FOREWIND

DOGGER BANK
TEESSIDE A & B

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Environmental Statement Chapter 5 Appendix C Health Impact Review

Application Reference 6.5.3

Dogger Bank Teesside A & B

Health Impact Review

Forewind

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Final Report
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1 INTRODUCTION

1.1 Background

1.1.1 As part of the Environmental Impact Assessment (EIA) process, this report assesses any potential (material) impacts on the health of the local population, in relation to the onshore infrastructure associated with Dogger Bank Teesside A & B. This report is included as an Appendix to the full description of the project (**Chapter 5 Project Description**). Human health aspects of the offshore and nearshore environment are not part of this assessment which relates to onshore activities.

1.1.2 To inform the Environmental Statement (ES), Forewind has undertaken a thorough pre-application consultation programme including the following key stages:

- Scoping Report submitted to the Planning Inspectorate (May 2012);
- Scoping Opinion received from the Planning Inspectorate (June 2012);
- First stage of statutory consultation (in accordance with sections 42 and 47 of the Planning Act 2008) on Preliminary Environmental Information (PEI) 1 (report published May 2012); and
- Second stage of statutory consultation (in accordance with sections 42, 47 and 48 of the Planning Act 2008) on the ES (published November 2013) designed to allow for comments before final application to the Planning Inspectorate).

1.1.3 In addition, consultation for the Dogger Bank Creyke Beck A & B application (Forewind August 2013) has also been taken into account for Dogger Bank Teesside A & B where pertinent.

1.1.4 The Scoping Report (submitted May 2012 for Dogger Bank Teesside) indicated that consideration of relevant potential impacts on health would be included in the ES. Scoping responses included the representations from The National Infrastructure Directorate within the Planning Inspectorate, formerly the Infrastructure Planning Commission (IPC) and the Health Protection Agency (HPA). Public Health England also provided useful formal responses.

1.1.5 A summary of the consultation carried out at key stages throughout the project, of relevance to human health, is presented in **Table 1.1**. This table only includes key items which have been addressed in the review. A full explanation of how the consultation process has shaped the ES, as well as tables of all responses received during the statutory consultation periods, is provided in the Consultation Report.

Table 1.1 Consultation responses – scope of health impacts

Date	Consultees	Summary of Response
August 2012 (Scoping opinion)	The Planning Inspectorate	The Secretary of State considers that it is a matter for the Applicant to decide whether or not to submit a stand-alone Health Impact Assessment (HIA). However, the Applicant should have regard to the responses received from the relevant consultees regarding health, and in particular to the comments from the Health and Safety Executive and the Health Protection Agency in relation to electrical safety issues (see Appendix 2).

Date	Consultees	Summary of Response
August 2012 (Scoping opinion)	HPA	The HPA considers that the onus is on the applicant to conduct the assessment of compliance with the referenced advice and policy to gather and present the information clearly, leaving no additional analysis on the part of the HPA. The assessment should be clearly laid out, either as an identified section of a report which can be read in isolation or as a separate report.
September 2013	HPA	HPA gave no specific comments on the draft EIA report but recommended a number of guidance documents and broad public health implications to be considered (e.g. air quality and land contamination).
December 2013	Public Health England	The ES needs to make a number of references to explain the differences between "static" electric and magnetic fields and "AC" EMFs.

1.1.6 Forewind has addressed these initial concerns outlined in **Table 1.1**, hence the preparation of this technical appendix to outline further information relating to the points raised. Ongoing changes have been made to this document as feedback has been received from stakeholders.

1.1.7 In line with good practice, the assessment process has included the identification and review of the potential public health impacts of the full life-cycle (i.e. development, operation and decommissioning) of the project's features, including their emissions (DCLG 2006). The findings are documented in individual Chapters (see below) and in this Health Impact Review (HIR).

1.1.8 The ES provides information on a range of parameters relating to the environmental impacts of the project; see the project description (**Chapter 5**) and on air quality (**Chapter 30 Air Quality**), noise (**Chapter 29 Noise and Vibration**) and traffic and access (**Chapter 28 Traffic & Access**). The consideration of human health is implicitly part of those chapters and others; however, the ES is not intended to be a detailed assessment of potential "human" and "public health" implications. It is therefore not a Health Impact Assessment (HIA) in the formal sense but rather a HIR, i.e., a review of the health interactions and findings of the project and those in the receiving environment of impacts.

1.1.9 This HIR has been carried out as a result of feedback suggesting that provision of information to explain the electric and magnetic fields (EMF) associated with the project would be valuable in the ES. For instance, in their consultation response, the HPA provided advice on standards of protection for exposure to non-ionising radiation, including the power frequency of EMF.

1.1.10 The following sections of this HIR include content that describes:

- The approach taken to the Review;
- Potential health effects (and impacts) that might arise primarily from the construction and operation phases (and in places, decommissioning);
- An explanation of EMF in the context of the cable proposals; and
- Findings and conclusions.

