossal Point Fleetwood	34.46	Medium	Negligible	Negligible
17 Maughold, Isle of Man	31.29	High	Medium	Major-moderate

Analysis (cumulative)	km	
Max. distance where Low MoE occurred	20.8	Low only
Av. Distance where Low MoE occurred	20.8	Low only
Max. distance where Medium MoE occurred	31.3	Medium only
Av. distance where Medium MoE occurred	29.5	Medium only

Scheme name	Westermost Rough A		
Document	Seascape and Visual Assessment February 2009 p38		
Data source	http://www.marinedataexchange.co.uk		
Status	Implemented		

Windfarm details	as built or consented	as assessed in ES/SLVIA	Notes eg turbine types
Total turbine capacity MW	210		
No. of turbines	35	35 to 110	6 MW
Turbine blade tip height (m)	177	112 to 172	
Distance from nearest coast km	8		

Effect

No other windfarms present or taken into consideration (terminology in brackets if different in document)

Viewpoint	Distance (km) from turbine	Sensitivity of receptor (Sensitivity)	Magnitude of effect (Magnitude of impact)	Significance of effect (Significance of impact)
1 Spurn Head Bird Obervatory	17.50	Medium-high	Medium	Moderate
2 Seaside Road / Central Promenade, Withernsea	8.10	Medium	Medium-high	Moderate
3 Layby on Pilmar Lane, Roos	10.60	Medium-low	Medium-low	Moderate-minor
4 East Newton Road, Aldbrough	13.00	High	Medium	Moderate-major
5 North End Marine Drive / Eastgate, Hornsea	20.00	Medium-low	Low-medium	Minor-moderate
6 Viewing Point, North Harbour, Bridlington	35.00	Low-medium	Low-negligible	Minor-negligible
7 PROW, South Landing, Flamborough Head	34.50	Medium-high	Low-negligible	Minor
8 North Road, Halsham	12.50	Low	Low-medium	Minor-moderate
9 Stonebridge Car Park, Donna Nook	32.60	Low-medium	Low	Minor

Analysis	km	
Max. distance where Low MoE occurred	32.6	Low + Medium-low + Low-medium
Av. Distance where Low MoE occurred	18.9	Low + Medium-low + Low-medium
Max. distance where Medium MoE occurred	17.5	Medium only
Av. distance where Medium MoE occurred	15.3	Medium only

Combined Cumulative Effect no data found

From ES: "Three potential sources for cumulative effect have been identified. These include the operational wind farms at Out Newton and Hull Waste Water Treatment Works, the consented wind farm at Lisset Airfield (onshore) and those registered 'in planning' which includes the Humber Gateway (Round 2 offshore) and the onshore wind farm at Burton Pidsea."

Appendix E1 Wireline detailed analysis results

OESEA 4 Offshore wind farms – visual buffers

Wirelines assessment brief

Two landscape architects with experience in assessing wind farm development will assess the scale/size of effects of the wireframes separately using the definitions set out in DTI [2005] below, but ignoring the comments in relation to characteristics of any given seascape. Both assessments will be included in the report to illustrate where there is agreement or a range of evaluations.

Tasks

- Print out single windfarm wireframes at A3 and cumulative scenarios at A1 width
- Hold at the recommended viewing distance in an arc so all the paper image is at the same distance from your eyes.
- Make a judgement on the scale of effect for each scenario based on the DTI (2005) study magnitude of change table 5 below.
- Write down each judgement in the table provided overleaf
- Note comments about the process or limitations as separate text.

Table 5: Magnitude of change: names, descriptors and definitions

Magnitude	Name	Descriptors - appearance in central vision field	Definition
Very Large	Dominant	Commanding, controlling the view, foremost feature, prevailing, overriding.	Proposed offshore wind farm causes very large alteration to key elements/features/characteristics of the baseline seascape or visual conditions (pre-development) such that there is a fundamental change.
Large	Prominent	Standing out, striking, sharp, unmistakeable, easily seen	Proposed offshore wind farm causes large alteration to key elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is an unmistakeable change.
Moderate	Conspicuous	Noticeable, distinct, catching the eye or attention, clearly visible, well defined	Proposed offshore wind farm causes moderate alteration to elements/features/characteristics of the baseline seascape or visual conditions (pre-development) such that there is a distinct change.
Small	Apparent	Visible, evident, obvious, perceptible, discernible, recognisable.	Proposed offshore wind farm causes small loss or alteration to elements/features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is a perceptible change.
Very Small	Inconspicuous	Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite, subtle	Proposed offshore wind farm causes very small loss or alteration to elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is a barely distinguishable change.
Negligible	Faint	Weak, not legible, near limit of acuity of human eye	Proposed offshore wind farm causes negligible loss or alteration to elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is no legible change.

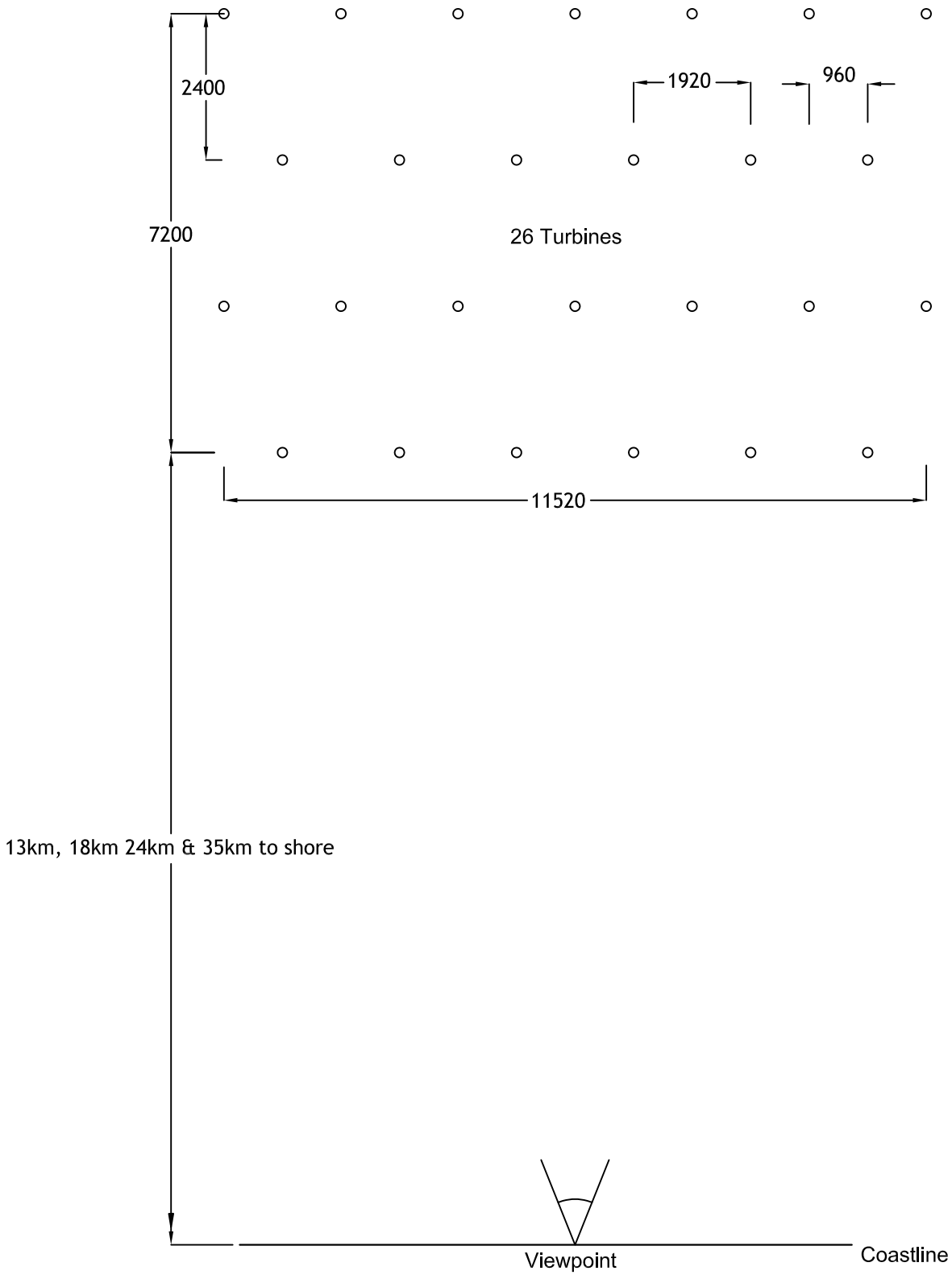
	Scale of change/effect	
Wireline Scenarios	**Landscape Architect A**	**Landscape Architect B**
Single large wind farm (Individual wind farm scenarios)		
350m high turbines at 13km from 6m elev	Very large/large	Very Large
400m high turbines at 13km from 6m elev	Very large/large	Large
350m high turbines at 24km from 6m elev	Moderate	Moderate
400m high turbines at 24km from 6m elev	Moderate	Moderate
350m high turbines at 35km from 6m elev	Small*	Small
400m high turbines at 35km from 6m elev	Small*	Small
350m high turbines at 44km from 6m elev	Very small*	Very small
400m high turbines at 44km from 6m elev	Very small*	Very small
350m high turbines at 13km from 22m elev	Very large/large	Very Large
400m high turbines at 13km from 22m elev	Very large/large	Very Large
350m high turbines at 24km from 22m elev	Moderate	Moderate
400m high turbines at 24km from 22m elev	Moderate	Moderate
350m high turbines at 35km from 22m elev	Small*	Small
400m high turbines at 35km from 22m elev	Small*	Small
350m high turbines at 44km from 22m elev	Very small*	Very small
400m high turbines at 44km from 22m elev	Very small*	Very small
350m high turbines at 13km from 100m elev	Very large/large	Very Large
400m high turbines at 13km from 100m elev	Very large/large	Very Large
350m high turbines at 24km from 100m elev	Moderate	Moderate
400m high turbines at 24km from 100m elev	Moderate	Moderate
350m high turbines at 35km from 100m elev	Small*	Small
400m high turbines at 35km from 100m elev	Small*	Small
350m high turbines at 44km from 100m elev	Very small*	Very small
400m high turbines at 44km from 100m elev	Very small*	Very small
500MW wind farm scenarios		
350m high turbines at 13km from 22m elev	Large	Very Large
400m high turbines at 13km from 22m elev	Large	Very Large
350m high turbines at 18km from 22m elev	Large	Large
400m high turbines at 18km from 22m elev	Large	Very Large
350m high turbines at 24km from 22m elev	Moderate	Moderate
400m high turbines at 24km from 22m elev	Moderate	Large
350m high turbines at 35km from 22m elev	Small	Small
400m high turbines at 35km from 22m elev	Small	

Wireframe Scenarios	Landscape Architect A	Landscape Architect B
	Scale of effect	Scale of effect
Cumulative scenarios		
20MW/350m (24km), 10MW/220m and 3.6MW/147m high turbine arrays	Very large**	Very Large
20MW/350m (35km), 10MW/220m and 3.6MW/147m high turbine arrays	Very large**	Large
20MW/350m, 20MW/350m and 3.6MW/147m high turbine arrays	Very large** (worst scenario)	Very Large

*Worst case – depends on good light and limited visibility modifiers (excellent visibility).

** Very confused and unbalanced composition with turbines becoming the dominant seascape characteristic

Appendix E2 Wireline wind farm scenario plans

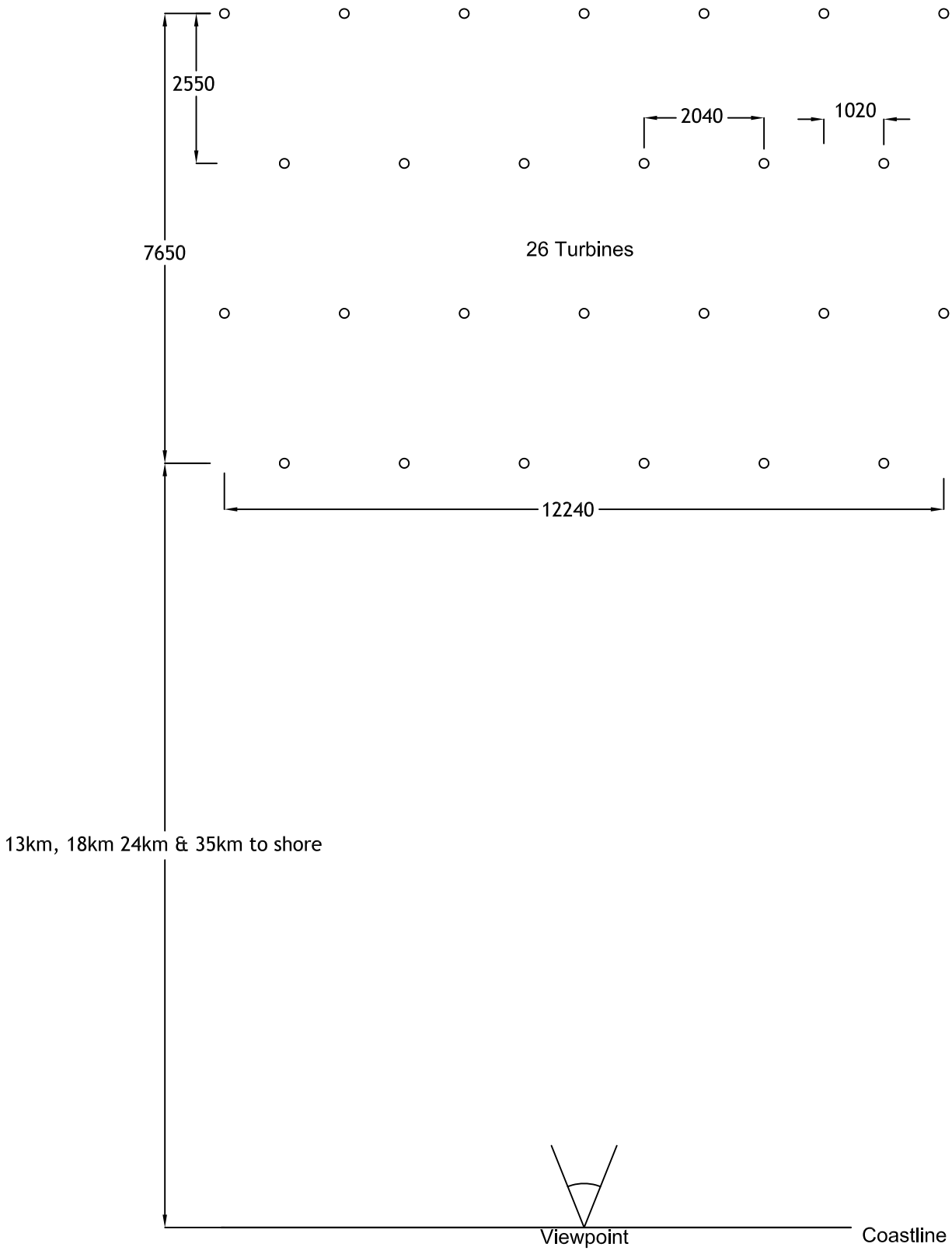


All Dimensions in metres
unless otherwise stated

Plan View
Scale 1: 100,000

Figure x
350m High 520MW Comparison Scenario

www.whiteconsultants.co.uk



All Dimensions in metres
unless otherwise stated

Plan View
Scale 1: 100,000

Figure x
400m High 520MW Comparison Scenario

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Appendix E3 Wirelines- 500MW wind farm with 350m and 400m high turbines

350m high turbines

400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 51cm for A3 sheet, 72cm for A2, 102cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
Horizontal angle of view: Cylindrical Projection 45 degrees	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 13km viewed from 22m elevation**
Distance to horizon: 18.1km	Number of turbines: 26	Drawn: TM	**Figure x**
	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

350m high turbines

400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 51cm for A3 sheet, 72cm for A2, 102cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
Horizontal angle of view: Cylindrical Projection 45 degrees	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 18km viewed from 22m elevation**
Distance to horizon: 18.1km	Number of turbines: 26	Drawn: TM	**Figure x**
	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

350m high turbines

400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 51cm for A3 sheet, 72cm for A2, 102cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
Horizontal angle of view: Cylindrical Projection 45 degrees	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 24km viewed from 22m elevation**
Distance to horizon: 18.1km	Number of turbines: 26	Drawn: TM	**Figure x**
	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

