Norfolk Vanguard Offshore Wind Farm

Chapter 27

Human Health

Environmental Statement

Volume 1

Applicant: Norfolk Vanguard Limited
Document Reference: 6.1.27
RHDHV Reference: PB4476-005-027
Pursuant to: APFP Regulation 5(2)(a)

Date: June 2018
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Kentish Flats Offshore Wind Farm

Environmental Impact Assessment
Environmental Statement

Document Reference: PB4476-005-027

June 2018

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Date: 25th May 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
02/05/18	01D	First draft for Norfolk Vanguard Limited review	DS	PT/ST/RH	AD
11/05/18	02D	Second draft following Norfolk Vanguard Limited review	DS	PT/RH	AD
25/05/18	01F	Final for ES submission	DS	PT	AD

Table of Contents

Tables

Plates

Appendices (Volume 3)

Glossary

AHAH	Access to Health Assets and Hazards
ALARP	As Low As Reasonably Practicable
BPM	Best Practicable Means
CoCP	Code of Construction Practice
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
EMF	Electromagnetic field
EMP	Environmental Management Plan
ES	Environmental Statement
ETG	Expert Topic Group
FTE	Full Time Equivalent
GIS	Gas Insulated Switchgear
HGV	Heavy Good Vehicle
HIA	Health Impact Assessment
HVAC	High Voltage Alternation Current
HVDC	High Voltage Direct Current
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEMA	Institute of Environmental Management and Assessment
IPC	Infrastructure Planning Commission
LEP	Local Enterprise Partnership
LSOA	Lower Super Output Area
MSOA	Medium Super Output Area
NPS	National Policy Statement
NRPB	National Radiological Protection Board
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
PHE	Public Health England
PM	Particulate Matter
PRoW	Public Rights of Way
SAGE	Stakeholder Advisory Group on Extremely Low Frequency Electric and Magnetic Fields
SoS	Secretary of State
UOESEA	UK Offshore Energy Strategic Environmental Assessment
WHO	World Health Organisation

Terminology

Indicative mitigation planting	Areas identified for mitigation planting at the onshore project substation and Necton National Grid substation.
Landfall	Where the offshore cables come ashore at Happisburgh South
Landfall compound	Compound at landfall within which HDD drilling would take place
Mobilisation area	Areas approx. 100 x 100m used as access points to the running track for duct installation. Required to store equipment and provide welfare facilities. Located adjacent to the onshore cable route, accessible from local highways network

	suitable for the delivery of heavy and oversized materials and equipment.
National Grid overhead line modifications	The works to be undertaken to complete the necessary modification to the existing 400kV overhead lines
National Grid substation extension	The permanent footprint of the National Grid substation extension
National Grid temporary works area	Land adjacent to the Necton National Grid substation which would be temporarily required during construction of the National Grid substation extension.
Necton National Grid substation	The existing 400kV substation at Necton, which will be the grid connection location for Norfolk Vanguard
Onshore 400kV cable route	Buried high-voltage cables linking the onshore project substation to the Necton National Grid substation
Onshore cable route	The 45m easement which will contain the buried export cables as well as the temporary running track, topsoil storage and excavated material during construction.
Onshore cables	The cables which take the electricity from landfall to the onshore project substation
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)
Onshore project substation	A compound containing electrical equipment to enable connection to the National Grid. The substation will convert the exported power from HVDC to HVAC, to 400kV (grid voltage). This also contains equipment to help maintain stable grid voltage.
Running track	The track along the onshore cable route which the construction traffic would use to access workfronts
The Applicant	Norfolk Vanguard Limited
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure
Trenchless crossing zone (e.g. HDD)	Temporary areas required for trenchless crossing works
Workfront	The 150m length of onshore cable route within which duct installation would occur

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27 HUMAN HEALTH

27.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the potential health effects associated with the Norfolk Vanguard Offshore Wind Farm (herein referred to as 'the project').

2. This chapter meets the requirements of the EIA Regulations 2017 in providing reasoned conclusions for the identification and assessment of any likely significant effects of the project on human health. Following best practice (Cave *et al*., 2017a), the chapter considers health effects with regards the general population and vulnerable population groups. Populations are considered at regional and local levels.

3. The chapter follows the World Health Organisation (WHO) definition of health as a state of physical, mental and social wellbeing, as well as the absence of disease or infirmity. Similarly, it also considers issues of wellbeing as a state in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to their, her or his community.

4. The context of people's lives determines their health. Therefore, both the WHO and Public Health England (PHE) consider that health and wellbeing are influenced by a range of factors, termed the 'wider determinants of health'. Determinants include the social and economic environment, the physical environment, and individual characteristics or behaviours.

5. The focus of the chapter is on community health and wellbeing and not on occupational health and safety. The term 'health' is used to describe 'human health' and 'wellbeing' unless specifically referenced otherwise.

6. This chapter informs and has been informed by other relevant chapters of this ES. These include:

   - Chapter 20 Water Resources and Flood Risk;
   - Chapter 21 Land Use and Agriculture;
   - Chapter 24 Traffic and Transport;
   - Chapter 25 Noise and Vibration;
   - Chapter 26 Air Quality;
   - Chapter 29 Landscape and Visual Impact Assessment;
   - Chapter 30 Tourism and Recreation;
   - Chapter 31 Socio-economics; and
   - Chapter 33 Onshore Cumulative Impacts.

7. This chapter brings together the relevant information on health, including assessing the findings of other chapters within this ES in population health terms. This approach aims to assist in identifying project factors which may affect human health and wellbeing.

27.2 Legislation and Guidance

27.2.1 Legislation

8. The following legislative context has informed the assessment.

9. The Health and Safety at Work Act 1974 (HM Government of Great Britain, 1974) places duties on employers to ensure, so far as is reasonably practicable: the health, safety and welfare at work of all their employees; and that persons not in their employment are not exposed to risks to their health or safety as a result of the activities undertaken. In both cases, the requirement for risks to be reduced to As Low As Reasonably Practicable (ALARP) is fundamental and applies to all activities within the scope of the Health and Safety at Work Act 1974.

10. The Control of Major Accident Hazards Regulations 1999 relate to the management of threshold quantities of dangerous substances identified in the regulations (HM Government of Great Britain, 1999).

11. The Health Protection Regulations 2010 came into force to complete the modernised legal framework for health protection in England. Three sets of regulations complement the updated Public Health (Control of Disease) Act 1984, which was substantially amended by the Health and Social Care Act 2008. These are:

- The Health Protection (Notification) Regulations 2010 (SI 2010/659);
- The Health Protection (Local Authority Powers) Regulations 2010 (SI 2010/657); and
- The Health Protection (Part 2A Orders) Regulations 2010 (SI 2010/658).

12. The Clean Air Act (1993) aims to reduce pollution from smoke, grit and dust and gives local authorities powers to designate smoke control areas (HM Government of Great Britain & Northern Ireland, 1993). The Air Quality Standards Regulations 2010 transpose into English law the requirements of Directives 2008/50/EC and 2004/107/EC on ambient air quality.

13. Part III of the Environmental Protection Act 1990 discusses control of emissions (including dust, noise and light) that may be prejudicial to health or a nuisance (HM Government of Great Britain & Northern Ireland, 1990).

14. The International Convention for the Prevention of Pollution from Ships (MARPOL) includes regulations aimed at preventing and minimising, both accidental and operational, pollution from ships (International Maritime Organisation, 1973).

15. The revised Bathing Water Directive 2006/7/EC safeguards public health and clean bathing waters (European Parliament and Council of the European Union, 2006). Bathing waters are also protected under the Water Framework Directive 2000/60/EC (European Parliament and Council of the European Union, 2000).

27.2.2 Guidance

16. Planning Practice Guidance on Environmental Impact Assessment (EIA) explains the requirements of the Town and Country Planning (EIA) Regulations 2017. The guidance does not provide any additional information in relation to defining, scoping or assessing 'population and human health'. Regard has therefore been given to the advice provided in the Institute of Environmental Management and Assessment, 2017: Health in Environmental Assessment, a primer for a proportionate approach (Cave *et al*., 2017a). Public Health England has also issued a briefing note on health in EIA for local public health teams (Cave *et al*., 2017b).

17. The approach to assessing health in EIA has also been informed by relevant UK guidance on Health Impact Assessment (HIA). In England there is no overarching guidance for HIA. However, generic principles are evident in specialist guidance such as that by the Department of Health in relation to HIA of government policy (Department of Health, 2010), or that by the London Healthy Urban Development Unit in relation to urban planning (NHS Healthy Urban Development Unit, 2015). In Wales there is good quality project level guidance on HIA by the Wales Health Impact Assessment Support Unit (WHIASU, 2012). Similarly in Northern Ireland overarching project level HIA guidance is provided by the Institute of Public Health in Ireland (Metcalfe *et al.,* 2009). HIA guidance from Scotland includes discussion of issues relevant to rural contexts (Higgens *et al.,* 2015).

18. Guidance published by the World Bank Group (World Bank Group, 2015) advises that community health and safety hazards specific to wind energy include blade or ice throw, aviation impacts, marine navigation, electromagnetic radiation, public access, and abnormal load transportation. Due to the project being located 47km from the coast (see Chapter 5 Project Description), blade or ice throw and aviation issues are unlikely to be a concern for local populations to the onshore cable route. Marine navigation is considered in Chapter 15 Shipping and Navigation. Abnormal loads are considered within the Abnormal Loads Assessment (Appendix 4 of the Outline Traffic Management Plan (TMP) (document reference 8.8).

19. Public Health England released guidance in 2013 regarding the health effects of exposure to electric and magnetic fields; this guidance has been used to consider the effects of electromagnetic fields (EMF) in section 27.6. (PHE, 2013a; 2013b)

20. In March 2004, the National Radiological Protection Board, NRPB (now part of PHE), published advice on limiting public exposure to electromagnetic fields. The advice

was based on an extensive review of the science and a public consultation on its website, and recommended the adoption in the UK of the EMF exposure guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP guidelines are based on the avoidance of known adverse effects of exposure to EMF at frequencies up to 300 GHz (gigahertz), which includes static magnetic fields and 50 Hz electric and magnetic fields associated with electricity transmission (McKinlay *et al*., 2004).

21. This human health chapter has had regard to the precautionary findings of the UK Stakeholder Advisory Group on Extremely Low Frequency Electric and Magnetic Fields (SAGE). SAGE was initiated by National Grid and was adopted by the Department of Health in order to provide advice to the Government (Stakeholder Advisory Group on ELF EMFs, 2010).

27.3 Methods

27.3.1 General Approach

22. This chapter sets out the methods for providing reasoned conclusions for the identification and assessment of any likely significant effects of the project on human health (as required by the EIA Regulations 2017).

23. Consistent with the objective of EIA (as set out in EIA Directive 2014/52/EC), the methods identify effects that provide, or are contrary to providing, a high level of protection to human health. This includes reasoned conclusions in relation to health protection, health improvement and/or improving services.

24. The methods provide a framework to identify (at both scoping and assessment):

- The 'likelihood' of the project having an effect on health; and
- If an effect is likely, whether it may be 'significant' in the terms of the EIA regulations.

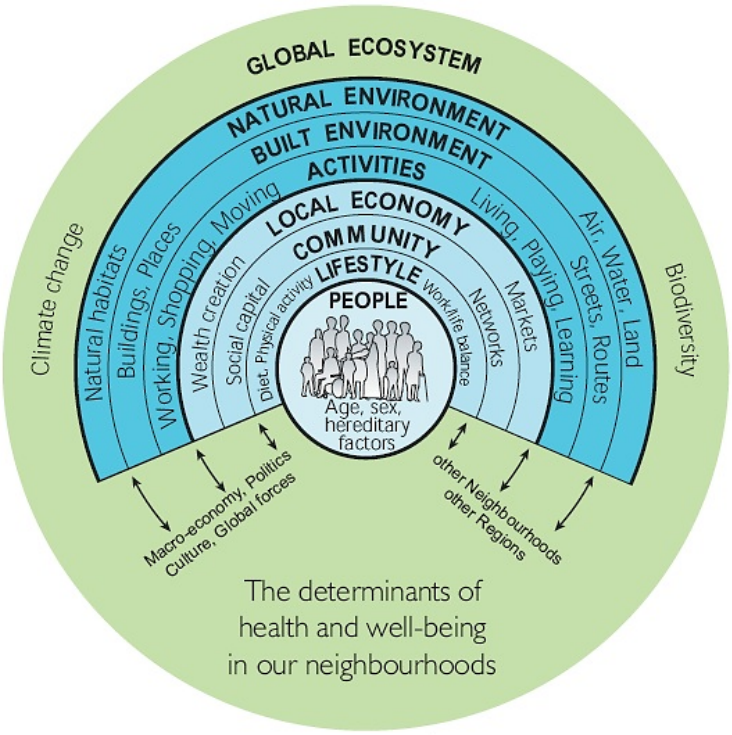
25. Effects are considered with regards the general population and vulnerable groups. Populations are considered at regional and local levels.

26. In line with best practice guidance from the WHO (WHO, 2012) and PHE (PHE, 2017c), "health determinants" are considered to understand effects of human health and wellbeing. The methodology uses emerging best practice published by the Institute of Environmental Management and Assessment (IEMA) in line with the 'Health in Environmental Impact Assessment: A Primer for a Proportionate Approach' (Cave *et al*., 2017a).

27.3.2 Health Determinants

27. Human health can be influenced by a wide variety of direct and indirect factors, from controllable factors such as lifestyle to uncontrollable factors such as genetics. The influences and effects can be wide-ranging and are likely to vary between individuals. In determining 'physical, mental and social wellbeing', external contributory factors, known as 'determinants', are considered. Determinants are a reflection of a mix of influences from an individual's society and environment.

28. The 'wider determinants of health' model is used to conceptualise how human health spans environmental, social and economic aspects. This is illustrated in Plate 27.1.



Source: Based on the Dahlgren and Whitehead (1991) diagram as amended by Barton and Grant (2006) and advised by Cave *et al*. (2017)

Plate 27.1 Wider determinants of public health

29. Influences that result in a change in determinants have the potential to cause beneficial or adverse effects on health, either directly or indirectly. The degree to which these determinants influence health varies, given the degree of personal choice, location, mobility, and exposure.

27.3.3 Likelihood

30. The first issue to consider in scoping or assessment is the likelihood of the project having an effect. A likely effect should be both plausible and probable.

- Plausible relates to their being a relevant source, pathway and receptor (see discussion of health pathways below).
- Probable relates to a qualitative judgement to exclude those effects that could only occur under certain very rare conditions, except where these relate to the projects vulnerability to major accidents or disasters (as required by Part 1 paragraph 4(4) EIA Regulation 2017).[1]

31. The term 'health pathways' describe how a specific activity of the project could change a determinant of health and potentially result in a change in health outcomes (an effect). Health pathways are considered with regards the source, pathway, and impact as follows:

- A 'source' represents an activity or factor that could affect the health outcomes of a receptor population.
- A 'pathway' describes the method or route by which the 'source' could affect the 'receptor' (either causation or association).
- A 'receptor' is the recipient of an effect from the 'source', via the 'pathway'.

32. Table 27.1 shows how the Source-Pathway-Receptor model can be used to identify plausible health effects.

Table 27.1 Use of a Source-Pathway-Receptor model to identify plausible health effects

Source	Pathway	Receptor	Plausible health effect?	Rationale
×	✓	✓	No	There is not a clear source from where a potential health effect could originate.
✓	×	✓	No	The source of a potential health effect lacks a means of transmission to a population.
✓	✓	×	No	Receptors that would be sensitive or vulnerable to the health effect are not present.
✓	✓	✓	Yes	Identifying a source, pathway and receptor does not mean an effect is a likely significant effect; the probability of the effect should be qualitatively considered and a professional judgement reached on the significance of effects that are considered likely.

27.3.4 Significance

33. A determination of significance is required for compliance with the EIA regulations 2017 when a potential effect of the project is likely (or relates to the project's vulnerability to major accidents or disasters)[1].

34. The determination of significance has two stages:

[1] Chapter 5 Project Description includes a section on Major Hazards and Disasters. This finds that there are no causal pathways between the project and major accidents.

- Firstly, the sensitivity of the receptor affected, and the magnitude of the effect upon it are characterised. This establishes whether there is a relevant population and a relevant change in health outcomes to consider.
- Secondly, a professional judgement is made as to whether or not the change in a population's health is significant. This judgement is based on the collection and presentation of data to evidence reasoned conclusions.

27.3.4.1 Sensitivity

35. Table 27.2 sets out factors characterising sensitivity for human health. The table informs the professional judgement on scoring high, medium, low or negligible sensitivity. In line with best practice a formulaic matrix approach to determining sensitivity has been avoided. The 'higher' and 'lower' sensitivity characterisations represent instructive positions on a spectrum that would also include more extreme, as well as intermediate, positions. Most situations have a mix of higher and lower characterising factors so a balanced expert view of sensitivity is taken.

Table 27.2 Factors characterising population sensitivity (Cave *et al.*, 2017a)

	Inequalities	Deprivation	Health status	Life stage	Outlook
Higher sensitivity	High levels of inequalities or inequities.	High levels of overall deprivation or a high level of deprivation for a relevant sub-domain of the indices of multiple deprivation. High levels of poor access to financial, social or political resources.	High levels of poor health and/or disability (particularly multiple or complex long-term health conditions). High reliance on (or low capacity in) healthcare facilities, staff or resources.	Presence of dependants (particularly the elderly or children), pregnant women, shift workers or the economically inactive.	Presence of groups with strong views or high degrees of uncertainty about the project who may anticipate risks to their health and thus be affected by not only actual changes, but also by the possibility of change.
Lower sensitivity	Low levels of inequalities or inequities.	Low levels of overall deprivation or a low level of deprivation for a relevant sub-domain of the indices of multiple deprivation. Good access to financial, social or political resources.	Low levels of poor health and/or low levels of disability. Low reliance on (or high capacity in) healthcare facilities, staff or resources.	Predominantly a working age population in steady good quality employment.	No indication that strong views are held about the project. People are well informed of the issues and potential effects.