2 DOGGER BANK TEESSIDE A & B AND HEALTH ASPECTS

2.1 Introduction

2.1.1 This section introduces some of the concepts and approaches to the assessment and review of health impacts. As a precursor to the sections on impacts, this section describes what health issues and influences are important for a wind energy project such as this. The concept of health determinants is introduced and this document outlines what pathways can link sources of health impact to receptors. Health impact is a relatively new tool within EIA and planning, and is an evolving discipline. Reference is made to a number of literature sources on health impacts, particularly in respect of health impacts relevant to cables associated with wind energy projects.

2.2 Health determinants

2.2.1 The health of individuals is influenced by a huge range of controllable and uncontrollable factors. From genetics to lifestyle, the influences can be wide-ranging in both scope and origin. In assessing "well-being", the contributory factors are known as "determinants". These determinants reflect the social and economic conditions of communities and contributions from the environment. Changes in the determinants of health have the potential to cause positive and negative effects either directly or indirectly. For any individual or community, the degree to which these determinants influence health varies, given the degree of personal choice, location, mobility and exposure. For communities, influences may be more uniform, such as access to services.

2.2.2 The construction, commissioning, operation and decommissioning of the onshore cable systems have the potential to influence health determinants. The key influences are typically from: employment and income factors; access to, and use of different modes of transport; the extent of involvement in physical activity; and the environment.

2.2.3 Dogger Bank Teesside A & B and its constituent parts are described fully in the main project description (**Chapter 5**), to which this report is an appendix. The key elements in relation to the HIR are:

- Cables coming ashore (landfall) along the Cleveland coast between Redcar and Marske-by-the-Sea;
- Two buried cable systems (i.e. one per project: Dogger Bank Teesside A & B);
- Two converter stations (co-located); and
- Connection to the existing National Grid Electricity Transmission (NGET) substation at Lackenby.

2.2.4 The onshore cable-laying and associated construction activities in combination with the benign situation during operation are considered to be a "standard" project. In other words, it is typical for this type of renewable energy project, for instance, in terms of size, cable length, placed depth and construction methodology. There are no extraordinary or particular features that require unique techniques or new approaches that have not been used before by construction contractors and operational personnel.

2.2.5 There will be some temporary disturbance in the form of minor inconveniences to local community access (e.g. to roads) during construction. Health Pathways and references to impact assessment chapters are given in Section 2.1.7. However, the number of people who will be adversely affected by work sites (i.e. that would significantly affect

the determinants listed above) – for example through temporary disturbances to traffic flows – will be small. Therefore, the scale and nature of the onshore cable systems, converter stations and features are not of a magnitude that will influence determinants such as: housing, access to services, social capital and education.

2.3 Health pathways

2.3.1 The ES chapters and HIR identify "pathways" and assess the extent to which they affect receptors at the community level. A key part of risk assessment is the linkage between "sources, pathways and receptors". In this case, the source would be a factor that has the potential to cause harm to human health. The pathway is the means, or route, by which a source of health impact can affect a receptor, such as a human or community.

2.3.2 In EIA, sensitive receptors are typically residential properties, schools, residential homes, hospitals, places of worship, but, in the context of health, also neighbourhoods and communities. It should be noted that the selection of sites and cable routes has been chosen to actively avoid interaction with sensitive receptors; this is described in a dedicated section (**Chapter 6 Assessment of Alternatives**).

2.3.3 In approaching a review of health, the following activities and aspects and their pathways need to be considered for Dogger Bank Teesside A & B:

- Land take – temporary loss of access to green space or agriculture. Potential diversions to access routes (e.g. footpaths), which might impact upon local users and visitors (**Chapter 23 Tourism and Recreation** and **Chapter 26 Land Use and Agriculture**);
- Noise impacts – from excavation machinery and associated movements; temporary disturbance, especially from any sensitive groups (e.g. schools, hospitals). These aspects are described in **Chapter 29**);
- Air emissions:
    - Dust – potential nuisance for neighbouring receptors to the new facilities, especially residential areas and sensitive groups (e.g. children/schools). Mitigation measures at source are described in the specialist air quality section (**Chapter 30**); and
    - Exhaust emissions and particulates from machinery – the equipment to be used by the civil works' contractors will include mobile machinery to prepare the trench and haul roads and vehicles to deliver equipment and materials. There might be some perceived risk of significantly increased exhaust emissions, but the assessment of air quality (**Chapter 30**) describes the limited significance of these potential impacts.
- Disruption of access to services and amenities – reduced access may invoke instances of nuisance to residents, passers-by and visitors to the area. These instances will be temporary;
- Health risks from changes to traffic flow and increase in vehicle movements – road transportation of materials and equipment to install the onshore cables along the approximately 9km route may increase the risk of accidents and new exposure to emissions. Sensitive groups include road users in and around the site area, the elderly and children;

- Employment changes – increases in employment and commercial opportunity associated with the project, leading to improved quality of life and standard of living (**Chapter 22 Socio-Economics**);
- Disruption to education – any noise or land take disturbance to sensitive receptors, for instance, schools and hospitals, can, in principle, contribute adversely towards concentration, and thus performance. Sensitive receptors are described in Section 3 of the specialist noise work (**Chapter 29**), Section 3.5 in the traffic section (**Chapter 28**) and Table 3.5 in the air quality work (**Chapter 30**); and
- Concerns about EMF from cable during operation – during consultation, some stakeholders have raised the possibility of health risks from the buried cable once the project is operational. This issue is addressed in this Chapter.

