

Norfolk Vanguard Offshore Wind Farm Consideration of potential impacts related to continuous periods of operation

Referred to in DCO Requirement 26(a)
and 26(d)

Applicant: Norfolk Vanguard Limited

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Photo: Kentish Flats Offshore Wind Farm



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Glossary

BS	British Standard
CNMP	Construction Noise Management Plan
CoCP	Code of Construction Practice
ETG	Expert Topic Group
HDD	Horizontal Directional Drilling
OCoCP	Outline Code of Construction Practice

Terminology

dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
dB(Z) (or previously L_{eq})	Decibels measured on a sound level meter incorporating a flat frequency weighting (Z weighting) across the frequency range.
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 μ Pa, the threshold of normal hearing is 0dB, and 140dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3dB(A) is the smallest perceptible change.
$L_{A10,T}$	The A weighted noise level exceeded for 10% of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise.
$L_{A90,T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 2014 it is used to define the 'background' noise level.
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
Onshore infrastructure	The combined name for all onshore infrastructure associated with the project from landfall to grid connection.
Onshore project area	All onshore electrical infrastructure (landfall; onshore cable route, accesses, trenchless crossing technique (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas; onshore project substation and extension to the Necton National Grid substation and overhead line modification).
The Applicant	Norfolk Vanguard Limited.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure.

1 INTRODUCTION

1. This assessment considers the potential for noise impacts at sensitive receptors, in the event of evening, weekend and night time working for continuous periods of operation that are required as listed under DCO Requirement 26(a) such as concrete pouring, drilling, cable pulling; and 26(d) - trenchless crossing installation techniques.
2. As detailed in the Applicant's Response to the ExA's Written Questions Q13.6 and Q20.59 (ExA; WQ; 10.D1.3), these activities would be programmed to be undertaken within the consented hours (0700 hours and 1900 hours Monday to Friday, and 0700 hours to 1300 hours on Saturdays) so far as possible but may need flexibility to continue beyond those hours. For example once concrete pouring, such as that required at the onshore project substation, has begun for the basis of foundations or other related works, it will be necessary to complete those works in a continuous period as dictated by aspects such as concrete curing requirements. Equally, once the process of cable pulling has commenced and a cable has begun to be pulled into a duct, it is necessary to complete the installation, which may extend beyond the working hours if unforeseen issues occur. With respect to trenchless crossings, once drilling has begun, it may not be suitable to stop the drilling process until the installation is complete – for instance, the drill head (and/or other technical elements) may need to be maintained at a certain level or pressure for a successful drill completion.
3. Specifically, this document considers the potential effects from proposed onshore construction works in accordance with the BS5228:2009+A1:2014 Evening and weekends (19:00 to 23:00 Monday to Friday, 13:00 to 23:00 Saturday and 07:00 to 23:00 Sunday), and night time (23:00 to 07:00) reference periods. Any associated potential impacts of the Norfolk Vanguard are highlighted, and possible mitigation is identified and assessed.
4. This document has been prepared in response to the ExA's schedule of changes to the draft DCO issued on 9th May 2019 and supports Environmental Statement (ES) Chapter 25 Onshore Noise and Vibration (DCO document 6.1.25).

2 ASSESSMENT METHODOLOGY

2.1 Approach

5. The noise impact assessment methodology was agreed with stakeholders as part of the evidence plan process and is detailed in full within ES Chapter 25 Onshore Noise and Vibration.
6. The agreed methodology is the threshold based ‘ABC’ method, based on British Standard (BS) 5228:2009+A1:2014¹. BS 5228 details the method, which specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels were assessed against noise limits derived from advice within Annex E of BS 5228. Table 2.1, reproduced from ‘BS 5228:2009+A1:2014 Table E.1’, presents the criteria for selection of a noise limit for a specific receptor location.

Table 2.1 Construction noise threshold levels based on the ABC method (BS 5228)

Assessment category and threshold value period (L _{Aeq})	Threshold value, in decibels (dB)		
	Category A ^{A)}	Category B ^{B)}	Category C ^{C)}
Night time (23.00 – 07.00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75
A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.			
B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.			
C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			
D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

7. BS 5228 states:

“If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.”

¹ BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise

8. The model used in this assessment incorporated noise sources located in the study area, nearby residential dwellings and other buildings, intervening ground cover and topographical information.
9. Noise levels for the construction phase were calculated using the methods and guidance in BS 5228. This approach includes methods for predicting receptor noise levels from construction works based on the number and type of construction plant and activities operating on site, with corrections to account for:
 - The 'on-time' of the plant, as a percentage of the assessment period;
 - Distance from source to receptor;
 - Acoustic screening by barriers, buildings or topography; and
 - Ground type.
10. SoundPLAN noise modelling was utilised in the construction phase assessment.
11. Construction noise impacts were assessed using the impact magnitude presented in Table 2.2 for the evening and weekend periods, and Table 2.3 for the night time period.

Table 2.2 Evening and weekends construction noise significance criteria

Impact magnitude	Construction noise level (dB)		
	A 55dB threshold	B 60dB threshold	C 65dB threshold
No Impact	≤55	≤60	≤65
Negligible Adverse	≥55.1 - ≤55.9	≥60.1 - ≤60.9	≥65.1 - ≤65.9
Minor Adverse	≥56.0 - <57.9	≥61.0 - <62.9	≥66.0 - <67.9
Moderate Adverse	≥58.0 - <59.9	≥63.0 - <64.9	≥68.0 - <69.9
Major Adverse	≥60	≥65	≥70

Table 2.3 Night time construction noise significance criteria

Impact magnitude	Construction noise level (dB)		
	A 45dB threshold	B 50dB threshold	C 55dB threshold
No Impact	≤45	≤50	≤55
Negligible Adverse	≥45.1 - ≤45.9	≥50.1 - ≤50.9	≥55.1 - ≤55.9
Minor Adverse	≥46.0 - ≤47.9	≥51.0 - ≤52.9	≥56.0 - ≤57.9
Moderate Adverse	≥48.0 - ≤49.9	≥53.0 - ≤54.9	≥58.0 - ≤59.9
Major Adverse	≥50	≥55	≥60

2.2 Receptor Sensitivity

12. For the construction phase assessment, the closest sensitive receptors are detailed in Table 2.4 and their locations are shown on ES Figure 25.2 (and included in Appendix 1 to this report). All noise sensitive receptors identified along the cable route are included here as the locations of the cable joint bays (where cable pulls would occur) are not yet known.
13. Receptors denoted with an asterisk represent locations where there are two or more points captured in the modelling for the same receptor location and represent either an alternative facade of the same building or where multiple dwellings are located at a single location.

Table 2.4 Receptor identification, sensitivity and classification

Receptor Identifier	Receptor Classification	Receptor Sensitivity	British National Grid Coordinates	
			Eastings	Northings
Landfall				
LFR1H	Residential	Medium	638487	330860
LFR2H	Residential	Medium	638426	330620
LFR3H	Residential	Medium	638512	329817
LFR4H	Residential	Medium	639335	330243
Onshore cable route				
CRR1	Residential	Medium	629201	331557
CRR2	Residential	Medium	628619	331677
CRR3	Residential	Medium	626857	331798
CRR4	Residential	Medium	624041	330725
CRR5	Residential	Medium	622796	330308
CRR6	Residential	Medium	621552	330315
CRR7	Residential	Medium	621539	329522
CRR8	Residential	Medium	621064	328819
CRR9	Residential	Medium	620112	328685
CRR10	Residential	Medium	617476	327674
CRR11	Residential	Medium	616340	326792
CRR12	Residential	Medium	614674	325519