36. The assessment characterises the relevant populations for each health issue. For each category, the text sets out detail on the one or more relevant factors from Table 27.2 that informed the score.

27.3.4.2 Magnitude

37. Table 27.3 sets out factors characterising magnitude for human health. The table informs the professional judgement on assigning scoring of large, medium, small or negligible magnitude. In line with best practice a formulaic matrix approach to

determining magnitude has been avoided. The 'larger' and 'smaller' magnitude characterisations represent instructive positions on a spectrum that would also include more extreme, as well as intermediate, positions.

Table 27.3 Factors characterising magnitude (Cave *et al.*, 2017a)

	Severity	Extent	Frequency	Reversibility	Exposure
Larger magnitude	Large change in the risk of developing a new health condition (or injury) or in the progression of an existing condition. Large change in symptoms, quality of life or day-to-day functioning. Large change in inequalities.	Most members of the relevant population affected. Substantial population displacement or influx.	Continuous or daily effects with chronic (long term) changes in health outcomes.	Permanent change in health outcomes once the project change ceases. Intergenerational effects.	A low (or high) concentration over a long time, or a high concentration over a short time. Low (or high) exposure to a large population or high exposure to a small population. A high degree of resource sharing with the project.
Smaller magnitude	Small change in the risk of developing a new health condition (or injury) or in the progression of an existing condition. Small change in symptoms, quality of life or day-to-day functioning. Small change in inequalities.	Few members of the relevant population. Little change in population.	Monthly or yearly affects with acute (short term) changes in health outcomes.	Change in health outcomes reverses once the project change ceases. No intergenerational effects.	A low concentration over a short time. Low exposure to a small population. A low degree of resource sharing with the project.

38. The assessment characterises the relevant changes in health outcomes for each health issue. For each professional judgement on magnitude, the text sets out detail on the one or more relevant factors from Table 27.3 that informed the score.

27.3.4.3 Judgement framework for significance

39. Having established that a source, pathway and receptor for impact exist, the magnitude/sensitivity methods are used to consider whether there is a relevant population to consider and a relevant change in health outcomes, a professional judgement is made as to whether or not the change in a population's health is significant.

40. The characterisation of sensitivity and magnitude provides consistency between EIA topics. However, other relevant information sources (in addition to sensitivity and magnitude) also need to be evidenced for the professional judgement on significance to be a reasoned and robust conclusion on population health outcomes.

41. The approach uses a framework for reporting on a range of data sources to ensure reasoned and robust professional judgements are reached. Key sources of data include: scientific literature; baseline conditions; health priorities; consultation responses; regulatory standards; and policy context.

42. Guide questions set out in Table 27.4 are used to inform the professional judgements on significance. The table informs the professional judgement on scoring major, moderate, minor or negligible significance. In line with best practice a formulaic matrix approach to determining significance has been avoided.

Table 27.4 Human health guide questions for determining significance (Cave *et al.*, 2017a)

Evidence sources	Guide questions
Scientific literature	Is there a sufficient strength of evidence from sufficiently high quality studies to support an association between the project change, a relevant determinant of health and a relevant health outcome? Does the literature indicate thresholds or conditions for effects to occur? Are particular population groups identified as being particularly susceptible?
Baseline conditions	Are relevant sensitivities or inequalities identified in the scientific literature present? Does the baseline indicate that conditions differ from relevant local, regional or national comparators? Are their geographic or population features of the baseline that indicate effects could be amplified?
Health priorities	Have local, regional or national health priorities been set for the relevant determinant of health or health outcome (e.g. in Joint Strategic Needs Assessments or in Health and Wellbeing Strategies)?
Consultation responses	Has a theme of local, regional or national consultation responses related to the relevant determinant of health or health outcome?
Regulatory standards (if appropriate)	Is the change one that would be formally monitored by regulators? Are there regulatory or statutory limit values set for the relevant context? Has EIA modelling predicted change that exceed thresholds from the scientific literature or set by regulators? Are there relevant international advisory guideline limit values (e.g. by the World Health Organisation)?
Policy context	Does local, regional or national government policy raise particular expectations for the relevant project change, determinant of health or health outcome (e.g. levels should be as low as reasonably practicable)? Is there a relevant international policy context (e.g. treaties or conventions)?

43. The text of the assessment section provides a structured discussion that responds to each of these questions for each health issue. The discussion provides reasoned conclusions for the professional judgement as to whether in EIA terms an issue is significant, or not. Where appropriate, variation expressed in each evidence source has been reported. This approach is considered proportionate and in line with best practice for the consideration of human health in EIA.

44. Ultimately for human health, a likely significant effect is one that should be brought to the attention of the determining authority, as the effect of the project is judged to provide, or be contrary to providing, a high level of protection to human health. This may include reasoned conclusions in relation to health protection, health improvement and/or improving services.

45. For the purposes of the EIA, major and moderate effects are deemed to be significant. In addition, whilst minor effects are not significant in their own right, it is

important to distinguish these from other non-significant effects as they may contribute to significant cumulative effects.

46. Where significant adverse effects are identified, mitigation has been considered to reduce the significance of such effects. Similarly, enhancements have been considered where significant and proportionate opportunities to benefit population health have been identified. The residual effects represent the output of iterative assessment, taking into consideration the mitigation and enhancement measures.

47. The health chapter takes as its starting point the residual effects as assessed and determined in other relevant EIA topic chapters. This includes taking into account relevant embedded and standard good practice mitigation.

27.3.4.4 Population conclusions

48. A population health approach has been used, as it would be disproportionate to reach conclusions on the potential health outcomes of individuals. To take account of potential inequalities, where appropriate, conclusions on a particular health issue have been reached for more than one population. For example:

- One conclusion for the general population (for a defined area); and
- A second separate sub-population conclusion for relevant vulnerable groups (as a single defined class of sensitivities for that issue).

27.3.5 Cumulative Impact Assessment

49. The Human Health chapter takes a different approach to the methodology used for the Cumulative Impact Assessment (CIA) described in Chapter 6 EIA Methodology.

50. The cumulative assessment considers the inter-relationships between health effects both from within the project and in combination with effects from other projects. These are considered for:

- Project geographies:
  - Landfall;
  - Onshore cable route;
  - Onshore project substation;
  - National Grid substation extension and overhead line modifications;
  - Locally, regional, and nationally.
- For the following vulnerable populations:
  - Children and young people;
  - Older people;
  - People with existing poor health; and
  - People living in deprivation.

51. Firstly, the intra-project cumulative effects are considered. The aim of this is step is to understand if different effects on health determinants from the project would cumulatively create a larger health effect. For example, at a section of the project would changes to noise levels, traffic density, and air quality combine to provide a more significant effect than on their own.

52. Secondly the inter-project cumulative effects are considered. As with other chapters, projects are screened for assessment based on a list agreed with Norfolk County Council. Then projects are considered for cumulative effect at different locations and for different vulnerable populations.

27.4 Scope

27.4.1 Spatial scope

27.4.1.1 Study Areas

53. The project makes landfall at Happisburgh South, which is within the North Norfolk District. The onshore cable route travels inland towards Necton, through the Broadland and Breckland Districts of Norfolk County.

54. The following geographic area classifications have been used:

- Site-specific;
- Local (North Norfolk, Broadland and Breckland Districts);
- Regional (Norfolk County);
- National (England); and
- International.

55. The 'site specific' level considers localised effects with reference to routine statistics collected for Lower Super Output Areas (LSOAs), see Section 27.5.3 on baseline. Specific consideration is given to the following three most representative LSOAs:

- North Norfolk 012A (representative of the population at landfall);
- Breckland 004C (representative of the onshore cable route population[2]); and
- Breckland 004A (representative of the population at the onshore project substation and the National Grid substation extension and overhead line modification).

56. The onshore cable route through Breckland 004C includes trenched and trenchless sections, mobilisation areas and a representative spread of dwellings. The LSOAs selected are not intended to indicate the area of effect, but rather the profile of the affected population. It is considered disproportionate to the assessment to include

[2] Breckland 004C has been selected as a representative LSOA to characterise the population along the onshore cable route. Across the indices of multiple deprivation Breckland 004C is typically more deprived than other LSOAs along the onshore cable route (Department for Communities and Local Government, 2015).

all LSOAs along the cable route. Using Breckland 004C to characterise the population along the cable route is consistent with proportionately assessing the worst case.

57. Within the study areas the assessment defines ten population groups (described below). Defining these population groups allows a structured and consistent discussion in both the assessment and the cumulative assessment. Six of these population groups are geographically defined, the remaining four are defined in relation to reasons that a population may be sensitive, other than due to proximity.

58. The study areas used in other chapters of this ES are of relevance, but do not necessarily define the boundaries of potential health effects. For example, effects on mental health and wellbeing are subjective and may not be limited to the area defined in relation to achieving certain regulatory thresholds. Consequently, this health chapter uses study areas to broadly define representative population groups rather than to set boundaries on the extent of potential effects.

27.4.1.2 Geographic Population Groups

59. Six population groups have been selected based on the geographic study areas:

- The population near landfall (site-specific);
- The population along the onshore cable route (site-specific);
- The population near the onshore project substation and National Grid substation extension (site-specific);
- The population near the National Grid extension and overhead line modification;
- The population of North Norfolk, Broadland and Breckland districts (local);
- The population of Norfolk county (regional); and
- The population of England and beyond the borders of England (national and international).

27.4.1.3 Potentially Vulnerable Groups

60. In addition, four further population groups are defined in relation to their potential sensitivity to changes associated with the project (beneficial or adverse):

- Children and young people;
- Older people;
- People with existing poor health (physical and mental health); and
- People living in deprivation, including those on low incomes.

61. These groups are intentionally broadly defined to facilitate a consistent discussion across health issues and as a basis to considering cumulative effects. The assessment section discusses detail relevant to particular health issues. People falling into more than one group may be especially sensitive.

27.4.2 Temporal Scope

62. The temporal scope has been defined as follows:

- 'Very short term' relates to effects measured in hours, days or weeks (e.g. effects, associated with cable laying activity past a particular dwelling);
- 'Short term' relates to effects measured in months (e.g. requirements of the overall construction stage, such as workforce use of accommodation);
- 'Medium term' relates to effects measured in years (e.g. local employment during construction);
- 'Long term' relates to effects measured in decades (e.g. the operational stage).

27.4.3 Topic Scope

63. The scope of issues considered by this health chapter has been informed by the project Scoping Report (Royal HaskoningDHV, 2016), has taken into account the Planning Inspectorate Scoping Opinion (The Planning Inspectorate, 2016), and has been developed in response to the EIA Regulations 2017.

64. The scope of the health chapter focuses on the onshore infrastructure associated with the project. Following the principles outlined in section 27.3.4 (factors relating to likelihood) and section 27.3.5 (factors relating to significance) the following potential effects have been scoped out:

- Potential Offshore Health Effects Scoped Out:
  - PHE note that operational windfarms should not produce emissions, pollutants, or waste products;
  - Landscape and visual impacts due to offshore wind turbines that are beyond the 35km limit of visual significance identified in Department of Trade and Industry (DTI) guidance;
  - The potential for the offshore wind farm, or its support vessels, to pose a hazard to shipping and/or aviation are not expected to have significant appreciable or significant effects on human health;
  - The presence of cable laying and support vessels close to the shore due to temporary nature of such activities;
  - The potential for bathing waters to be affected by sedimentation and/or fuel spills associated with the horizontal drilling of the onshore cable route at the landfall; and
  - Effects due to the subsequent development of port facilities.
- Potential Onshore Health Effects Scoped Out:
  - Due to the manufacturing of the offshore elements of the offshore wind farm;

- The potential for negative health or social effects due to the workforce because:
- workers are likely to be UK based;
- working age and of good health;
- migrant workers would be distributed across Norfolk and Suffolk in existing rental accommodation (such as hotels); and
- it is expected that migrant workers would return to their homes over the weekend;
- effects on local services because resident workers would continue to use their registered GP and migrant workers would be distributed across the region; and
- A high standard of workforce conduct is mandated by the Vattenfall Wind Power Ltd (a parent company of Norfolk Vanguard Limited) code of conduct[3] both at work and when staying in host communities.

27.4.3.1 Potential onshore health effects scoped in

65. The following paragraphs set out the topic scope for health issues that have been assessed in this chapter due to the potential for likely significant effects to human health. These effects will also be considered cumulatively within the project and with other projects.

66. The chapter assesses the potential for likely significant health effects to occur during construction and operation as described in Table 27.5.

Table 27.5 Potential sources of impact leading to potential health effects

Potential Source	Potential pathway	Potential Receptor	Relevant ES chapter
Construction			
Noise from excavation machinery and associated movements	Temporary nuisance	Site specific populations or any sensitive groups such as schools or residential homes	Chapter 25 Noise and Vibration
Dust generated during construction	Temporary nuisance or inhalation of particulates	Site specific populations	Chapter 26 Air Quality
Exhaust emissions and particulates from machinery		Site specific populations and localised populations within Norfolk County	
Accidental spillage	Emissions to ground or surface water	Site specific populations	Chapter 19 Ground Conditions and Contamination

[3]Norfolk Vanguard Limited is a company owned by Vattenfall Wind Power Limited (VWPL) and operating under VWPL's code of conduct, this is available on VWPL's corporate website at: https://corporate.vattenfall.com/globalassets/corporate/about_vattenfall/corporate_governance/doc/code_of_conduct_2014.pdf

Potential Source	Potential pathway	Potential Receptor	Relevant ES chapter
			Chapter 20 Water Resources and Flood Risk
Temporary disturbance or obstruction of roads and footpaths due to road transportation of materials and equipment, workforce traffic, and construction areas	Loss of access to green space or diversions to access routes	Site specific populations and localised populations within Norfolk County	Chapter 30 Tourism and Recreation
	Disruption of access to services and amenities	Site specific populations and localised populations within Norfolk County	Chapter 24 Traffic and Transport
Construction and operation			
Increases in employment and commercial opportunity	Increased wealth in populations	Population of New Anglia Local Enterprise Partnership (LEP)	Chapter 31 Socio-economics
Operation			
Noise from the onshore project substation	Long term nuisance	Site specific population at the onshore project substation	Chapter 25 Noise and Vibration
Electromagnetic Fields from the underground cables, onshore project substation, and National Grid substation extension	Interaction with magnetic fields	Site specific population along the cable route and at the onshore project substation.	See Footnote for details[4][5]

27.5 Data Sources

27.5.1 Types of Data and Evidence

67. Data sources relating to human health receptors are presented in the following chapters:

- Chapter 20 Water Resources and Flood Risk;
- Chapter 21 Land Use and Agriculture;
- Chapter 24 Traffic and Transport;
- Chapter 25 Noise and Vibration;
- Chapter 26 Air Quality;
- Chapter 30 Tourism and Recreation; and
- Chapter 31 Socio-economics.

[4] For information on Norfolk Vanguard EMF - https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-emf-information-sheet.pdf

[5] For information on Norfolk Vanguard and Hornsea Project Three cable route crossing - https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-orsted-emf-information-sheet.pdf

68. This health chapter is also informed by the following evidence sources, relevant data for which is summarised in the sections below:

- Scientific literature;
- Baseline conditions;
- Health priorities;
- Project-specific consultation responses; and
- Policy context.

69. The review of evidence sources has been structured using the following seven themes that cut across the scope of construction, operational and decommissioning effects of the project.

- Noise;
- Air quality;
- Ground and/or water contamination;
- Physical activity;
- Journey times and/or reduced access;
- Employment; and
- EMF.

27.5.2 Scientific Literature

70. An evidence base of publicly available information has been used to support the scoping and assessment conclusions of this health chapter. Evidence statements have been extracted from a review of abstracts and full articles published in English on PubMed from the past five years. The review is not exhaustive and aims to provide a summary only of the key issues relevant to the scope of this chapter. This is provided in Appendix 27.1.

27.5.3 Baseline Conditions

71. Health Profiles (Public Health England, 2017a), Health Assets Profiles (Public Health England, 2017b) from PHE and Wider Determinants of Health (Public Health England, 2017c) from PHE have informed the local, regional and national baseline for this health chapter.

72. Office of National Statistics and Nomis official labour market statistics (Nomis, 2017 have also informed the baseline (see Appendix 27.1 Table 27.1, Table 27.2, and Table 27.3). Whilst more recent statistics have been collected for some socio-economic variables, the 2011 census is considered an appropriate baseline for use in this chapter as it provides consistent comparative data across the population groups used in the assessment.

73. The Index of Multiple Deprivation 2015 has been consulted and referenced as appropriate, including sub-domains and underlying indicators (Department of Communities and Local Government, 2015).

27.5.3.1 General

74. The onshore areas associated with the landfall and onshore cable route are predominantly rural in nature typified by small villages and hamlets and individual residential properties. The northern tip of the Norfolk Broads National Park is also adjacent to potential project areas. The onshore project substation is located near the village of Necton to the west of the town of Dereham. This is also rural in nature with the village of Necton containing the largest concentration of residential properties.

75. The population within these areas has demonstrated moderate population growth, with the projected growth to 2025 similar to the UK national average projected between mid-2016 and mid-2026 (6.4%) (ONS 2017).

76. All areas considered above have a higher proportion of retirement-aged people in relation to their working age populations when compared with the national UK averages.

77. Much of the onshore infrastructure is largely routed through agricultural land. The onshore cable route passes close to built-up areas at North Walsham, as well as passing some individual properties.

78. Individual receptors that are sensitive to potential health effects from the construction phase have been discussed in the other ES chapters (such as noise and air quality). Sensitive receptors are typically associated with fixed infrastructure such as residential properties, schools, hospitals, footpaths, cycleways etc. This health chapter considers population group effects, rather than individual receptors.

27.5.3.1.1 Norfolk County

79. The health of people in Norfolk is varied compared with the England average. About 18% (25,500) of children live in low income families compared to 20% average in England. Life expectancy for both men and women is higher than the England average.

80. Life expectancy is 6.3 years lower for men and 4.2 years lower for women in the most deprived areas of Norfolk than in the least deprived areas.