2.3.4 In the majority of cases, the disruption during construction will be temporary and subject to mitigation measures such as management controls and consultation with local residents.

2.4 Evidence for health effects

2.4.1 Methodologies used in health impact studies use an evidence base to identify health pathways and thus, evaluation of the extent of health impacts. The evidence base is compiled from two sources of information on the links between human activities and health: scientific papers; and secondary sources of information (e.g. information released by representative groups (e.g. Primary Health Trusts, health charities, and local authorities), pamphlets from organisations representing health issues).

2.4.2 Information from secondary sources has been collated from internet sources. In consultation with representative organisations with a health remit in the local public health sector (see **Table 1.1**), no community or public health data was forthcoming.

2.4.3 Health impact is not a precise process at the present time and is mostly qualitative in its approach. Linkages between activities and consequent health effects are rarely understood sufficiently for the exposure-response relationships to be defined. Links between accident risk from road traffic flows and changes in air pollution (i.e. air quality) are the two pathways where such relationships are most developed.

2.5 Evaluating health effects

2.5.1 Air quality and noise parameters have health-based guidelines and defined objectives defined in regulations. For instance, to meet the UK's European and international obligations on standards of air quality, monitoring and assessing air quality and its subsequent reporting is undertaken while a National Strategy on Air Quality (2007) is in place. The Committee on the Medical Effects of Air Pollution (COMEAP) is an expert Committee that provides advice to government departments and agencies, via the Department of Health's Chief Medical Officer, on all matters concerning the effects of air pollutants on health. The Department of Health has published an indicator for air pollution as part of its Public Health Outcomes Framework (Public Health England, since 2010). The Clean Air Act (1993) aims to reduce pollution from smoke, grit and dust and gives local authorities powers to designate smoke control areas. In the case of noise nuisance, local authorities have a number of regulatory powers to help them manage problems including provisions in the Environmental Protection Act 1990.

2.5.2 These were designed to protect the public; however, many such effects will depend upon the tolerances and physical characteristics of the individual receptor. In air pollution, epidemiological studies have shown clear associations between exposure to increased concentrations of particulates (PM_{10}) and increased symptoms such as asthma attacks. These effects appear to have no lower threshold concentration. The response is very small, but can become significant when large populations are exposed. It is most unlikely that any detectable response could be observed in any communities living close to and around construction worksites. Any increase in PM_{10} concentrations over background levels will typically be very small and also the exposed population numbers are typically very small.

2.5.3 Large-scale demolition, and most heavy construction activity, can generate emissions of PM_{10}. However, large-scale demolition or heavy construction activity will not occur for the onshore elements of Dogger Bank Teesside A & B; refer to the main project description (**Chapter 5**).

2.5.4 In noise science, investigations have shown how receptor annoyance is related to exposure to noise and this can be expressed in an estimated “exposure response curve”. Most existing research has been carried out for road, rail and aircraft noise and each source produces a different curve.

2.5.5 Potential links to noise and health of children has been researched with effects including stress and interference with mental processes although links are not yet established sufficiently for HIA. The order of magnitude of noise required to cause a material effect is much higher than one would experience at a typical construction site.

2.5.6 Many of the benefits of Dogger Bank Teesside A & B will influence the health of some people in subtle ways that are not amenable to simplistic “cause-and-effect” treatments.

2.5.7 However, this evaluation of the potential effects on health does rely on a combination of judgment and experience, risk-based analyses, public input, literature reviews and case studies of effects associated with other similar projects. Consequences can only be described in terms of the nature of possible effects, the numbers of people involved and perhaps a comment relating to background levels of such effects.

2.5.8 The HPA has mentioned the need to be aware of the potential health impact associated with the “electromagnetic” fields. However, we will use the term “EMF” (electric and magnetic fields) rather than electromagnetic – see further details in paragraph 4.2.1.

2.6 Standards and guidance

2.6.1 The HPA 2008 guidance document states that there is no body of evidence conclusively linking wind farms and their associated infrastructure with adverse health effects arising from emissions of chemicals. When operational, generating energy from wind should not produce significant emissions, pollutants, or waste products. The HPA concludes that installations are thus, highly unlikely to lead to public health impacts from chemicals and their emissions.