Receptor Identifier	Receptor Classification	Receptor Sensitivity	British National Grid Coordinates	
			Eastings	Northings
CRR13	Residential	Medium	613566	324845
CRR14	Residential	Medium	612407	324571
CRR15	Residential	Medium	610614	323766
CRR16	Residential	Medium	610371	324051
CRR17	Residential	Medium	607760	323241
CRR17*	Residential	Medium	607783	323218
CRR18	Residential	Medium	607005	322752
CRR18*	Residential	Medium	607963	322050
CRR19	Residential	Medium	607222	321422
CRR20	Residential	Medium	606512	319754
CRR21	Residential	Medium	604278	318181
CRR22	Residential	Medium	604083	317158
CRR23	Residential	Medium	601848	315627
CRR24	Residential	Medium	602296	316062
CRR25	Residential	Medium	601162	315520
CRR26	Residential	Medium	599421	315165
CRR27	Residential	Medium	598860	314764
CRR27*	Residential	Medium	598449	315202
CRR28	Residential	Medium	596693	315074
CRR29	Residential	Medium	595124	313971
CRR30	Residential	Medium	594860	312829
CRR31	Residential	Medium	594432	312604
CRR32	Residential	Medium	594844	312217
CRR33	Residential	Medium	593103	311683
CRR1E	Residential	Medium	635955	331279
CRR1F	Residential	Medium	636234	330640
CRR1G	Residential	Medium	635922	330536

Receptor Identifier	Receptor Classification	Receptor Sensitivity	British National Grid Coordinates	
			Eastings	Northings
CRR2E	Residential	Medium	636342	330967
CRR2E*	Residential	Medium	636266	330857
CRR2F	Residential	Medium	636740	329994
CRR2G	Residential	Medium	636305	330188
CRR3E	Residential	Medium	635639	330637
CRR3F	Residential	Medium	637398	330249
CRR3G	Residential	Medium	635268	330521
CRR4E	Residential	Medium	634743	330872
CRR4G	Residential	Medium	635375	329810
Onshore project substation and National Grid substation extension				
SSR1	Residential	Medium	588486	309896
SSR2	Residential	Medium	589787	309564
SSR3	Residential	Medium	592046	310041
SSR3*	Residential	Medium	592071	310047
SSR4	Residential	Medium	590955	311011
SSR4*	Residential	Medium	590959	310999
SSR5	Residential	Medium	588826	311107
SSR6	Residential	Medium	591717	311554
SSR6*	Residential	Medium	591718	311547
SSR7	Residential	Medium	589770	311296
SSR8	Residential	Medium	589914	311696
SSR9	Residential	Medium	591060	311805
SSR10	Residential	Medium	590741	309382
SSR11	Residential	Medium	588478	310811

2.3 Impact Significance

14. Following the identification of receptor sensitivity and magnitude of the effect, it is possible to determine the significance of the impact. A matrix is presented in Table 2.5 as a guide.

Table 2.5 Impact significance matrix

		Negative magnitude				
		High/ Major	Medium/ Moderate	Low/ Minor	Negligible	No Impact
Sensitivity	High	Major	Major	Moderate	Minor	Minor
	Medium	Major	Moderate	Minor	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible

2.4 Assumptions and indicative plant list

15. The following assumptions for construction activities have been made:
- For the purposes of this assessment it was assumed evening and weekend construction activities would normally take place between 1900hrs and 2300hrs Monday to Friday, between 1300hrs and 2300hrs on Saturday and between 0700hrs and 2300hrs on Sunday;
 - For the purposes of this assessment it was assumed night time construction activities would normally take place between 2300hrs and 0700hrs Monday to Sunday;
 - All ground was assumed to have an absorption factor of 0.6 to represent the mixed ground conditions in the area;
 - All noise sources were modelled as point sources at a height of 1.5m;
 - Residential properties were modelled as two-storey buildings at a height of 8.5m;
 - For daytime, receiver levels were predicted at ground floor level (+1.5m) considered representative of daytime resting and amenity space;
 - For night time, receiver levels were predicted at first floor level (+4.0m) considered representative of night time resting; and
 - Acoustic propagation effects were calculated using the BS 5228 methodology which takes into account distance attenuation, barriers and ground absorption.

16. The results of the modelling calculations are presented as the dB $L_{Aeq,T}$ noise level covering the activity period highlighted based on the assumptions set out in this section.
17. Based on ES Chapter 5 Project Description, an indicative list of construction equipment was developed for construction works extending into the evening and night time at both the Onshore Project Substation / National Grid Extension and associated with trenchless crossings / cable pulls along the cable route. These are detailed in Table 25.6 and Table 2.7.

Table 2.6 Construction noise (evening / night time) – Onshore Project Substation / National Grid Extension

Name	No.	Source Type	LwA dB(A)	On time Correction
Cement Mixer Truck (Discharging)	1	Point	103	50%
Truck Mounted Concrete Pump and Boom Arm	1	Point	108	50%
Generator	1	Point	105	75%

Table 2.7 Construction noise (evening / night time) – trenchless crossing / cable pulling (per location)

Name	No.	Source Type	LwA dB(A)	On time Correction
<i>Trenchless crossing</i>				
Backhoe Loader	1	Point	96	50%
Dumper	1	Point	101	50%
Drilling Rig	1	Point	105	75%
Water Pump	1	Point	93	75%
Generator	1	Point	105	100%
<i>Cable pull</i>				
Conveyor Drive Unit	2	Point	95	100%
Field Conveyor (Rollers)	1	Point	71	100%
Cement Mixer Truck (Discharging)	1	Point	103	50%
Generator	1	Point	105	100%

2.5 Best practice mitigation

Best practice construction noise mitigation techniques, detailed within the outline Code of Construction Practice (OCoCP) (DCO document 8.1), have been incorporated into the noise model, which is consistent with the agreed methodology and the findings reported in ES Chapter 25. Whilst best practice mitigation represents a reduction in noise levels of between 5-10dB(A), the assessment has taken a conservative approach and assumed that only a 5dB(A) reduction would be achieved following incorporation of these mitigation measures.

3 POTENTIAL IMPACTS

18. This section outlines potential impacts at the nearest receptors as a result of the Project and their significance, using the assessment methodology described in section 1.1.
19. The potential for cumulative construction noise impacts at the onshore project substation and National Grid Extension receptors related to Norfolk Boreas construction have also been assessed. Norfolk Vanguard will install the ducts for Norfolk Boreas (if both projects are consented) and the cable pulling phases for each project will occur at separate times; as such there is no potential for cumulative noise impacts between the two projects for those phases of the works.
20. The Norfolk Vanguard and Hornsea Project Three, cable installation works have the potential to be undertaken at the same time. The potential for cumulative noise impacts identified within ES Chapter 25 Noise and Vibration was limited to construction traffic noise on shared road links based on the peak daily HGV movements. Trenchless crossing and cable pulls would be programmed to be undertaken within the consented hours (0700 hours and 1900 hours Monday to Friday, and 0700 hours to 1300 hours on Saturdays) so far as possible but may need flexibility to continue beyond those hours. For example once drilling has begun, it may not be suitable to stop the drilling process until the installation is complete for technical reasons. This extension to working hours to complete the cable pull or trenchless crossing would not generate any HGV movements. On this basis there is no potential for cumulative traffic noise impacts with Hornsea Project Three during the evening, weekend and night time reference periods.
21. Similarly the potential for inter-related noise impacts identified within ES Chapter 25 Noise and Vibration was limited to construction traffic noise. As outlined above any extension to the working hours to complete a cable pull or trenchless crossing would not generate HGV movements. On this basis there is no potential for inter-related construction traffic noise impacts.

3.1 Onshore Project Substation / National Grid Extension

22. The results of the construction noise modelling for the onshore project substation and National Grid extension works at the nearest noise sensitive receptors (NSR) in relation to the evening and night time noise criteria are set out in Table 25.8.