350m high turbines

400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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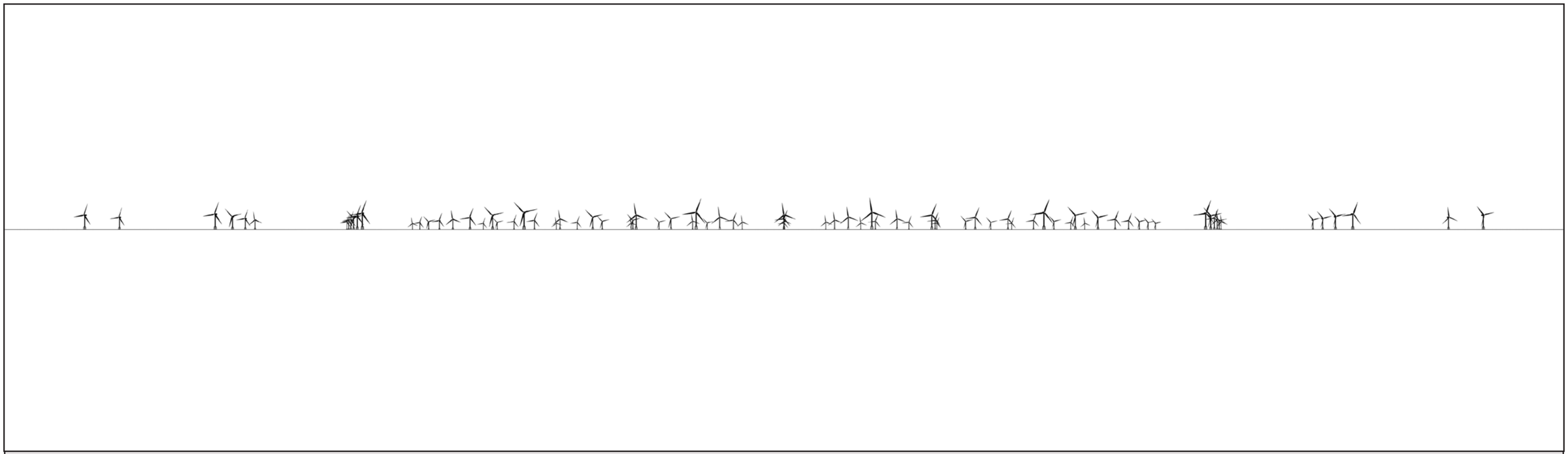
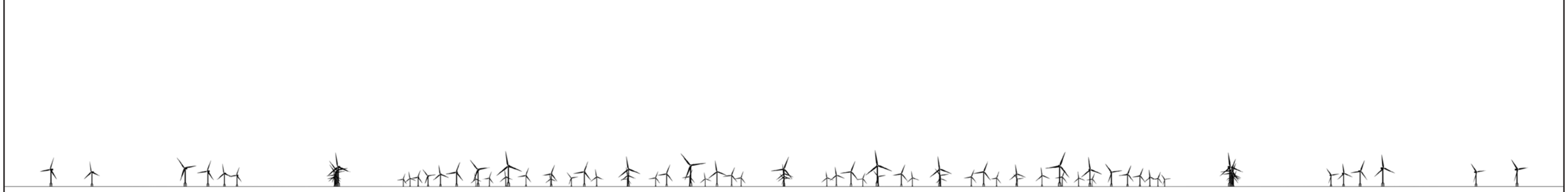
Viewing distance: 51cm for A3 sheet, 72cm for A2, 102cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 35km viewed from 22m elevation**
Horizontal angle of view: Cylindrical Projection 45 degrees	Number of turbines: 26	Drawn: TM	**Figure x**
Distance to horizon: 18.1km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

Appendix E4 Wirelines- Large wind farm with 350m and 400m high turbines



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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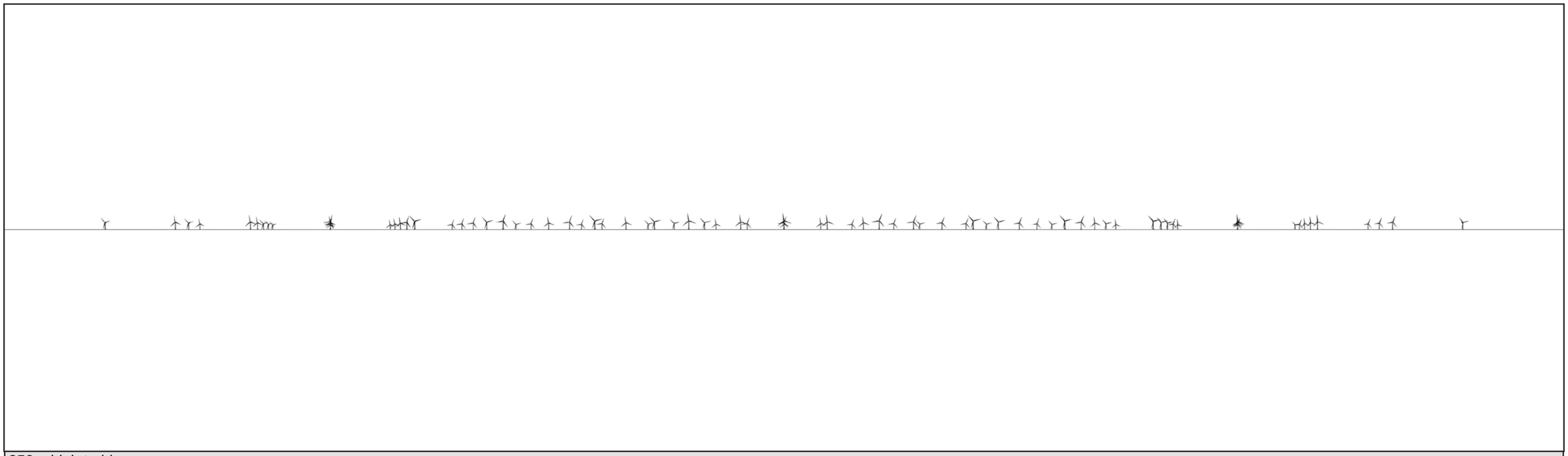
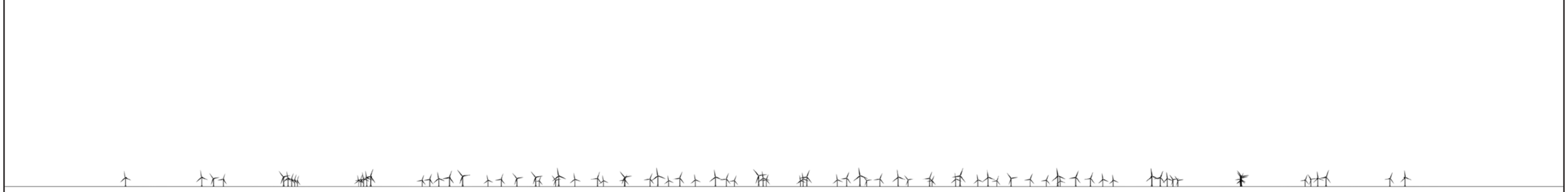
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 13km viewed from 6m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 9.4km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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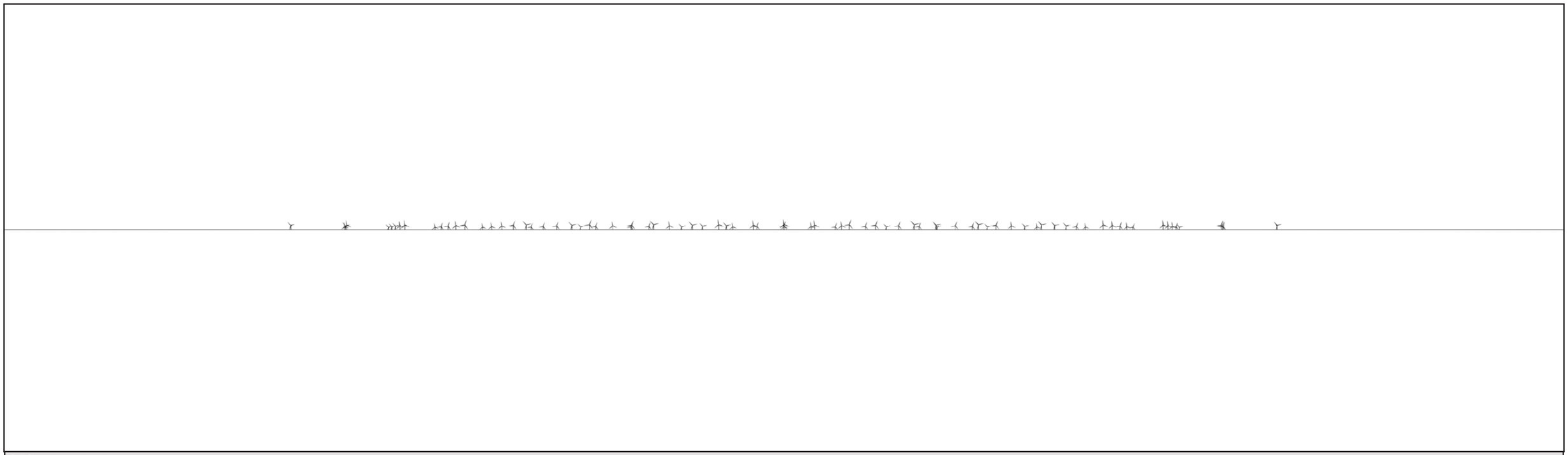
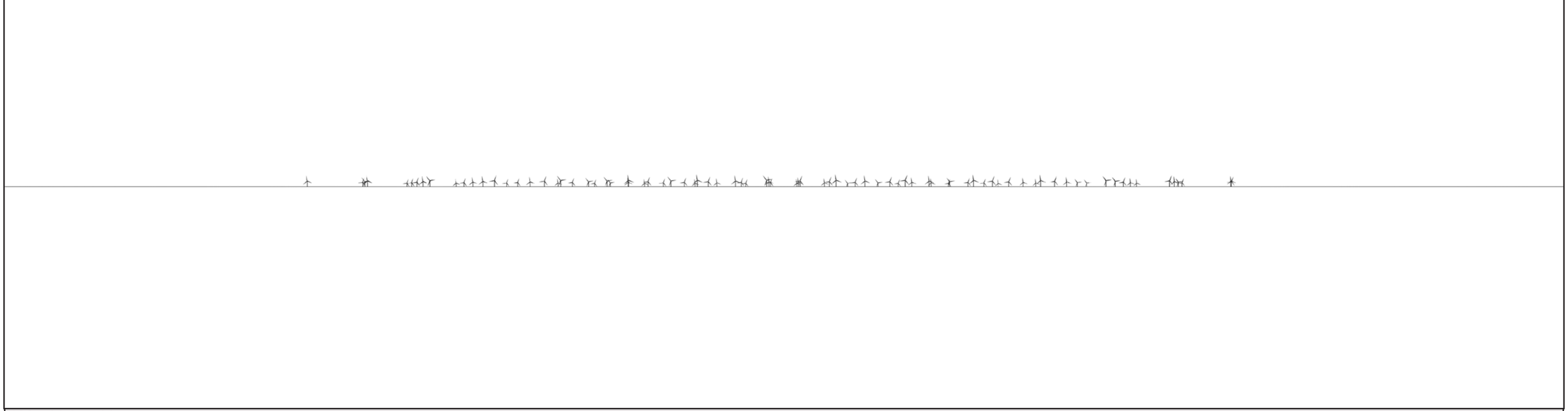
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 24km viewed from 6m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 9.4km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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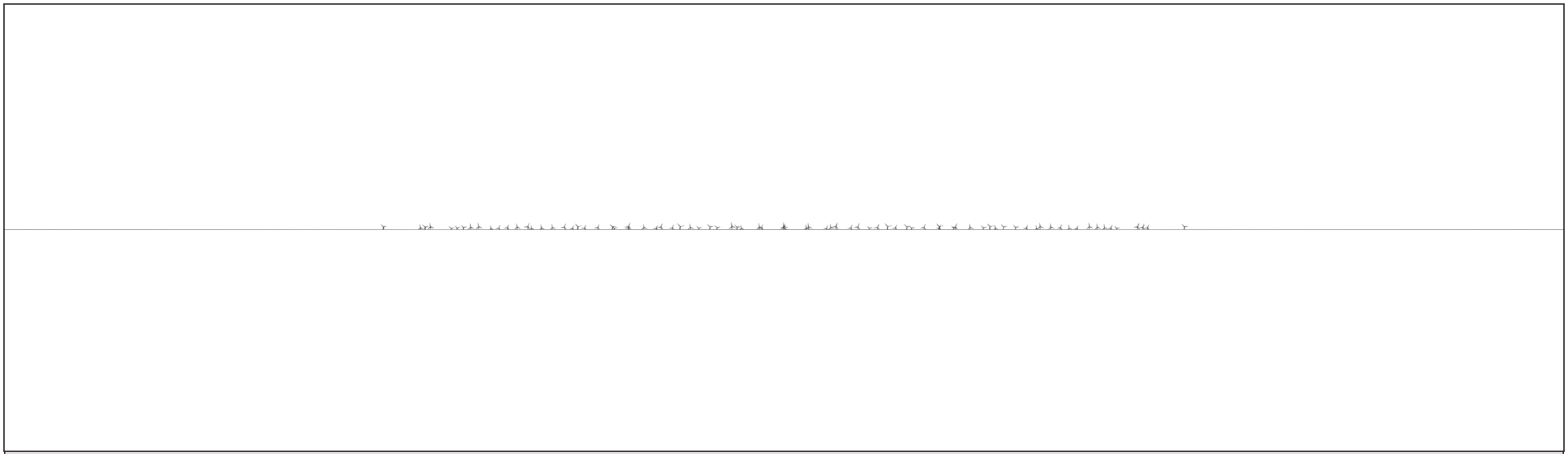
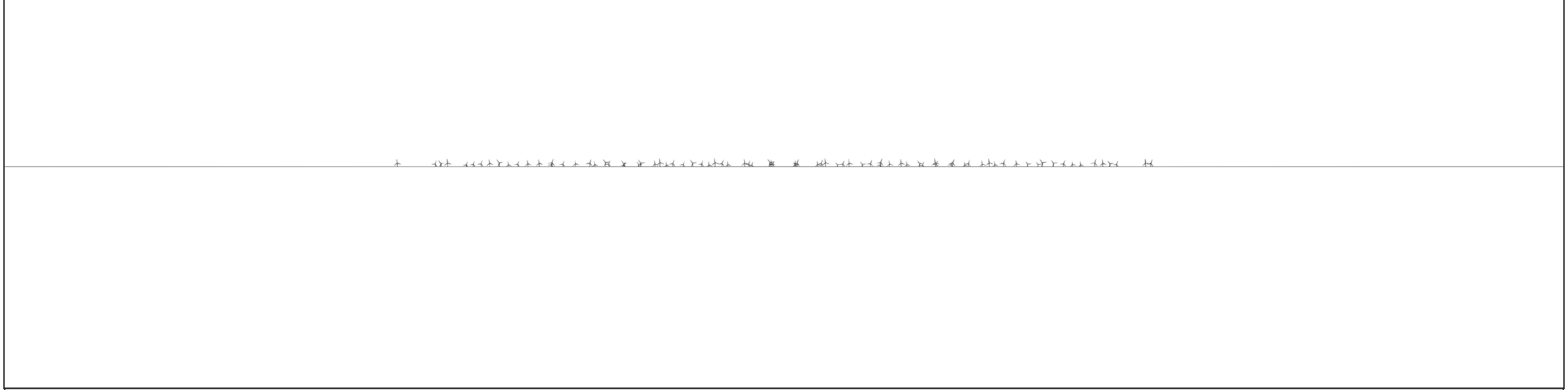
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 35km viewed from 6m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 9.4km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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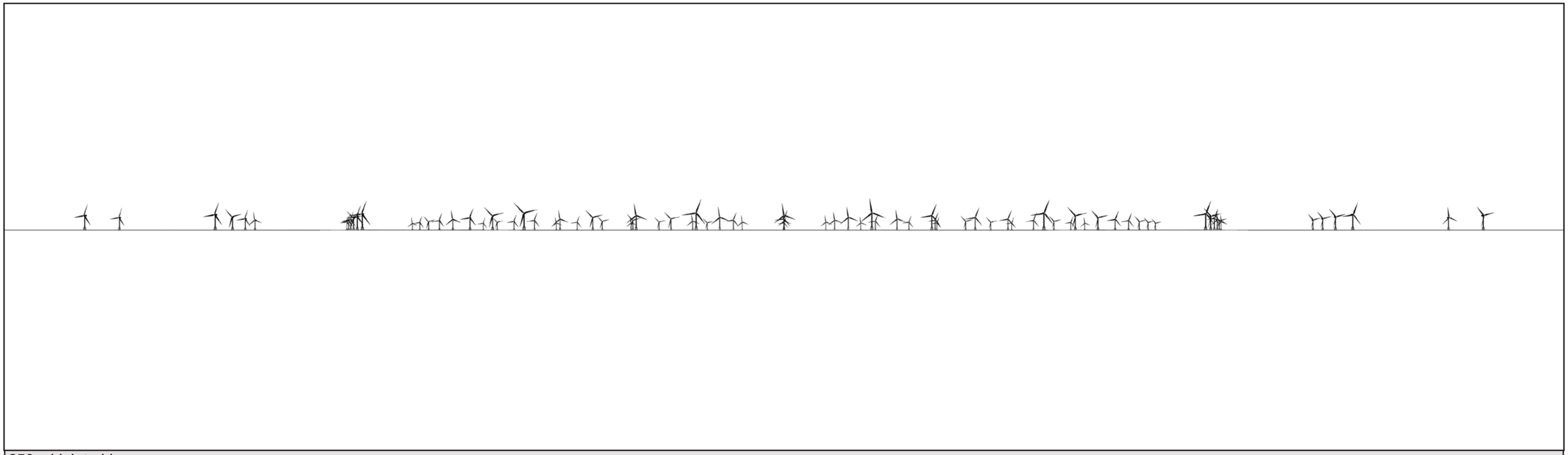
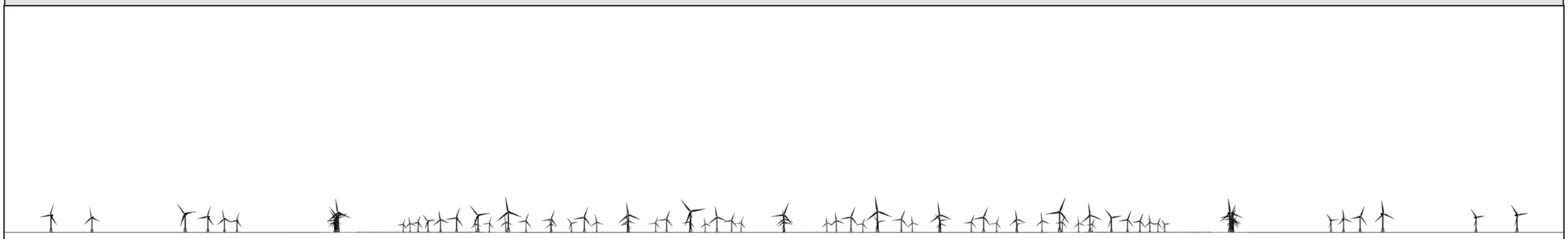
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 44km viewed from 6m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 9.4km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