2.6.2 There is potential for impacts to arise during the construction and decommissioning phases from the transport of materials and equipment (e.g. accidents, leaks, spills). The movement of material (e.g. contaminated soil and excavated spoil) off-site has the potential to lead to adverse impacts, such as pollution, if not managed properly. There are a full set of recommendations on mitigation measures relating to the avoidance of waste generation, storage, handling and transport of wastes in line with best practice in

other chapters (**Chapter 24 Geology, Water Resources and Land Quality**; **Chapter 26**; and **Chapter 28**). If adopted and implemented correctly, these will reduce anticipated impacts to negligible.

2.6.3 The project will be constructed and operated in compliance with the International Commission on Non-Ironizing Radiation Protection (ICNIRP) Guidelines on EMF. These 1998 guidelines, updated step-by-step in 2009 concern limiting exposure to time-varying EMFs (up to 300 GHz). The advice of the ICNIRP is requested by many national and international organisations including the European Union and Governments, including Ministries in the UK. The ICNIRP's health protection guidance is also sought from a wide variety of bodies so they are considered to be a very credible authority on EMF.

2.6.4 In a useful body of work – including that published online by the National Grid, Powerwatch and the Department of Communications, Marine and Natural Resources, Ireland – reference is made to a wide range of potential applications, for example, mobile telephony, overhead cables and electrical appliances, as well as the perceived risks of EMFs. The National Grid mentions High Voltage underground cables. There is no corresponding document in the UK.

2.6.5 Around 4% of the high-voltage electricity network in England and Wales is underground, mainly in urban areas and areas of scenic beauty. With underground cables, the individual conductors, being insulated, can be closer together, leading to greater cancellation of EMFs and lower fields. They can have higher (than overhead cables) fields close to the cables but magnetic fields at ground level from underground cables fall much more rapidly with distance than those from a corresponding overhead line. They also produce no external electric field (Energy Networks Association, 2013).

3 EXISTING ENVIRONMENT AND APPROACH

3.1 Introduction

3.1.1 This section describes the existing environment in relation to public health and potential receptors. It is based on a desk-top study of existing information sources and provides the context for the impact assessment.

3.1.2 Redcar and Cleveland is located on the north east coast of England, south of the River Tees and its Estuary. The last available Census data (2010) puts the population at 137,400 with mid-2012 estimates (Tees Valley Unlimited) indicating 200 less and a longer-term projection of 2,000 fewer by 2025. The population is spread across the main urban conurbation of Redcar and Greater Eston. It also encompasses smaller commuter towns, rural villages and coastal settlements. Rural areas make up a significant part of the Borough, especially the landscape in East Cleveland which is largely agricultural, making up 90% of the total land area.

3.1.3 In its plans and improvement strategies (i.e. Joint Strategic Needs Assessment for Redcar and Cleveland) for the next five years, Redcar & Cleveland Borough Council (RCBC) has said that “healthier communities and older people” is one of six key areas for attention (RCBC and NHS Redcar & Cleveland). RCBC’s “Health and Well-being Strategy” 2013 – 2018 outlines a wide range of initiatives, quantified targets and a monitoring programme with integrated health goals. These cover a range of topics from raising awareness about smoking while pregnant and a formal Healthy Child Programme through to support of sporting activities and encouraging people to get fitter (RCBC 2012). These goals are summarised in RCBC’s overall 2013-2018 Plan.

3.2 Regional sensitivity

3.2.1 The health of people in Redcar and Cleveland is considered to be under the England average for many parameters. Deprivation is higher than average and about 6,700 children live in poverty. Life expectancy for women is lower than the England average. Life expectancy is 13.1 years lower for men and 8.4 years lower for women in the most deprived areas compared to the most affluent areas in Redcar and Cleveland (English Public Health Observatories (EPHO) *et al.* 2012).

3.2.2 Over the last ten years all-cause mortality rates have fallen. Early death rates from cancer and from heart disease and strokes have also fallen. The former is worse than the England average. About 18.8% of Year 6 children are classified as obese. Levels of teenage pregnancy, GCSE attainment, breastfeeding initiation, smoking in pregnancy and under-18 alcohol-specific hospital stays are all worse than the England average (*ibid*).

3.2.3 Estimated levels of adult 'healthy eating' and obesity are worse than the England average. Hospital stays for alcohol related harm are worse than the England average.

3.2.4 RCBC has taken action to reduce early deaths for example in weight and alcohol awareness. The Council is improving services to older people through support in living independently, direct payment and access to transport initiatives (*ibid*).

3.3 Key receptors

3.3.1 Sensitive receptors, as outlined in the relevant noise and air quality sections (**Chapter 29** and **Chapter 30**) are typically residential premises but can also include schools, hospitals and care homes and places of worship.