81. In Year 6 of school, 18% (1,427) of children are classified as obese, better than the average for England. The rate of alcohol specific hospital stays among those under 18 is 26 per 100,000 population, better than the average for England. This represents 43 stays per year. Levels of GCSE attainment are worse than the England average.

The number of smokers as a proportion of the population is worse than the England average. Levels of breastfeeding initiation are better than the England average.

82. The rate of alcohol-related harm hospital stays is 676 per 100,000 population, worse than the average for England. This represents 6,134 stays per year. The rate of self-harm hospital stays is 225 per 100,000 population, worse than the average for England. The rate of smoking related deaths is 247 per 100,000 population, better than the average for England. This represents 1,527 deaths per year in the County. Estimated levels of adult excess weight are worse than the England average. Estimated levels of adult smoking are better than the England average. The rate of people killed and seriously injured on roads is worse than average. Rates of sexually transmitted infections and TB are better than average. The rate of statutory homelessness is worse than average. Rates of violent crime, long term unemployment, early deaths from cardiovascular diseases and early deaths from cancer are better than average.

83. Health priorities for Norfolk County Council are the social and emotional wellbeing of children aged 0-5, obesity, and dementia.

27.5.3.1.2 North Norfolk District

84. The health of people in North Norfolk is varied compared with the England average. In North Norfolk District, approximately 17% (2,300) of children live in low income families compared to 20% average in England. Life expectancy for both men and women is higher than the England average.

85. Life expectancy is 2.9 years lower for men in the most deprived areas of North Norfolk than in the least deprived areas.

86. In school Year 6, 17.0% (137) of children are classified as obese, better than the average for England. The rate of alcohol-specific hospital stays among those under 18 is 18 per 100,000 population, better than the average for England. This represents 3 stays per year. Levels of breastfeeding initiation are better than the England average.

87. The rate of alcohol-related harm hospital stays is 703 per 100,000 population, worse than the average for England. This represents 826 stays per year. The rate of self-harm hospital stays is 221 per 100,000 population. This represents 182 stays per year. Estimated levels of adult excess weight are worse than the England average. Estimated levels of adult smoking are better than the England average. Rates of sexually transmitted infections and TB are better than average. Rates of violent crime, long term unemployment and early deaths from cardiovascular diseases are better than average.

27.5.3.1.3 Broadland District

88. The health of people in Broadland is generally better than the England average. Broadland is one of the 20% least deprived districts/unitary authorities in England, however about 10% (2,000) of children live in low income families. Life expectancy for both men and women is higher than the England average.

89. Life expectancy is 3.4 years lower for men and 4.2 years lower for women in the most deprived areas of Broadland than in the least deprived areas.

90. In Year 6, 13.4% (160) of children are classified as obese, better than the average for England. The rate of alcohol-specific hospital stays among those under 18 is 33 per 100,000 population. This represents 8 stays per year. Levels of teenage pregnancy, GCSE attainment and breastfeeding initiation are better than the England average.

91. The rate of alcohol-related harm hospital stays is 588 per 100,000 population, better than the average for England. This represents 797 stays per year. The rate of self-harm hospital stays is 205 per 100,000 population. This represents 250 stays per year. Estimated levels of adult excess weight are worse than the England average. Estimated levels of adult smoking and physical activity are better than the England average. The rate of people killed and seriously injured on roads is worse than average. Rates of sexually transmitted infections and TB are better than average. Rates of violent crime, long term unemployment, early deaths from cardiovascular diseases and early deaths from cancer are better than average.

27.5.3.1.4 Breckland

92. The health of people in Breckland is varied compared with the England average. About 16% (3,500) of children live in low income families. Life expectancy for men is higher than the England average.

93. Life expectancy is 4.8 years lower for men and 2.5 years lower for women in the most deprived areas of Breckland than in the least deprived areas.

94. In Year 6, 19.4% (235) of children are classified as obese. The rate of alcohol-specific hospital stays among those under 18 is 11 per 100,000 population, better than the average for England. This represents 3 stays per year. Levels of GCSE attainment are worse than the England average.

95. The rate of alcohol-related harm hospital stays is 656 per 100,000 population. This represents 928 stays per year. The rate of self-harm hospital stays is 175 per 100,000 population. This represents 223 stays per year. The rate of people killed and seriously injured on roads is worse than average. Rates of sexually transmitted infections and TB are better than average. Rates of statutory homelessness, violent crime, long term unemployment and early deaths from cardiovascular diseases are better than average.

96. Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 set out baseline data for site specific, local, regional and national population groups. The data covers a range of variables relevant to the scope of this chapter. Following the tables, the data is discussed under the eight themes that cut across the scope of construction and operational effects of the project.

27.5.3.2 Noise

97. Noise effects are considered at the site-specific level (representative of landfall, cable route, and onshore project substation, see section 27.4.1). Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate.

98. The environmental baseline for noise has been provided in Chapter 25 Noise and Vibration.

99. The human health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

100. People who spend extended periods at home may experience greater noise exposure durations than those who are absent during normal working hours.

- In North Norfolk LSOA 012A (representative of the population at landfall) 40% of households have no adults in employment (compared to an average of 33% for England); 19% of households include dependent children (compared to an average of 29% for England); and 28% of households include a person with a long-term health problem or disability (compared to an average of 26% for England). These proportions are consistent with the high percentage of people aged over 65 years old (25% in North Norfolk 012A compared to an average of 16% for England). In North Norfolk 012A approximately 18% of people report working mainly at or from home (compared to an average of 10% for England).
- In Breckland LSOA 004C (representative of the onshore cable route population) 32% of households have no adults in employment (compared to an average of 33% for England); 25% of households include dependent children (compared to an average of 29% for England); and 29% of households include a person with a long-term health problem or disability (compared to an average of 26% for England). These proportions are more reflective of national averages, though continue to be influenced by the regional trend of a high percentage of people aged over 65 years old (22% in Breckland 004C (and Norfolk County) compared to an average of 16% for England). In Breckland 004C approximately 18% of people report working mainly at or from home (compared to an average of 10% for England).
- In Breckland LSOA 004A (representative of the population at the substation) 52% of households have no adults in employment (compared to an average of 33%

for England); 19% of households include dependent children (compared to an average of 29% for England); and 31% of households include a person with a long-term health problem or disability (compared to an average of 26% for England). These proportions are consistent with the high percentage of people aged over 65 years old (35% in Breckland 004A compared to an average of 16% for England). In Breckland 004A approximately 15% of people report working mainly at or from home (compared to an average of 10% for England).

101. Deprivation can increase sensitivity to change:

- For overall deprivation[6], North Norfolk 012A LSOA is ranked 8,484 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 30% most deprived neighbourhoods in the country.
- For overall deprivation, Breckland 004C LSOA is ranked 8,926 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 30% most deprived neighbourhoods in the country.
- For overall deprivation, Breckland 004A LSOA is ranked 18,957 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 50% least deprived neighbourhoods in the country.

102. The indicator for noise effects is not reported on smaller area statistics. Therefore, baseline exposure to transport related noise is considered representative of the regional (County) level. This indicates that 2.1% of people are exposed to road, rail and air transport noise of 65 dB(A) or more during the daytime (compared to an average of 5.2% for England). (Public Health England 2017a and 2017b)

103. During the night-time transport related noise at the regional (County) level (the indicator not reporting on smaller area statistics) indicates that 3.0% of people are exposed to road, rail and air transport noise of 55 dB(A) or more during the night-time (compared to an average of 8.0% for England). The most recent Census data available is from 2011. (Public Health England 2017a and 2017b)

104. Data from 2015 at the local level indicates a baseline of approximately 4.0 complaints about noise per year per thousand population in North Norfolk District (compared to an estimated value of 7.1 per thousand population in England). In Broadland District the baseline rate is 3.5 noise complaints per thousand population. In Breckland District the baseline rate is 0.5 noise complaints per thousand population (Public Health England 2017a and 2017b).

[6] The index of multiple deprivation is comprised of domains for: income; employment; education, skills and training; health deprivation and disability; crime; barriers to housing and services; and living environment.

27.5.3.3 Air quality

105. Air quality effects are expected at the site specific level (see section 27.4.1). Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate.

106. The environmental baseline for air quality has been provided in Chapter 26 Air Quality. The assessment concluded that the short term particulate matter (PM_{10}) objective was predicted to be met at all modelled locations.

107. The health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

108. Data from 2015 at the local level indicates a baseline annual mean concentration of human-made fine particulate matter ($PM_{2.5}$) of 8.2 µg/m^3 in North Norfolk District (compared to an annual mean of 8.3 µg/m^3 in England). In Broadland District the annual mean baseline for $PM_{2.5}$ is 8.7 µg/m^3. In Breckland District the annual mean baseline for $PM_{2.5}$ is 8.4 µg/m^3. In comparison to target thresholds these baselines are well below the UK AQO threshold of 25 µg/m^3, but close to the WHO guide value of 10 µg/m^3 (Public Health England 2017a and 2017b).

109. As with potential noise disturbance, people who spend extended periods at home may experience greater air pollutant exposure durations than those who are absent during normal working hours. See section 27.5.3.2 for the noise baseline.

27.5.3.4 Ground and / or water contamination

110. The environmental baseline for ground conditions and water resources has been provided in Chapter 19 Ground Conditions and Contamination and Chapter 20 Water Resources and Flood Risk respectively.

111. The human health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

112. The potential for ground disturbance of historic contamination or new spills of pollutants (such as fuel or oil) to affect communities is dependent on proximity and behavioural exposure influences. This may include use of bathing waters or encountering in situ or mobilised contamination (dust or aerosols) whilst in the outdoor environment. Compared to adults, children are more vulnerable to water contamination because they would ingest a greater amount as a proportion of body mass.

- In North Norfolk 012A (representative of the population at landfall) 14% of the resident population were aged under 16 at the 2011 Census (compared to an average of 19% for England). The population density of 0.7 persons per hectare is low compared to the average for England (4.1 persons per hectare).

- In Breckland LSOA 004C (representative of the cable route population) 16% of the resident population were aged under 16 at the 2011 Census (compared to an average of 19% for England). The population density of 0.4 persons per hectare is low compared to the average for England (4.1 persons per hectare).
- In Breckland LSOA 004A (representative of the population at the substation) 13% of the resident population were aged under 16 at the 2011 Census (compared to an average of 19% for England). The population density of 1.2 persons per hectare is low compared to the average for England (4.1 persons per hectare).

27.5.3.5 Physical activity

113. Physical activity effects are expected at the site-specific level (see section 27.4.1). Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate.

114. The human health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

115. In North Norfolk LSOA 012A the proportion of people reporting their health to be very good or good (77%) is lower than average for England (81%). The proportion reporting fair health is above average (17%) compared to the average for England (13%). The proportion of people reporting bad or very bad health (6%) is slightly higher than the average for England (5%). This is consistent with a lower percentage of people reporting that their day-to-day activities are not limited (77%) compared to the average for England (82%). These health statistics are likely to reflect the older age profile of the area (25% of the population aged over 65, compared to an average of 16% for England).

116. In Breckland LSOA 004C the proportion of people reporting their health to be very good or good (78%) is lower than average for England (81%). The proportion reporting fair health is slightly above average (14%) compared to the average for England (13%). The proportion of people reporting bad or very bad health (9%) is higher than the average for England (5%). This is consistent with a lower percentage of people reporting that their day-to-day activities are not limited (79%) compared to the average for England (82%). These health statistics are likely to reflect the older age profile of the area (22% of the population aged over 65, compared to an average of 16% for England).

117. In Breckland LSOA 004A the proportion of people reporting their health to be very good or good (73%) is lower than average for England (81%). The proportion reporting fair health is above average (20%) compared to the average for England (13%). The proportion of people reporting bad or very bad health (7%) is higher than the average for England (5%). This is consistent with a lower percentage of people reporting that their day-to-day activities are not limited (72%) compared to the average for England (82%). These health statistics are likely to reflect the older age

profile of the area (35% of the population aged over 65, compared to an average of 16% for England).

118. At the regional level (Norfolk County) the percentage of people aged 16+ with sports club membership is 19.3% (compared to an average of 22.0% in England, 2015/16 data). Despite these slightly lower membership statistics, the percentage of the adult population that is active (56.5%) is similar to the average for England (57%). This is consistent with a slightly higher percentage of people (18.8%) using outdoor space for exercise or other health reasons (compared to an average of 17.9% for England). These factors are likely to relate to the rural nature of Norfolk County.

119. Health deprivation can increase sensitivity to change:

- For the health deprivation and disability domain[7] of deprivation, North Norfolk 012A LSOA is ranked 19,670 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 50% least deprived neighbourhoods in the country.
- For the health deprivation and disability domain of deprivation, Breckland 004C LSOA is ranked 16,240 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 50% most deprived neighbourhoods in the country.
- For the health deprivation and disability domain of deprivation, Breckland 004A LSOA is ranked 16,457 out of 32,844 LSOAs in England; where 1 is the most deprived LSOA. This is amongst the 50% least deprived neighbourhoods in the country.

120. Access to a vehicle is indicative of being able to access alternative physical activity opportunities.

- In North Norfolk 012A (representative of the population at landfall) the baseline indicates 92% of households have a vehicle (compared to an average of 74% for England).
- In Breckland 004C (representative of the onshore cable route population) the baseline indicates 92% of households have a car or van (compared to an average of 74% for England).
- In Breckland 004A (representative of the population at the substation) the baseline indicates 87% of households have a car or van (compared to an average of 74% for England).

[7] The health deprivation and disability domain of deprivation is comprised of indictors for: years of potential life lost; comparative illness and disability ratio; acute morbidity; and mood and anxiety disorders.

27.5.3.6 Journey times and / or reduced access

121. There is a potential for journey times and/or access to be affected at the local level (see section 27.4.1)). Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate.

122. The environmental baseline for traffic has been provided in Chapter 24 Traffic and Transport.

123. The human health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

124. At the local level the average distance travelled to work in North Norfolk District is 21 km, above the 15km average for England. In Broadland District the average distance travelled to work is 15 km. In Breckland the average distance travelled to work is 20 km.

125. Data from 2014 to 2016 indicates that the baseline rate of people killed or seriously injured on the roads in North Norfolk is 40.0 per 100,000 resident population, similar to the average of 39.7 for England. In Broadland District the equivalent baseline rate is 44.0 per 100,000 resident population). In Breckland the equivalent baseline rate is 48.0 per 100,000 resident population, above average for England.

126. The Access to Health Assets & Hazards (AHAH) index measures the percentage of the population who live in LSOAs which score in the poorest performing 20% of domains for access to retail services, access to health services, and physical environment. The AHAH index provides information on how conducive to good health an area is relative to other areas. In North Norfolk 29.3% of the population live in LSOAs which score in the poorest performing 20% on the AHAH index (although above the average of 21.2% for England). In Broadland District the equivalent baseline proportion is 14.7%, below the average for England. In Breckland the equivalent baseline proportion is 26.0%, above average for England.

127. Access deprivation can increase sensitivity to change:

- For the barriers to housing and services domain[8] of deprivation, North Norfolk District is ranked 23 out of 326 in England; where 1 is the most deprived area.
- For barriers to housing and services domain of deprivation, Broadland District is ranked 134 out of 326 in England; where 1 is the most deprived area.
- For barriers to housing and services domain of deprivation, Breckland is ranked 44 out of 326 in England; where 1 is the most deprived area.

[8] The barriers to housing and services domain of deprivation is comprised of indictors for: road distance to a post office; road distance to a primary school; road distance to general store or supermarket; road distance to a GP surgery; household overcrowding; homelessness; and housing affordability. Uses rank of average rank.

27.5.3.7 Employment

128. Employment effects are expected at the regional level (see section 27.4.1). Baseline data is discussed accordingly.

129. The environmental baseline has been provided in Chapter 31 Socio-economics.

130. The human health baseline relevant to this topic from Appendix 27.1 Table 27.1, Table 27.2 and Table 27.3 can be summarised as follows.

131. 2016-17 employment estimates at the regional level in Norfolk County indicate that 76.9% of working age people are in employment (compared to an average of 74.4% for England).

132. In Norfolk County the baseline percentage of people in skilled manual occupations (26%) is above the average for England (22%). 2011 census data indicates the County has 4,493 people employed as plant and machine operatives, 2,935 as construction operatives and 2,172 working in elementary construction operations. The baseline suggests there would be an appropriate pool of construction workers who would benefit from employment opportunities associated with the onshore cable laying tasks of the project.

133. Income deprivation in Norfolk County was 13.2% in 2015 (below average compared to 14.7% for England). The percentage of older people affected by income deprivation (14.1%) is below the average for England (16.2%). Similarly, the percentage of children affected by income deprivation (17.7%) is also below the average for England (19.9%).

134. In terms of gender pay equality, the ratio between the gross median hourly earnings for women and the gross median hourly earnings for men is 78.9% (shows scope for improvement, but is slightly below the average of 79.4% for England).

27.5.3.8 Electromagnetic fields

135. Electric and magnetic fields and the electromagnetic forces they represent are an essential part of the physical world. Their sources are the charged fundamental particles of matter (principally electrons and protons). EMFs occur naturally within the body in association with nerve and muscle activity allowing these functions to happen. Humans also experience the natural static magnetic field of the Earth (to which a magnetic compass responds) and natural static electric fields in the atmosphere.

136. Electric and magnetic fields occur in the natural world, and people have been exposed to them for the whole of human evolution. The advent of modern technology and the wider use of electricity and electrical devices have inevitably introduced changes to the naturally occurring EMF patterns. Energised high voltage power-transmission equipment, along with all other uses of electricity, is a source of

EMFs, for example many households make use of large kitchen appliances and mobile technology. Both the AC and DC fields exist in addition to the Earth's steady natural fields.

137. Following PEIR, Norfolk Vanguard Limited has made the decision to use HVDC technology. Within the UK, the frequency of AC mains electricity is 50 hertz (Hz). AC fields are described as Extremely Low Frequency (ELF). HVDC is constant and therefore has a frequency of 0Hz and has constant electric and magnetic fields, otherwise known as static fields. Electric and magnetic fields are produced by AC power systems operating at 50 Hz frequencies. Sources of static fields are from the earth's natural fields, and fields from DC lines and cables. A short distance of HVAC (400kV cables) will be used between the onshore project substation and the National Grid substation extension.