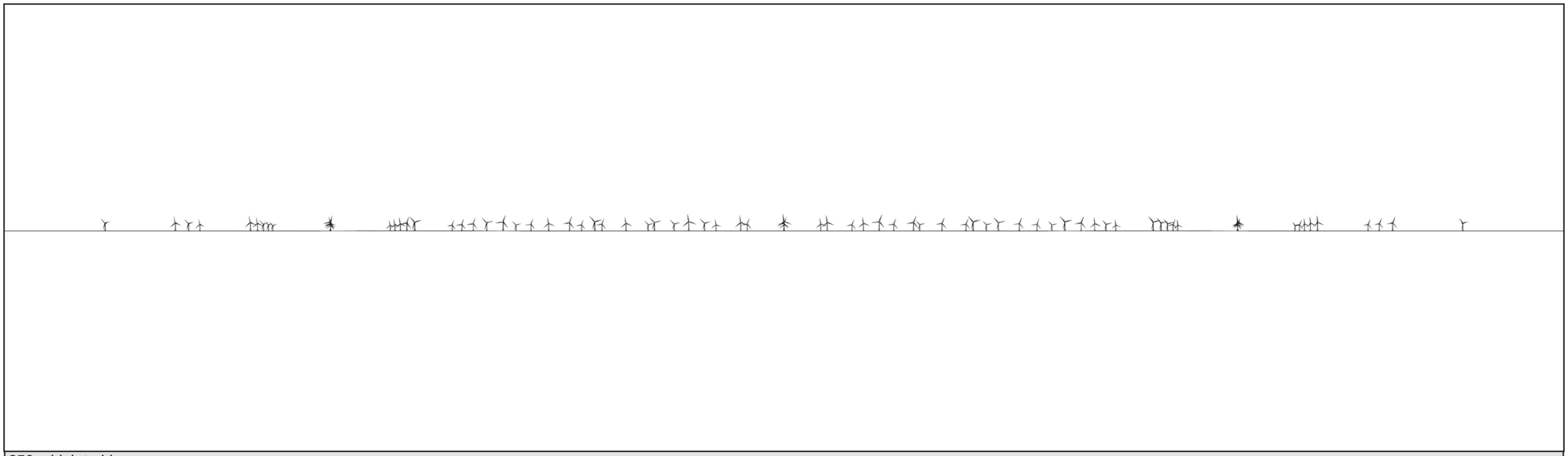


350m high turbines

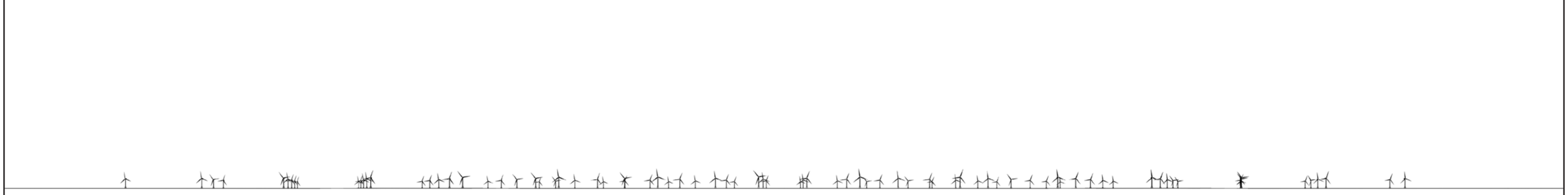


400m high turbines

Notes: An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction www.whiteconsultants.co.uk	Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast** **20MW turbines at 13km viewed from 22m elevation** **Figure x**
		Height to hub: 190m & 230m	Version: 1	
	Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	
	Distance to horizon: 18.1km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

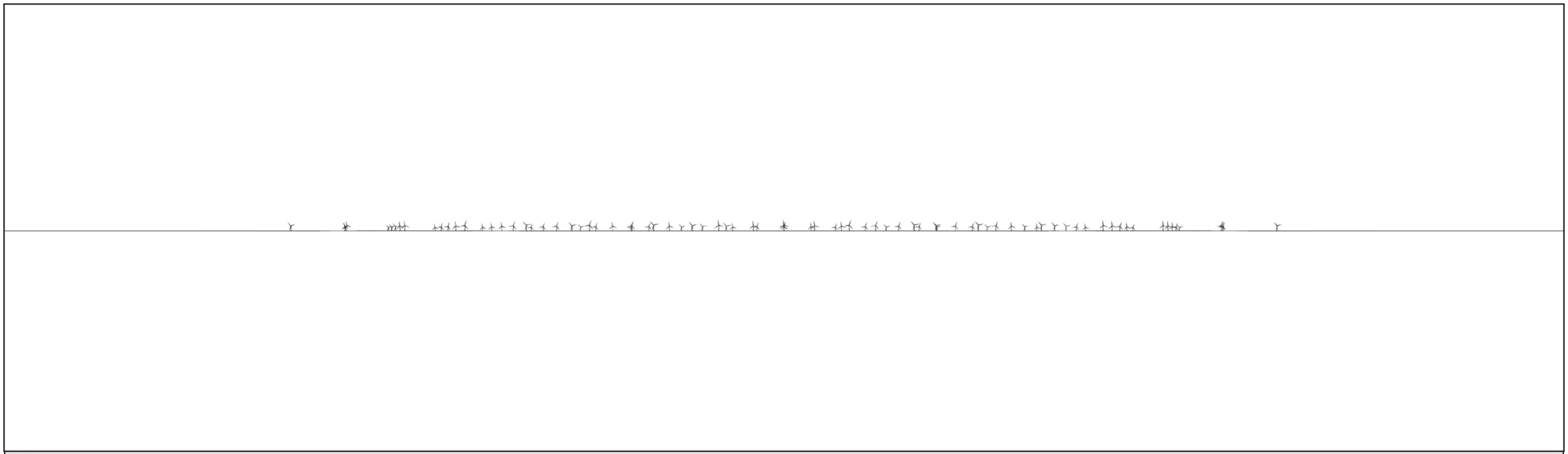


350m high turbines

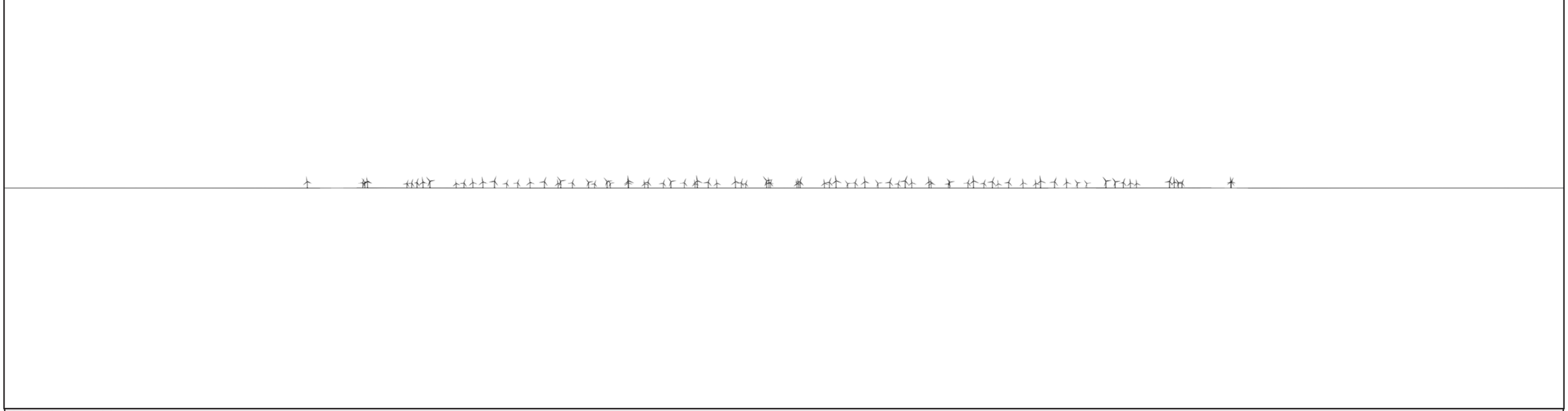


400m high turbines

Notes: An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction	Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
		Height to hub: 190m & 230m	Version: 1	**20MW turbines at 24km viewed from 22m elevation**
	Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
www.whiteconsultants.co.uk	Distance to horizon: 18.1km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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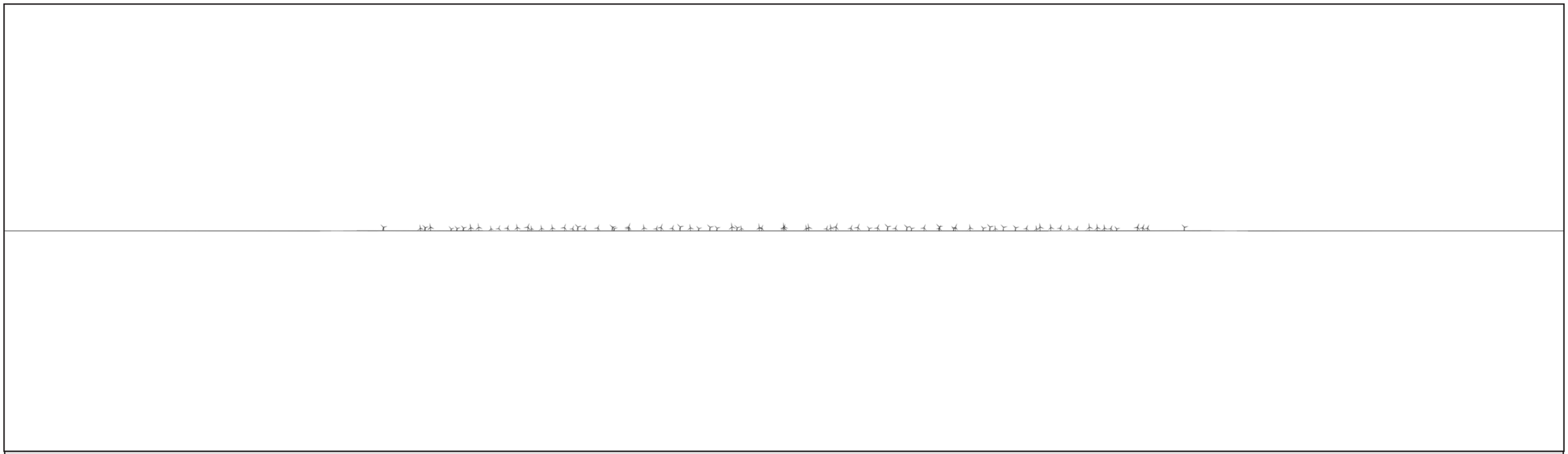
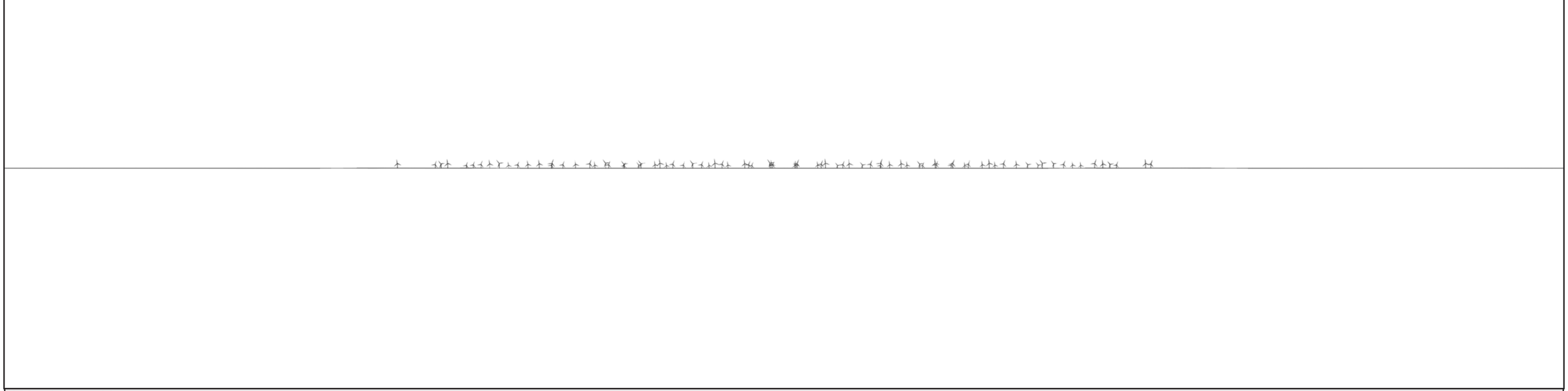
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 35km viewed from 22m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 18.1km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