3.3.2 The main land use along the cable route corridor is agriculture. Land uses are discussed in the land use chapter (**Chapter 26**) and those associated with tourism and recreation is also considered fully in a dedicated chapter (**Chapter 23**).

3.3.3 The most sensitive receptors to the onshore construction areas have been identified in the individual chapters of the ES.

4 PROJECT INFRASTRUCTURE AND HEALTH

4.1 Summary of Dogger Bank Teesside A & B

4.1.1 A full description of the activities proposed during the construction is provided in the main text of **Chapter 5**.

4.1.2 Broadly, the most sensitive environmental areas in terms of proximity of receptors to project activities are:

- The corridor in which the High Voltage Direct Current (HVDC) and High Voltage Alternating Current (HVAC) cable route is located;
- The corridor and enabling works at the existing NGET substation at Lackenby; and
- Sensitive residential receptors surrounding the converter stations site.

4.1.3 The particular activities considered likely to have a potential "interaction" with community, public health and H&S (e.g. for workers) include:

- Construction of onshore cable systems including landfall joint transition bays and cable jointing pits – installation techniques include open cut trenching and trenchless installation methods such as Horizontal Directional Drilling (HDD);
- Construction of two (in total for Dogger Bank Teesside A & B) co-located new onshore converter stations and associated infrastructure and landscaping;
- Temporary construction compounds and laydown areas;
- Temporary upgrade of existing access tracks, construction of new access tracks and haul roads;
- Stockpiling of topsoil and subsoil;
- Cable-laying activities;
- Re-use of excavated soil in trenches;
- Disposal of excess spoil; and
- Removal and reinstatement of existing drainage systems.

4.1.4 The location of the activities and features above have been planned as far away from sensitive receptors as possible.

4.1.5 During the operational phase of the wind farm, the impacts arising from the onshore components are limited. Access will be required to the converter stations, throughout the lifetime of the project in the case of a "fault" situation and/or occasional maintenance visits.

4.2 Electric and magnetic fields (EMF)

4.2.1 Note on terminology: a physicist will always speak of "electric fields", "magnetic fields", or "electromagnetic radiation". When we use the abbreviation "EMF", we mean "electric and magnetic fields". The term "electromagnetic fields" is not one that has a very clear meaning but usually includes both electric fields and magnetic fields.

4.2.2 EMF and the invisible energy forces they represent are an essential part of the physical world and of life itself. For instance, EMFs occur naturally in the body with nerve and muscle activity. Wherever electricity is generated and used, there will be EMFs.

4.2.3 Often, the components of EMF, the electric field and magnetic field are studied and addressed separately. Humans are subject to the natural magnetic field of the Earth. There are also natural electric fields in the atmosphere. EMFs associated with electricity are present within all household appliances.

4.2.4 Modern electric man-made power systems operate using alternating current (AC) almost exclusively. Mains frequency is the frequency of the oscillations of AC in the electric power grid transmitted from a power station to end-user. In large parts of the world, including the UK, this is 50 hertz (Hz). AC fields (and other electromagnetic, non-ionizing radiation from 1 – 300Hz) are also described as Extremely Low Frequency (ELF). Direct current, on the other hand, is constant, such as current from a battery. Its electric and magnetic fields are also constant (at a frequency of zero) and are referred to as “static fields”. Electric and magnetic fields are produced by power systems operating at 50Hz frequencies. Sources of static fields are the Earth’s natural fields, and fields from lines and cables.

4.2.5 Electric fields are produced by charge separation and are measured in volts per metre (V/m) or kilovolts per metre (kV/m) where 1 kV/m = 1,000 V/m.

4.2.6 The size of an electric field depends on the operating voltage of the electrical equipment and can exist when there is no current flowing. Electrical equipment can be designed to avoid producing an external field through the use of screening or coverings. Underground electricity cables, which are enclosed in a metal sheath to screen and protect the integrity of the cable, do not generate any external electric fields.

Sources and exposure limits

4.2.7 There are natural sources of EMFs as well as those relating to equipment. Naturally occurring electric fields are produced by the build-up of electric charges in the atmosphere.

4.2.8 The Earth’s magnetic field, which everyone is constantly exposed to, is around 50μT in the UK. The Earth’s electric field is usually around 100V/m, but thunderstorms can stimulate an increase to many thousands of V/m. Both these natural fields are static. They are naturally occurring background levels and it is safe for humans to be exposed to that. All other values given in this section are for variable (50Hz) fields, typical of the UK’s electricity supply. Reference levels (which are significantly above naturally occurring background levels) that provide some context to these figures are provided in the following text and tables.

4.2.9 **Table 4.1** and **Table 4.2** provide typical figures for common sources of exposure to electric fields and magnetic fields respectively.