138. Electric fields depend on the operating voltage of the equipment producing them and are measured in V/m (volts per metre). The operating voltage of most equipment is a relatively constant value. Electric fields are shielded by most common building materials, trees, and fences, and diminish rapidly with distance from the source.

139. As a consequence of their design, some types of equipment do not produce an external electric field. This applies to underground cables and gas insulated switchgear (GIS), which are enclosed in a metal sheath (a protective metal layer within the cable) and have solid metal enclosures respectively.

140. Magnetic fields are measured in µT (microtesla) and depend on the electrical currents flowing, which vary according to the electrical power requirements at any given time. They are not significantly shielded by most common building materials or trees but do diminish rapidly with distance from the source.

27.5.4 Health Priorities

141. Health priorities from the Norfolk Health and Wellbeing Strategy (Norfolk County Council, 2015) and Norfolk Joint Strategic Needs Assessment (JSNA) (Norfolk Health and Wellbeing Board and Norfolk County Council, 2015) have informed this health chapter.

142. The Norfolk Health and Wellbeing Strategy outlines the following priority areas:

- "Promoting the wellbeing of pre-school children;
- Reducing obesity; and
- Supporting people with dementia and their carers."

143. Within these priority areas, the strategy provides a number of intentions categorised by prevention, reducing inequality, and integration. The following strategic intentions have the potential to be influenced by the project:

- *"Improving mental health"* of pre-school children may be effected by noise disturbance, or air pollutants if these impacts are found to be significant;
- *"Create a healthier physical environment"* to reduce obesity may be effected if playing fields or public rights of way are significantly affected by the project; and
- *"Improve the dementia care pathway"* as well as *"Improve services for those unable to live independently"* for those with dementia may be effected if it is found that traffic disturbance is significant and may be potentially reducing access to GPs, care homes, or households.

144. These effects may also be felt by people outside of the priority areas as well as discussed in the JSNA. This covers four key areas with the following findings:

- Population – is 90% white ethnic group with the lowest proportion of other ethnic groups in North Norfolk. Although the area is viewed as having a rural character almost half of residents live in urban areas. As measured by Wellbeing surveys by the ONS, the happiest people live in South Norfolk, and the most satisfied live in North Norfolk.
- Children and Families – North Norfolk has the lowest numbers of children. 17.3% of Norfolk's children live in low income families. The highest levels are in Great Yarmouth and Norwich. Around 1 in 10 children in Reception are classed as obese but this ratio halves to 1 in 5 by Year 6 of school (around 10 years old). There is also a strong emphasis on supporting children in the Early Years (defined as up to the age of 5) because issues in early life can adversely impact on future life chances.
- Working Age Population – around 60% of Norfolk's population are between 16 and 64, which is below the national average suggesting an ageing population. Around 75% are employed, which is above the national average suggesting good employment opportunities.
- 31.7% of adults takes part in 30 minutes of moderate intensity sport at least once a week, which is slightly below the national average.
- Around 53 in 100,000 people in Norfolk die prematurely from heart disease, which is below the national average. Life expectancy for both men and women is approximately 1 year above the national average at 79.7 and 83.6 respectively. This suggests the health of people in Norfolk is generally slightly better than the rest of the UK but health also reduces as deprivation increases.
- Older People – it is projected that by 2021, 25% of Norfolk's population will be over 65. There will also be a 40% growth in those over 85, 27% growth in those from 75 to 84, and a 19% growth in those from 65 to 74. This suggests that people are living longer and as a result the levels of dementia are projected to

rise from 15,730 cases in 2017 to 18,240 cases in 2022. Older people are also susceptible to disability as a result or falls and death due circulatory or respiratory disease during winter.

145. Both the strategy and needs assessment highlight areas that may be adversely affected by the project. Young children and older people may be sensitive to noise and vibration impacts, especially at night when trying to sleep. The significance of potential impact sources are covered in Chapter 25 Noise and Vibration.

146. Similarly, families with young children and the carers of the elderly may be impacted by traffic disturbances if they cannot easily reach facilities such as GPs, care homes, or day care. The significance of potential impact sources are covered in Chapter 24 Traffic and Transport.

147. The districts that the project interacts with have plentiful open space and public rights of ways which facilitate enjoyment of the open space. Reducing access to this may reduce people's ability or enthusiasm to undertake exercise and so maintain their health. The significance of potential impact sources are covered in Chapter 30 Tourism and Recreation.

148. However, the project may also have positive impacts in relation to the priority areas. For example, an increase in local employment and training opportunities may provide skills for young people and income for households with children under five. In the long term, ensuring energy security through renewable generation may reduce electricity bills and allow older people to afford sufficient energy throughout the winter.

27.5.5 Consultation Responses

149. Consultation is a key driver of the EIA and ES, and is an ongoing process throughout the lifecycle of the project, from the initial stages through to consent and post-consent. To date, consultation regarding human health has been conducted through the Scoping Report (Royal HaskoningDHV, 2016), Expert Topic Group (ETG) meetings held in January 2017, and the Preliminary Environmental Information Report (PEIR) (Norfolk Vanguard Limited, 2017). Consultation responses with regards the determinants of health considered in this assessment are summarised in Table 27.6. Full details of the project consultation process are presented within Chapter 7 Technical Consultation and the Consultation Report (document reference 5.1).

Table 27.6 Formal consultation responses

Consultee	Date / document	Comment	Response / where addressed in the ES
Noise			
Secretary of State	Scoping Opinion (November 2016)	The Secretary of State recommends that the methodology and choice of noise receptors are agreed with the relevant Environmental Health Department of the Council and the Environment Agency.	Follow up consultation meetings held with stakeholders to discuss content on the 25th January and 20th July 2017. Noise impacts have been considered under section 27.6.3.1.
Secretary of State	Scoping Opinion (November 2016)	Noise impacts on people should be specifically addressed and particularly any potential noise disturbance at night and other unsocial hours such as weekends and public holidays.	
Necton Substation Action Group	PEIR (December 2017)	The Action Group identifies that approximately 30 people have the potential to be affected by the onshore project substation. A school and pre-school are also noted to be approximately 1 mile away.	This observation has been considered in the conclusion of section 27.6.3.1.
Air quality			
Secretary of State	Scoping Opinion (November 2016).	The Secretary of State recommends that the methodology and choice of air quality receptors are agreed with the relevant Environmental Health department of the Local Authorities and the Environment Agency.	The methodology was agreed as part of the air quality assessment described in Chapter 26 Air Quality.
Public Health England	PEIR (December 2017	PHE note that traffics movements associated with the onshore construction activities may generate localised dust emissions leading to potential complaints.	This has been considered in Chapter 26 Air Quality and the conclusions included in the assessment in section 27.6.3.2.
Ground and / or water contamination			
Public Health England	Scoping Opinion (November 2016)	There is potential for impacts to arise during the construction and decommissioning phases from the transport of material and equipment. PHE would expect the applicant to adhere to best practice guidance during these phases and for them to	Norfolk Vanguard Limited is committed to best practice in environmental management. Appropriate mitigation measures are detailed in Chapter 20 Water Resources and Flood Risk as well as Chapter 24 Traffic and Transport. Outline construction

Consultee	Date / document	Comment	Response / where addressed in the ES
		ensure that potential impacts are assessed and minimised.	methods are detailed in Chapter 5 Project Description that include appropriate safety precautions.
Public Health England	PEIR (December 2017)	PHE note that the applicant is yet to develop a Construction and Environmental Management Plan (CEMP) to include measures to protect the public from harmful substances during the life of the project.	An Outline Code of Construction Practice (document reference 8.1) for onshore works, and Outline Project Environmental Management Plan (document reference 8.14) for offshore works will be submitted with the DCO application.
Physical activity			
No relevant consultation comments received.			
Journey times and/or reduced access			
NHS England	PEIR (December 2017)	NHS England note that the project may have an impact on healthcare services within the vicinity of the application site. To evaluate the level of mitigation required as a direct result of the project, NHS England request further detail on the number of residents/ patients the project is anticipated to generate (an employment plan/ trajectory) and whether any healthcare provision would be provided by the applicant.	The number of in migrant workers has been considered in both Chapter 30 Tourism and Recreation and Chapter 31 Socio-economics. Journey times have been considered in Chapter 24 Traffic and Transport. Conclusions from these assessments have been considered in section 27.6.3.5.
Employment			
No relevant consultation comments received.			
EMF			
Public Health England	PEIR (December 2017)	PHE request that the project evaluate any potential risks to health or impacts that might arise as a result of electric and magnetic fields associated with the project's electrical infrastructure.	This is considered under section 27.6.5.2.
Necton Substation Action Group	PEIR (December 2017)	The Action Group notes that the whole village of Necton would potentially be affected by the substation.	This is considered in section 27.6.5.2.

27.5.6 Policy Context

150. National Policy Statements (NPS) produced by the UK Government set the policy context for the development of new energy infrastructure in the UK. Table 27.7 summarise the relevant health provisions of the NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c), which informs the NPS for Renewable Energy (EN-3) (Department of Energy and Climate Change, 2011b); and the NPS for Electricity Networks (EN-5) (Department of Energy and Climate Change, 2011a). However, EN-5 has been included under EMF due to its specific guidance in this area.

Table 27.7 Review of National Policy Statements with regards health determinants

Section	Description	Response
General		
EN-1, 4.10	Issues relating to discharges or emissions from a proposed project which affect air quality, water quality, land quality and the marine environment, or which include noise and vibration may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes. The planning and pollution control systems are separate but complementary. The planning system controls the development and use of land in the public interest. It plays a key role in protecting and improving the natural environment, public health and safety, and amenity, for example by attaching conditions to allow developments which would otherwise not be environmentally acceptable to proceed and preventing harmful development which cannot be made acceptable even through conditions. Pollution control is concerned with preventing pollution through the use of measures to prohibit or limit the releases of substances to the environment from different sources to the lowest practicable level. It also ensures that ambient air and water quality meet standards that guard against impacts to the environment or human health. In considering an application for development consent, the IPC [*now the Planning Inspectorate and the Secretary of State*] should focus on whether the development itself is an acceptable use of the land, and on the impacts of that use, rather than the control of processes, emissions or discharges themselves. The IPC should work on the assumption that the relevant pollution control regime and other environmental regulatory regimes, including those on land drainage, water abstraction and biodiversity, will be properly applied and enforced by the relevant regulator. It should act to complement but not seek to duplicate them.	Potential discharges and emissions are considered in: • Chapter 9 Marine Water and Sediment Quality; • Chapter 19 Ground Conditions and Contamination; • Chapter 20 Water Resources and Flood Risk; and • Chapter 26 Air Quality.
EN-1, 4.13	As described in the relevant sections of this NPS and in the technology- specific NPSs, where the proposed project has an effect on human beings, the ES should assess these effects for each element of the project, identifying any adverse health impacts, and identifying measures to avoid, reduce or compensate for these impacts as appropriate. The impacts of more than one development may affect people simultaneously, so the applicant and the IPC should consider the cumulative impact on health.	Effects on human beings are considered in: • Section 27.6; • Chapter 30 Tourism and Recreation; and • Chapter 31 Socio-economics.
Noise		
EN-1, 4.13	The direct impacts on health may include increased noise. The IPC will want to take account of health concerns when setting requirements	Chapter 25 Noise and Vibration considers

Section	Description	Response
	relating to a range of impacts such as noise.	direct noise impacts.
EN-1, 5.11	The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims: • Avoid significant adverse impacts on health and quality of life from noise; • Mitigate and minimise other adverse impacts on health and quality of life from noise; and • Where possible, contribute to improvements to health and quality of life through the effective management and control of noise.	Potential noise effects are considered in section 27.6.3.1.
EN-1, 5.11	Excessive noise can have wide-ranging impacts on the quality of human life, health (for example owing to annoyance or sleep disturbance) and use and enjoyment of areas of value such as quiet places and areas with high landscape quality. The Government's policy on noise is set out in the Noise Policy Statement for England. It promotes good health and good quality of life through effective noise management. Similar considerations apply to vibration, which can also cause damage to buildings. In this section, in line with current legislation, references to "noise" below apply equally to assessment of impacts of vibration.	Potential health effects are considered in section 27.6.3.1 and section 27.6.5.1.
Air quality		
EN-1, 4.13	The direct impacts on health may include increased air pollution, dust or odour.	Chapter 26 Air Quality considers direct air quality impacts.
EN-1, 4.13	Generally, those aspects of energy infrastructure which are most likely to have a significantly detrimental impact on health are subject to separate regulation (for example for air pollution) which will constitute effective mitigation of them, so that it is unlikely that health concerns will either constitute a reason to refuse consents or require specific mitigation under the Planning Act 2008.	Potential health effects are considered in section 27.6.3.2.
Ground and / or water contamination		
EN-1, 4.13	The direct impacts on health may include increased hazardous waste and substances or increased water pollution.	Direct effects are considered in: • Chapter 09 Marine Water and Sediment Quality; • Chapter 19 Ground Conditions and Contamination; • Chapter 20 Water Resources and Flood Risk; and • Potential health effects are considered in Section 27.6.3.3.
EN-1, 5.14	Government policy on hazardous and non-hazardous waste is intended to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Where this is not possible, waste management regulation ensures that waste is disposed of in a way that is least damaging to the environment and to human health.	
EN-1, 5.15	Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction, operation and decommissioning stages, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive.	
Physical activity		
EN-1, 4.13	New energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to the use of open space for recreation and physical activity.	Effects on populations are considered in:

Section	Description	Response
EN-1, 5.10	The Government's policy is to ensure there is adequate provision of high quality open space (including green infrastructure) and sports and recreation facilities to meet the needs of local communities. Open spaces, sports and recreational facilities all help to underpin people's quality of life and have a vital role to play in promoting healthy living. Green infrastructure in particular will also play an increasingly important role in mitigating or adapting to the impacts of climate change.	• Chapter 30 Tourism and Recreation; • Chapter 31 Socio-economics; and • Potential health effects are considered in section 27.6.3.4.
EN-1, 5.10	Applicants will need to consult the local community on their proposals to build on open space, sports or recreational buildings and land. Taking account of the consultations, applicants should consider providing new or additional open space including green infrastructure, sport or recreation facilities, to substitute for any losses as a result of their proposal. Applicants should use any up-to-date local authority assessment or, if there is none, provide an independent assessment to show whether the existing open space, sports and recreational buildings and land is surplus to requirements.	
Journey times and / or reduced access		
EN-1, 4.13	The direct impacts on health may include increased traffic.	Direct effects are considered in Chapter 24 Traffic and Transport. Potential health effects are considered in Section 27.6.3.5.
EN-1, 4.13	New energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to transport or key public services.	
Employment		
EN-1, 4.2	To consider the potential effects, including benefits, of a proposal for a project, the IPC will find it helpful if the applicant sets out information on the likely significant social and economic effects of the development, and shows how any likely significant negative effects would be avoided or mitigated. This information could include matters such as employment, equality, community cohesion and well-being.	Employment is considered in Chapter 31 Socio-economics. Potential health effects are considered in section 27.6.4.
Electromagnetic fields (EMF)		
EN-1, 4.13	The direct impacts on health may include increased exposure to radiation.	Potential health effects are considered in section 27.6.5.2. Exposure limits are discussed below in section 27.5.6.1 and assessed in section 27.6.3.5.
EN-5 2.10	The International Commission on Non-Ionizing Radiation Protection (ICNIRP21) developed health protection guidelines in 1998 for both public and occupational exposure. These are expressed in terms of the induced current density in affected tissues of the body, "basic restrictions", and in terms of measurable "reference levels" of electric field strength (for electric fields), and magnetic flux density (for magnetic fields).	
EN-5 2.10	The balance of scientific evidence over several decades of research has not proven a causal link between EMFs and cancer or any other disease. The Health Protection Agency's Centre for Radiation, Chemical and Environmental Hazards keeps under review emerging scientific research and/or studies that may link EMF exposure with various health problems and provides advice to the Department of Health on the possible need for introducing further precautionary measures.	

27.5.6.1 EMF Exposure limits

151. In March 2004, the NRPB provided new advice to the Government, replacing previous advice from 1993, and recommending the adoption in the UK of guidelines published in 1998 by the ICNIRP (ICNIRP, 1998). The Government subsequently adopted this recommendation, saying that limits for public exposures should be applied in the terms of the 1999 EU Recommendation (EU Council, 1999). For static fields, the limits that apply are likewise those given in the 1999 EU Recommendation, in this case derived from 1994 ICNIRP guidelines. Table 27.8 summarises the recommended values.

Table 27.8 Recommended values for power frequencies

Public exposure level	Electric Fields	Magnetic Fields
Power frequency		
Basic restriction (induced current density in central nervous system)	2mA/m2	
Reference level (external unperturbed field)	5,000V/m	100µT
Field corresponding to the basic restriction	9,000V/m	360µT
Static		
Basic restriction	None	40,000 µT

152. In recommending these levels, the NRPB considered the evidence for all suggested effects of EMFs. It concluded that the evidence for effects on the nervous system of currents induced by the fields was sufficient to justify setting exposure limits, and this is the basis of their quantitative recommendations (NRPB, 2004). It concluded that the evidence for effects at lower fields, for example the evidence relating to childhood leukaemia (discussed further below), was not sufficient to justify setting exposure limits, but was sufficient to justify recommending that the Government consider possible precautionary actions. Precautionary measures are considered in more detail below.

153. The EMF guidelines are documented in NPS EN-5 and practical details of their application are explained in the Code of Practice, 'Power Lines: Demonstrating compliance with EMF public exposure guidelines – a voluntary Code of Practice' published by the Department of Energy and Climate Change (DECC, 2012). It is the electricity industry's policy to comply with the Government guidelines on EMF, and this Code of Practice forms an integral part of this policy.