Table 25.8 Construction noise impacts – onshore project substation / National Grid extension

Phase	BS5228 Threshold dB(A)	Predicted noise level range $L_{Aeq,T}$ dB (Standard mitigation applied)	Impact Magnitude range (Standard mitigation only)	Required Enhanced Mitigation (Yes/No) and range dB(A)	Residual Impact
Onshore project substation and National Grid substation extension receptors					
Evening and Weekends All substation NSRs	55	<25.0 to 41.8	No Impact	No	Negligible with standard mitigation
Night time All substation NSRs	45	<25.0 to 41.8	No Impact	No	Negligible with standard mitigation
Onshore project substation and National Grid substation extension receptors (cumulatively with Norfolk Boreas construction)					
Evening and Weekends All substation NSRs	55	<25.0 to 44.8	No Impact	No	Negligible with standard mitigation
Night time All substation NSRs	45	<25.0 to 44.8	No Impact	No	Negligible with standard mitigation
No additional mitigation required beyond standard CoCP measures to avoid significant adverse impacts.					

23. During the evening, weekend and night time reference periods for works at the onshore project substation and National Grid extension works (including the potential for cumulative construction with Norfolk Boreas) the magnitude of effect after standard mitigation was assessed as no impact at medium sensitivity receptors representing an impact of **negligible** significance at all receptors.
24. No further mitigation is required beyond the best practice (embedded) mitigation already set out within the OCoCP (DCO document 8.1).

3.2 Trenchless Crossing / Cable Pull

25. The results of the construction noise modelling for trenchless crossing / cable pull works at NSR in relation to the evening and night time noise criteria are set out in Table 25.9.

Table 25.9 Construction noise impacts – trenchless crossing / cable pulling works

Phase	BS5228 Threshold dB(A)	Predicted noise level range $L_{Aeq,T}$ dB (Standard mitigation applied)	Impact Magnitude range (Standard mitigation only)	Required Enhanced Mitigation (Yes/No) and range dB(A)	Residual Impact
Cable Route receptors					
Evening and Weekends 1 NSR location where works may result in an impact which requires enhanced mitigation (Threshold Category A (55) Exceeded at CRR2).	55	55.6	Minor Impact	Yes	Negligible with enhanced mitigation
Evening and Weekends All other NSRs	55	<20.0 to 55.0	No Impact	No	Negligible with standard mitigation
Night time 8 NSR locations where trenchless crossing / cable pulling works may result in impact which requires enhanced mitigation (Threshold Category A (45) Exceeded at CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31).	45	45.0 to 57.0	Minor to Major Impact	Yes (Noise reduction of up to 12.0 dBA required)	Negligible with enhanced mitigation
Night time All other NSRs	45	<20.0 to 45.0	No Impact	No	Negligible with standard mitigation
Onshore project substation and National Grid substation extension receptors					
Evening and Weekends All substation NSRs	55	<25.0	No Impact	No	Negligible with standard mitigation
Night time All substation NSRs	45	<25.0	No Impact	No	Negligible with standard mitigation
No additional mitigation required beyond standard CoCP measures to avoid significant adverse impacts.					
Enhanced mitigation techniques will be required such as noise absorption barriers.					

26. During the evening and weekend reference periods for trenchless crossing / cable pulling works the magnitude of effect after standard mitigation was assessed as no impact at medium sensitivity receptors, with the exception of CRR2. This represents an impact of **minor adverse** significance at CRR2 and enhanced mitigation measures will be required should works take place during the evening or weekend reference periods.
27. An impact of **negligible** significance has been determined at all other NSRs during the evening and weekend reference periods for trenchless crossing / cable pulling works . No further mitigation is required beyond the best practice (embedded) mitigation already set out within the OCoCP (DCO document 8.1).
28. During the night time reference period for trenchless crossing / cable pulling works the magnitude of effect after standard mitigation was assessed as minor to major at medium sensitivity receptors CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31. This represents impacts of **minor to major adverse** significance. Enhanced mitigation measures will be required at these receptors should works take place during the evening or weekend reference periods.

3.2.1 Enhanced Mitigation / Residual Impacts

3.2.1.1 Localised screening/temporary noise barriers

29. During the night time reference period, the predicted impact (including standard mitigation) at onshore cable route receptors CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31 during trenchless crossing and cable pulling works were assessed as impacts of **minor to major adverse** significance.
30. In order to ensure these impacts are mitigated as far as reasonably possible, the standard mitigation (also detailed in the OCoCP), coupled with more site-specific solutions such as the use of temporary noise barriers and/or temporary spoil bunds, would be applied.
31. As an example of the relative effectiveness of applying a temporary localised noise barrier BS 5228 states:

“as a working approximation, if there is a barrier or other topographic feature between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10 dB when the noise screen completely hides the sources from the receiver. High topographical features and specifically designed and positioned noise barriers could provide greater attenuation.”

32. An absorptive barrier was applied to 3 sides of the operating plant for each location as mitigation and included in the noise model. At receptors CRR2, CRR3, CRR5, CRR20 a 3.5m barrier was included. At receptors CRR1 and CRR31 a 4m barrier was included. At receptor CRR26 a 4.5m barrier was specified. The predicted noise levels are detailed in Table 25.10.

Table 25.10 Construction noise impacts – following application of enhanced mitigation

Phase	BS5228 Threshold dB(A)	Predicted noise level $L_{Aeq,T}$ dB (Standard mitigation applied)	Impact Magnitude (Standard mitigation only)	Further Mitigation (Yes/No) and range dB(A)	Residual Impact
Cable Route receptors					
Evening and Weekends – Trenchless crossing / cable pulling works (CRR2)	55	44.2	No Impact	No	Negligible with enhanced mitigation
Night time – Trenchless Crossing / cable pulling works (CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31)	45	39.3 to 44.7	No Impact	No	Negligible with enhanced mitigation
Required Mitigation Key					
No additional mitigation required to avoid significant adverse impacts.					

33. With the incorporation of enhanced mitigation measures, the magnitude of effect is reduced to no impact for medium sensitivity receptors CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31 which represents a residual impact of **negligible** significance.
34. The exact specification of any noise barriers that may be required to mitigate significant residual construction noise will be determined and agreed during detailed design based on the confirmed list of plant and equipment. Noise barriers will be introduced with the appropriate specification for the location and noise reduction required.
35. A Construction Noise Management Plan (CNMP) will be included in the final CoCP, as required under Requirement 20 (2)(e) of the DCO. The OCoCP commits the Applicant to delivering a CNMP, which will apply throughout that stage of construction and will detail standard embedded mitigation and where applicable, enhanced mitigation measures (noise barriers etc). The final CoCP (including the relevant CNMP) for works would require approval by the relevant planning authority prior to the commencement of works.

36. The timing and duration of any essential works proposed to be undertaken outside of the consented hours of work, i.e. 07.00 to 19.00 Monday to Friday and 07.00 to 13.00 on Saturdays, would need to be agreed with the relevant planning authority in writing in advance, and must be carried out within the agreed time, as set out in Requirement 26 of the DCO.

4 SUMMARY

37. Construction phasing, plant numbers, type and on-time data were provided for equipment that may be used during the evening and night time reference periods for potential essential activities at the onshore project substation and National Grid extension and trenchless crossings / cable pulling works along the cable route. As a worst case all noise sensitive receptors along the cable route have been considered as the locations of joint bays (where cable pulls would occur) are not yet known. The assessment also consider the potential for cumulative impacts.
38. As detailed in the Applicant's Response to the ExA's Written Questions Q13.6 and Q20.59 (ExA; WQ; 10.D1.3) these activities would be programmed to be undertaken within the consented hours so far as possible but may need flexibility to continue beyond those hours.
39. The predicted noise levels were **negligible** at all NSRs for evening, weekend and night time working for works associated with the onshore project substation and National Grid extension.
40. The predicted noise levels at NSR CRR2 assessed for the evening and weekend reference periods represented an impact of **minor adverse** significance for trenchless crossing / cable pulling works. With the inclusion of noise absorptive barriers positioned around 3 sides of each piece of plant, noise is reduced below 55dB(A) representing a residual impact of **negligible** significance.
41. The predicted noise levels at all other NSRs for the evening and weekend reference periods represented an impact of **negligible** significance for trenchless crossing / cable pulling works.
42. The predicted noise levels at NSRs CRR1, CRR2, CRR3, CRR5, CRR20, CRR26, CRR31 during the night-time reference period for trenchless crossing / cable pulling works represented impacts of **minor to major adverse** significance in the absence of mitigation. With the inclusion of noise absorptive barriers positioned around 3 sides of each piece of plant, noise would be reduced below 45dB(A) at these NSRs representing a residual impact of **negligible** significance.
43. The predicted noise levels at all other NSRs for the night time reference period represented an impact of **negligible** significance for trenchless crossing / cable pulling works.