Table 4.1 Electric fields from typical sources

Electric field source	Electric field V/m
Natural fields (DC)	100
Main power (home) (AC)	100
Electric trains and trams (AC)	300
TV and computer screens (AC)	10

Table 4.2 Magnetic fields from typical DC sources

	Magnetic Field (μT)	
Electric field source	**Close to appliance**	**One metre away**
Vacuum cleaner	800	2
TV, washing machine	50	0.2
Bedside clock	50	0.02
Refrigerator	2	0.01

4.2.10 The UK Government sets guidelines for exposure to EMF on the advice from the HPA. In March 2004, the UK Government decided, in principle, to adopt the guidelines published by the International Commission on Non-Ionising Radiation Protection (ICNIRP 2010). These guidelines include reference and permitted levels of exposure. Reference levels are those beyond which further investigation would be required to ensure that the permitted levels are not reached. They also form the basis of an EU recommendation on public exposure.

4.2.11 The ICNIRP "reference levels" for the public are:

- 100 μT for magnetic fields; and
- 5,000V/m for electric fields.

The permitted levels of exposure are higher at:

- 360 μT for magnetic fields; and
- 9,000V/m for electric fields.

The size of fields per cable type, are shown below.

Table 4.3 Size of fields for 400kV HVAC cables

Type of field	High voltage AC	Reference level of exposure	Permitted level of exposure
Electric field	0 (zero); as cables covered with metallic screens	5,000 V/m	9,000 V/m
Magnetic field (at zero distance from centreline of cable)	Approx. 25 μT	100 μT	360 μT

(Source of magnetic fields data: EMF Helpline, National Grid, 2014)

Table 4.4 Size of fields for 400kV HVDC cables

Type of field	High voltage DC	Reference level of exposure	Permitted level of exposure
Electric field	0 (zero); as cables covered with metallic screens	5,000 V/m	9,000 V/m
Magnetic field (at zero distance from centreline of cable)	Approx. 5-10 µT	100 µT	400 µT

(Source of magnetic fields data: ICNIRP 2009)

5 ASSESSMENT OF IMPACTS

5.1 Approach to review of potential health impacts

5.1.1 During an HIA process, the positive and negative health concerns are identified and, if required, recommendations made. Prioritising impacts and allocating significance to them is derived from the risk management approach in HIA practice. Health impacts have different degrees of likelihood and consequence. There are no specific statutory guidelines which inform the management or assessment of health impacts.

5.1.2 An adaptation of the four-step procedure for determining impact severity (Birley 2011) has been used to categorise impact significance for this health impact review. These categories are shown in **Table 5.1** below.

Table 5.1 Definitions of impact

Impact	Risk and consequence components			
	Extent	**Intensity**	**Duration**	**Health effect**
No impact or negligible	Rare	Minor	<1 month	Not perceptible
Minor	Local, small and limited, e.g., a small number of households affected.	Easy adaptation to the health impacts.	1-12 months. Low frequency.	Annoyance, minor injuries or illness (not requiring hospital visit).
Moderate	Project area, medium, but localised.	Adaptation with some difficulty. Maintenance of pre-impact level of health with support required.	1-6 years. Medium or intermittent frequency.	Moderate injury or illness that may require hospitalisation.
Major	Extends beyond project area. Regional level.	Unable to adapt to health impact or to maintain pre-impact level of health/.	>6 years. Long-term/irreversible. Constant frequency.	Loss of life, severe injuries or chronic illness that may require hospitalisation.

5.1.3 The identification of health-related issues and impacts are based on knowledge of the project, experience in major renewables and infrastructure development projects and the interaction and exchange of information between specialists and experts during the EIA process. The assigning of issue/impact significance is also based on project experiences, in particular involvement in EIA, Environment and Social Impact Assessment (ESIA), HIA, sustainability HSE for major projects. An understanding of the source-pathway-receptor linkage, receptor sensitivity and the application of the definitions are a crucial part of assessing impacts.

5.1.4 In EIA, potentially significant impacts categorised as major or moderate need to be avoided and/or mitigation measures applied to ameliorate the effects. The residual impact (i.e. following the successful implementation of mitigation measures) need to be acceptable to all interested parties.

5.2 Construction

Disturbance and nuisance

5.2.1 There is the potential for the works to cause disturbance and nuisance to residents and the public during construction. This is mostly associated with traffic and access (**Chapter 28**), noise and vibration (**Chapter 29**) and dust and air quality (**Chapter 30**). The duration of works will have an influence on this potential impact, and therefore whether a single project is constructed or two projects are constructed concurrently (or sequentially with a gap of up to five years), the impact level will remain similar. There is also the option for a build scenario with enabling actions by the first project to support the second. A worst-case project envelope is therefore being assessed.

5.2.2 The physical presence of equipment, materials and workers on land near receptors may give rise to concerns around safety and security. Adopting a precautionary approach via continued consultation/liaison via a defined communications protocol (e.g. via the chosen contractor) is a commitment already identified in other chapters. Successful adoption of mitigation measures is expected to reduce the magnitude of this effect to low, resulting in a **negligible** residual impact.