154. The ICNIRP guidelines (ICNIRP, 1998) are set so as to prevent external exposure to EMFs that could cause currents to be induced in the body large enough to cause effects on nerves, with a substantial safety margin. These induced currents can be expressed as a current density and it is on current density that the guidelines are based. The ICNIRP guidelines recommend that the general public are not exposed to levels of EMFs able to cause a current density of more than 2mA/m2 within the human central nervous system. This recommendation is described as the "basic

restriction". The external fields that have to be applied to the body to cause this current density have to be calculated by numerical dosimetry, since in-vivo measurements of current density are not practical.

155. The ICNIRP guidelines also contain "reference levels". For the public, the reference level for electric fields is 5kV/m, and the reference level for magnetic fields is 100µT. The 1999 EU Recommendation (EU Council, 1999) uses the same values as ICNIRP (ICNIRP, 1998).

156. In the ICNIRP guidelines and the EU Recommendation, the actual limit is the basic restriction. The reference levels are not limits, but are guides to when detailed investigation of compliance with the actual limit, the basic restriction, is required. If the reference level is not exceeded, the basic restriction cannot be exceeded and no further investigation is needed. If the reference level is exceeded, the basic restriction may or may not be exceeded.

157. The Code of Practice on compliance (DECC, 2012) endorses this approach and gives the values of field corresponding to the basic restriction, stating:

158. "*The 1998 ICNIRP exposure guidelines specify a basic restriction for the public which is that the induced current density in the central nervous system should not exceed 2mA m-2. The Health Protection Agency specify that this induced current density equates to uniform unperturbed fields of 360µT for magnetic fields and 9.0kV m-1 for electric fields. Where the field is not uniform, more detailed investigation is needed. Accordingly, these are the field levels with which overhead power lines (which produce essentially uniform fields near ground level) shall comply where necessary. For other equipment, such as underground cables, which produce non-uniform fields, the equivalent figures will never be lower but may be higher and will need establishing on a case-by-case basis in accordance with the procedures specified by HPA. Further explanation of basic restrictions, reference levels etc is given by the Health Protection Agency.*"

159. The Code of Practice (DECC, 2012) also specifies the land uses where exposure is deemed to be for potentially a significant period of time and therefore where the public guidelines apply. These land uses are, broadly, residential uses and schools.

160. Therefore, if the EMFs produced by an item of equipment are lower than 9kV/m and 360µT, the fields corresponding to the ICNIRP basic restriction, it is compliant with the ICNIRP guidelines and hence with PHE recommendations and Government policy. If the fields are greater than these values, the equipment is still compliant with Government policy if the land use falls outside the residential and other uses specified in the Code of Practice (DECC, 2012) and it may still be compliant if the fields are non-uniform.

27.6 Potential Effects

27.6.1 Embedded Mitigation

161. Norfolk Vanguard Limited has committed to a number of techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process.

162. A range of different information sources has been considered as part of embedding mitigation into the design of the project (for further details see Chapter 5 Project Description, Chapter 4 Site Selection and Assessment of Alternatives and the Consultation Report (document reference 5.1)) including engineering requirement, feedback from community and landowners, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

163. The following sections outline the key embedded mitigation measures relevant for this assessment. These measures are presented in Table 27.9. Where embedded mitigation measures have been developed into the design of the project with specific regard to human health these are described in Table 27.10.

Table 27.9 Embedded mitigation

Parameter	Mitigation measures embedded into the project design	Notes
Strategic approach to delivering Norfolk Vanguard and Norfolk Boreas	Subject to both Norfolk Vanguard and Norfolk Boreas receiving development consent and progressing to construction, onshore ducts will be installed for both projects at the same time, as part of the Norfolk Vanguard construction works. This would allow the main civil works for the cable route to be completed in one construction period and in advance of cable delivery, preventing the requirement to reopen the land in order to minimise disruption. Onshore cables would then be pulled through the pre-installed ducts in a phased approach at later stages. In accordance with the Horlock Rules, the co-location of Norfolk Vanguard and Norfolk Boreas onshore project substations will keep these developments contained within a localised area and, in so doing, will contain the extent of potential impacts.	The strategic approach to delivering Norfolk Vanguard and Norfolk Boreas has been a consideration from the outset.
Commitment to HVDC technology	Commitment to HVDC technology minimises environmental impacts through the following design considerations; • HVDC requires fewer cables than the HVAC solution. During the duct installation phase this reduces the cable route working width (for Norfolk Vanguard and Norfolk Boreas combined) to 45m from the previously identified worst case	Norfolk Vanguard Limited has reviewed consultation received and in light of the feedback, has made a number of decisions in relation to the project design. One of these decisions is to deploy

Parameter	Mitigation measures embedded into the project design	Notes
	of 100m. As a result, the overall footprint of the onshore cable route required for the duct installation phase is reduced from approx. 600ha to 270ha; • The width of permanent cable easement is also reduced from 54m to 20m; • Removes the requirement for a CRS; • Reduces the maximum duration of the cable pull phase from three years down to two years; • Reduces the total number of jointing bays for Norfolk Vanguard from 450 to 150; and • Reduces the number of drills needed at trenchless crossings (including landfall).	HVDC technology as the export system.
Site Selection	The project has undergone an extensive site selection process which has involved incorporating environmental considerations in collaboration with the engineering design requirements. Considerations include (but are not limited to) adhering to the Horlock Rules for onshore project substations and National Grid infrastructure, a preference for the shortest route length (where practical) and developing construction methodologies to minimise potential impacts. Key design principles from the outset were followed (wherever practical) and further refined during the EIA process, including; • Avoiding proximity to residential dwellings; • Avoiding proximity to historic buildings; • Avoiding designated sites; • Minimising impacts to local residents in relation to access to services and road usage, including footpath closures; • Utilising open agricultural land, therefore reducing road carriageway works; • Minimising requirement for complex crossing arrangements, e.g. road, river and rail crossings; • Avoiding areas of important habitat, trees, ponds and agricultural ditches; • Installing cables in flat terrain maintaining a straight route where possible for ease of pulling cables through ducts; • Avoiding other services (e.g. gas pipelines) but aiming to cross at close to right angles where crossings are required; • Minimising the number of hedgerow crossings, utilising existing gaps in field boundaries; • Avoiding rendering parcels of agricultural land inaccessible; and • Utilising and upgrading existing accesses where possible to avoid impacting undisturbed ground.	Constraints mapping and sensitive site selection to avoid a number of impacts, or to reduce impacts as far as possible, is a type of primary mitigation and is an inherent aspect of the EIA process. Norfolk Vanguard Limited has reviewed consultation received to inform the site selection process (including local communities, landowners and regulators) and in response to feedback, has made a number of decisions in relation to the siting of project infrastructure. The site selection process is set out in Chapter 4 Site Selection and Assessment of Alternatives.

Parameter	Mitigation measures embedded into the project design	Notes
Duct Installation Strategy	The onshore cable duct installation strategy is proposed to be conducted in a sectionalised approach in order to minimise impacts. Construction teams would work on a short length (approximately 150m section) and once the cable ducts have been installed, the section would be back filled and the top soil replaced before moving onto the next section. This would minimise the amount of land being worked on at any one time and would also minimise the duration of works on any given section of the route.	This has been a project commitment from the outset in response to lessons learnt on other similar NSIPs. Chapter 5 Project Description provides a detailed description of the process.
Long HDD at landfall	Use of long HDD at landfall to avoid restrictions or closures to Happisburgh beach and retain open access to the beach during construction. Norfolk Vanguard Limited have also agreed to not use the beach car park at Happisburgh South.	Norfolk Vanguard Limited has reviewed consultation received and in response to feedback, has made a number of decisions in relation to the project design. One of those decisions is to use long HDD at landfall.
Trenchless Crossings	Commitment to trenchless crossing techniques to minimise impacts to the following specific features; • Wendling Carr County Wildlife Site; • Little Wood County Wildlife Site; • Land South of Dillington Carr County Wildlife Site; • Kerdiston proposed County Wildlife Site; • Marriott's Way County Wildlife Site / Public Right of Way (PRoW); • Paston Way and Knapton Cutting County Wildlife Site; • Norfolk Coast Path; • Witton Hall Plantation along Old Hall Road; • King's Beck; • River Wensum; • River Bure; • Wendling Beck; • Wendling Carr; • North Walsham and Dilham Canal; • Network Rail line at North Walsham that runs from Norwich to Cromer; • Mid-Norfolk Railway line at Dereham that runs from Wymondham to North Elmham; and • Trunk Roads including A47, A140, A149.	A commitment to a number of trenchless crossings at certain sensitive locations was identified at the outset. However, Norfolk Vanguard Limited has committed to certain additional trenchless crossings as a direct response to stakeholder requests.

Table 27.10 Embedded mitigation for human health

Parameter	Mitigation measures embedded into the project design	Notes
EMF	Norfolk Vanguard Limited would comply with Government policy on EMF exposure limits.	N/A
Commitment to no overhead lines	The commitment to use underground cable systems for the onshore cable route over the 60km route between the landfall and electrical connection point, avoids the requirement to construct new overhead lines. The mitigation embedded in this approach will lead to notably reduced impacts on landscape and visual receptors during the construction phase and minimal impacts during the operational phase. It also notably reduces the potential for the onshore cable route to contribute to significant cumulative effects. The construction works will be notably smaller scale than those required to install new overhead lines and post construction the onshore cable route will have a negligible impact on landscape and visual receptors as the components will be buried under ground, with the exception of the small scale link boxes.	N/A
Strategic landscape mitigation	Mitigation measures associated with the onshore project substation, National Grid substation extension and A47 form part of a strategic approach to enhancing landscape character and bio-diversity in the local area. Figure 29.12 shows how mitigation planting will contribute to the wider landscape structure of the area and help consolidate green corridors for wildlife. Mitigation planting for the onshore project substation is shown in Figure 29.9a. This has been designed to screen the onshore project substation. Details of the mitigation planting are presented in section 29.7.1 and the OLEMS (document reference 8.7). Mitigation planting for the National Grid substation extension is shown in Figure 29.10a. This has been designed to screen the National Grid substation extension in views from Necton. Details of the mitigation planting are presented in section 29.7.1 and the OLEMS (document reference 8.7).	N/A

27.6.2 Worst Case Scenario

164. The full project description is provided in Chapter 5 Project Description of the ES. The following sections summarise the key elements of the project that may affect health.

165. Assumptions considered for a worst-case scenario are outlined in Table 27.11.

Table 27.11 Worst case assumptions

Worst case assumptions			
Element	**Worst case criteria**	**Worst case definition**	**Notes**
Landfall			
Construction	Maximum temporary works duration	30 weeks	
	Working hours	24 hour working may be required for duct installation	

Worst case assumptions Element	Worst case criteria	Worst case definition	Notes
	Expected noise level	See Chapter 25 Noise and Vibration.	
Onshore cable route			
Construction	Length Width Peak onshore construction employment Total ducting duration Total cable pull, joint and commission duration Total	60km 45m 420 personnel at any one time. 70% of workers from outside the Norfolk / Suffolk area 2 years 2 years 6 years	It is expected that during most construction works the onshore workforce will be 70-90 people. The construction window is planned in two stages of 2 years split across 6 years.
Permanent joint pits	Maximum number and required dimensions Access	Assume 150 at 90m^2 and 2m deep each Periodic access to installed link boxes / test pits may be required for inspection, estimated to be annually.	Norfolk Vanguard only, spaced approximately one per circuit per 800m cable. 1 link box per circuit per 5km (24).
Onshore project substation			
Construction	Peak onshore construction employment Maximum land take for temporary works area Maximum duration	420 personnel at any one time. 100% from outside the Norfolk / Suffolk area 20,000m^2 (200m x 100m) 30 months	It is expected that during most construction works the onshore workforce will be 70-90 people. Worst case duration of 30 months, with an indicative duration of 24 months.
Operation	Maximum land take for permanent footprint Maximum height Access Expected noise level	75,000m^2 19m building with 25m lightning protection masts, fences 3.4m high 1 visit per week, site lighting required during maintenance visits only See Chapter 25 Noise and Vibration.	No illumination at night.

Worst case assumptions			
Element	**Worst case criteria**	**Worst case definition**	**Notes**
National Grid extension and overhead line modification			
Construction	Maximum land take for temporary works area – substation extension	67,500m^2	The busbar would be extended in a westerly direction with seven additional Air Insulation Switchgear (AIS) bays for Norfolk Vanguard. Worst case duration of 30 months, with an indicative duration of 24 months.
	Maximum land take for temporary works area – overhead line	174,264m^2	
	Works hours and maximum duration	12 hour working day, 5 to 7 days a week, for 30 months	
	Maximum height of temporary towers	45m	
	Fencing	4m high	
Operation	Maximum land take for substation extension permanent footprint	49,300m^2	Includes existing Necton National Grid substation area. Not normally illuminated other than infrequent inspection and maintenance activities (during working hours only). No illumination required at night.
	Maximum land take for overhead line permanent footprint	9,250m^2	
	Maximum height of permanent towers	55m	
	Access	1 visit per month, site lighting required during maintenance visits only	

27.6.3 Potential Effects during Construction

27.6.3.1 Noise

166. During construction, there is potential for noise to temporarily arise from construction works and movement of heavy goods vehicles across the onshore project area.

167. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population near landfall (site-specific);
- The population along the onshore cable route (site-specific);
- The population near the onshore project substation and National Grid substation extension (site-specific);
- Children and young people;
- Older people; and

- People with existing poor health (physical and mental health).

168. The key health outcomes relevant to noise as a determinant of health are cardiovascular health (only as a result of chronic noise effects), mental health (including stress, anxiety or depression) and cognitive performance in children, particularly at school. This is particularly relevant to two of the health priorities (section 27.5.4) outlined by Norfolk County Council, care for the elderly and support to young children.

169. The temporal scope for this effect (as described in section 27.4.2) varies depending on the area of the project:

- At landfall, there is a short term temporal scope due to long horizontal drilling and presence of a temporary onshore works area.
- Along the onshore cable route there is a short term temporal scope because (as described in Chapter 5 Project Description) the onshore cable route will be constructed sequentially. Therefore, any noise will be generated along 150m intervals for approximately one week before moving along the route. The running track will be used during construction between mobilisation areas for more than a week up to one or two months at a time due to sequential nature of the construction. Works are proposed to be undertaken during the day time.
- At the onshore project substation and National Grid substation extension, there is a short term temporal scope because the works are planned across several weeks.
- With regards traffic noise, there is a medium term temporal scope because this will be a requirement for the entirety of the project. However, locally, the impacts will be short term as the works move along the cable route.

170. The conclusions of Chapter 25 Noise and Vibration of this ES can be summarised as follows:

- **No residual impact** at landfall after mitigation;
- **Negligible** localised impacts along the cable route following the application of mitigation measures;
- **No residual impact** at the onshore project substation following the application of mitigation measures;
- **Minor adverse** impacts due to traffic noise following mitigation; and
- **No impacts** due to vibration.

171. The mitigation measures taken into consideration during the assessment are described in Chapter 25 Noise and Vibration. Details regarding mitigation are outlined within the Outline Code of Construction Practice (OCoCP) (document reference 8.1).

172. The potential effect is considered likely because (based on the methods described in section 27.3.4) there is a plausible source-pathway-receptor relationship where:

- The source is construction plant and operations;
- The pathway is pressure waves through the air; and
- Receptors are communities of people.

173. Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

174. The sensitivity of the general population and particularly for vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4). The general population is considered to be of low sensitivity. This reflects the baseline population profile in section 27.5.3.1 which is characterised as follows:

- In Norfolk County, North Norfolk, and Breckland the health of people is varied. Life expectancy is higher overall but lower in the most deprived areas, when compared against England averages.
- The health of people in Broadland District is generally better than the England average.

175. Some people would be more sensitive to changes in noise. For this population, sensitivity is considered high. This reflects the site-specific baseline population profile in section 27.5.3.2. Vulnerability in this case is particularly linked to:

- Living close to sources of noise;
- Age (both young people and older people);
- Existing poor health (e.g. Long-term illness);
- Spending more time in affected dwellings (e.g. Due to low economic activity, shift work; or ill health);
- Vulnerability due to deprivation or health inequalities; or
- Having strong views or high degrees of uncertainty about the project (which may be associated with health effects even below thresholds that are generally considered acceptable).

176. The baseline indicates a sub-population more likely to spend extended periods at home due to retirement or long term illness as approximately 25 to 30%. Some populations in North Norfolk and Breckland in the vicinity of the onshore project area are amongst the 30% most deprived neighbourhoods in the England.

177. The magnitude of the change due to the project can be characterised as small (based on the methods described in section 27.3.4.2). Construction related noise close to particular dwellings or other community receptors would be infrequent and of short duration (being predominantly limited to periods of passing trench work or vehicle

traffic). The levels of noise experienced would be within working noise limits for temporary disruption. At these levels it is unlikely that there would be changes in the risk of developing a new health condition or of exacerbating an existing condition. Reductions in wellbeing associated with short-term, or very short-term, noise levels would be unlikely to persist beyond the period of elevated exposure. The general exposure profile would be one of low exposure to a small population.

178. Chapter 25 Noise and Vibration describes how, following implementation of mitigation, residual impacts are assessed as not significant. At one modelled location (Link 21 and 25, see Appendix 25.2), project-generated traffic may, at most, have a moderate adverse impact with most areas experiencing no impact or a negligible impact.

179. The significance of the potential effects has been informed by the guide questions in Table 27.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific literature does show a causal link between chronic noise above certain thresholds and health determinants. The evidence does not indicate a lower threshold at which health effects do not occur.
- Baseline conditions do show that compared to national comparators the affected population has higher levels of deprivation in the populations around the onshore project area. The populations have a marginally higher level of retirement aged people and marginally higher level of people with long-term health conditions. This suggest that there is potential for more people to be at home during the day. But the proportion of children is relatively low by a comparable amount. The baseline does not indicate any special conditions that are likely to amplify noise effects (e.g. due to extreme topography).
- Norfolk County Council's health priorities focus on care for children below five and people who suffer from dementia. Whilst noise is not a key public health priority issue for the County, localised issues are a priority of Norfolk Environmental Health Practitioners', who have legal powers to investigate and control statutory noise nuisance.
- Consultation responses predominantly refer to requirements for the assessment in Chapter 25 Noise and Vibration to comply with relevant standards and undertake appropriate consultation. Chapter 25 Noise and Vibration describes how, assuming mitigation is implemented, residual impacts are assessed as not significant.
- In line with the NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c) it can be confirmed that (based on the assessment in Chapter 25 Noise and Vibration) the project has avoided significant impacts for noise and vibration, has proposed mitigation in place where impacts are

predicted, and will put in place measures to effectively manage and control noise.