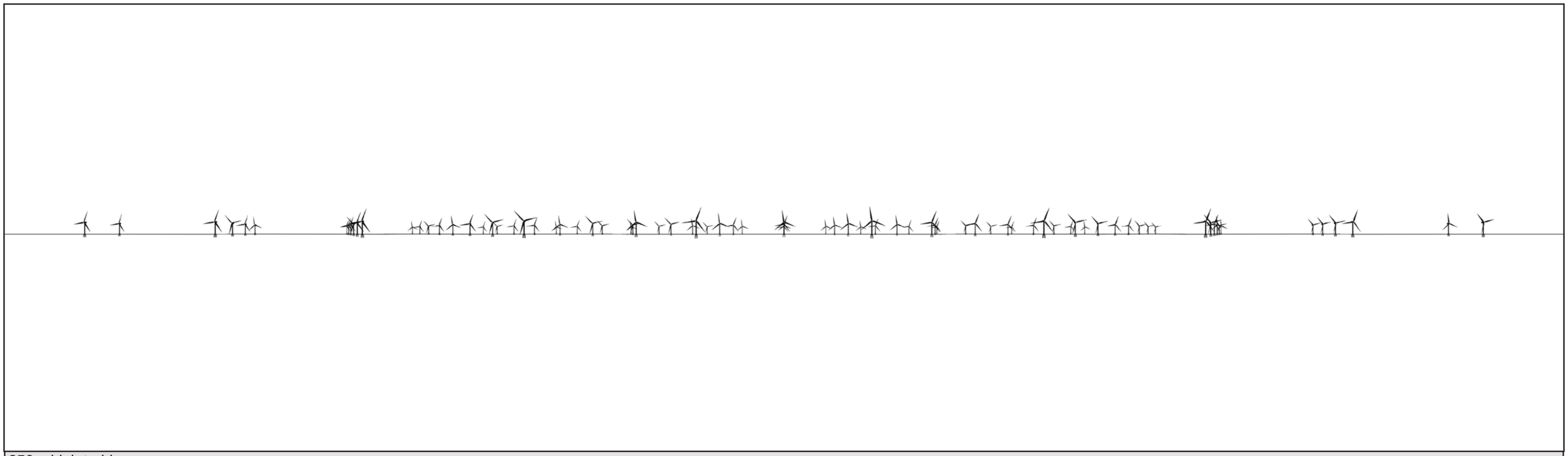


350m high turbines

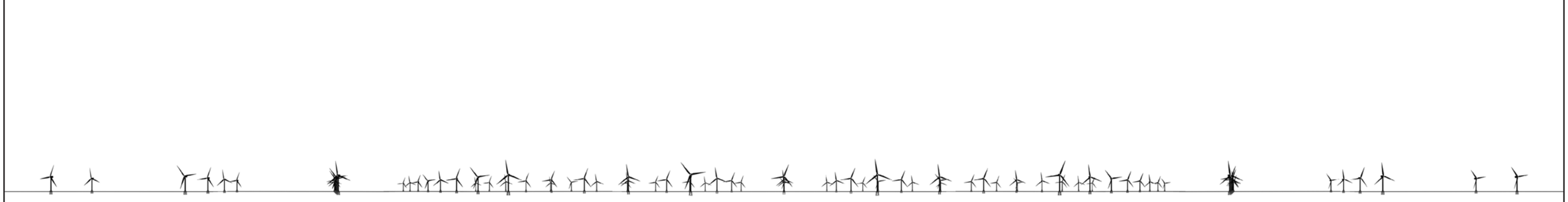


400m high turbines

Notes: An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction www.whiteconsultants.co.uk	Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast** **20MW turbines at 44km viewed from 22m elevation** **Figure x**
	Horizontal angle of view: Cylindrical Projection 75 degrees	Height to hub: 190m & 230m	Version: 1	
	Distance to horizon: 18.1km	Number of turbines: 84	Drawn: TM	
		Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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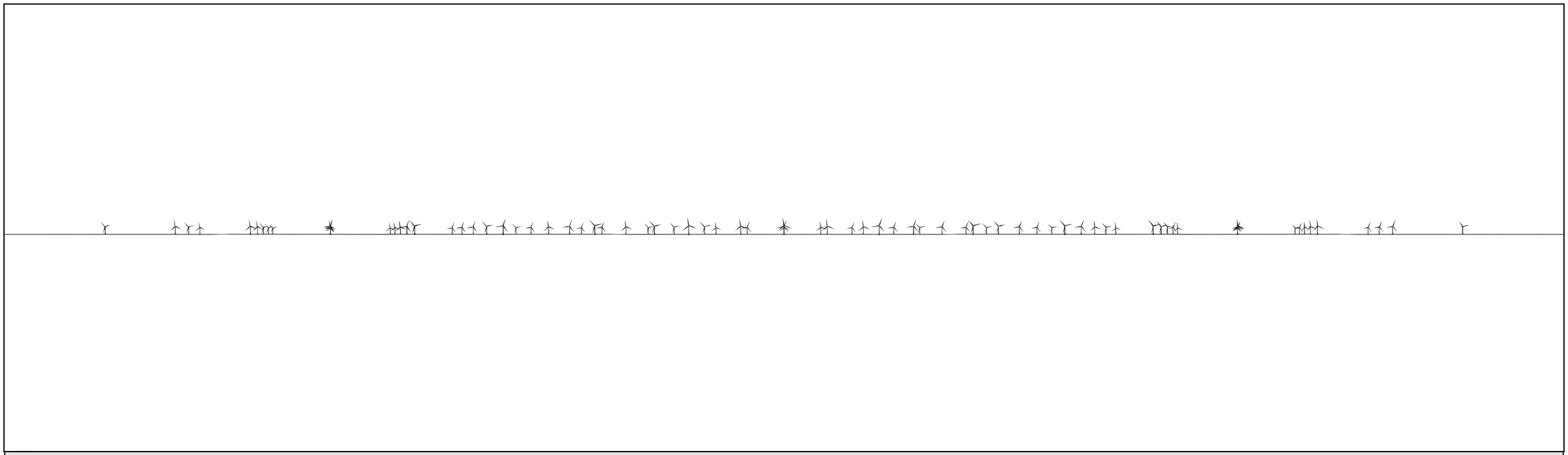
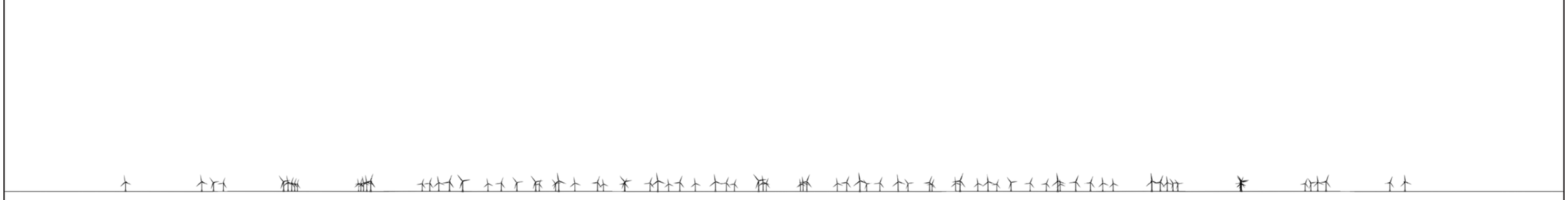
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 13km viewed from 100m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 38.6km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

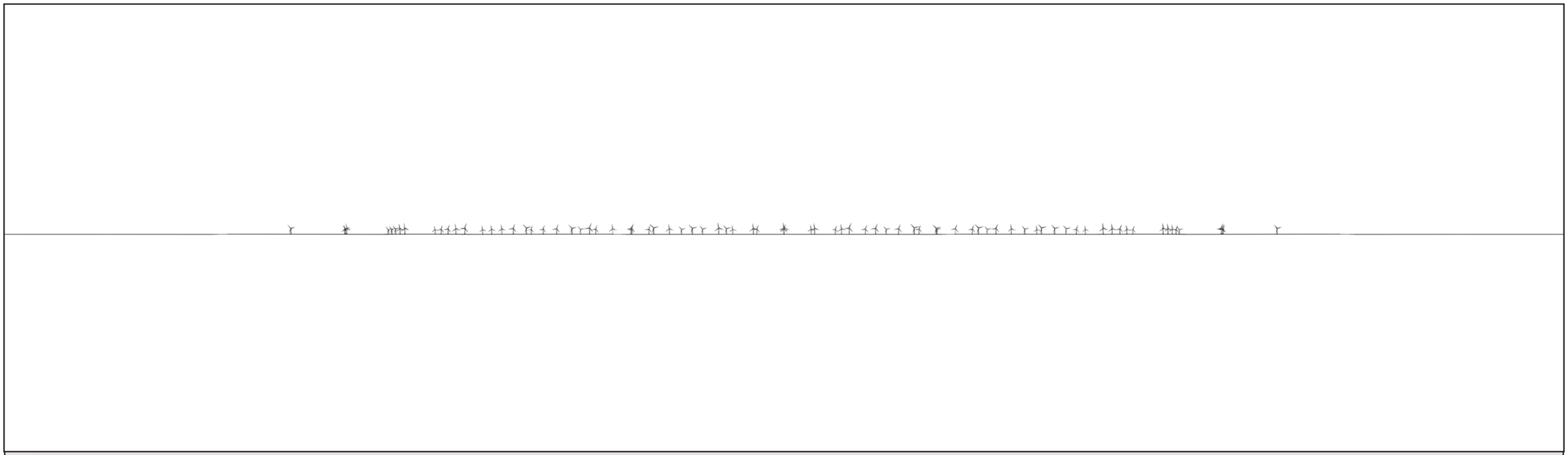


350m high turbines

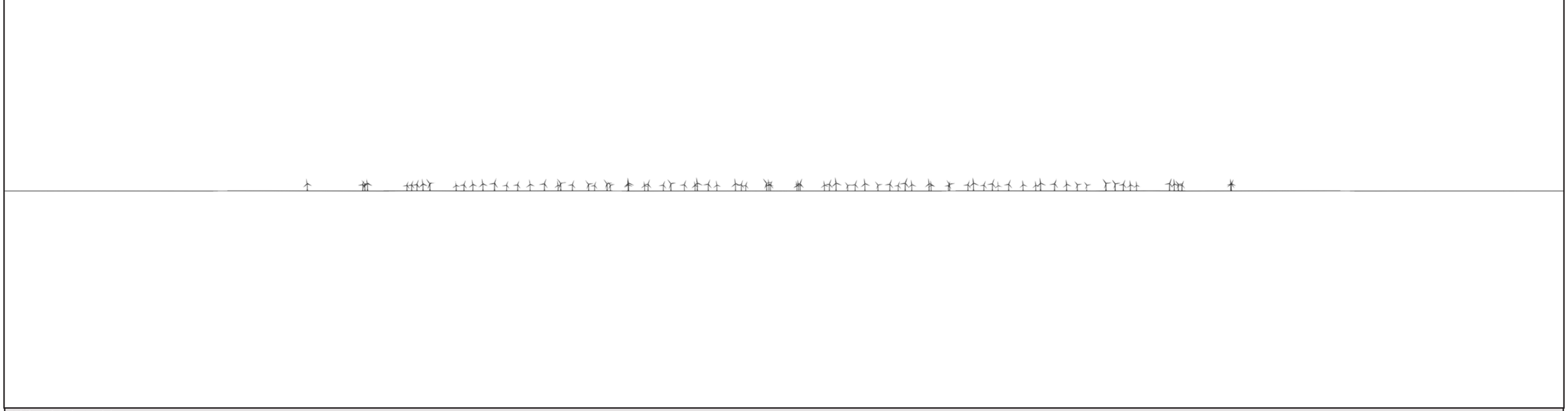


400m high turbines

Notes: An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction www.whiteconsultants.co.uk	Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast** **20MW turbines at 24km viewed from 100m elevation** **Figure x**
	Horizontal angle of view: Cylindrical Projection 75 degrees	Height to hub: 190m & 230m	Version: 1	
	Distance to horizon: 38.6km	Number of turbines: 84	Drawn: TM	
		Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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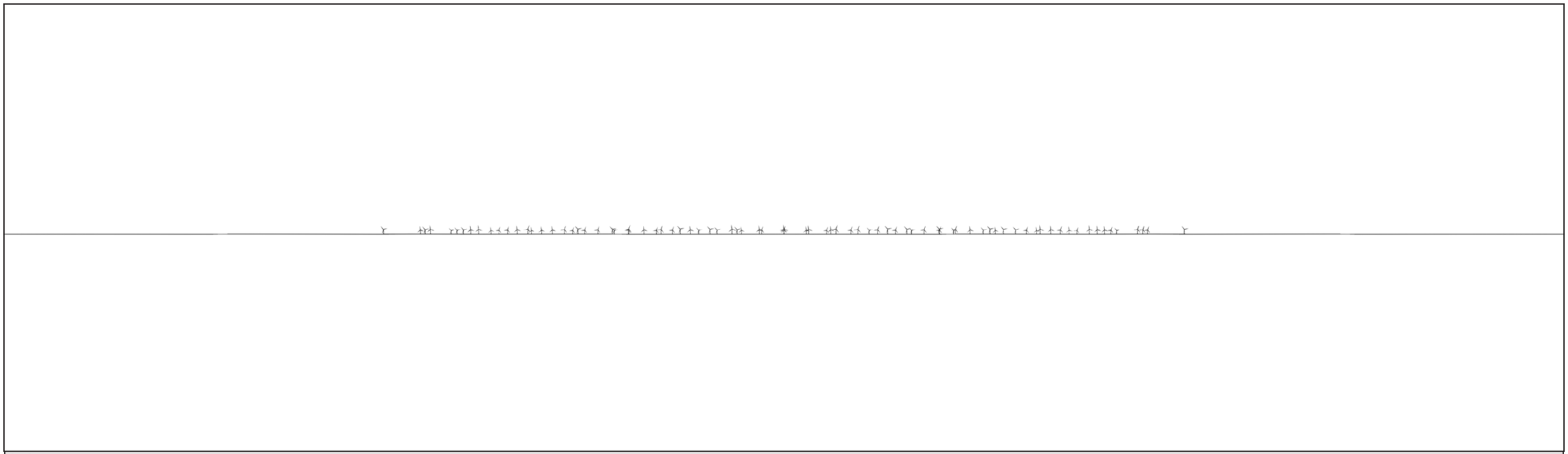
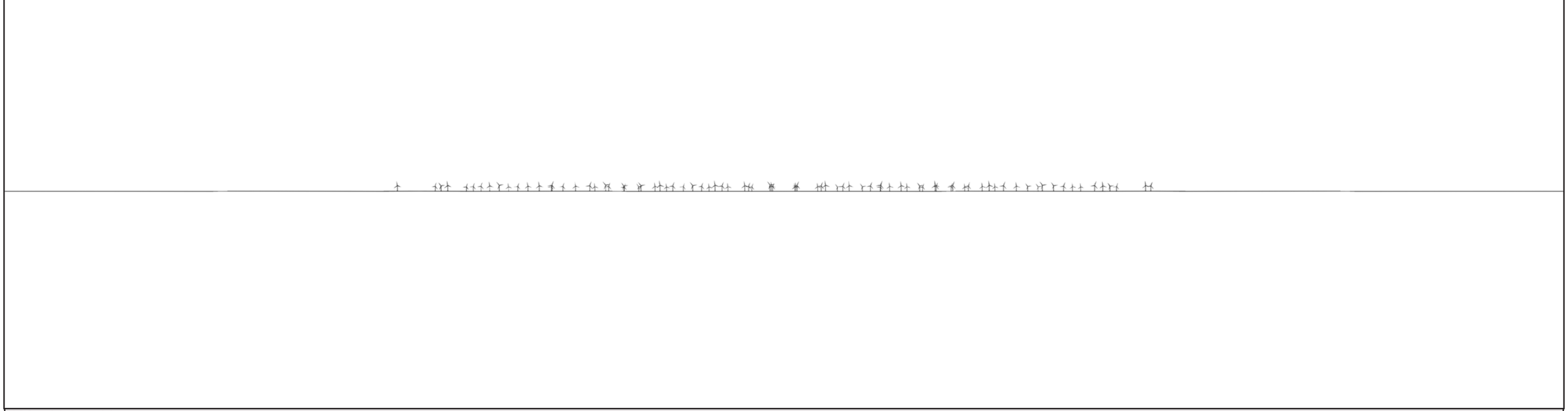
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 35km viewed from 100m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 38.6km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	