44. The exact specification of any noise barriers that may be required to mitigate significant residual construction noise will be determined and agreed during detailed design based on the confirmed list of plant and equipment and detailed within a CNMP produced for each stage of the works.
45. The CNMP will be included in the final CoCP as required under Requirement 20 (2)(e) of the DCO. The OCoCP commits the Applicant to delivering a CNMP, which will apply throughout that stage of construction and will detail standard embedded mitigation and where applicable, enhanced mitigation measures (such as noise barriers). The final CoCP (including the relevant CNMP) for works would require approval by the relevant planning authority prior to the commencement of works.
46. The assessment provided within this note, combined with the mitigation captured within the CoCP (commitment to deliver a CNMP for each stage of the works), demonstrates that should works be required to extend beyond the consented working hours (and with written approval from the relevant planning authority) potential noise impacts at the nearest noise sensitive receptors can be mitigated such that residual impacts would be negligible.
47. On this basis, the continuous periods of operation listed under DCO Requirement 26(a) such as concrete pouring, drilling, cable pulling; and 26(d) - trenchless crossing installation techniques, have been assessed for impacts associated with evening, weekend and night time working, and appropriate mitigation is captured within the OCoCP and secured through Requirement 20(2)(e).

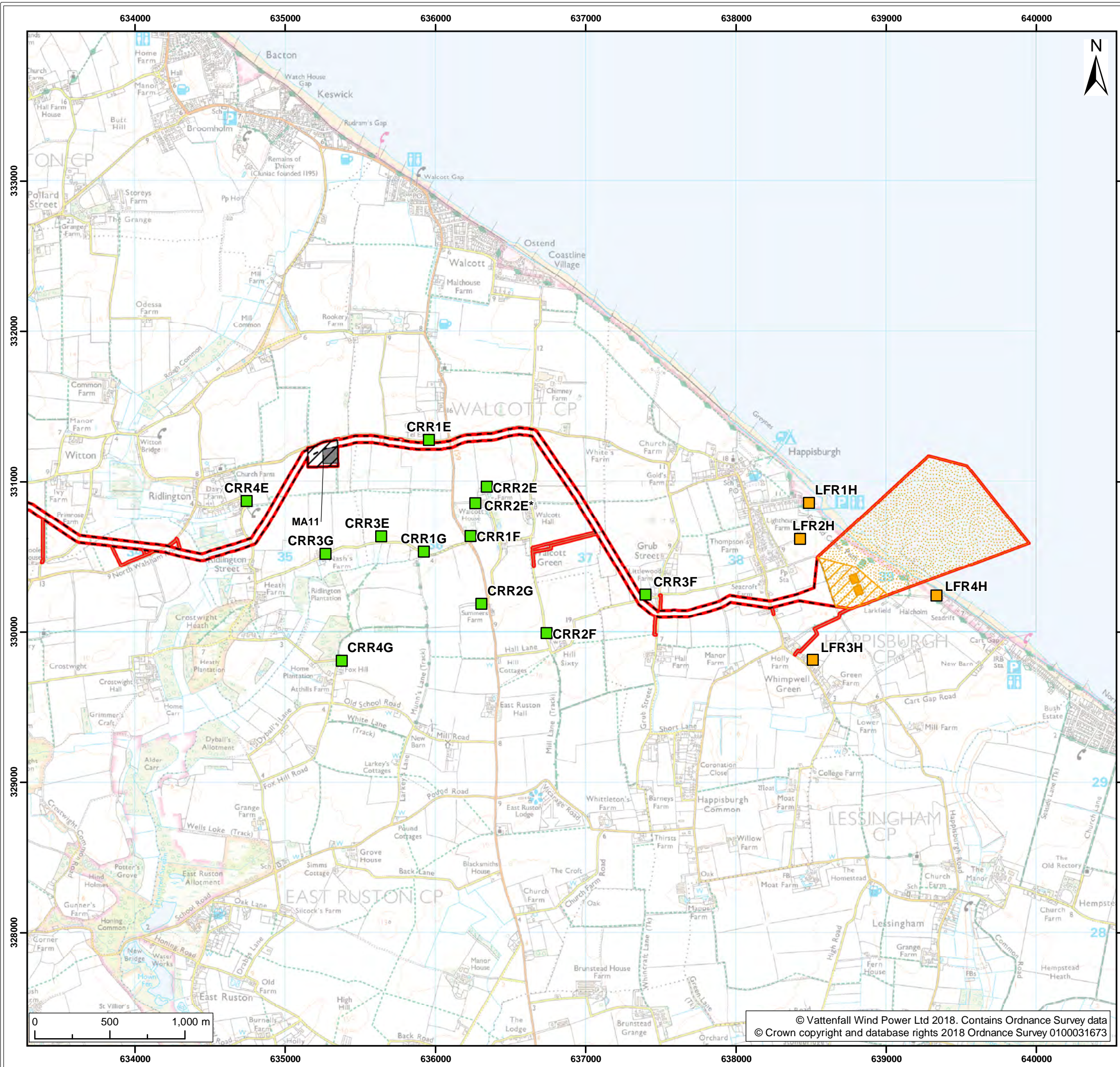
5 REFERENCES

BSI (2014). British Standards Institution [BS] 5228-1:2009+A1:2014 “Code of practice for noise and vibration control on construction and open sites – Part 1: Noise”.

BSI (2014). British Standards Institution [BS] 5228-2: 2009+A1:2014 “Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration”.

Norfolk Vanguard. (2018) Norfolk Vanguard Offshore Wind Farm Chapter 25 Onshore Noise and Vibration Environmental Statement, Volume 1 (Reference: PB4476-005-025).

6 APPENDIX 1 LOCATIONS OF NOISE SENSITIVE RECEPTORS



Legend:

- Norfolk Vanguard onshore red line boundary
- Landfall**
 - Landfall zone
 - Landfall compound zone
 - Indicative landfall compound
- Onshore cable route**
 - Onshore cable route
 - Mobilisation zone
 - Indicative mobilisation area compound
- Access**
 - Construction access
 - Operation access
- Noise receptor location**
 - Landfall noise receptor location
 - Cable corridor noise receptor location