180. The conclusion of the assessment for population health is that the **significance of the effect would be negligible for the general population** and **minor adverse for vulnerable groups**. Vulnerability in this case relates to, carers, young children, retirement aged population, those with long term illness, and those who are unemployed or shift workers who are most likely to spend more of their time at home and who are living adjacent to the project. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

27.6.3.2 Air quality

181. During construction, there is potential for air quality to be temporarily affected by dust and fine particulate from construction, and emissions from construction vehicles.

182. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population near landfall (site-specific);
- The population along the onshore cable route (site-specific);
- The population near the onshore project substation and National Grid substation extension (site-specific);
- Children and young people;
- Older people; and
- People with existing poor health (physical and mental health).

183. The key health outcomes relevant to this determinant of health are an increased risk of cardiovascular diseases (Meo and Suraya, 2015) and asthma exacerbation (Orellano *et al*., 2017).

184. The temporal scope for this effect (as described in section 27.4.2) varies depending on the area of the project:

- At landfall, there is a short term temporal scope due to long horizontal drilling and the presence of landfall compound.
- Along the cable route there is a very short term temporal scope because (as described in Chapter 5 Project Description) the cable route will be constructed sequentially. Therefore, any dust or emissions will be generated along 150m intervals for approximately one week before moving along the route. Works are proposed to be undertaken during the day time.
- At the onshore project substation, there is a short term temporal scope because the works are planned across several weeks.

- With regards traffic emissions, there is a medium term temporal scope because this will be a requirement for the entirety of the project. However, locally, the impacts will be short term as the works move along the cable route.

185. The conclusions of Chapter 26 Air Quality of this ES can be summarised as follows:

- Impacts due to construction dust and fine particulate are not significant with appropriate mitigation; and
- Construction vehicle exhaust emissions are not significant.

186. The mitigation measures taken into consideration during the assessment are as described in Chapter 26 Air Quality.

187. The potential effect is considered likely because (based on the methods described in section 27.3.4) there is a plausible source-pathway-receptor relationship:

- Sources of dust are excavated materials and sources of particulate or emissions are construction traffic;
- The pathway is dispersion through the air; and
- Receptors are communities of people.

188. Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

189. The sensitivity of the general population and vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4.1):

- The sensitivity of the general population is considered to be low because overall health indicators show a healthy population of working age, with a skew towards an older population. This is discussed in more detail under section 27.6.3.1.
- As with noise, the sensitivity of vulnerable groups is considered high. This is because there is a marginally higher proportion of households where nobody is in employment, of retirement aged people, and where people have long term illness. The deprivation of some neighbourhoods in North Norfolk and Breckland is amongst the 30% most deprived in England. However, there is also a marginally lower number of children as a proportion of the population.

190. The magnitude of the change due to the project can be characterised as low (based on the methods described in section 27.3.4.2). For air pollutants that are respirable (e.g. NO_2, PM_{10} and $PM_{2.5}$), the change in air quality close to particular dwellings or other community receptors would be infrequent and of short duration (being predominantly limited to periods of passing trench work or vehicle traffic). The changes would be below all recognised statutory thresholds for health protection. For particles of non-respirable size, coarser (larger and heavier) fractions of dust are

expected to rapidly reduce in concentration with distance from source due to precipitation. The potential for nuisance-type dust effects is therefore expected to be occasional and limited. For finer fractions of dust precipitation rates would be slower, affecting a wider area and thus more people. However, exposure is expected to be low due to the finer dust particles dispersing (reducing in concentration) with increased distance. At these levels it is unlikely that there would be changes in the risk of developing a new health condition or of exacerbating an existing condition. Given the semi-rural context (where baseline air quality is generally good) it is unlikely that there would be a significant change in population health outcomes for the neighbouring community during these periods.

191. The significance of the potential effects has been informed by the guide questions in 27.3.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific literature does indicate a causal link between air pollution due to dust, particulate, and various gases, including those associated with internal combustion engines with health impacts. Whilst the literature supports there being thresholds set for health protection purposes, it also acknowledges that for some air pollutants there are non-threshold health effects (i.e. when there is no known exposure threshold level below which adverse health effects may not occur). The assessment has identified population groups that may be particularly sensitive to air quality effects. The assessment in Chapter 26 shows that the concentration of pollutants is not likely to exceeded thresholds set for health protection (i.e. UK AQOs).
- Baseline conditions show that there is a marginally higher proportion of people that are likely to be at home, i.e. closer to the construction area, for more of the day.
- These populations align with the Health Priority areas of Norfolk County Council who have a particular focus on older age people and people suffering from long term illness.
- Consultation responses refer to the requirement of the air quality assessment to be agreed with appropriate stakeholders. It can be confirmed that Chapter 26 Air Quality details that this has been undertaken.
- The air quality assessment is summarised above and indicates that with mitigation and control measures implemented the onshore construction works would be within statutory requirements (UK AQOs) and would be unlikely to result in nuisance from widespread dust deposition. The assessment undertaken in Chapter 26 Air Quality follows regulatory guidance as required in the UK.
- The NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c) does require projects to consider air pollution, which has been

undertaken, but notes that projects with significantly detrimental impacts on health are subject to separate regulations.

192. The conclusion of the assessment for population health is that the significance of the effect would be **negligible for the general population** and **minor adverse for vulnerable groups**. Vulnerability in this case relates to people living adjacent to the cable route with existing poor respiratory health (such as asthma or chronic obstructive pulmonary disease), as well as carers, young children, retirement aged population, those with long term illness, and those who are unemployed or shift workers who are most likely to spend more of their time at home. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

27.6.3.3 Ground and / or water contamination

193. During construction, water quality has the potential to be temporarily affected by construction site run-off, or temporary impoundment of water courses. Drinking water is not likely to be affected because the population of Norfolk is supplied by piped drinking water and do not abstract water directly from surface or ground water sources without treatment.

194. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population near landfall (site-specific);
- The population along the onshore cable route (site-specific);
- The population near the onshore project substation (site-specific);
- Children and young people;
- Older people; and
- People with existing poor health (physical and mental health).

195. The key health outcomes relevant to this determinant of health relate to potential toxicological exposure associated with contaminated bathing water. Effects may relate to either biological toxins (e.g. associated with eutrophication) or chemical toxins (e.g. associated with mobilisation of historic contamination).

196. The temporal scope for these effects is (as described in section 27.4.2) short term because the most likely pathways are at points where the cable makes landfall, or where the onshore cable route crosses small scale watercourses using temporary dam and diversion methods. As described in Chapter 5 Project Description, at this point water would be impounded upstream of the crossing and, therefore, has the potential to stagnate.

197. The conclusions of Chapter 20 Water Resources and Flood Risk and Chapter 19 Ground Conditions and Contamination of this ES can be summarised as follows:

- The impact assessment identified several potential impacts upon water resource receptors (that are not drinking water sources) during construction of the proposed onshore development, of which impacts were assessed to vary from minor to negligible, depending upon the receptor. Where impacts have been assessed as minor, this is due to the heightened sensitivity or value of the receptor, for example as a result of international and national nature conservation designation status associated with a water body or due to a water body being classified as having Good Ecological Potential under the Water Framework Directive.
- Following implementation of mitigation measures to prevent ground and groundwater pollution and interconnection of aquifer units in the footprint of the project are in place, the development is predicted to have only minor adverse effects in relation to geology and ground conditions.

198. The mitigation measures taken into consideration during the assessment are as described in Chapter 20 Water Resources and Flood Risk and Chapter 19 Ground Conditions and Contamination.

199. Based on the methods described in section 27.3.4 there is a plausible but unlikely source-pathway-receptor relationship:

- Sources include the potential for increased water turbidity, accidental fuel spill, or mobilisation of historic contamination;
- The pathway would be contaminants in bathing waters; and
- Receptors include users of the beach at landfall and users of watercourses.

200. The plausibility of the potential effect occurring largely depends on unusual conditions to make the source-pathway-receptor linkage. Other than increased water turbidity (which has limited potential to affect health), the sources relate to accidental releases of pollutants or the unexpected encountering of historic contamination. Mitigation measures are described in Chapter 20 Water Resources and Flood Risk and Chapter 19 Ground Conditions and Contamination to reduce the probability of a risk occurring in the first place and should it occur, further mitigation to reduce the risk of widespread contamination that could affect the public.

201. The sensitivity of the general population and vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4.1). The general population is considered to be of low sensitivity. This reflects the limited likelihood that people would interact with bodies of water for recreational purposes. Vulnerability in this case is particularly linked to: age (both young people and older people); and existing poor health (e.g. long-term illness).

202. The magnitude of the change due to the project can be characterised as very low (based on the methods described in section 27.3.4.2). With regard to coastal or

fluvial bathing waters, any change in water quality would be expected to rapidly reduce in concentration with distance from source due to dispersion. Any increased turbidity in coastal water associated with the landfall HDD methods would be transitory and temporary and unlikely to affect the bathing water quality to the extent of deterring swimmers or other recreational water users. The marine activities would mitigate against, and monitor for, any spills or historic contamination as described in Chapter 9 Marine Water and Sediment Quality. The general water related pollutant exposure profile would be one of low exposure (if any) to a small population.

203. The significance of the potential effects has been informed by the guide questions in 27.3.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific literature indicates sufficient strength of evidence from sufficiently high-quality scientific studies to establish that clean and sufficient drinking water is required to remain healthy. Children may be particularly sensitive to toxicological effects due to developmental stage and more time spent outdoors, including use of bathing waters. The baseline indicates that the areas affected by the project typically have a lower than average percentage of young people (compared to national comparators) and lower population density (compared to national comparators).
- Whilst a review of regional public health needs assessments and strategies indicates that water quality, as a determinant of health, is not a key public health priority issue, health priorities for Norfolk County Council do focus on young people generally.
- The Chapter 20 Water Resources and Flood Risk and Chapter 19 Ground Conditions and Contamination results indicate that the risks for population health are likely to be negligible. At points, such as crossing of small scale water courses, the public would not have access to any impounded water.

204. The conclusion of the assessment for population health is that the significance of the effect would be **negligible for the general population** and **negligible for vulnerable groups**. Vulnerability in this case may particularly relate to disruption in the unlikely event of a serious contamination event that may require bathing waters to be temporally closed or temporary use of alternative emergency water sources. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

27.6.3.4 Physical activity

205. During construction, there is the potential for physical activity to be temporarily affected by the project temporarily diverting Public Rights of Way (PRoWs). All other

interaction with public spaces such as playing fields and common land has been avoided through site selection as part of the embedded mitigation for the project.

206. The population groups relevant to this assessment, due to either proximity or other sensitivity (as defined in section 27.5.1) are:

- The population near landfall (site-specific);
- The population along the onshore cable route (site-specific);
- The population near the onshore project substation (site-specific);
- Children and young people;
- Older people;
- People with existing poor health (physical and mental health).

207. The key health outcomes relevant to this determinant of health are physical health conditions (e.g. cardiovascular health) and mental health conditions (e.g. stress, anxiety or depression) associated with levels of physical activity and obesity levels. For example, due to the level of active travel (such as road cycling), leisure activities (such as team sports on public facilities) or outdoor activities (such as hiking or mountain biking).

208. The temporal scope for these effects is (as described in section 27.4.2) very short term. This is because the onshore cable route does not directly impact any community infrastructure (such as sports facilities) as described in Chapter 31 Socio-economics. However, temporary and reversible impacts to Public Rights of Way and coastal waters are discussed in Chapter 30 Tourism and Recreation. During these periods there would be a change in the tranquillity and perceived quality of physical activity opportunities.

209. The conclusions of these chapters of this ES can be summarised as follows, assuming mitigation is implemented:

- There is no residual impact on community infrastructure (such as sports facilities) due to site selection avoiding interaction with these sites;
- The residual impact on the majority of PRoWs would be minor adverse and the impact on high value PRoWs would be moderate adverse. This is not because the impact is higher or for a longer duration but only because, as nationally significant walking or cycling routes, they are considered to be of higher value than local routes.

210. The mitigation measures taken into consideration during the assessment are as described in Chapter 30 Tourism and Recreation and Chapter 31 Socio-economics. Disturbance of people using space near the construction site are mitigated through the measures described in section 27.6.3.1 Noise and section 27.6.3.2 Air Quality. Any alternative routes of PRoWs would be agreed with Norfolk County Council and managed as per the PRoW Strategy (document reference 8.4).

211. The potential effect is considered likely for outdoor activities (based on the methods described in section 27.3.4) but not for sports activities using community infrastructure. This is because there is a plausible source-pathway-receptor relationship between the onshore project and PRoWs (including recreational use of coastal waters/beaches) but not for community infrastructure:

- The source is trenching activity and vehicles/plant operations increasing emissions and disturbance on the PRoWs (including recreational use of coastal waters/beaches);
- The pathway is pressure waves, gases and dust particulates travelling through the air reducing amenity; and
- Receptors are users of the PRoWs (including uses of coastal waters/beaches), resulting in a lower level of active travel or outdoor recreation.

212. The effects would be due to the sequential construction of the onshore cable route. Approximately 150m of onshore cable route will be installed per week and during this time any PRoWs would be temporarily diverted or, at worst, temporarily closed as agreed with the local authority for around a week. After this, the site would be reinstated except for a temporary running track which would have a controlled crossing until the cable route between the mobilisation areas had been completed. The area would then be reinstated but some time would be required before the same level of natural coverage (such as grass, shrubs, and hedge rows) returns.

213. The sensitivity of the general population and vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4.1):

- The general population is considered to be of medium sensitivity. This reflects the site-specific baseline population profile in section 27.5.3.5. This indicates that on some measures the population is less healthy and more deprived than national comparators. Physical activity is known to be an important factor for many health and quality of life outcomes.
- Some people would be more sensitive to changes in physical activity. For this population, sensitivity is considered high. Vulnerability in this case is particularly linked to people who are less able to adapt to changes and who have limited access to alternatives (e.g. walking routes with a tranquil setting). These people may undertake less exercise during the period that they are affected by active project works and therefore forgo the benefits to physical and mental health. Young or older people may have higher levels of dependence on carers or public transport to access alternative physical activity opportunities. People (adults and children) who are already overweight or obese would be particularly sensitive to fewer opportunities to be physically active.

214. The magnitude of the change due to the project can be characterised as low (based on the methods described in section 27.3.4.2). The reduction in the quality of the environment would be temporary, reversible, and localised. Temporary diversions may marginally increase the length of a PRoW, which may disincentivise use by some people. However, the temporary diversions would be unlikely to affect population physical activity levels to the extent of changes in the risk of developing new health conditions or of exacerbating existing conditions. Any short-term changes in physical activity levels would be unlikely to have a lasting influence on population health.

215. The significance of the potential effects has been informed by the guide questions in section 27.3.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific evidence draws a strong link between levels of physical activity and physical and mental health outcomes. The evidence also indicates that nearly half of people aged over 60 years may be inactive.
- The representative baseline of neighbourhoods around the landfall, onshore cable route, and onshore project substation report a marginally lower level of very good or good health and daily activity level compared to the average for England. This reflects the marginally higher proportion of people aged over 60. However, all representative neighbourhoods show a lower level of childhood obesity than the average for England. There is also marginally fewer children as a proportion of the population.
- Norfolk County Council includes obesity reduction, improvements in mental health and creating a healthier physical environment as key health priorities. However, there are no consultation responses with regards impacts on physical activity. There are also no regulatory standards with regards physical activity.

216. The conclusion of the assessment for population health is that any changes in health outcomes associated with disruption of, or reduced environmental quality (noise, dust, air quality and views) along, PRoWs (including recreational use of coastal waters/beaches) would be **negligible for the general population and negligible for vulnerable groups.** This is because the only direct impact on access of physical activity would be in relation to diversion of PRoWs which are temporary, localised, and reversible. Vulnerability in this case relates to people who currently make frequent use of the routes primarily due to their current tranquillity and for whom there are access barriers to alternate routes in the area. People over the age of 60 and those with existing health conditions may particularly benefit from physical activity, so would also be particularly sensitive to any change. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

27.6.3.5 Journey times and / or reduced access

217. During construction, there is the potential for journey times and access to be temporarily affected by an increase in the number of HGVs or employee vehicles on the road and temporary traffic management at certain locations. These have the potential to lead to temporary delays and temporarily reduce access to local services.

218. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population of North Norfolk, Broadland and Breckland Districts (local);
- People living in deprivation, including those on low incomes; and
- People with existing poor health (physical and mental health).

219. Travelling to, or accessing health care, underpins management of illness or injury. The key health outcomes relevant to this determinant of health are emergency response times or non-emergency treatment outcomes associated with delays or non-attendance caused by increased traffic and journey times arising from additional project traffic.

220. The temporal scope for these effects is (as described in section 27.4.2) variable:

- With regards delays due to traffic management along routes:
  - At landfall, there is a short term temporal scope due to long horizontal drilling and presence of a temporary onshore works area.
  - Along the onshore cable route there is a very short term temporal scope because (as described in Chapter 5 Project Description) the cable route will be constructed sequentially.
  - At the onshore project substation and National Grid substation extension, there is a short term temporal scope because the works are planned across several weeks.
- With regards traffic movement, the temporal scope would also be short term. Although the project as a whole has a medium term (measured in years) temporal scope, for areas where impacts are predicted in Chapter 24 Traffic and Transport, the duration is measured in weeks.

221. Chapter 24 Traffic and Transport of this ES concludes that the residual magnitude of driver delay impacts is low but, through consultation, has identified that some of the junctions assessed (mainly on to the A47) have a high sensitivity because they form part of the Strategic Road Network. The traffic assessment includes an assessment of driver delays and concludes that the impact would be minor.