350m high turbines



400m high turbines

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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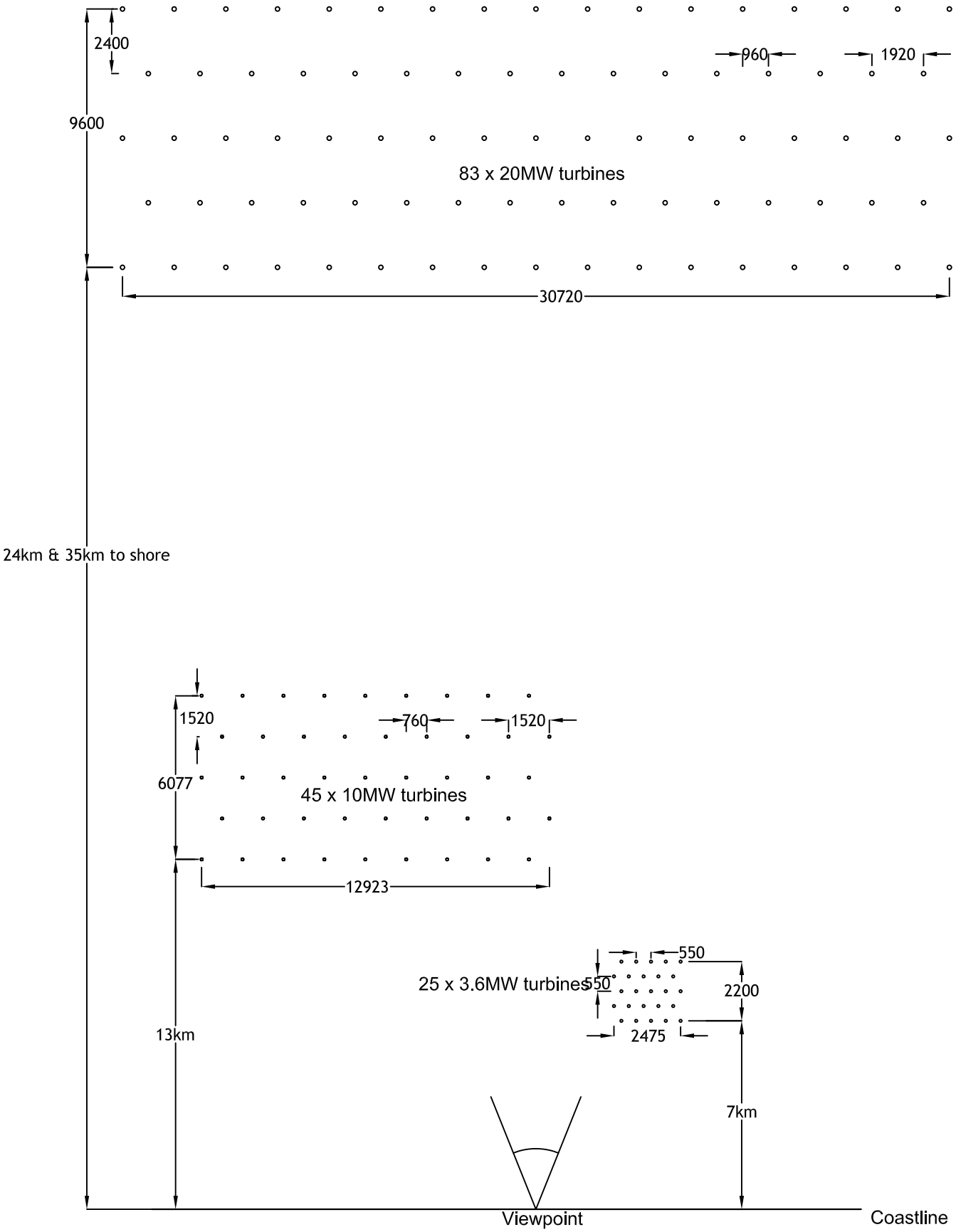
Viewing distance: 30cm for A3 sheet, 43cm for A2, 61cm for A1	Turbine height to blade tip: 350m & 400m	Date: 12/9/19	Title: **View of windfarm from coast**
	Height to hub: 190m & 230m	Version: 1	**20MW turbines at 44km viewed from 100m elevation**
Horizontal angle of view: Cylindrical Projection 75 degrees	Number of turbines: 84	Drawn: TM	**Figure x**
Distance to horizon: 38.6km	Spacing of turbines: 7.5 x 6 rotor diameter	Checked: SW	

Appendix E5 Cumulative wireline wind farm scenario plans



All Dimensions in metres
unless otherwise stated

Plan View
Scale 1: 200,000

Figure x - Cumulative Windfarm Scenario 20, 10 and 3.6MW Turbines

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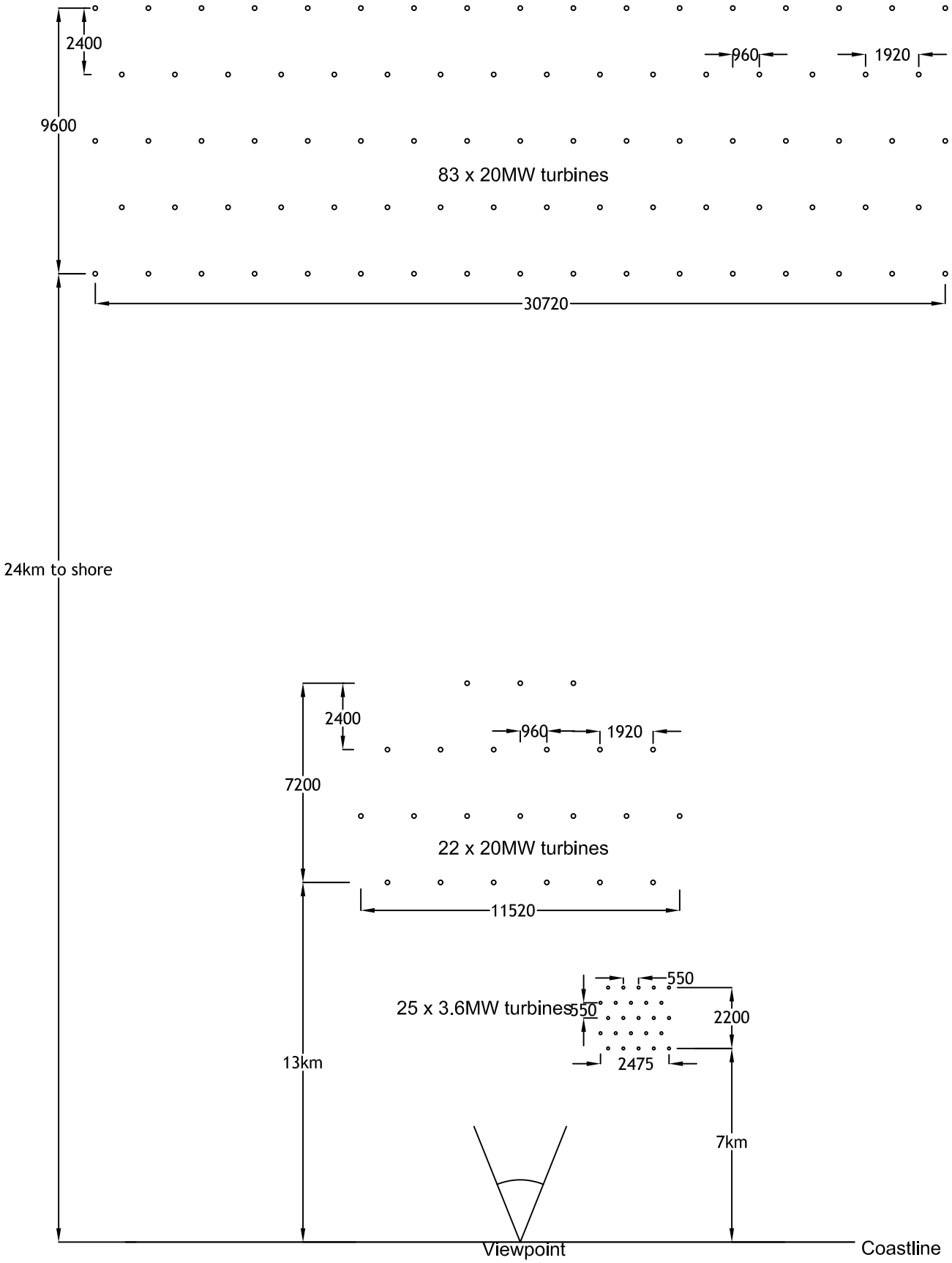

All Dimensions in metres
unless otherwise stated

Plan View
Scale 1: 200,000

Figure x - Cumulative Windfarm Scenario 20, 20 and 3.6MW Turbines

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Appendix E6 Cumulative wirelines

View of windfarms from coast from 22m elevation

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 25.5cm for A3 sheet, 36cm for A2, 51cm for A1	Turbine height to blade tip: 350m @ 24km, 220m @ 13km, 137m @ 7km	Date: 12/9/19	Title: **Cumulative Effects Scenario**
	Height to hub: 190m @ 24km, 125m @ 13km, 83.5m @ 7km	Version: 1	**84 x 20MW turbines at 24 km +**
Horizontal angle of view: Cylindrical Projection 90 degrees	Number of turbines: 84 + 45 + 25	Drawn: TM	**45 x 10MW at 13 km + 25 x 3.6MW at 7 km**
Distance to horizon: 18.1km	Spacing of turbines (m): 1920 x 2400, 1520 x 1520 & 550 x 550	Checked: SW	

View of windfarms from coast from 22m elevation

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 25.5cm for A3 sheet, 36cm for A2, 51cm for A1	Turbine height to blade tip: 350m @ 24km, 220m @ 13km, 137m @ 7km	Date: 12/9/19	Title: **Cumulative Effects Scenario**
	Height to hub: 190m @ 24km, 125m @ 13km, 83.5m @ 7km	Version: 1	**84 x 20MW turbines at 35 km +**
Horizontal angle of view: Cylindrical Projection 90 degrees	Number of turbines: 84 + 45 + 25	Drawn: TM	**45 x 10MW 13 km + 25 x 3.6MW at 7 km**
Distance to horizon: 18.1km	Spacing of turbines (m): 1920 x 2400, 1520 x 1520 & 550 x 550	Checked: SW	

View of windfarms from coast from 22m elevation

Notes:

An earth's radius of 7430km has been used to account for the combined effects the earth's curvature and light refraction

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Viewing distance: 25.5cm for A3 sheet, 36cm for A2, 51cm for A1	Turbine height to blade tip: 350m @ 24km, 350m @ 13km, 137m @ 7km	Date: 12/9/19	Title: **Cumulative Effects Scenario**
	Height to hub: 190m @ 24km, 190m @ 13km, 83.5m @ 7km	Version: 1	**84 x 20MW turbines at 24 km +**
Horizontal angle of view: Cylindrical Projection 90 degrees	Number of turbines: 84 + 22 + 25	Drawn: TM	**22 x 20MW at 13 km + 25 x 3.6MW at 7 km**
Distance to horizon: 18.1km	Spacing of turbines (m): 1920 x 2400, 1920 x 2400 & 550 x 550	Checked: SW	

Appendix F SVIA analysis of visual effects related to turbine numbers

Summary analysis of SVIA visual effects of offshore wind farms based on number of turbines in array

Wind farm	Round	Status	Turbine capacity in MW*	Maximum turbine height to blade tip (m)**	Max no. of turbines	Maximum windfarm capacity (MW)**	Nearest coast km	Existing windfarms in baseline?	No. of SVIA viewpoints	Low magnitude of effect***		Medium magnitude of effect	
										Average Distance km	Maximum Distance km	Average Distance km	Maximum Distance km
Hywind	Demo	Implemented	6	178	5	30	23	n	7	25.9	29		
Kincardine	SFD	Construction	7 (8.4)	176	7	50	15	n	23	23.2	36	19.6	35
Gunfleet Sands 2	1	Implemented	3.6	128	22	173	8.5	y	8	12.1	19.6		
North Hoyle	1	Implemented	2	107	30	60	7.5	n	12	18.3	21.8	11.2	13.5
Kentish Flats	1	Implemented	3	140 (115)	30	90	8	n	13	21.1	26.9	11.2	12.1
Thanet Extension		Submitted	08-Dec	250	34	340	8	y	18	26.3	44.1	16.1	19.9
Burbo Bank Extension		Implemented	3.6	223 (187)	36	254	7	y	18	21.7	30.6	15.1	22
East Anglia ONE North	3	Submitted	Dec-19	300	53	800	36	n	17	42.9	48.8		
Inch Cape	Sco 1	Consented	9.5	291	72	1000	15	y	26	42	52.5	29.7	34.8
Moray West	3	Consented	10-Dec	285	85	1116	22	y	25	40.8	53	25.8	28
Sheringham Shoal	2	Implemented	3.6	172 (135)	88	317	17	n	26	23.5	25	19.2	21
Walney 1	2	Implemented	3.6	202 (137)	93	186	15	y	17	23.2	23.4	16.5	18.8
Thanet Sands	2	Implemented	3	150 (115)	100	300	11	n	10	21.8	27.7	17.5	17.5
Westermost Rough A	2	Implemented	6	172 (177)	110	210	8	n	9	18.9	32.6	15.3	17.5
Seagreen	3	Consented	12.5	280	120	1500	27	y	13	35.3	38	32	32
Navitus Bay	3	Refused	8	200	121	970	14	n	12	24.9	28.2	19.5	23.1
Neart na Gaoithe	Sco 1	Consented	08-Oct	197 (208)	128	448	15	y	18	32.9	39	28	28
West of Duddon Sands	2	Implemented	3.6	150	139	389	14	y	17	23.3	26.3	11	14.6
Greater Gabbard	2	Implemented	3.6	170 (131)	141	504	23	n	6				
Beatrice Offshore	Sco 1	Construction	7	198	142	588	22	n	16	29.7	33.1	22.2	25.6
Gwynt y Mor	2	Implemented	3.6	140	160	576	18	y	36	22.3	35.8	14.3	15.3
Rampion	3	Construction	3.6-7 (3.45)	210 (140)	175	400	13	n	29	26.4	29.5	19.9	30
Docking Shoal	2	Withdrawn	03-Jun	145	177	540	14	y	8	22.3	26.3	19.1	19.1
Walney Extension		Implemented	8.25	222	207	659	19	y	17	25.6	32.3		
London Array	2	Implemented	3.6	175 (147)	271	630	21	y	18	21	21		
Atlantic Array	3	Withdrawn	5	180	278	1390	14	n	37	28.4	37.5	20.9	27.5

* Shows as assessed in SVIA (implemented output in brackets) ** in SVIA (implemented height or number in brackets). *** Low magnitude category includes equivalent of low and medium/low

	Table ordered in terms of number of turbines from lowest to highest
	Lowest distance for effect
	Highest distance for effect

Appendix G Seasonal visibility percentage variation at coastal stations

Coastal Surface Stations – Visibility Percentage Ranges

1. St Athan (2998E, 1683N) (49m AMSL)

Across a 10 year spread, 16-20km and 26-30km are the most common visibility ranges recorded at St Athan surface station. Any visual observations beyond 30km are very rare which suggests a distinct visual cut off point. The patterns of seasonal variations on a monthly basis are very clear within the visual ranges. As expected (taking into account meteorological phenomenon), the summer months (June – September) experience a much larger 'maximum percentage' visual range (26 - 30km) in comparison to the winter months (November – February) which experience a much lower variable range (6-20km).

Visibility Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year
0 to 5	13.3	15.8	19.0	11.9	11.5	6.6	6.7	6.2	8.0	12.7	10.5	17.0	11.6
6 to 10	18.2	21.3	18.4	19.4	17.2	10.4	9.1	9.3	12.0	15.6	14.6	17.4	15.2
11 to 15	21.7	20.8	18.9	19.0	16.8	16.8	13.2	12.3	13.7	15.9	17.3	16.2	16.9
16 to 20	18.5	17.4	16.0	16.5	18.5	19.9	17.9	14.2	14.4	16.3	18.5	17.4	17.1
21 to 25	13.0	11.6	11.3	14.0	15.4	18.0	19.5	17.0	16.0	14.3	15.9	13.7	15.0
26 to 30	11.5	9.5	11.6	14.3	15.7	22.0	25.6	25.6	22.7	17.0	16.5	12.9	17.1
31 to 35	2.5	2.0	2.5	2.8	2.6	3.3	4.7	7.7	6.9	4.4	4.0	3.4	3.9
35+	1.3	1.4	2.3	2.0	2.3	3.0	3.2	7.7	6.3	3.9	2.7	2.0	3.2

2. Rhyl (2994E, 3746N) (77m AMSL)

Across a 10 year spread, 26-30km is the most common visibility range recorded at Rhyl surface station. There are no obvious patterns of seasonal variability within this dataset. In general, visibility appears to remain consistently throughout the 21-30km range. At an average of 10% all year round, observations beyond 30km are more regular, in particular from September – November (14.3 – 14.9%). There does appear to be a significant visual range consistent throughout the year which altogether does not run in parallel to the Taylor (1998) study, which suggested visibility scores fall drastically at around 18km.