5.2.3 Whichever sequential build scenario is considered, it effectively doubles the length of the construction period and therefore doubles the exposure time of receptors to construction activities and thus, potential associated nuisances.

5.2.4 The baseline noise survey was carried out and demonstrated that noise at the converter station study area was typical of a heavy industrial area and affected by roads.

5.2.5 Section 6.1.1 of the noise and vibration assessment outlines the six nearest receptors (all residential, including farms) to the HVDC or HVAC cable route construction working area and to the major HDD construction working area. On site construction works associated with the converter stations are considered to have a negligible environmental effect.

5.2.6 Construction noise impacts arising from onsite works, within the working areas of the landfall, cable corridor and converter stations were assessed. Receptors that will experience negligible impacts (noise levels of 65dB or less) were eliminated from the assessment through a screening process, which identified six receptors that may experience a **minor adverse** impact or greater. Of those six receptors, only one was predicted to experience a medium impact magnitude under a single project scenario (four under a two project scenario); see **Chapter 29** for details.Mitigation was recommended to reduce construction noise at this location, which comprised of the installation of site perimeter fencing to screen the construction works from residential properties. The residual impacts following the application of mitigation were **negligible** to **minor adverse** at all affected receptors, taking account the temporary nature of the construction phase.

5.2.7 Noise generated by construction-related traffic was assessed and considered **negligible** under both single and two projects' scenarios.

5.2.8 Various construction compounds will be established close to the landfall, along the cable route and for the converter stations. The compounds will generally be used for storage of materials, equipment and plant and will not be a source of significant construction activity. Indicative locations of all compounds show that they are not in the immediate vicinity of residential properties and indeed, have been planned that way, i.e., to avoid

disturbance with receptors. As such, it is deemed that they will not result in any significant construction noise affecting receptors and the resulting negligible effects will have no health impact.

5.2.9 **Table 6.7** in the specialist noise work (**Chapter 29**) shows that there will be a (far) less than 25% increase in traffic flow along the affected road links. A change of 2.3% on the A1053 represents the biggest predicted increase when Dogger Bank Teesside A & B are constructed together. For Dogger Bank Teesside A or B (single project) the change would be 1.3%. This equates to a noise increase of less than 1dB, which is regarded as an imperceptible (i.e. not detectable by the humans) change in noise levels. Based on this prediction, no health impacts from noise nuisance will occur.

5.2.10 Adverse health impacts in relation to noise and vibration are not anticipated.

5.2.11 The air quality chapter of the ES (**Chapter 30**) provides a characterisation of the existing environment for air quality in Redcar & Cleveland Borough.

5.2.12 Existing air quality in the Study Area is considered to be good in the context of national air quality Objectives for NO_2 and PM_{10}. The main impacts in relation to air quality are associated with construction, however, after the application of mitigation measures, residual impacts are assessed as being of minor adverse (or less). These are considered acceptable given the temporary nature of the impacts and no health impacts can be associated with this.

Traffic and transport

5.2.13 The traffic study (**Chapter 28**) of the ES has assessed the potential impacts of the onshore traffic changes associated with Dogger Bank Teesside A & B on sensitive receptors in the surrounding area. The chapter is underpinned by a supporting Traffic Assessment containing a detailed access strategy, derivation and distribution of the traffic demand and highway operation assessments. The strategy is to manage traffic impacts through embedding mitigation in design.

5.2.14 The specialist traffic and access assessment identifies a number of potential impacts during the construction phase of Dogger Bank Teesside A & B. These are in the aspects of: pedestrian severance, peak change in total traffic flow, pedestrian amenity, highway safety and driver delay. For the construction of a single project all cases have a negligible impact. For the construction of two projects (worst-case), **minor adverse residual impacts** on highway safety are identified following the successful implementation of a Construction Traffic Management Plan and a Construction Travel Plan.

5.2.15 This detailed assessment concluded no moderate or major adverse impacts on pedestrian amenity, highway safety and driver delays. Impacts in these topics were identified as having either **minor adverse** or **negligible** significance levels. No public health impacts are anticipated with traffic and transport during construction.

5.2.16 A cumulative impact assessment was undertaken reviewing projects, activities and plans relevant to traffic and access. This has concluded that that the York Potash Project (YPP) has the potential to lead to adverse cumulative impacts when considered in combination with Dogger Bank Teesside A & B. This potash mine will be located approximately 2km south of Sneaton village in the North York Moors and involves a buried pipeline (approximately 43km long) from the mine to a processing facility within the Wilton Complex. However, it is has also been established that there is no detail

within the public domain with regards to the project timing, expected traffic and access impacts of the YPP. Recognising this, and the uncertainty with regard to timing, Forewind will assess any implications of the YPP traffic demand when further detail becomes available and consider measures within the context of the proposed Construction Traffic Management Plan.