222. General mitigation measures taken into consideration for traffic and transport impacts are detailed in Chapter 24 Traffic and Transport. Traffic impacts during

construction will be managed through a Traffic Management Plan, Travel Plan and Access Management Plan (DCO requirement 21).

223. The potential effect is considered likely because (based on the methods described in section 27.3.4) this is a potential source-pathway-impact relationship as follows:

- The source relates to an increased number of vehicles on the road network or temporary traffic management measures due to the project;
- The pathway is journey times or accessibility to amenities/services, particularly healthcare (emergency and non-emergency); and
- The receptor is local road users.

224. Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

225. The sensitivity of the general population and vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4.1):

- The sensitivity of the general population is considered to be low because journey times to work are similar to the average in England and the population is considered to be in generally good health hence requiring fewer visits to primary health care. Furthermore, as part of embedded mitigation for the project developed through the site selection process, the project has avoided built up areas and locations where health care facilities are located.
- A small number of vulnerable communities may be affected more than the general population. The sensitivity of vulnerable groups is considered high because deprivation indices (as discussed in section 27.5.3.6) show some neighbourhoods around the landfall, onshore cable route, and the onshore project substation are ranked between 23 and 44 out of 326 in England (where 1 is most deprived). Deprived populations may already face more access barriers than the general population and therefore be more sensitive to access changes. The more sensitive population particularly includes those accessing health services (emergency or non-emergency) at times and locations where there may be some increase in congestion. Ambulance services (and the recipients of their care) are particularly sensitive to delays.

226. The magnitude of the change due to the project can be characterised as low as follows (based on the methods described in section 27.3.4.2):

- Only small changes in journey times would be expected, largely relating to short delays at key junctions;
- The frequency of any delays is likely to be low because works are sequential and delays would be temporary. Any change is considered unlikely to be of a scale that would affect quality of life or receipt of time-critical healthcare;

- Any change in journey times would be reversible as the project does not make any permanent change to the road network; and
- Although a large number of people may be affected, the change experienced by people is expected to be small. The general exposure profile would be one of low exposure to a large population.

227. The significance of the potential effects has been informed by the guide questions in 27.3.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific literature shows an association between access and healthcare outcomes. The evidence base shows a correlation between areas with greater access to primary health care and lower hospitalization rates for ambulatory care sensitive conditions (conditions which are potentially avoidable by well-functioning primary care). (Rosano *et al*., 2013)
- Transportation barriers to health care access are common, and greater for vulnerable populations. Patients with a lower socio-economic status have higher rates of transportation barriers to ongoing health care access than those with a higher socio-economic status. Transportation barriers can also affect access to pharmacies and thus medication adherence. (Syed *et al*., 2013)
- Baseline conditions shows that some communities in the vicinity of the onshore project area may have a lower socio-economic status and therefore face higher rates of transportation barriers.
- Although transportation is not a specific health priority of the Norfolk County Council it underpins other health priorities such as support to children under the age of 5, and support to carers of the long term ill such as older people with dementia.
- The only consultation response with regards journey times to primary health care is from NHS England who request an analysis of the likely increase in demand for services as a result of the project. Chapter 31 Socio-economics has undertaken an assessment of labour demand and shows that the project will have a minor beneficial impact on job creation. Staff employed in construction of the onshore element of the project are likely to be of working age and in good health. It is therefore unlikely that this would lead to an increased demand on health services because those that are recruited locally would maintain their local GP and it is expected that those who are recruited from outside of Norfolk would be distributed across the New Anglia LEP region.
- There are no regulatory standards with regards impacts on journey times. The Department of Health target is that the ambulance service reaches 75% of life-

threatening calls within eight minutes. The East of England Ambulance Service NHS Trust already faces challenges in meeting this target[9].

- The NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c) mirrors NHS England's consultancy response with regards a need to determine if the change in population would increase demand on local services.

228. The conclusion of the assessment for population health is that the significance of the effect would be **negligible for the general population and minor adverse for vulnerable groups**. Vulnerability in this case relates to people living in deprived areas in the vicinity of the landfall, onshore cable route, and onshore project substation, particularly people with long-term illnesses (and their carers) and users of ambulance services.

27.6.4 Potential Effects during Construction and Operation

27.6.4.1 Employment

229. Employment has been considered across both construction and operation because, as discussed in Chapter 31 Socio-economics, the development of the project is part of a wider process of developing an offshore wind supply chain in the New Anglia LEP region. Therefore, from a human health point of view, creating a demand for transferable skills (both between construction projects and on to operation of projects) has a multiplying effect on employment. Direct employment by the project also creates indirect employment in the supply chain and induced employment due to expenditure.

230. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population of Norfolk County (regional); and
- People living in deprivation, including those on low incomes.

231. The key health outcomes relevant to this determinant of health are indirect influences on physical health (e.g. cardiovascular conditions) and mental health conditions (e.g. stress, anxiety or depression) due to improvements in social determinants, such as improved socio-economic position, greater job security and facilitating beneficial lifestyle choices (e.g. healthier eating and recreational physical activity, including for dependants).

232. The temporal scope for these effects is (as described in section 27.4.2) is variable:

[9] NHS England. Ambulance Quality Indicators. Accessed April 2018. http://www.ambulancestats.co.uk/presentation.php#1 and https://www.england.nhs.uk/statistics/statistical-work-areas/ambulance-quality-indicators/

- During construction the temporal effect is measured in years but individuals may only be directly employed for months at a time. However, the overall effect on direct and indirect employment would be considered across the duration of the construction phase and is therefore medium term;
- During operation it is expected that people would be permanently employed and that this employment could last for decades. Therefore, the temporal scope is long term.

233. The conclusions of Chapter 31 Socio-economics of this ES found that employment had a minor beneficial impact on the labour market of the New Anglia LEP. However, the cumulative impact of developing the New Anglia LEP as a hub for offshore wind would have moderate long term benefits with the potential of creating major benefits if appropriate training and supply chain development is undertaken across the different offshore wind projects in operation, construction or development off the coast of the New Anglian LEP.

234. The enhancement measures taken into consideration during the assessment are the positive engagement that Norfolk Vanguard Limited is undertaking with local supply chain companies and the New Anglia LEP.

235. The potential effect is considered likely because (based on the methods described in section 27.3.4) there is a potential source-pathway-impact relationship:

- The source is direct and indirect job creation due to the development of the project;
- The pathway is through employment, with increased probability of effect due to supply chain and skills development being undertaken by Norfolk Vanguard Limited;
- The receptor is people of working age in the regional labour market (and their dependants).

236. The sensitivity of the general population and for vulnerable groups (collectively as a single group) can be characterised as follows (based on the methods described in section 27.3.4.1). Sensitivity in this case is related to how likely it is a population could benefit from being employed:

- Most people in the region are already be in stable employment that would not be affected by the project (or are a dependant of such a person). The regional population also has below average income deprivation compared to national comparators. However, as described in Chapter 31 Socio-economics, education deprivation is relatively high compared to the rest of England. People with a lower educational attainment may find it harder to gain employment in technical areas required by the offshore wind industry. The sensitivity of the general population is therefore considered to be medium.

- For some groups, there is the potential for high levels of sensitivity. Vulnerable populations include young people choosing their careers, people on low incomes or who are unemployed and future young or older people who may rely on those employed by the project.

237. The magnitude of the change due to the project can be characterised as follows (based on the methods described in section 27.3.4.2). There would be direct and indirect employment opportunities both during construction and during operation. Construction jobs would be short- to medium-term, but include upskilling that would have longer term benefits. Operational jobs could provide several decades (around 30 years) of benefit to those employed and their dependants. The majority of the jobs are expected to be drawn from the regional level, providing benefits to those employed as well as their dependants. Compared to national comparators, the higher proportion of retired people (and lower proportion of young people) close to the actual project sites suggests that fewer direct economic benefits would be experienced in these areas. The project's relatively small contribution to direct employment (as a proportion of the regional labour market) suggests the change, whilst positive, is unlikely to be associated with a widespread reduction in inequalities or a widespread increase in prosperity or quality of life. The magnitude (from the health perspective) is considered positive but low, driven by the longer term regional benefits to upskilling and employment.

238. The significance of the potential effects has been informed by the guide questions in Table 27.4. The following discussion sets out the reasoned conclusions for the professional judgement reached (summarising relevant evidence from section 27.5):

- Scientific literature shows that good quality employment is generally associated with better health. Employment can have a protective effect on depression and general mental health (van der Noordt *et al*., 2014). Unemployment may occur due to poor health, it may also cause poor health (Herbig *et al*., 2013).
- The baseline shows that the labour market in the New Anglia region is relatively strong. Although the average income deprivation is lower than the national average there are more deprived areas close to landfall, onshore cable route, and onshore project substation that may struggle to benefit from employment opportunities.
- There were no relevant consultation responses with regards employment as a determinant of health. However, comments relating to increased demand on local services or changes to population size are related to potential in-migration due to employment opportunity. These have been considered in Chapter 31 Socio-economics which also finds that the level of in-migration would not be significant in relation to the size of the population.
- There are no regulatory standards with regards employment as a determinant of health.

- The NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c) recommends "*considering the potential effects, including benefits, of a proposal for a project, the IPC will find it helpful if the applicant sets out information on the likely significant social and economic effects of the development, and shows how any likely significant negative effects would be avoided or mitigated. This information could include matters such as employment, equality, community cohesion and well-being*." These effects have been considered between this chapter, Chapter 30 Tourism & Recreation, and Chapter 31 Socio-economics.

239. The conclusion of the assessment for population health is that the significance of the effect would be **negligible for the general population** and **minor beneficial for vulnerable groups.** Vulnerability in this case relates to direct and indirect employment opportunities for people living in deprivation or who are of working age (including their dependants).

27.6.5 Potential Effects during Operation

27.6.5.1 Noise

240. The potential for noise impacts during operation of the onshore project substation has been considered in Chapter 25 Noise and Vibration.

241. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.4.1):

- The population near the onshore project substation (site-specific) including the following vulnerable groups;
  - Children and young people;
  - Older people;
  - People with existing poor health (physical and mental health); and
  - People living in deprivation, including those on low incomes.

242. The key health outcomes are the same as those discussed in section 27.6.3.1 in relation to construction noise effects.

243. The temporal scope for this effect is (as described in section 27.4.2) long term as it relates to the operational phase of the project.

244. Against the background noise level, Chapter 25 Onshore Noise and Vibration of this ES found that 10 of 11 receptor sites would experience no impact and only one location would experience, at most, a minor adverse impact before mitigation.

245. The mitigation measures taken into consideration during the assessment are described in Chapter 25 Onshore Noise and Vibration. Norfolk Vanguard Limited are committed to providing a final design of the project which is able to meet the

rigorous standards of low noise emissions expected by both the UK regulatory bodies and stakeholders. Noise reduction technology and design approach is discussed within the assessment and there are many proved mitigation options that, through the detailed design process, can be combined to create a design that will comfortably meet the required low noise emissions, resulting in no impacts.

246. Based on the methods described in section 27.4.2 there is not a plausible source-pathway-receptor relationship for all but one location. Before mitigation all locations are assessed to have no impact except for one location at SSR10 near Ivy Todd Farm (see Figure 25.2) where there would, at most, be a minor significant impact:

- Following implementation of the mitigation measures outline in Chapter 25 section 25.8.6.2 there would be no residual impact from noise arising from the onshore project substation.
- Therefore, the pathway that existed for one receptor location would be removed following implementation of mitigation; and
- Due to this, there would be no impact from noise from the onshore project substation.

27.6.5.2 Electromagnetic fields (EMF)

247. During operation, EMF effects may arise from the operation of the onshore project substation and National Grid substation extension, along the onshore cable route, and the location where the cable route crosses with that of Hornsea Project Three. Further information about EMF of Norfolk Vanguard's infrastructure and where it interacts with Hornsea Project Three's cable route can be found on the Norfolk Vanguard Limited website[10 and 11].

248. The population groups relevant to this assessment, due to either proximity or other sensitivity are (as defined in section 27.3.4):

- The population near the onshore project substation (site-specific); and
- The population along the cable route including the following vulnerable groups;
  - Children and young people;
  - Older people;
  - People with existing poor health (physical and mental health); and
  - People living in deprivation, including those on low incomes.

[10] For information on Norfolk Vanguard EMF - https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-emf-information-sheet.pdf

[11] For information on Norfolk Vanguard and Hornsea Project Three cable route crossing - https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-orsted-emf-information-sheet.pdf

249. Norfolk Vanguard Limited's policy is only to design and install equipment that is compliant with the relevant exposure limits. To ensure this, all of the equipment for the project capable of producing EMFs has been assessed in accordance with the provisions of the Government's Code of Practice on Compliance, which is compliant with ICNIRP guidance (ICNIRP, 1998). Therefore, there is very limited potential for changes in physical health due to EMF exposure.

250. The temporal scope for potential effects would be likely to be long term due to the operation of the infrastructure over many years.

251. EMF effects have been analysed by the National Grid on behalf of Norfolk Vanguard Limited. These cover operation in general and with a focus on the point at which the Norfolk Vanguard and Hornsea Project Three cable routes will cross.

252. Table 27.12[8] shows the general magnetic fields of the HVDC onshore project cable compared to the DC public exposure limit of 40,000 µT. This shows that for the length of the onshore cable route the EMF has been assessed to be less than 1% of the ICNIRP exposure limit.

253. Table 27.13[8] the magnetic fields of the HVAC cables that would be necessary between the onshore project substation and the National Grid substation extension in comparison with the AC public exposure limit of 360µT. This shows that if directly over the buried cables the EMF would 8% of the exposure limit which quickly drops to less than 1% when over 25m away. It should be noted that the short length of AC cable will be installed in land that the public do not have access to.

254. Table 27.14[9] shows the worst-case scenario if both Norfolk Vanguard and Hornsea Project Three's cables operate under HVAC. Although this is impossible due to Norfolk Vanguard Limited's decision to use HVDC it shows that if standing directly over the HVAC buried cables the EMF would be 14% of exposure limit. If Hornsea Project Three elect to use HVAC and consider the use of HVDC in Norfolk Vanguard the exposure will be lower than this due to this project's decision to use HVDC. Table 27.15[9] shows the worst-case if Hornsea Project Three elect to use HVDC. In this case the exposure would be less than 1% of the exposure limit

Table 27.12 Calculated DC Magnetic Fields from onshore cable route

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (µT)	33.7	1.27	0.26	0.06
% ICNIRP exposure limit	<1%	<1%	<1%	<1%

Table 27.13 Calculated AC Magnetic Fields from cables between onshore project substation and National Grid extension

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (µT)	29.7	4.11	0.26	0.03
% ICNIRP exposure limit	8%	1%	<1%	<1%

Table 27.14 Worst-case AC magnetic fields at crossing point

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (µT)	50.7	1.14	0.49	0.23
% ICNIRP exposure limit	14%	<1%	<1%	<1%

Table 27.15 Worst-case DC magnetic fields at crossing point

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (µT)	60.8	1.46	0.59	0.23
% ICNIRP exposure limit	<1%	<1%	<1%	<1%

255. National Grid recommended that no mitigation measures for the cable design and crossing point are necessary as both technology options have been demonstrated to comply with the current public exposure guidelines as detailed in NPS EN-5. If these requirements are met NPS EN-5 states that "no further mitigation should be necessary".

256. Based on the methods described in section 27.3.4 there is no a plausible source-pathway-receptor relationship:

- The source of EMF arising from the onshore cable route, cable crossing point, and onshore project substation are all below regulatory exposure limits;
- There is no demonstrable health effect due to static EMF from HVDC cables and the HVAC elements of the onshore project substation are designed within regulatory standards; and
- Receptors would be people living close to the onshore substation and cable route. But assessment by National Grid shows that, at most, EMF fields would be less than 1% of ICNIRP exposure limit where public have access to and 8% of exposure limits due to the HVAC lines between substations where the public would not have access. EMF would extend to, at most, 100m and all human receptors live beyond this boundary and any that would travel within this boundary would do so for a very short time. A review of scientific literature shows absolutely no link between momentary interaction with EMF fields and health effects.

257. Due to this, the conclusion of the assessment for population health is that there would be **no effect** for the general population or for vulnerable groups due to EMF during operation.

27.6.6 Potential Effects during Decommissioning

258. This section describes the potential impacts of the decommissioning of the onshore infrastructure with regards to effects on Human Health. Further details on decommissioning are provided in Chapter 5 Project Description.

259. No decision has been made regarding the final decommissioning policy for the project, as it is recognised that industry best practice, rules and legislation change over time. It is likely the cables would be pulled through the ducts and removed, with the ducts themselves left in situ.

260. In relation to the onshore project substation, the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime, but are expected to include:

- Dismantling and removal of outside electrical equipment from site located outside of the onshore project substation buildings;
- Removal of cabling from site;
- Dismantling and removal of electrical equipment from within the onshore project substation buildings;
- Removal of main onshore project substation building and minor services equipment;
- Demolition of the support buildings and removal of fencing;
- Landscaping and reinstatement of the site (including land drainage); and
- Removal of areas of hard standing.

261. Whilst details regarding the decommissioning of the onshore project substation are currently unknown, considering the worst case scenario which would be the removal and reinstatement of the current land use at the site, it is anticipated that the effects would be similar to or less than those during construction.

262. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the project so as to be in line with current guidance, policy and legislation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licensing and consenting approach.

27.7 Inter-relationships

263. There are many inter-relationships between determinants of health and health outcomes. This section on inter-relationships considers both intra-project effects and inter-project effects. Inter-project effects relate to the combined influence from different aspects of this project on the same population groups. Inter-project effects consider the effect of this project in combination with the expected effects of other projects that may be occurring at a similar time with effects to the same populations.

27.7.1 Intra-project Cumulative Effects

264. Intra-project cumulative effects consider whether there are areas where effects to more than one health determinant by the project may lead to a health outcome.