Visibility Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year
0 to 5	7.5	9.1	10.5	9.2	9.3	6.0	5.9	10.0	6.7	9.5	6.3	9.0	8.3
6 to 10	11.1	12.0	14.0	14.9	13.4	11.8	10.9	11.4	13.8	13.6	10.8	19.0	13.1
11 to 15	8.6	9.0	9.2	10.5	10.3	12.9	13.0	10.6	10.5	11.0	7.6	11.0	10.3
16 to 20	11.3	13.5	13.4	12.7	14.1	20.7	21.0	19.4	14.4	13.2	12.7	13.0	14.9
21 to 25	21.3	19.4	17.5	15.1	16.8	20.3	22.6	18.7	15.1	13.9	17.9	18.6	18.1
26 to 30	24.2	21.8	18.8	18.4	20.0	19.2	17.6	17.5	18.3	18.0	23.1	16.3	19.4
31 to 35	6.0	6.0	6.2	6.7	6.5	4.3	4.1	4.9	6.3	7.1	7.3	5.2	5.9
35+	9.9	9.2	10.4	12.7	9.6	4.9	4.8	7.5	14.9	13.6	14.3	7.8	10.0

3. Leuchars (3468E, 7209N) (10 AMSL)

Across a 10 year spread, visibility beyond 35km is the most common range recorded at Leuchars surface station. In comparison to all of the other observation stations, this figure is extremely high and therefore suggests that there may be some discrepancies in the data. As reported by SNH (2005) based on work by Husar & Husar (1998), the visual range of Scotland is significantly higher than that for England and Wales which may provide some indication of why the visual range is so high. However, this study only looked at the coefficient of air clarity (haze) rather than meteorological conditions. Looking at distances beyond 30km in more detail, the table below indicates that there is a clear pattern occurring every five kilometres in that the frequency of recordings varies between high and low. It is not clear why these fluctuating observations would occur at these distances.

Visibility Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year
0 to 5	6.8	8.8	12.4	11.7	7.7	6.8	10.0	11.2	8.3	7.7	5.3	8.2	8.7
6 to 10	8.7	8.7	9.2	8.2	8.9	8.7	8.0	7.7	7.3	7.8	8.1	12.0	8.6
11 to 15	10.2	10.4	8.8	9.6	10.4	9.1	8.5	8.1	9.0	10.4	9.7	11.8	9.7
16 to 20	12.8	11.4	10.0	10.6	11.8	10.2	11.1	10.7	11.3	12.5	10.8	10.8	11.2
21 to 25	10.7	8.8	10.0	8.6	9.7	9.6	10.1	8.6	10.7	10.0	9.1	10.1	9.7
26 to 30	12.8	11.4	9.0	12.5	11.8	11.6	11.8	12.1	13.1	12.2	11.3	11.5	11.8
31 to 35	3.6	4.1	5.1	5.2	5.2	5.9	5.7	5.5	5.8	6.2	5.1	3.7	5.1
35+	34.2	36.4	35.6	33.6	34.4	38.2	34.7	36.2	34.4	33.4	40.7	31.9	35.3

4. Weybourne (6069E, 3436N) (21m AMSL)

Across a 10 year spread, 26-30km is the most common visibility range recorded at Weybourne surface station. Any visual observations beyond 30km are very rare which suggests a distinct visual cut off point. The patterns of seasonal variations on a monthly basis are very clear within the visual ranges. As expected (taking into account meteorological phenomenon), the summer months (June – September) experience a much larger 'maximum percentage' visual range (26 - 30km) in comparison to the winter months (November – February) which experience a much lower variable range (6-15km).

Visibility Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year
0 to 5	9.8	14.7	16.7	12.4	7.8	6.8	8.0	8.7	8.9	9.2	9.4	12.6	10.4
6 to 10	19.4	20.9	18.6	19.5	14.2	10.6	13.3	12.9	13.1	13.3	15.3	19.4	15.9
11 to 15	17.0	20.2	19.5	18.0	16.4	12.8	15.2	13.9	14.6	14.4	22.5	18.9	16.9
16 to 20	17.7	15.7	17.0	16.5	15.0	15.6	15.6	15.8	16.8	17.2	19.3	17.9	16.7
21 to 25	17.8	13.6	13.9	16.3	16.3	20.7	18.3	19.8	18.3	18.4	15.4	14.2	16.9
26 to 30	16.2	12.7	11.6	14.4	23.2	26.8	24.2	25.1	25.2	22.7	15.2	14.1	19.3
31 to 35	1.5	1.8	1.6	1.9	3.8	4.0	2.9	3.2	2.6	3.6	2.1	2.2	2.6
35+	0.6	0.4	1.1	0.9	3.3	2.6	2.5	0.7	0.4	1.1	0.9	0.7	1.2

5. Hurn (4117E, 0978N) (10m AMSL)

Across a 10 year spread, 26-30km is the most common visibility range recorded at Hurn surface station. However, upon reflection, the months June-November have recorded 21-25km as the most frequent observation. There are no clear seasonal patterns within this dataset; however a higher visual range is present during the summer months as would be expected with increased levels of sunlight.

Visibility Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year
0 to 5	14.0	14.1	16.8	11.5	9.8	4.9	5.1	7.4	10.3	13.0	12.6	19.6	11.6
6 to 10	15.5	20.8	18.6	16.9	14.0	10.6	9.8	10.3	12.9	15.7	15.9	18.8	15.0
11 to 15	15.5	13.9	13.2	13.8	14.0	13.3	14.1	11.4	13.7	13.7	12.1	12.4	13.4
16 to 20	14.0	11.7	11.4	13.8	14.4	16.7	18.0	15.6	16.1	15.2	15.1	11.5	14.5
21 to 25	16.2	12.4	15.5	16.1	18.3	21.6	20.2	22.9	19.7	18.1	19.1	14.6	17.9
26 to 30	19.1	17.6	17.8	17.8	18.4	21.1	20.0	21.1	17.8	16.3	18.1	15.6	18.4
31 to 35	3.4	4.8	3.3	5.2	5.7	5.4	5.3	4.8	4.4	4.1	4.0	3.7	4.5
35+	2.3	4.7	3.3	4.7	5.4	6.4	7.4	6.6	5.1	3.9	3.0	3.7	4.8

Appendix H North Wales site visit 2016

Offshore Energy Strategic Environmental Assessment

Review and update of Seascape and Visual Buffer study for Offshore Wind farms

ADDENDUM: NORTH WALES COAST SITE VISITS

for

Hartley Anderson

April 2016

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with

Northumbria University

CONTENTS

1. Introduction

1.1. The North Wales coast was visited in the 2008 Round 3 Seascape Study to explore a range of issues in terms of the visibility and visual intrusion of existing and proposed offshore windfarms. At the time there were two Round 1 windfarms constructed at North Hoyle and Burbo Banks and a third was part way through construction with bases in place at Rhyl Flats. These were around 7-8 km offshore. In addition, the Gwynt y Mor Round 2 windfarm, around 13-16km offshore, had recently been given approval. This has now been constructed and can be viewed along with the other constructed developments. It is therefore pertinent to revisit the area to assess the individual and cumulative effects of these windfarms and comment on the Gwynt y Mor seascape and visual impact assessment (SLVIA) photomontages. The previous report commented on the North Hoyle assessment and wireframes which are not considered to require review or commenting upon further. The Burbo Bank extension wind farm is consented but not yet under construction.

2. Method

2.1. The area was visited on two days- 17th and 30th March 2016 and one viewpoint, at Llandudno promenade, was visited at night on 16 March. The visibility was only poor to good with haze on 17th March which necessitated a second visit on 30ty March which benefited from good to very good visibility. However, the weather on the 2nd visit included sunny spells, high cloud and some haze and as such did not represent a worst case visibility scenario such as very good/excellent (see Appendix B). The photos taken on 17th March were not of sufficient quality/resolution to put in the report. Sample photos to illustrate this report have been used from the 30th March visit only. Six viewpoints were visited to allow comparison with the Gwynt y Mor Study. From these, four have been assessed to give a representative range of viewpoints from different elevations, angles and distances:

- Great Orme car park
- Llandudno promenade, War Memorial
- Rhos on Sea seafront
- Prestatyn, East of Nova Centre

2.2. One viewpoint was visited at night to establish the effect of lighting:

- Llandudno promenade, War Memorial

2.3. The other two viewpoints visited were:

- Abergele seafront
- Bryn Llwyn viewpoint, near Gwaenysgor

2.4. Photographs were taken at each viewpoint using a Canon EOS 600D 18MP digital SLR with a Canon lens at 35mm [equivalent to around 50mm for SLR camera] on a tripod. It should be noted that this lens setting may have been subject to slight variation as it was not taken using a fixed lens and this has been taken into account in the reporting. At each viewpoint photographs were taken over a period of around 15 minutes to optimise the potential visibility. Observations of visibility of wind farms were made and conclusions on visual impact drawn. At some viewpoints comparisons were drawn between SVIA photomontages and the

completed windfarms and photos prepared for this report. The observations were made by a team of two chartered landscape architects. The record of each assessed viewpoint is set out in **Appendix A.** Visibility definitions are set out in **Appendix B.** The definitions for scale of effect are as set out for magnitude of change in DTI (2005) in **Appendix C**. This is consistent with the approach taken for assessing the wireframes.

3. Observations and Conclusions

3.1. The following observations were made:

- As the study period has been in the winter months starting in January 2016 it has been difficult to find days when the visibility is sufficient to assess the effects of Gwynt y Mor and the other windfarms. This reinforces the statistics of the relatively limited number of days that windfarms further offshore are easily visible and/or may have a significant visual impact. This is expanded upon in Appendix C of the main report.
- Different weather conditions had significant effects on the visibility of turbines on the site visits. When sunlight was on turbines, especially when behind the viewer, they were highly visible from long distances eg Gwynt y Mor from 16-28km. Conversely, in overcast and hazy conditions turbines at 8km were difficult to see and could be barely perceptible at around 14km. It was observed that there were variations across the windfarms in variable conditions with some turbines in shade beneath cloud, while others were in sun. Therefore, the windfarm turbines did not appear to be as a strong coherent group in these variable conditions. The closer the windfarm, the less this effect changed the perception of the windfarm eg 8-10km compared to 13-20km.
- The sea state at the time of the second, 30th March 2016, inspection was slight and the horizon line very evident and clear by comparison to windier/rougher sea conditions. This contributed to the increased visibility and clarity of the turbines.
- From the higher viewpoints, the windfarms looked more coherent as the whole of the wind farm and their layout could be seen clearly against the darker sea area. The difference in scale and detail between different windfarms could also be compared eg Gwynt y Mor and Rhyl Flats windfarms from Great Orme.
- From the lower viewpoints, the windfarms looked further away on the horizon, although the turbines were still prominent when sunlit but were often seen against a lighter sky which reduced their effect. The layout of the windfarm was less easy to comprehend than when viewed from higher viewpoints.
- The 35mm digital SLR lens (equivalent to the 50 mm SLR lens) photographs made the windfarm look smaller than when viewed in real life.
- The Gwynt y Mor photomontages showed a different layout to that that was implemented. They also appeared to make turbines smaller than they appeared in real life even though they were for 5MW turbines and those implemented were 3.6MW turbines. Where tested, the photomontage designed to illustrate a view from a viewing distance of around 400mm

had to be held at about 200mm to achieve a similar effect to that seen on site.

- The three Round 1 windfarms are spaced such that they are well separated and sit within an overall seascape as prominent elements but without dominating it apart from adjacent short stretches of coast. While the North Hoyle layout is organised and coherent allowing views to the horizon, there is blade overlapping. It is very clear that the grid is rectilinear and at right angles to the coast. This gives it a semi-industrial appearance. The Burbo Bank layout appears as a well separated 'drift' of turbines when viewed from along the coast in Wales. The Rhyl Flats windfarm is the least successful with rows parallel, and centrally placed, to the concave part of the coast. This makes the layout appear over-regimented and forming the focus of many views. The juxtaposition of the three different layouts is disruptive to the composition of the seascape.
- The Round 2 Gwynt y Mor windfarm is larger, extending further along the coast and is further out to sea than the Round 1 windfarms. It is therefore visible in good visibility at all the viewpoints. The distance of the windfarm away from the coast and its spread means that much of the array did not appear to be in regimented rows for the most part, although this was apparent in places. In many cases, though, there was overlapping between the turbines of the various windfarms which led to a confused image in clear conditions.
- At night, navigational lighting on each turbine was highly apparent at at least a distance of 16km in the case of Gwynt y Mor. Rhyl Flats was more apparent at 11km. The red aviation lighting was brighter but less numerous as it lies on the edges of arrays and could be seen for long distances in good visibility conditions eg Gwynt y Mor from 16-23km. the actual turbines structures themselves could not be seen. Therefore, at night, Gwynt y Mor and Rhyl Flats look like another coastline with a large industrial installation with tall structures. This effect was significantly adverse at a distance of 16km.

3.2. The four existing windfarms off the Welsh Coast combined with the Burbo Banks windfarm to the east create a windfarm seascape with wind turbines as the dominant element in views out to sea along the coast in many places between the Great Orme and the Point of Ayr. This does not mean that offshore wind farm development is inappropriate for the majority of this stretch of coastline due to its particular characteristics. However, it raises the issue of the suitability of this approach in other seascapes and the capacity of this seascape to absorb more or larger development. The spread of Gwynt y Mor and Rhyl Flats combined taking the majority of the horizon in the framed view from Llandudno promenade is not a desirable precedent. Burbo Banks extension with significantly larger turbines relatively close inshore is likely to exacerbate the effect on the eastern stretch of the coast.

APPENDIX A: OESEA 3 Seascape Site Visit Records

SITE VISIT: 17 March 2016

Date:	17/03/16		Time [24h]:	10.00
Location:	Great Orme		Height m AOD	201m
Eastings	Approx. 276660		Northings:	Approx. 383405
Distances [nearest] from windfarms	Gwynt y Mor: 16.2 km	North Hoyle: 26.9 km	Rhyl Flats: Around 12km	Burbo Bank: -
Weather Conditions	Cloudy with sea mist			
Perceived Visibility	Poor			
Light conditions	Overcast			
Commentary	**General:** Relatively poor weather conditions mean that no windfarm can be seen. **Gwynt y Mor:** Description of effect: not visible **North Hoyle:** Description of effect: not visible **Rhyl Flats:** Description of effect: not visible **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: none visible			
Photomontage comments/comparisons with site view and photos	Not able to judge in visibility conditions.			

Date:	17/03/16		Time [24h]:	10.30
Location:	Llandudno promenade by War Memorial		Height m AOD	6m
Eastings	Approx. 278200		Northings:	Approx. 382600
Distances [nearest] from windfarms	Gwynt y Mor: 16 km	North Hoyle: 25.7 km	Rhyl Flats: Around 11km	Burbo Bank: -
Weather Conditions	Cloudy and hazy with some sun			
Perceived Visibility	Moderate/poor			
Light conditions	Slightly overcast			
Commentary	**General:** Relatively poor weather conditions mean that only part of the Gwynt y Mor windfarm can be seen and the turbines are indistinct. North Hoyle and Burbo Bank turbines are not visible. **Gwynt y Mor:** Description of effect: barely perceptible Scale of effect : very small **North Hoyle:** Description of effect: not visible **Rhyl Flats:** Description of effect: perceptible but hazy Scale of effect : small **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: variable visibility means the full extent of windfarms are not visible but appear to fill the majority width of view framed between Great Orme and Little Orme Scale of effect: small/ medium			
Photomontage comments/comparisons with site view and photos	Difficult to judge in visibility conditions.			