Note: *alternative monitoring location

Project: Norfolk Vanguard	Report: Environmental Statement
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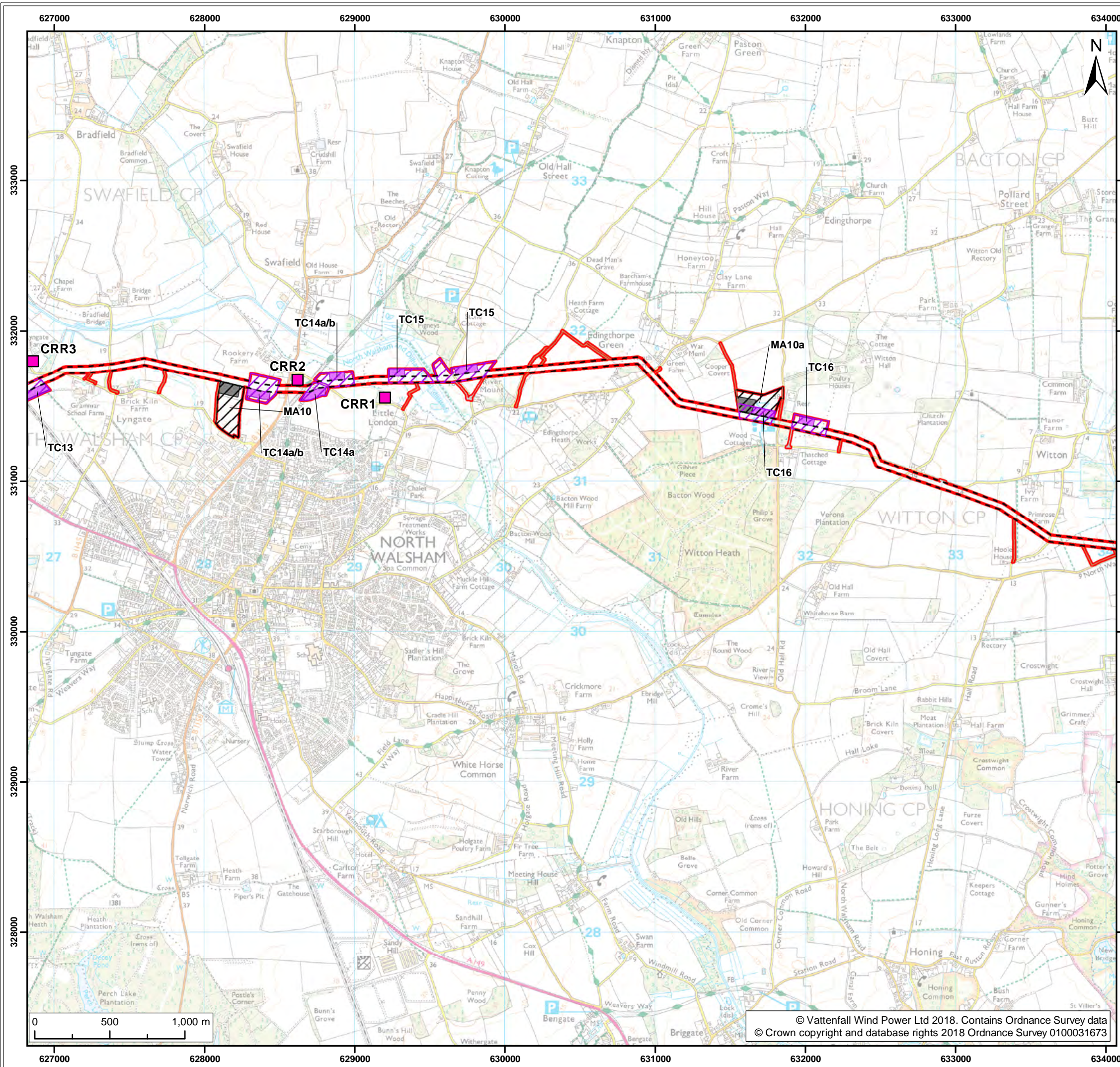
Title:
Noise receptor locations
(map 1 of 9)

Figure: 25.2	Drawing No: PB4476-005-025-002				
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03	26/04/2018	AB	MS	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700

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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project: Norfolk Vanguard	Report: Environmental Statement
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Title:
Noise receptor locations
(map 2 of 9)

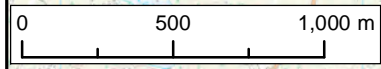
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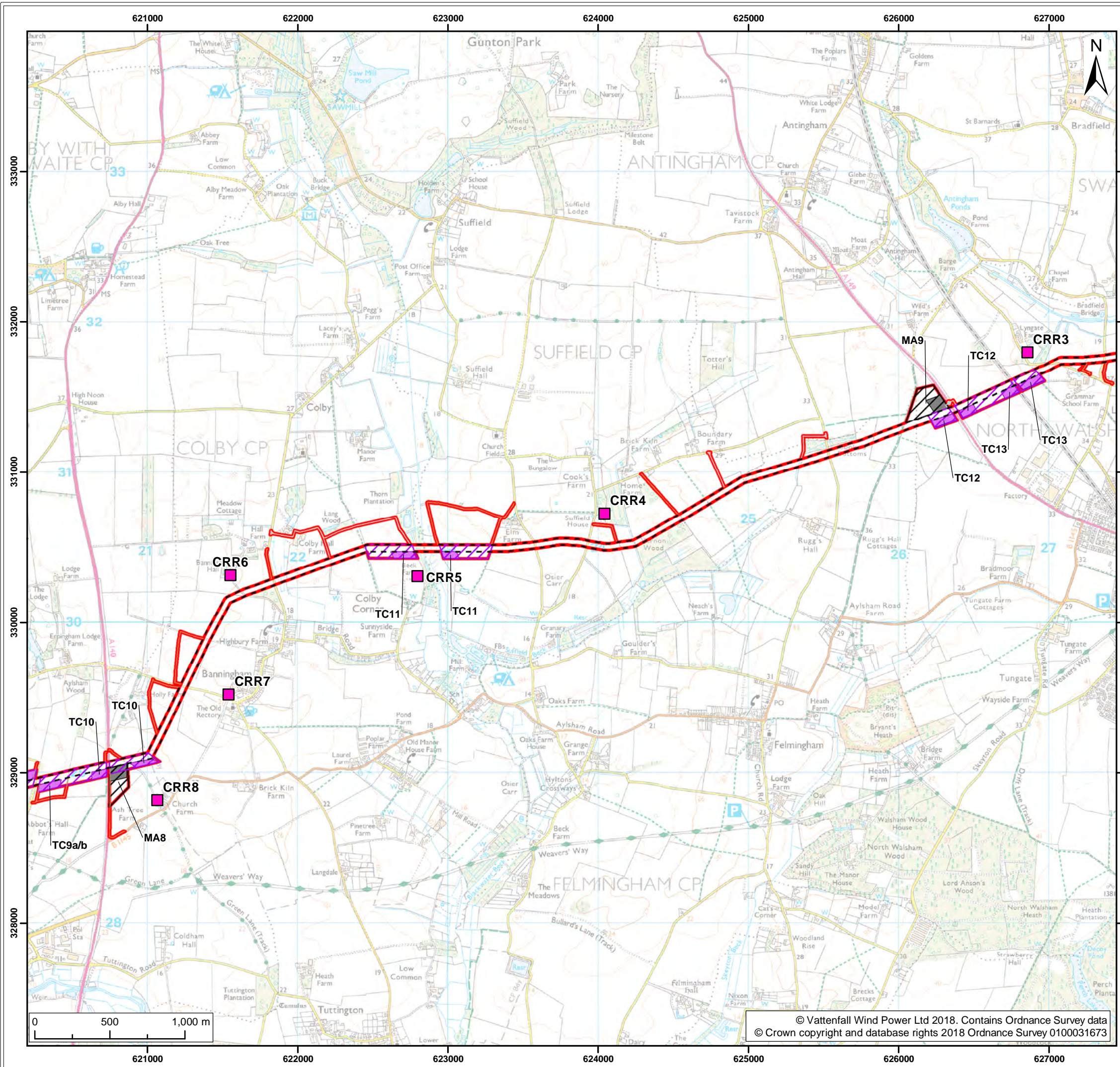
Co-ordinate system: British National Grid EPSG: 27700

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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