265. The following section considers the overall effect of different elements of the project on the same population groups. This includes populations geographically defined within the project area, as well as those defined for other sensitivities (see section 27.4.1).

266. Cumulative intra-project effects are found to be negligible for the general population due to the embedded mitigation as a result of consultation and design decisions that have avoided impacts on health determinants. Due to their increased likelihood to spend more time at home and their vulnerability to environmental changes it is assessed that there is an increased likelihood of minor adverse effects on older people, those with existing health conditions and those living in deprived areas. However, there is also the possibility that increased employment for people living in deprived areas may have a beneficial effect which would lead to improvements in other health determinants. Although the potentially positive effect for people living in more deprived areas would not directly counter the potentially adverse effect for retired people the two may balance out across affected communities.

267. Table 27.16 summarises effects for each geographic population and concludes with a professional judgement of the intra-project cumulative effect scores.

268. Table 27.17 similarly summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the intra-project cumulative effect score.

269. The scores in Table 27.16 and Table 27.17 are carried forward into the next section, which considers inter-project cumulative effects.

Table 27.16 Intra-project cumulative effects descriptions and scores for site specific population groups

	Site-specific		
	Population near landfall	**Population along the onshore cable route**	**Population near the onshore project substation and National Grid substation extension**
Description of cumulative effect	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • Indirect Employment; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities • Indirect Employment; • EMF; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • Indirect Employment; • EMF; and • Journey times or reduced access.
	The general population intra-project cumulative effect is considered to be negligible due to the very short temporal scope of negligible effects and the avoidance of significant impacts through design decisions.	The general population intra-project cumulative effect is considered to be negligible. This is due to the sequential construction process which results generally negligible effects of very short temporal scope at individual locations.	The general population intra-project cumulative effect is considered to be negligible. Consultation and site selection has led to design decisions that reduce the likelihood of health outcomes due to accumulated effects.
	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** intra-project cumulative effect. This is because, although the effects are negligible and transient, due to the likelihood of vulnerable groups being at home during the day they may feel the effects accumulate more rapidly.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** intra-project cumulative effect. This is because, although the effects are negligible and transient, due to the likelihood of vulnerable groups being at home during the day they may feel the effects accumulate more rapidly.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** intra-project cumulative effect. The cumulative effect on physical health is negligible but it is considered that anxiety due to perceived risk may result in short term minor adverse health effects.

Table 27.17 Intra-project cumulative effect descriptions and scores for potentially vulnerable groups within site specific populations

	Potentially vulnerable groups			
	Children and young people	**Older people**	**People with existing poor health (physical and mental health)**	**People living in deprivation, including those on low incomes**
Description of cumulative effect	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • EMF; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • EMF; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • Employment; and • Journey times or reduced access.
	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered to be **negligible**. This is because the main effect on children would be a change in conditions that reduce their ability to concentrate while at school but design decisions have avoided these effects.	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered to be **minor adverse** due to the increased percentage of older people in the community and the likelihood that they would spend more time at home where they may feel the effects accumulate more rapidly.	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered to be **minor adverse** because they are more likely to be at home where they may feel the effects accumulate more rapidly and may feel anxiety more acutely due to their existing conditions.	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered to be **negligible**. On the one hand deprivation may increase their vulnerability of effects but on the other hand the increased opportunity for training and employment may have a beneficial effect.

27.7.2 Inter-project Cumulative Effects

270. Inter-project cumulative effects are those effects that would increase due to the presence of more than one project in an area. However, the assessment finds that due to the geographic spread of the relevant projects, populations are unlikely to feel significant increase in health effects as a result of a number of projects being constructed. This is significantly improved by the decision to install the ducts along the onshore cable route for Norfolk Boreas during the construction of Norfolk Vanguard and hence avoiding the accumulation of effects on local populations and the decision to pursue the HVDC electrical connection only.

271. The following section considers the overall effect of Norfolk Vanguard and other projects on health. This includes consideration of geographically defined populations, as well as those defined for other sensitivities (see section 27.4.1).

272. Table 27.18 summarises the projects that were agreed with Norfolk County Council to be considered with regards cumulative effects.

273. Table 27.19 summarises effects for each geographic population and concludes with a professional judgement of the inter-project cumulative effect scores.

274. Table 27.20 similarly summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the inter-project cumulative effect score.

275. These scores are a professional judgement on the overall effect for health.

Table 27.18 Summary of projects considered for inter-project cumulative health effects

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
National Infrastructure Planning							
Norfolk Boreas Offshore Wind Farm	Pre-application	Expected construction date 2026	0 – projects are co-located	Pre-application outline only	High	Yes	Overlapping proposed project boundaries may result in impacts of a direct and / or indirect nature during construction and operation.
Hornsea Project Three Offshore Wind Farm	Pre-application	Expected construction date 2021	0 – cable intersects project	Full PEIR available: http://hornseaproject3.co.uk/Documents-library/PEIR-Documents	High	Yes	Overlapping proposed project boundaries at Reepham may result in impacts of a direct and / or indirect nature during construction and operation. There is also the potential for cumulative traffic impacts during construction.
Dudgeon Offshore Wind Farm	Commissioned	Constructed	0	http://dudgeonoffshorewind.co.uk/	High	Yes	The Dudgeon onshore cable route is to the north of Norfolk Vanguard, connecting to the grid at Necton, on the same site as the connection for Norfolk Vanguard. Community comments received during consultation express frustration due to impacts from this project. Therefore, the cumulative impact will probably be felt more through a negative perception relating to communities.
A47 corridor improvement programme	Pre-application	Expect 2021 to 2022	2.5 at closest point up to 23 at furthest	Current timescales estimate that the DCO will be submitted in Summer 2018	Medium	No	Works due to be completed before the project programme is due to begin.

[1] Shortest distance between the considered project and Norfolk Vanguard – unless specified otherwise.

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
Norwich Western Link	Pre-application	2022	2.8	https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline	Medium	No	With regards to the potential for cumulative impacts associated with the potential overlap of construction traffic, noting the lack of information available at this stage, it is not possible to provide a meaningful assessment of cumulative impacts. It is therefore proposed that, if approved, through the development of the CTMP, Norfolk Vanguard Limited and its Contractors would engage stakeholders to try and establish opportunities to co-ordinate activities and avoid peak traffic impacts.
Third River Crossing (Great Yarmouth)	Pre-application	Expected to start in 2020	28	https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/great-yarmouth/third-river-crossing	Medium	No	Analysis does show that the port of Great Yarmouth is a strategic port for the offshore wind industry in the East of England and industrial areas have been designated for development. Therefore, there may be some cumulative effect due to this. However, development of the port and associated industrial areas would be considered under a separate DCO and therefore outside the scope of this assessment.
King's Lynn B Power Station amendments	Pre-application	Construction expected 2018	28	https://www.kingslynnbccgt.co.uk/	Medium	No	Works due to be completed before the project programme is due to begin.

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
NNDC							
PF/17/1951 Erection of 43 dwellings and new access with associated landscaping, highways and external works, and amendments to substation)	Awaiting decision	Anticipated Q2 2018	0.7	Application available: https://idoxpa.north-norfolk.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=_NNORF_DCAPR_92323	High	No	Works due to be completed before the project programme is due to begin.
Bacton Gas Terminal Extension	Approved	Approved 20/09/2016. Expires 20/09/2019.	3	Approved PDS available https://idoxpa.north-norfolk.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=_NNORF_DCAPR_88689	Medium	Yes	Bacton Gas Terminal is situated to the north of Happisburgh and will therefore not have a direct impact on affected communities. However, as with other construction projects in this area, negative perceptions of these projects may influence people's perceptions of the Norfolk Vanguard project and how they perceive impacts.
Bacton Gas Terminal coastal protection	Approved	Approved 18/11/2016. Expires 18/11/2019.	2.5	Approved PDS available	Medium	Yes	
Bacton and Walcott Coastal Management	Approved	Expected construction date 2018	1	Public information leaflets available: https://www.north-norfolk.gov.uk/media/3	Medium	Yes	

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
Scheme				371/bacton-to-walcott-public-information-booklet-july-2017.pdf			
Breckland Council							
21-31 new dwellings in Necton (BLR/2017/0001/PIP)	Awaiting decision	Not known. Application submitted November 2017.	1.0	http://planning.breckland.gov.uk/OcellaWeb/showDocuments?reference=BLR/2017/0001/PIP&module=pl	Medium	No	There are three ways that housing developments could cumulatively affect communities: • Through disturbance due to noise, vibration, or dust; • Through increases in local population leading to stress on local services; and • Through traffic delays. Although these developments are within Necton they are far enough from the onshore project substation area for cumulative noise impacts to not arise to community receptors. As in-migration due to construction and operational staff of Norfolk Vanguard has been scoped out due to its small scale, it is unlikely to contribute significantly to a cumulative impact. Increased traffic density is considered in Chapter 24 Transport and Traffic. It is not
4-8 new dwellings in Necton (BLR/2017/0002/PIP)	Awaiting decision	Not known. Application submitted November 2017.	1.0	http://planning.breckland.gov.uk/OcellaWeb/showDocuments?reference=BLR/2017/0002/PIP&module=pl	Medium	No	

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
							possible to determine if these will culminate in community impacts but it is assumed to be highly unlikely due to the low level of human health outcomes assessed in Chapter 27 Human Health.
70 dwellings (3PL/2016/0298/D) (Phase 2 of 3PL/2012/0576/O)	Approved (21/09/16)	Not known. Application submitted March 2016.	6.4	http://planning.breckland.gov.uk/OcellaWeb/planningDetails?reference=3PL/2016/0298/D&from=planningSearch	Medium	No	There are three ways that housing developments could cumulatively effect communities: • Through disturbance due to noise, vibration, or dust; • Through cumulative distortion to the labour market; and • Through traffic delays. These projects are far enough from the onshore project substation area for cumulative noise impacts to not arise to community infrastructure receptors. Construction workers that could transfer between housing and the project would probably be providing general services. The increase in demand of these services due to the project is insignificant in comparison to the size of the labour market therefore this will not be considered. Increased traffic density is considered in
98 dwellings at Swans Nest with access from Brandon Road (3PL/2017/1351/F) (Phase 3 of 3PL/2012/0576/O)	Awaiting decision (due 30/03/2018)	Not known. Application submitted Jan 2016.	6.4	http://planning.breckland.gov.uk/OcellaWeb/planningDetails?reference=3PL/2017/1351/F&from=planningSearch	Medium	No	
175 dwellings with access at land to west of Watton Road, Swaffham (3PL/2016/00	Awaiting decision (due 13/10/2017)	Not known. Application submitted Jan 2016.	6.4	http://planning.breckland.gov.uk/OcellaWeb/planningDetails?reference=3PL/2016/0068/O	Medium	No	

Project	Status	Development period	[1]Distance from Norfolk Vanguard site (km)	Project definition	Project data status	Included in CIA	Rationale
68/O) (Swans Nest Phase B)							Chapter 24 Transport and Traffic. It is not possible to determine if these will culminate in community impacts but it is assumed to be highly unlikely due to the low level of human health outcomes assessed in Chapter 27 Human Health.

Table 27.19 Inter-project cumulative effects descriptions and scores for geographic population groups

Description of Cumulative effects					
Site-specific			Local	Regional	National and international
Population near landfall	**Population along the onshore cable route**	**Population near the onshore project substation**	**Population of North Norfolk, Broadland and Breckland Districts**	**Population of Norfolk County**	**Population of the England and beyond the borders of England**
Cumulative effects relate to the combined population health influences from: • Norfolk Boreas; • Bacton Gas terminal extension; • Bacton Gas terminal extensions coastal protection; and • Bacton Coastal Management.	Cumulative effects relate to the combined population health influences from: • Norfolk Boreas; • Dudgeon; and • Hornsea Project Three.	Cumulative effects relate to the combined population health influences from: • Norfolk Boreas; and • Dudgeon.	Cumulative effects relate to the combined population health influences from: • Norfolk Boreas; • Dudgeon; • Hornsea Project Three; • Bacton Gas terminal extension; • Bacton Gas terminal extensions coastal protection; and • Bacton Coastal Management.		Cumulative effects relate to the combined population health influences from: • Norfolk Boreas; • Dudgeon; and • Hornsea Project Three.
The general population inter-project cumulative effect is considered to be **negligible** due to the co-location of the	The general population inter-project cumulative effect is considered to be **negligible** because the	The general population inter-project cumulative effect is considered to be **negligible** because Dudgeon has	The general population inter-project cumulative effect is considered to be **negligible**. Due to the projects being distributed across the area the		The general population inter-project cumulative effect is considered to be **moderate beneficial** due to the reduction

Description of Cumulative effects					
Site-specific			Local	Regional	National and international
Population near landfall	**Population along the onshore cable route**	**Population near the onshore project substation**	**Population of North Norfolk, Broadland and Breckland Districts**	**Population of Norfolk County**	**Population of the England and beyond the borders of England**
landfall for Norfolk Boreas and Norfolk Vanguard and the various works at Bacton are far enough away to not lead to health effects at landfall.	cable route for Dudgeon has been constructed and Norfolk Vanguard would have installed the ducts for the onshore cable route for Norfolk Boreas. There is also only one location where Norfolk Vanguard's cable will cross Hornsea Project Three.	already been constructed and Norfolk Boreas would include a similar level of embedded mitigation to Norfolk Vanguard. Therefore, the combined effects are unlikely to lead to further health effects.	cumulative effects due to noise or air quality are likely to negligible. The effect on increased employment may be minor beneficial but the increase in traffic may be minor adverse.		in carbon dioxide emissions as a result of constructing utility scale renewable energy generation. This leads to a myriad of environmental health benefits to support a more sustainable society.
For relevant vulnerable groups, combined proximity and increased sensitivity may also result in a **minor adverse** inter-project cumulative effect.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect. This is due to strong opinions of the perceived effect of the construction of Dudgeon's cable route which may create increased anxiety about further projects.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect. This is due to strong opinions of the perceived effect of the construction of Dudgeon's onshore project substation which may create increased anxiety about further projects.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect. The magnitude of effects would be the same as the general population but the increased sensitivity may lead to a slightly greater likelihood of negative health outcomes.		For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **moderate beneficial** inter-project cumulative effect. Similarly, the mitigation of climate change may be beneficial but also the development of offshore wind increases the employment potential in deprived areas and offsets the down turn in employment in the offshore oil industry.

Table 27.20 Inter-project cumulative effect descriptions and scores for potentially vulnerable groups within geographic populations

	Potentially vulnerable groups			
	Children and young people	**Older people**	**People with existing poor health (physical and mental health)**	**People living in deprivation, including those on low incomes**
Description of cumulative effect	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • EMF; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • EMF; and • Journey times or reduced access.	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • Employment; and • Journey times or reduced access.
	The main effect on children would be a change in conditions that reduce their ability to concentrate while at school but design decisions have avoided these effects. Therefore, the cumulative effect is considered **negligible**.	Due to the increased percentage of older people in the community and the likelihood that they would spend more time at home where they may feel the effects accumulate more rapidly. The inter-project cumulative effect, is considered to be **minor adverse.**	The inter-project cumulative effect is considered to be **minor adverse** because they are more likely to be at home where they may feel the effects accumulate more rapidly and may feel anxiety more acutely due to their existing conditions.	The inter-project cumulative is considered to be **negligible**. On the one hand deprivation may increase their vulnerability of effects but on the other hand the increased opportunity for training and employment may have a minor beneficial effect.

27.8 Summary

276. After consideration of potential health effects during the construction and operation phases of the project, there are not predicted to be any significant effects on physical or mental health as a result of the project. These are summarised in Table 27.21 for the project and in Table 27.22 for inter-related effects.

Table 27.21 Summary of health effects

Potential effects	Temporal scope	Probability of effect	Sensitivity of		Magnitude of effect	Significance of effect on	
			General population	Vulnerable population		General population	Vulnerable population
Construction							
Noise	Mainly short term	Plausible	Low	High	Low	**Negligible**	**Minor adverse**
Air quality	Mainly short term	Plausible	Low	High	Low	**Negligible**	**Minor adverse**
Ground/water contamination	Short term	Plausible but improbable	Medium	High	Low	**Negligible**	**Negligible**
Physical activity	Very short term	Likely	Medium	High	Low	**Negligible**	**Minor adverse**
Journey times or reduced access	Short term	Likely	Low	High	Low	**Negligible**	**Minor adverse**
Construction and Operation							
Employment	Medium to long term	Likely	Medium	High	Low	**Negligible**	**Minor beneficial**
Operation							
Noise	Long term	Low probability	Low	High	None	**No effect**	**No effect**
EMF and public understanding of risk	Medium term	Low probability	Medium	High	Low	**Negligible**	**Minor adverse**
Electricity affordability	Long term	Likely	Medium	High	Medium	**Minor beneficial**	**Moderate beneficial**
Decommissioning							
The possible health effects arising from the decommissioning of the project are considered to be similar in scale and nature to those considered here for construction.							

Table 27.22 Summary of inter-related health effects

Population group	Intra-project effects		Inter-project effects	
	General population	Vulnerable population	General population	Vulnerable population
Population near landfall	**Negligible**	**Minor adverse**	**Negligible**	**Minor adverse**
Population along the onshore cable route	**Negligible**	**Minor adverse**	**Negligible**	**Minor adverse**
Population near the onshore project substation	**Negligible**	**Minor adverse**	**Negligible**	**Minor adverse**
Population of North Norfolk, Broadland and Breckland Districts[12]	n/a	n/a	**Negligible**	**Minor adverse**
Population of Norfolk County[12]	n/a	n/a		
Population of the England and beyond the borders of England[12]	n/a	n/a	**Moderate beneficial**	**Moderate beneficial**
Children and young people	**Negligible**		**Negligible**	
Older people	**Minor adverse**		**Minor adverse**	
People with existing poor health (physical and mental health)	**Minor adverse**		**Minor adverse**	
People living in deprivation, including those on low incomes	**Negligible**		**Minor beneficial**	

[12] Intra-project effects are not considered at spatial scale of District or above because these are localised and would only be felt by individual communities.

27.9 References

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