Date:	17/03/16		Time [24h]:	11.52
Location:	Rhos on Sea		Height m AOD	6m
Eastings	Approx. 284310		Northings:	Approx. 380810
Distances [nearest] from windfarms	Gwynt y Mor: 14.3 km	North Hoyle: 20.8 km	Rhyl Flats: Around 8km	Burbo Bank: -
Weather Conditions	Cloudy and hazy with some sun			
Perceived Visibility	Good with haze			
Light conditions	Combination of sun and shade from cloud cover			
Commentary	**General:** Moderate weather conditions mean that some of the Gwynt y Mor windfarm can be seen with the turbines picked out by sun visible. Rhyl Flats turbines are all visible. Burbo Bank turbines are not visible. **Gwynt y Mor:** Description of effect: noticeable with turbines clearly stacking in parts Scale of effect : moderate **North Hoyle:** Description of effect: Just apparent Scale of effect : very small **Rhyl Flats:** Description of effect: prominent- very clear Scale of effect : large **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: the two windfarms overlap each other and therefore the turbines in different patterns and at different distances interfere with each other visually. Scale of effect: large			
Photomontage comments/comparisons with site view and photos	No comparison made.			

Date:	17/03/16		Time [24h]:	13.17
Location:	Nova Centre, Prestatyn		Height m AOD	8m
Eastings	Approx. 306235		Northings:	Approx. 383835
Distances [nearest] from windfarms	Gwynt y Mor: 12.6 km	North Hoyle: 7.8 km	Rhyl Flats: approx 14 km	Burbo Bank: -
Weather Conditions	Hazy with sun			
Perceived Visibility	Moderate			
Light conditions	Sunny			
Commentary	**General:** The haze means that Gwynt y Mor windfarm is indistinct and hardly visible. North Hoyle turbines are visible and appear close but the haze makes their outlines less distinct. Rhyl Flats and Burbo Bank turbines are not visible. **Gwynt y Mor:** Description of effect: barely perceptible – only some turbines visible Scale of effect : small **North Hoyle:** Description of effect: the turbines are prominent and stand out. The stacking of the turbines in a linear grid is highly apparent. Scale of effect : large **Rhyl Flats:** Description of effect: none Scale of effect : **Burbo Bank:** Description of effect: none **Cumulative**: Description of effect: north Hoyle contributes the majority of effect although turbines are apparent further to the west. Scale of effect: large			
Photomontage comments/comparisons with site view and photos	The Gwynt y Mor photomontage needed to be held at a viewing distance of 200mm to replicate the apparent size of the implemented turbines. This contrasts with the stated viewing distance of around 400 mm. It should also be noted that the Gwynt y Mor turbines illustrated in the photomontage are stated as 5 MW compared to the 3.6 MW implemented. Therefore it is clear that the turbines in reality are larger than those illustrated in the photomontage and are closer to the 260mm depth photograph.			

SITE VISIT: 30 March 2016

Date:	30/03/16		Time [24h]:	12.50
Location:	Great Orme		Height m AOD	201m
Eastings	Approx. 276660		Northings:	Approx. 383405
Distances [nearest] from windfarms	Gwynt y Mor: 16.2 km	North Hoyle: 26.9 km	Rhyl Flats: Around 12km	Burbo Bank: -
Weather Conditions	Sunny with generally clear skies but some cloud			
Perceived Visibility	Very good			
Light conditions	Overcast on Great Orme but sunny out to sea			
Commentary	**General:** Fairly clear visibility but some atmospheric interference. Both Gwynt y Mor and Rhyl Flats windfarms can be seen clearly with North Hoyle apparent beyond the latter. The yellow bases are apparent in the closer two windfarms, being more vivid in the closer turbines. **Gwynt y Mor:** Description of effect: very noticeable to prominent, medium proportion of horizon, seen in the context of the sea surface with it as the primary backcloth rather than the sky but some turbines breach the horizon. It forms a distinct large cluster of many turbines relatively close together, occasionally stacking. Scale of effect : large **North Hoyle:** Description of effect: visible behind Rhyl Flats creating some minor visual interference . Scale of effect : minor **Rhyl Flats:** Description of effect: prominent, covering a small/medium proportion of horizon forming a distinct cluster or apparently wider spaced turbines. Scale of effect : large **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: combined windfarms cover a large proportion of the horizon. They appear as distinct clusters although they overlap slightly. They form the focus of the view. Scale of effect: large			
Photomontage comments/ comparisons with site view and photos	The Gwynt y Mor photomontage, though relatively accurate proportionally, understates the perceived size of the development when assessed on site and in comparison with a 260mm depth photograph. The size of turbine and layout of windfarm actually implemented is different from the photomontage. The photomontage illustrates 5MW turbines at relatively wide spacings whereas the implemented windfarm uses 3.6MW turbines at closer spacings. The turbines within the North Hoyle windfarm are less visible in the weather conditions prevailing at the time of the visit than shown in the photomontage.			

Date:	30/03/16		Time [24h]:	12.15
Location:	Llandudno promenade by War Memorial		Height m AOD	6m
Eastings	Approx. 278200		Northings:	Approx. 382600
Distances [nearest] from windfarms	Gwynt y Mor: 16 km	North Hoyle: 25.7 km	Rhyl Flats: Around 11km	Burbo Bank: -
Weather Conditions	Sunny with some cloud			
Perceived Visibility	Very good			
Light conditions	Sunny over parts of the view and cloudy in other places			
Commentary	**General:** Both Gwynt y Mor and Rhyl Flats windfarms can be seen and together covered around 70% of the visible horizon between the pier and Little Orme headland. North Hoyle is apparent beyond the Rhyl Flats. The yellow bases are apparent in both windfarms, being more vivid in the Rhyl Flats turbines. The modern turbines contrast with the Victorian architectural style of the promenade, pier and associated buildings. The evident movement at this distance attracts attention in an otherwise static sea view. **Gwynt y Mor:** Description of effect: very noticeable, covering a large proportion of the horizon. It forms a large cluster of many turbines relatively close together, occasionally stacking. Scale of effect : large **North Hoyle:** Description of effect: visible behind Rhyl Flats creating some minor visual interference Scale of effect : minor **Rhyl Flats:** Description of effect: noticeable/prominent turbines close to, covering a small/medium proportion of horizon Scale of effect : moderate/large **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: combined windfarms cover a large proportion of the horizon in the framed view between Great Orme and Little Orme. Scale of effect: large			
Photomontage comments/comparisons with site view and photos	The Gwynt y Mor photomontage, though relatively accurate proportionally, understates the perceived size of the development when assessed on site and in comparison with a 260mm depth photograph. The size of turbine and layout of windfarm actually implemented is different from the photomontage. The photomontage illustrates 5 MW turbines at relatively wide spacings whereas the implemented windfarm uses 3.6 MW turbines at closer spacings. The turbines within the array which are further away are less visible in the weather conditions prevailing at the time of the visit than shown in the photomontage.			

Date:	30/03/16		Time [24h]:	11.53
Location:	Rhos on Sea		Height m AOD	6m
Eastings	Approx. 284310		Northings:	Approx. 380810
Distances [nearest] from windfarms	Gwynt y Mor: 14.3 km	North Hoyle: 20.8 km	Rhyl Flats: Around 8km	Burbo Bank: -
Weather Conditions	Sun and cloudy with slight haze			
Perceived Visibility	Good			
Light conditions	Combination of sun and shade from cloud cover			
Commentary	**General:** Good weather conditions mean that most of the Gwynt y Mor windfarm can be seen with the turbines picked out by the sun. Rhyl Flats turbines are all visible, although some are in shade. North Hoyle turbines do not appear to be visible and Burbo Bank turbines are not visible. The yellow bases are apparent in all windfarms, being more vivid (and detailed) in the closer turbines. **Gwynt y Mor:** Description of effect: noticeable with turbines in sun clearly stacking in parts but partly behind Rhyl Flats. Scale of effect : large **North Hoyle:** Description of effect: not apparent **Rhyl Flats:** Description of effect: prominent- clear, although nearest turbines are in the shade which slightly reduces the impact. Scale of effect : large **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: the two windfarms overlap each other and therefore the turbines in different patterns and at different distances interfere with each other visually. Scale of effect: large			
Photomontage comments/comparisons with site view and photos	No comparison made.			

Date:	30/03/16		Time [24h]:	10.54
Location:	Nova Centre, Prestatyn		Height m AOD	8m
Eastings	Approx. 306235		Northings:	Approx. 383835
Distances [nearest] from windfarms	Gwynt y Mor: 12.6 km	North Hoyle: 7.8 km	Rhyl Flats: approx 14 km	Burbo Bank: Approx 21km
Weather Conditions	Sun and cloudy with slight haze			
Perceived Visibility	Very good			
Light conditions	Combination of sun and shade from cloud cover			
Commentary	**General:** The variable cloud cover means that three of the four visible windfarms have some turbines in sun and some in shade. North Hoyle turbines are visible and appear close. Gwynt y Mor lies beyond this and spreads further west. Rhyl Flats and Burbo Bank turbines are both visible as separate clusters. The Douglas oil and gas platform at 24km is just visible beyond the windfarms. The yellow bases are apparent in all windfarms except Burbo Bank, being more vivid and detailed in the closer turbines. **Gwynt y Mor:** Description of effect: Most turbines visible- most in shade and some in sun. The array covers a moderate/large part of the horizon with a mix of well spaced and stacked turbines depending on the relative angle of view. The closest turbines lie behind North Hoyle which is more prominent as it is closer still. Scale of effect : large **North Hoyle:** Description of effect: all the turbines are visible and most are in the sun. The turbines are prominent and stand out. The stacking of the turbines in a linear grid is highly apparent. Scale of effect : large **Rhyl Flats:** Description of effect: all the turbines are visible as a separate cluster from the other windfarms, some being in shade and some being in sun. The turbines are noticeable and cover a small/medium extent on the horizon. Scale of effect: moderate **Burbo Bank:** Description of effect: the windfarm is apparent and visible with the sun on it. The layout of the turbines appears as a well spaced random drift with little overlapping of blades. The array covers a moderate spread of the horizon. Scale of effect: moderate/small. **Cumulative**: Description of effect: All four windfarms contribute to the effect covering a large part of the horizon and there is overlapping between North Hoyle and Gwynt y Mor. The combined effect is a seascape dominated by windfarm ie a windfarm seascape. Scale of effect: large/very large			
Photomontage	The Gwynt y Mor photomontage needed to be held at a viewing distance			

comments/comparisons with site view and photos	of 200mm to replicate the apparent size of the implemented turbines. This contrasts with the stated viewing distance of around 400 mm. It should also be noted that the Gwynt y Mor turbines illustrated in the photomontage are stated as 5MW compared to the 3.6MW implemented. Therefore it is clear that the turbines in reality are larger than those illustrated in the photomontage and are closer to the 260mm depth photograph. The turbines in the photograph are slightly more recessive than the photomontage due to some being in the shade.

SITE VISIT: 16/03/16 night view

Date:	16/03/16		Time [24h]:	21.00
Location:	Llandudno promenade by War Memorial		Height m AOD	6m
Eastings	Approx. 278200		Northings:	Approx. 382600
Distances [nearest] from windfarms	Gwynt y Mor: 16 km	North Hoyle: 25.7 km	Rhyl Flats: Around 11km	Burbo Bank: -
Weather Conditions	Mostly clear sky with some cloud, breezy			
Perceived Visibility	Good/Very good			
Light conditions	Dark, street, promenade and building lights apparent on almost three sides of the view.			
Commentary	**General:** The lights from both Gwynt y Mor and Rhyl Flats and probably North Hoyle windfarms can be seen and together covered around 70% of the visible horizon between the pier and Little Orme headland. 34 aviation navigation lights are visible. **Gwynt y Mor:** Description of effect: highly noticeable, covering a large proportion of the horizon. It forms a large cluster of red aviation lights with smaller but many more yellow/white navigation lights at the bases of the turbines. Scale of effect : moderate/large **North Hoyle:** Description of effect: just visible behind Rhyl Flats adding to the light Scale of effect : minor **Rhyl Flats:** Description of effect: noticeable aviation and navigation lights slightly more intense and extending the Gwynt y Mor array. Scale of effect : moderate/large **Burbo Bank:** Description of effect: not visible **Cumulative**: Description of effect: combined windfarms lights cover a large proportion of the horizon in the channelled view. The lights appear to form the edge of another coast with industrial installations. Though the lights of Llandudno surround the viewer on other sides of the view, these relate to the resort and have a different character. Scale of effect: large			
Photomontage comments/comparisons with site view and photos	No comparison available.			

APPENDIX B: Visibility definitions

Visibility definitions

Description	Range
Unknown	-
Very poor	Less than 1 km
Poor	Between 1-4 km
Moderate	Between 4-10 km
Good	Between 10-20 km
Very good	Between 20-40 km
Excellent	More than 40 km

Derived from Met Office onshore weather forecasts.

APPENDIX C: Magnitude of change definitions

Derived from DTI (2005).

Table 5: Magnitude of change: names, descriptors and definitions

Magnitude	Name	Descriptors - appearance in central vision field	Definition
Very Large	Dominant	Commanding, controlling the view, foremost feature, prevailing, overriding.	Proposed offshore wind farm causes very large alteration to key elements/features/characteristics of the baseline seascape or visual conditions (pre-development) such that there is a fundamental change.
Large	Prominent	Standing out, striking, sharp, unmistakeable, easily seen	Proposed offshore wind farm causes large alteration to key elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is an unmistakeable change.
Moderate	Conspicuous	Noticeable, distinct, catching the eye or attention, clearly visible, well defined	Proposed offshore wind farm causes moderate alteration to elements/features/characteristics of the baseline seascape or visual conditions (pre-development) such that there is a distinct change.
Small	Apparent	Visible, evident, obvious, perceptible, discernible, recognisable.	Proposed offshore wind farm causes small loss or alteration to elements/features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is a perceptible change.
Very Small	Inconspicuous	Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite, subtle	Proposed offshore wind farm causes very small loss or alteration to elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is a barely distinguishable change.
Negligible	Faint	Weak, not legible, near limit of acuity of human eye	Proposed offshore wind farm causes negligible loss or alteration to elements/ features/ characteristics of the baseline seascape or visual conditions (pre-development) such that there is no legible change.

VIEWPOINT PHOTOGRAPHS

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Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.

OS coordinates: approximately 276660 383405.

Approximate minimum distance to site: Gwynt y Mor- 16.2km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Great Orme, car park
Gwynt y Mor,Rhyl Flats and North Hoyle windfarms- part view

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Note: Photographs are reproduced to a size that fits the page and are not at a given scale.

OS coordinates: approximately 276660 383405.

Approximate minimum distance to site: Gwynt y Mor- 16.2km

Project: **OESEA 3 seascape and visual buffers update**
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Figure
Great Orme, car park
Gwynt y Mor,Rhyl Flats and North Hoyle windfarms

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Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.

OS coordinates: approximately 278200 382600

Approximate minimum distance: Gwynt y Mor- 16.2km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Llandudno promenade by Memorial Gwynt y Mor and Rhyl Flats windfarms

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Note: Photographs are reproduced to a size that fits the page and are not at a given scale.

OS coordinates: 278200 382600

Approximate minimum distance to site: Gwynt y Mor 16.2km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Llandudno promenade by Memorial
Gwynt y Mor and Rhyl Flats windfarms

www.whiteconsultants.co.uk

Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.

OS coordinates: approximately 284310 380810.

Approximate minimum distance to site: Gwynt y Mor- 14.3km, Rhyl Flats- c.8km, North Hoyle 20.8km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Rhos-on Sea
Gwynt y Mor, Rhyl Flats and North Hoyle windfarms

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Note: Photographs are reproduced to a size that fits the page and are not at a given scale.

OS coordinates: approximately 284310 380810.

Approximate minimum distance to site: Gwynt y Mor- 14.3km, Rhyl Flats- c.8km, North Hoyle 20.8km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Rhos-on Sea
Gwynt y Mor, Rhyl Flats and North Hoyle windfarms

www.whiteconsultants.co.uk

Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.

OS coordinates: approximately 306235 383835.

Approximate minimum distance: Gwynt y Mor- 12.6km, North Hoyle- 7.8km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Nova Centre, Prestatyn
Gwynt y Mor and North Hoyle windfarms part of array

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Note: Photographs are reproduced to a size that fits the page and are not at a given scale. Locations of the development site are estimated and do not infer visibility from the viewpoint.

OS coordinates: approximately 306235 383835.