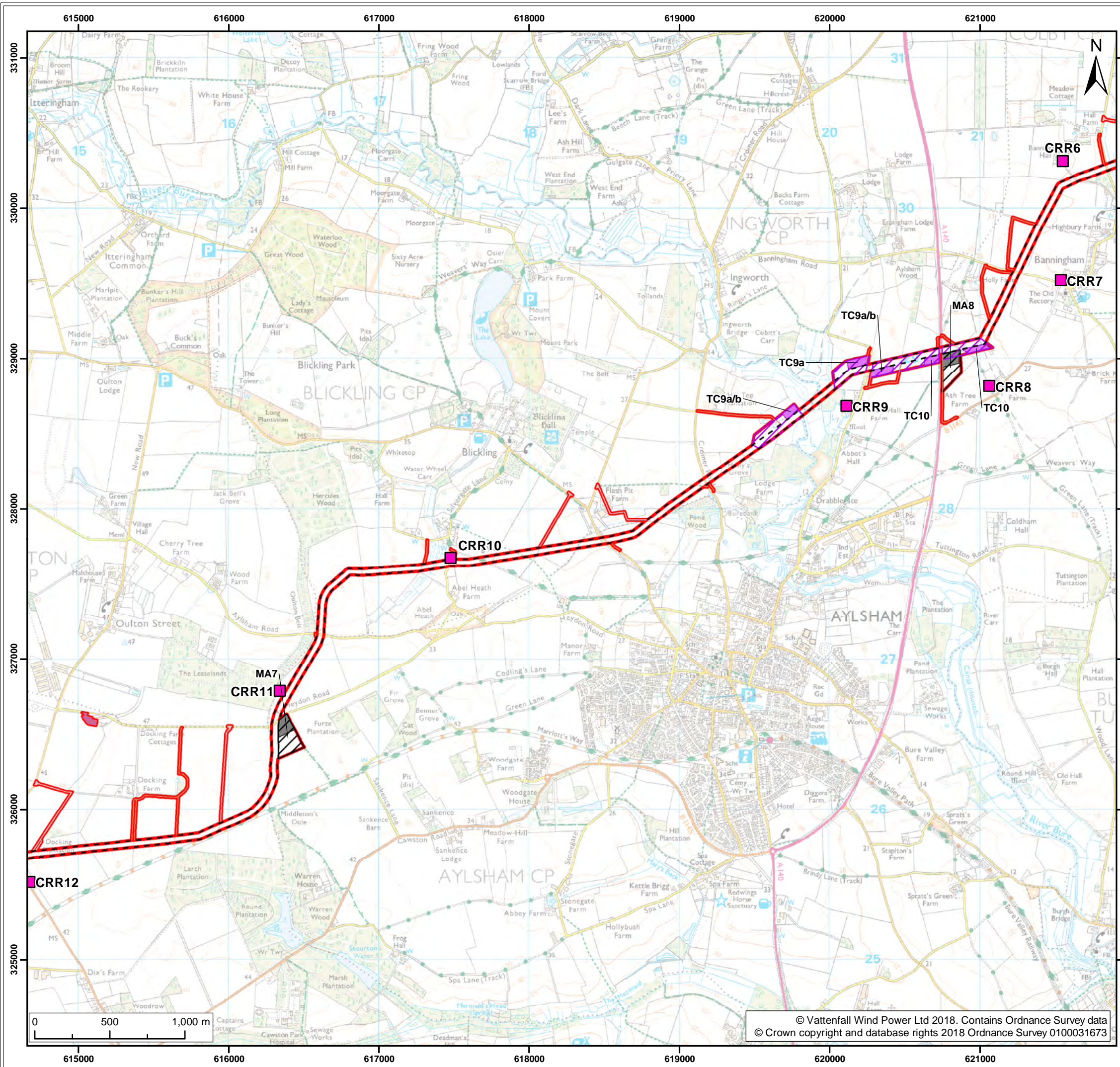
Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement
Title:	
Noise receptor locations (map 3 of 9)	

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Co-ordinate system: British National Grid EPSG: 27700

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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Cable logistics area
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

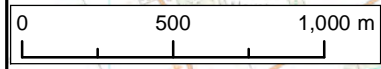
Title:
Noise receptor locations
(map 4 of 9)

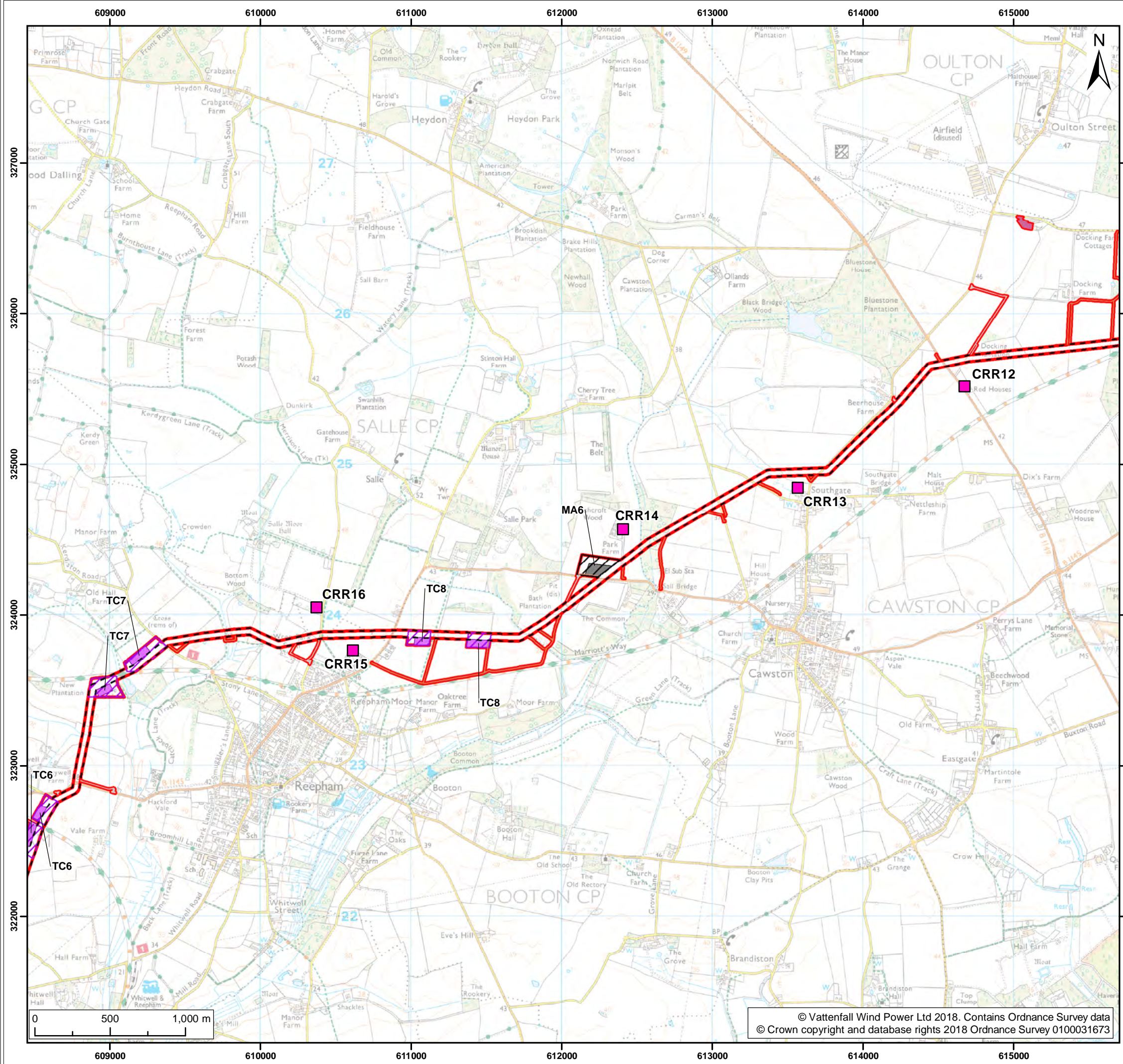
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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Cable logistics area
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

Title:

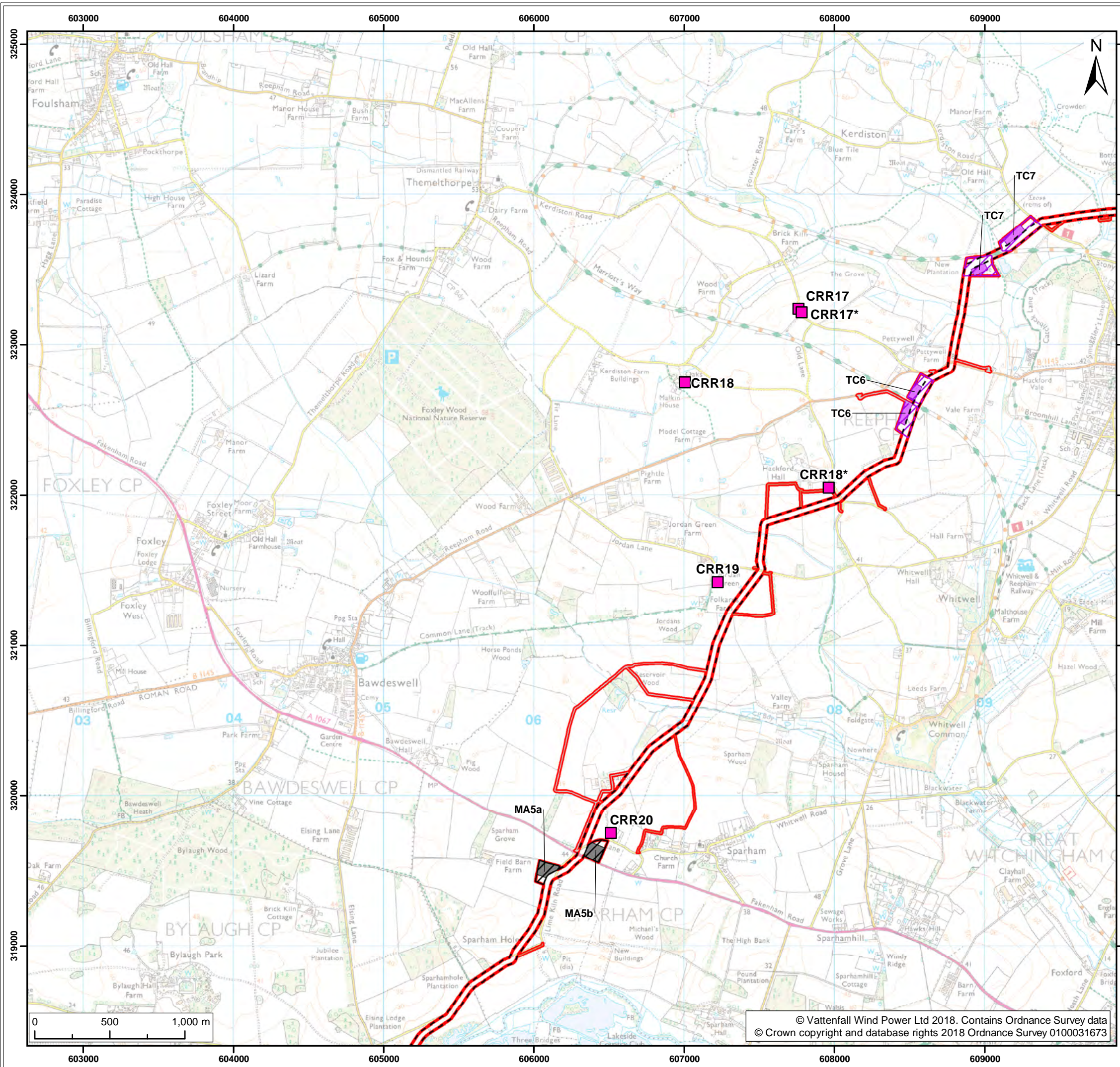
Noise receptor locations
(map 5 of 9)

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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

Title:

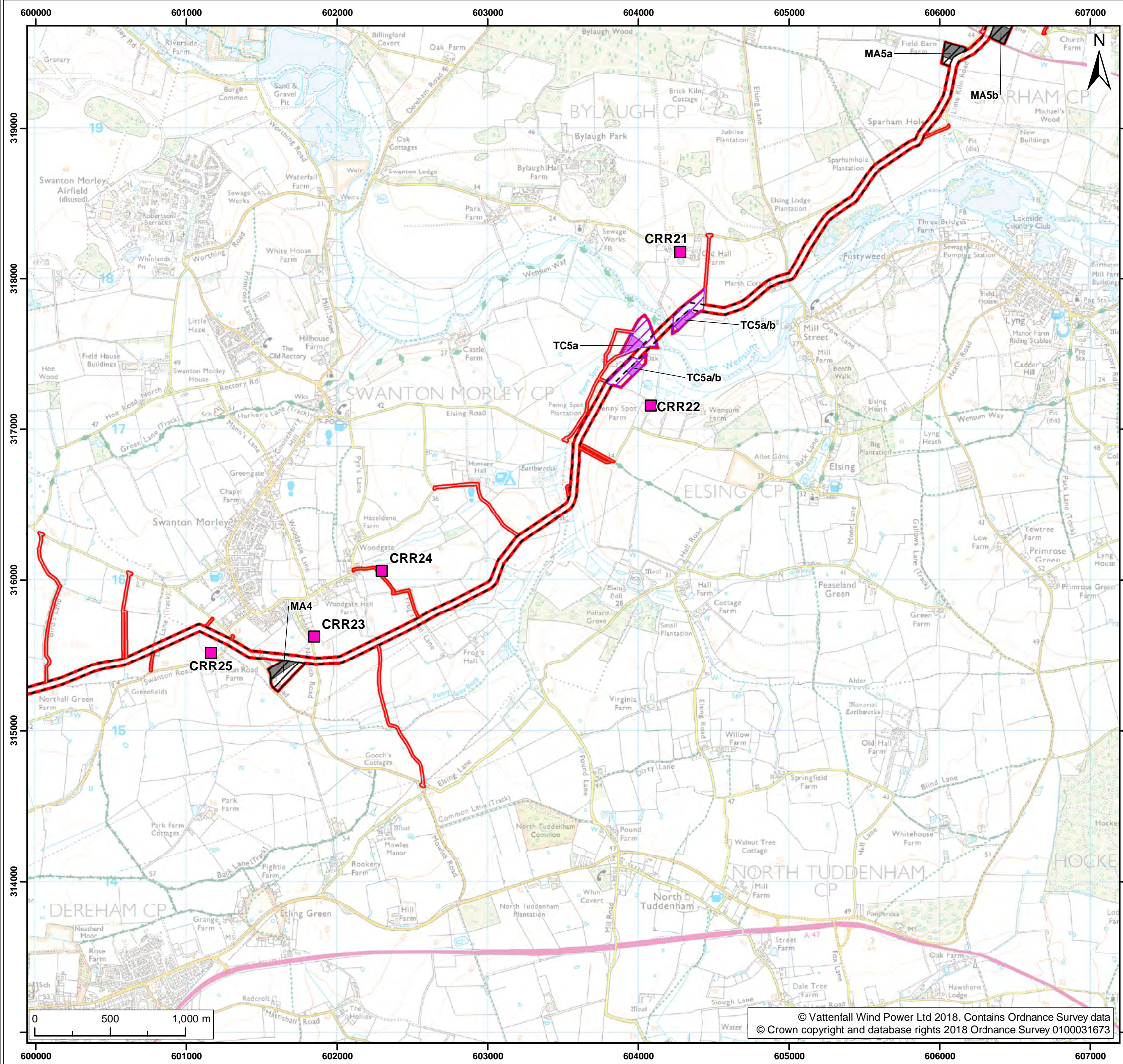
Noise receptor locations
(map 6 of 9)

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Co-ordinate system: British National Grid EPSG: 27700



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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