Approximate minimum distance: Gwynt y Mor- 12.6km, North Hoyle- 7.8km

Project: **OESEA 3 seascape and visual buffers update**
Client: Hartley Anderson
Date: 8 April 2016
Status: Final

Figure
Nova Centre, Prestatyn
Gwynt y Mor,Rhyl Flats and North Hoyle windfarms

Appendix I East coast site visits 2019

Offshore Energy Strategic Environmental Assessment

Review and update of Seascape and Visual Buffer study for Offshore Wind farms

APPENDIX: EAST COAST SITE VISITS

for

Hartley Anderson

October 2019

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with

Northumbria University

CONTENTS

1. Introduction

1.1. The east of England coast was visited in October 2019 to explore a range of issues in terms of the visibility and visual intrusion of existing offshore windfarms. At this time there are a number of windfarms are different sizes at different distances from the coast. The main objective was to look at the visibility of those wind turbines further offshore. Two main groups were assessed:

- Off the north Norfolk coast: Race Bank, Sheringham Shoal and Dudgeon wind farms
- Off the Suffolk and Essex coast: Greater Gabbard/Galloper, London Array, East Anglia 1 and Gunfleet arrays.

2. Method

2.1. The area was visited on two days (separated by a rainy day) – 23rd and 25th October 2019 and one viewpoint, at Aldeburgh, was visited at night on 24th October. Overall, the visibility ranged from poor through to good and very good visibility (see **Appendix I/A** for ranges). However, the days were generally cloudy with little sunshine and where this occurred it was patchy. Therefore no windfarms were viewed with full sun on them. In most views the backcloth to the turbines was grey and only occasionally was there a light sky backcloth on the horizon.

2.2. The photos taken do not reflect the visibility of the wind turbines due to limitations of photographic resolution. The observer's naked eye was able to pick up wind turbines at some distance (35km +) although the contrast between them and the backcloth was limited due to weather conditions. The viewpoints visited were for the most part assessed as part of seascape and visual impact assessments (SVIAs) for the relevant windfarms. These included:

- Wells-next-the-Sea beach
- Beeston Bump, near Sheringham
- Aldeburgh seafront
- Old Felixstowe seafront
- Holland-on-Sea seafront

2.3. The viewpoint visited at night to establish the effect of lighting was:

- Aldeburgh seafront (from building in street behind)

2.4. Photographs were taken at each viewpoint using a Canon EOS 6D 18MP full frame digital SLR with a fixed 50mm Canon lens on a tripod. At each viewpoint photographs were taken over a period of between 15 and 90 minutes to optimise the potential visibility. Observations of visibility of wind farms were made and conclusions on visual impact drawn *based on weather conditions at the time*. For each viewpoint, the SVIA assessment is summarised for comparison. The approach by SVIA assessors vary from assessing the worst case/excellent visibility through to averaging the worst and most common case. SVIA photomontages were not available for most of the viewpoints. As such, it is useful to view the site visual assessment of windfarms of the North Wales coast in April 2016. The observations were made by a chartered landscape architect with over 30 years landscape planning experience including LVIAs/SVIAs. The record of each

assessed viewpoint is set out in **Appendix I/A with photos in Appendix I/B.** The definitions for scale of effect are as set out for magnitude of change in DTI (2005). This is consistent with the approach taken for assessing the wireframes.

Visibility definitions for weather are as follows based on Met Office weather records:

Table 1 Visibility definitions

Description	Range
Unknown	-
Very poor	Less than 1 km
Poor	Between 1-4 km
Moderate	Between 4-10 km
Good	Between 10-20 km
Very good	Between 20-40 km
Excellent	More than 40 km

3. Observations and Conclusions

3.1. The following observations were made:

- The assessment during late October with visibility conditions only good and very good at best and little sun meant that the windfarms were not viewed in the worst case situation. The conditions prevailing were likely to be typical of various times of day and year though with an expectation of both worse and better visibility.
- Different weather conditions had significant effects on the visibility of turbines on the site visits. When sunlight was on individual turbines, especially when behind the viewer, they were visible from long distances eg 33km at Dudgeon. Conversely, in overcast and misty conditions turbines at 17km were difficult to see. It was observed that there were variations across the windfarms in variable conditions with some turbines in shade beneath or within cloud, while others were in very limited sun. Therefore, the windfarm turbines did not appear to be as a strong coherent group in these variable conditions. The closer the windfarm, the less this effect changed the perception of the windfarm eg 9km and 17km compared to 24-33km.
- From the higher viewpoints, the windfarms looked more coherent as the whole of the wind farm and their layout could be seen against the slighter darker sea area (Sheringham Shoal and Gunfleet).
- From the lower viewpoints, the layout of the windfarm was less easy to comprehend than when viewed from higher viewpoints although straight rows and stacking were still apparent (London Array).
- The digital SLR lens photographs made the windfarm look smaller and less distinct than when viewed in real life.
- The juxtaposition of close inshore and offshore windfarms is visually disruptive although it is clear that there is physical separation (London Array and Gunfleet).
- The SVIA judgements of Gunfleet II are based on the existence of Gunfleet I, with reduced levels of effects. The combined cumulative effect is not addressed. Gunfleet I SVIA is not available.

- The SVIA judgements of London Array are lower than may be expected. These partly rely on the presence of ship traffic into Felixstowe and Harwich and the existence of Gunfleet I/II closer inshore from some viewpoints. The combined cumulative effect is not addressed.
- Currently there is visual separation between wind farms on the north coast of Norfolk so they appear as separate coherent groups. This is a positive feature.
- At night, in very good weather conditions, navigational lighting on each turbine was just visible on the horizon at 33km in the case of Greater Gabbard/Galloper. As an isolated group on the horizon this was not a significant effect.

APPENDIX I/A: OESEA Update Seascape Site Visits Records: East coast of England

Site visits to assess existing offshore wind farms off the East coast of England

Places visited:

- Wells-next-the-Sea and Sheringham- 23 October 2019
- Aldeburgh, Felixstowe and Holland-on-Sea- 25 October 2019

Dudgeon		**SVIA 2009 Assessed:** No. of turbines: 168- 56 Height to blade tip: 115-190m Output: 3MW-10MW				**Constructed:** No. of turbines: 67 Height to blade tip: 187m (154m blade diameter) Hub height: 110m Output: 6MW (Siemens)			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: visibility good to very good, cloudy but with some sunshine- arrays not highlighted in full- just in part. Occasional sea mist.
5: 3MW layout	Beeston Bump	33	Very high	Very small	Minor				
5: 10MW layout	Beeston Bump	33	Very high	Very small	Moderate/ minor				
5: 6MW layout constructed	Beeston Bump (summit)	33				Very high/ high	Very small	Moderate/ minor	Not significant. Turbines are visible in very good visibility but are indistinct/light grey when no sun on them and light sky backcloth. The size of turbines are very small and appear distant. Not visible in moderate or good visibility. (Not worst case scenario as visibility not excellent).

Sheringham Shoal		**SVIA 2015 Assessed:** No. of turbines: 88 Height to blade tip: 117-172m max Output: 3-6MW?				**Constructed:** No. of turbines: 88 Height to blade tip: 135m Output: 3.6MW			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: visibility good to very good, cloudy but with some sunshine- arrays not highlighted in full- just in part. Occasional sea mist.
2	Wells-next-the Sea (beach)	25	High	Low	Minor	Very high	Small	Major/ moderate to moderate	Significant. The turbines are apparent in very good visibility and especially with sun on them with movement of blades visible. The size of turbines are small. Not visible in moderate visibility with sea mist. Slightly oblique view. (Not worst case scenario as visibility not excellent).
3	Beeston Hill (summit)	17	High	High	Major	Very high/ High	Moder-ate	Major	Significant. The turbines are noticeable in good to very good visibility without sun and very noticeable with part sun on them with movement of blades highly visible. (Full sun on array not seen). The size of turbines are medium. Not visible in moderate/poor visibility with sea mist. Slightly oblique view. (Not worst case scenario as visibility not excellent and not full sun from behind viewer). Therefore SVIA is likely to be correct in magnitude for worst case.

Race Bank		**SVIA 2009 Assessed:** No. of turbines: 88-206 Height to blade tip: 135-180m Hub height: 90-100m Base diameter: 6m tapering to 4.5m at top Output: 3-6MW				**Constructed:** No. of turbines: 91 Height to blade tip: 187m like Dudgeon? Hub height: 110m like Dudgeon? Blade Dia: 154m Output: 6MW (Siemens SWT-6.0 154)			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: visibility good to very good, cloudy but with some sunshine- arrays not highlighted in full- just in part. Occasional sea mist.
8 viewpoints (only NTS available)	North Norfolk and Lincolnshire	27km closest	Not available	Not avail-able	Minor at most (all beyond the limit of visual signif-icance)	-	-	-	Note: Docking Shoal is closer and in front of the array for some viewpoints such as Brancaster Bay which is illustrated by a photomontage. However, it is assumed that Docking Shoal is not considered as part of baseline assessment as it is also going through the application process at the time of this SVIA.
-	Wells-next-the Sea (beach)	27-30	See above	See above	See above	Very high	Very small	Moderate	Not significant. The turbines are just visible in very good visibility but are very indistinct/light grey when no sun on them and light sky backcloth. The size of turbines are very small and appear distant. Not visible in moderate or good visibility. (Not worst case scenario as visibility not excellent).

Greater Gabbard		SVIA Assessed: No. of turbines: 141 Height to blade tip: 170m max Output: 6MW?				Constructed: No. of turbines: 140 Height to blade tip: 131m Output: 3.6MW			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: Aldeburgh: visibility good to very good in early morning, cloudy but with some sunshine in patches, with sun low in the sky over the sea to east - arrays not highlighted in full- just occasionally in small part. Occasional sea mist offshore enveloping array. Felixstowe: visibility good to very good in mid-morning, generally cloudy and grey but with some very limited sunshine in patches- arrays not highlighted in full- just occasionally in small part. Occasional sea mist offshore enveloping arrays.
2	Old Felixstowe seafront	33.5 (to 49km for furthest turbine)	High	Moderate to subst-antial in excellent visibility. None in moderate visibility.	Moder ate to major. Minor to none as largely indistin ct. Not signific ant.	High	Very small/ neglig-ible	Minor	Not significant *in weather conditions*. The windfarm was only visible for short periods of time with the turbines generally light grey against the light morning sky on the horizon, when visible. Turbines and bottom of blades, partially obscured by curvature of the Earth. Turbine blade movement was not apparent.
3	Aldeburgh seafront	29 (to 52km for furthest turbine)	High	Occasion-ally substant-ial ,	Major to minor or	High	Very small	Moderate/ minor	Not significant *in weather conditions.* The windfarm was only visible for short periods of time with the turbines generally grey against the light morning

				generally negligible.	none. Not significant.				sky on the horizon, when visible. Turbines further away partially obscured by curvature of the Earth. Turbine blade movement was not apparent. (Note that Galloper forms part of the array visible from Aldeburgh).
-	Holland on Sea	45	-	-	-	-	-	-	Not visible.

London Array		**SVIA 2005 Assessed:** No. of turbines: upto 271 Height to blade tip: upto 175m Output: upto 6MW?				**Constructed:** No. of turbines: 175 Height to blade tip: 147m Hub height: 87m Rotor diameter 120m Output: 3.6MW			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: Felixstowe: visibility good to very good in mid-morning, generally cloudy and grey but with some very limited sunshine in patches- arrays not highlighted in full- just occasionally in small part. Occasional sea mist offshore enveloping arrays. Holland on Sea: visibility good with part of the view very good in late-morning, generally cloudy and grey with some light over the sea behind the nearer turbine arrays but cloud and mist enveloping most of the further arrays.
25	Holland-on-Sea	24	Medium	Low to negligible	Negligible	High/ medium	Medium/ small	Moderate	Not significant *in weather conditions*. The windfarm was only visible for short periods of time. Noticeable with the turbines in clear linear pattern- straight rows with some stacking and between light and dark grey tone against cloudy horizon. Full height of turbines fully visible-possibly a function of the height of the viewpoint. Turbine blade movement was apparent. Gunfleet, 1, 2 and 3 arrays are in the view closer to, so this reduces the degree of expected change-this is mentioned in SVIA and results in SVIA judgement of negligible significance.

33	Felixstowe seafront (Cobbolds Point)	31	Medium	Negligible	Neglig-ible	High/ medium	Very small		Not significant *in weather conditions*. The windfarm was only visible for short periods of time with the turbines generally dark grey against the grey sky on the horizon, when visible. Turbines and bottom of blades, partially obscured by curvature of the Earth. Turbine blade movement was difficult to discern in the light conditions. Sea traffic into ports of Felixstowe and Harwich apparent in middle ground. SVIA minimises effects partly by referral to sea traffic so is not a measure of perceived size and effect of turbines alone.

Gunfleet Sands		**Gunfleet 1 SVIA Assessed 2003:** No. of turbines: 30 Height to blade tip: 131-147m? Output: 3.6MW **Gunfleet 2 SVIA Assessed 2007-8:** No. of turbines: 18 Height to blade tip: 131-147m? Output: 3.6MW **Gunfleet 3 SVIA Assessed 2011:** No. of turbines: 2 Height to blade tip: 187m? Output: 6MW				**Constructed:** As assessed.			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: Holland on Sea: visibility good with part of the view very good in late-morning, generally cloudy and grey with some light over the sea behind the turbine arrays. No sun on turbines.
	Radar tower , Holland Haven	8.3	Medium-low	Medium-low	Moder ate-minor	-	-	-	Takes Gunfleet 1, which is largely in front of this array, into account as part of the baseline and therefore is an additional effect. Therefore the effect is smaller than it would be if considered together.
	Holland-on-Sea seafront path	9	-	-	-	High/ medium	Moderat e/ minor (addition al) Large (combin ed cumulati ve)	Mod-erate	*As an addition* to the Gunfleet 1 array the turbines extend the array to the east reducing the coherence of the original layout as only two rows extend in this direction. However, the consented first phase is closer to the shore with the greater number of turbines and therefore has a larger effect. The *combined* cumulative magnitude effect of the three phases (actually implemented together) is large. The array is highly rectilinear in rows with stacking and dominates the sea view. Significant.

East Anglia 1		SVIA 2011 Assessed: No. of turbines: 102 Height to blade tip: 160-195m max Hub height: 120m min Base diameter: 5-8.5m tapering to 3.5-5m at top Output: 6, 7.5, 10MW				Under construction (one third erected at time of assessment): No. of turbines: 102 Height to blade tip: 167m 154m diameter blade? Hub height: 90m Base diameter: Output: 7MW			
Vpt No.	**Location**	**Developer's SVIA**				**This review**			
		Distance To Nearest Turbine (Km)	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Sensitivity**	**Mag Of Effect**	**Signif-icance**	**Comments**
									Overall weather conditions: visibility good to very good in early morning, cloudy but with some sunshine in patches, with sun low in the sky over the sea to east.
		Scoped out as nearest coast at 43.4km is beyond 40km study area ('based on DTI guidance')							
	Aldeburgh seafront	55km minimum-not known where constructed turbines are.	-	-	-	-	-	-	Not visible

APPENDIX I/B: Sample Viewpoint Photographs

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Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.

OS coordinates: approximately

Approximate minimum distance to wind farm: Sheringham Shoal- 17 km

Project: **OESEA seascape and visual buffers update**
Client: Hartley Anderson
Date: 24 October 2019
Status: Final

Figure
Beeston Bump, Sheringham
Sheringham Shoal wind farm

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Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.
OS coordinates: -
Approximate minimum distance to wind farms:
Dudgeon- 33km
Sheringham Shoal- 17 km

Project: **OESEA seascape and visual buffers update**
Client: Hartley Anderson
Date: 24 October 2019
Status: Final

Figure
Beeston Bump, Sheringham
Dudgeon wind farm (to right)
Sheringham Shoal (to left)

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Note: Photographs are reproduced to 260mm deep to give an impression of the scale of development that may be seen on site.
OS coordinates: -
Approximate minimum distance:
Greater Gabbard- 29km

Project: **OESEA seascape and visual buffers update**
Client: Hartley Anderson
Date: 24 October 2019
Status: Final

Figure
Behind Aldeburgh seafront
Greater Gabbard/Galloper windfarms

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Note: Photographs are reproduced to a size that fits the page and are not at a given scale.
OS coordinates: -
Approximate minimum distance to site:
Gunfleet Sands- 9km
London Array- 24km

Project: **OESEA seascape and visual buffers update**
Client: Hartley Anderson
Date: 25 October 2019
Status: Final

Figure
Holland-on-Sea coastal path
Gunfleet Sands and London Array windfarms