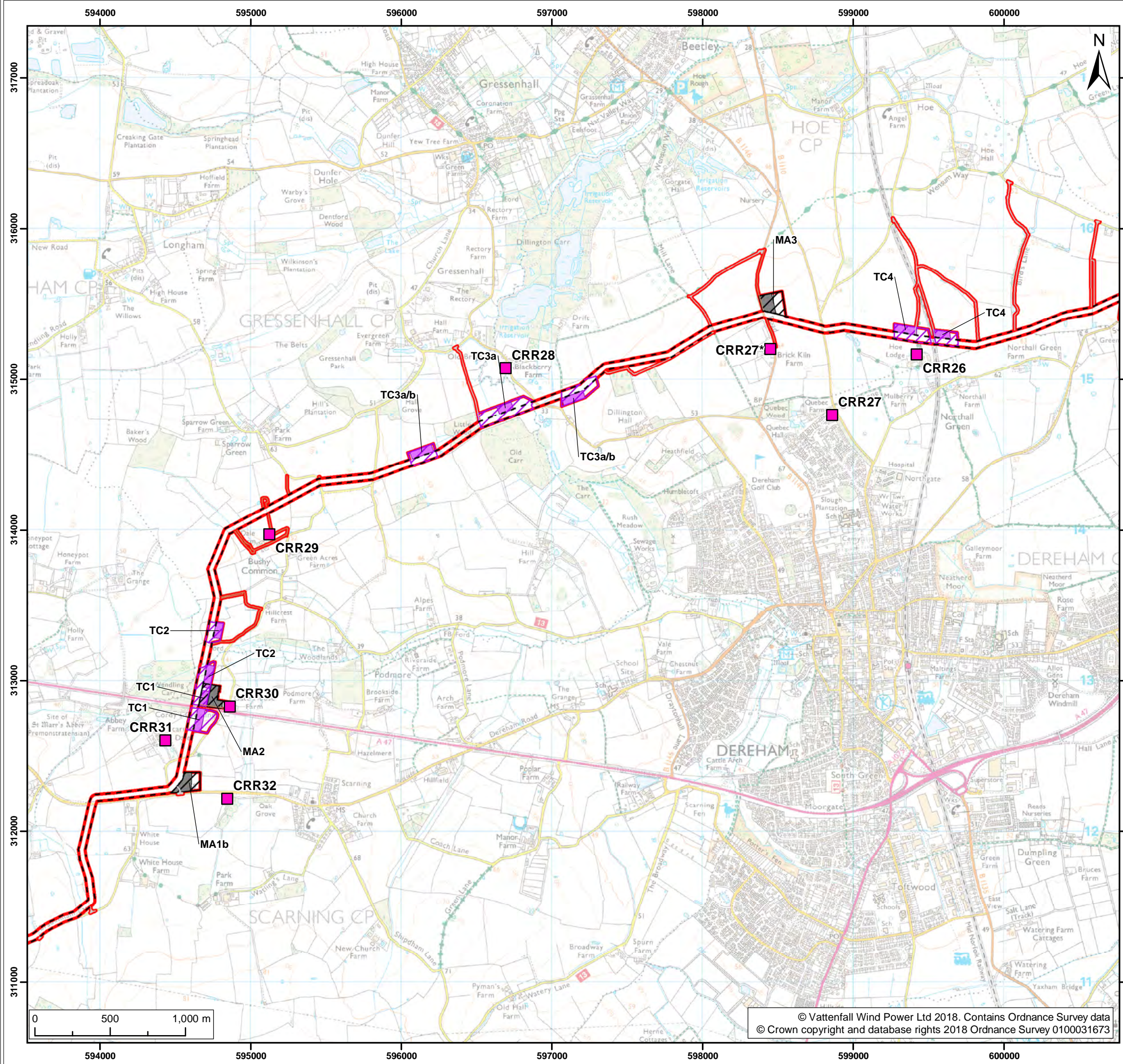
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Noise receptor locations
(map 7 of 9)

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03	26/04/2018	AB	MS	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700

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- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access
 - Noise receptor location**
 - Onshore cable corridor noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

Title:

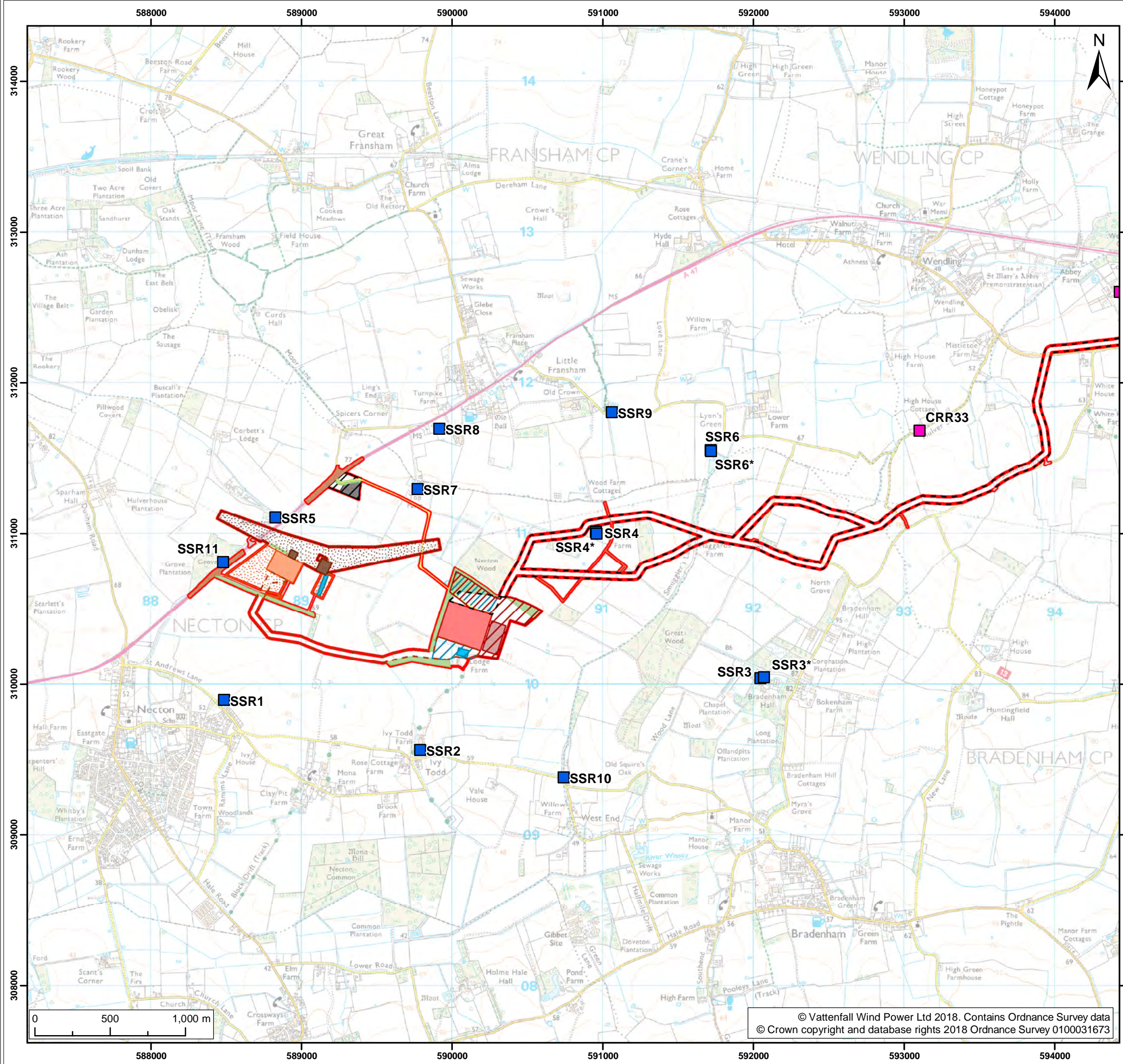
Noise receptor locations
(map 8 of 9)

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Co-ordinate system: British National Grid EPSG: 27700

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Legend:

- Norfolk Vanguard onshore red line boundary
- Onshore cable route
 - Onshore cable route
 - Onshore 400kv cable route
- Mobilisation zone
- Indicative mobilisation area compound
- Access
 - Permanent access
 - Construction access
 - Operation access
- Onshore project substation
 - Onshore project substation
 - Onshore project substation temporary construction compound zone
 - Indicative onshore project substation temporary construction compound
- National Grid
 - National Grid substation extension
 - National Grid new / replacement overhead line tower
 - National Grid temporary works
 - Overhead line temporary works
- Mitigation areas
 - Attenuation pond zone
 - Indicative attenuation pond
 - Indicative mitigation planting
- Noise receptor location
 - Onshore cable corridor noise receptor location
 - Onshore project substation noise receptor location

Note: *alternative monitoring location

Project:	Report:
Norfolk Vanguard	Environmental Statement

Title:
Noise receptor locations (map 9 of 9)

Figure: 25.2	Drawing No: PB4476-005-025-002				
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