Lifestyle and physical activity

5.2.17 The work on tourism-related aspects (**Chapter 23**) identifies the short-term disruption to publicly available areas and features, such as disruption and reduced amenity to the Kirkleatham Museum and the Kirkleatham Owl Centre, the local towns and villages, the National Cycle Trail, public rights of way (PRoW) and other footpaths (including beaches at the landfall location) during construction. These impacts will be managed through liaison with the managers of the features, with the PRoW Officer and continued communication with the local community.

5.2.18 Short-term minor adverse residual impacts have been identified for these access impacts, but these will **not** have a significant effect on public health.

Socio-economics and employment

5.2.19 Job creation generally promotes financial security and can lead to higher standards of living. The economic benefits are both microeconomic and macroeconomic, and there is also an important mutually reinforcing relationship between economic benefits and social benefits.

5.2.20 There are three aspects to employment:

- The *income* aspect, where employment provides income security;
- The *production* aspect; employment results in increased production of goods and services; and
- The *recognition* aspect, the employee is engaged in a worthwhile activity.

5.2.21 In addition, there are numerous indirect benefits – the *economic and social multipliers* – that accompany these when members of communities are employed at productive jobs.

5.2.22 In general, the initial job and income growth associated with employment translates into further spending and rising incomes throughout the community. The social multipliers bring benefits to individuals, families, neighbourhoods and communities, for instance, in decreased crime, drugs, and family disruption, and increased and strengthened security, education, healthcare for the infirm and elderly, as well as in environmental protection (i.e. increased wealth can free-up money for conservation).

5.2.23 Studies have shown that unemployment is directly related to ill physical and mental health, as well as poor pre-natal care. Individuals who are unemployed are prone to depression with financial insecurity associated with joblessness, stress and anxiety.

5.2.24 The construction of Dogger Bank Teesside A or B (i.e. a single project) has the potential to generate an estimated 436 full-time employee (FTE) jobs in the north east of England, particularly within the engineering and construction sectors (**Chapter 22**). The construction of both Dogger Bank Teesside A & B has the potential to generate an estimated 872 FTE jobs. This represents a **potential beneficial effect** upon employment levels in the region.

5.2.25 In addition, local business can be expected to see a diverse range of benefits through the provision of support services, goods, accommodation for project workers, etc. The amount of spending that occurs is difficult to predict at this stage but an estimated 588 FTE "indirect" jobs are expected to be created during the construction phase of Dogger Bank Teesside A or B (i.e. for a single project) and an estimated 1,092 FTE "indirect" jobs for the construction of both Dogger Bank Teesside A & B. This represents a **potential beneficial effect** to employment in the region.

5.3 Operation

5.3.1 Reference should be made to the full description of the project's features (**Chapter 5**) of the ES for full details of the operational phase, however in summary the activities considered likely to impact on public heath are:

- The physical presence of the converter stations;
- General site activities at the converter stations, where routine monitoring and maintenance activities will take place;
- Operation of the buried electrical cable systems; and
- Occasional routine cable system maintenance works – access to inspection pits.

Disturbance and nuisance

5.3.2 The noise study (**Chapter 29**) identifies a potential increase in noise levels to properties close to the converter stations as a result of one or both converter stations operating.

5.3.3 An assessment of operational noise for the converter stations was conducted using computer modelling software. With mitigation in place to meet the specified reduction in equipment noise levels during design, residual impacts from the operation of the converter stations is assessed to be **negligible** at all residential and non-residential receptors. As such, a **negligible** residual impact is expected for the operational noise of both Dogger Bank Teesside A & B operating concurrently.

5.3.4 None of the issues are sufficient to cause detrimental health impacts on receptors in the short-term or long-run. **No impact** on public health is anticipated.

5.3.5 The air quality study (**Chapter 30**) reports that following the completion of construction, local traffic will return to existing flows and volumes. There may be minor adverse residual impacts for land taken out of existing use at the converter stations site, land drainage and restrictions on land use along the cable route. There will be minimal maintenance and site traffic associated with the general operation of the cable systems and converter stations. As such, a **negligible** impact on local air quality is anticipated and the same conclusion can be drawn for the impact on public health.It has been identified that there are **negligible** residual impacts associated with dust generation, traffic and marine vessel emissions during the operation and decommissioning of the project. **No impact** on public health is anticipated.

Traffic and transport

5.3.6 During the operational phase of Dogger Bank Teesside A & B, traffic movements will be limited to that generated by the daily operation and periodic maintenance of the converter stations. The latter could be staffed 24-hours per day by up to two full-time personnel for each day and night shift, i.e., worst-case of eight daily vehicle movements per converter station (i.e. 16 movements). Operations staff would in all likelihood access the site from the existing Wilton Complex on the A174. The additional traffic movements are nowhere near the 10% threshold required under the Guidelines for the Environmental Assessment of Road Traffic (IEMA 1993). Therefore, **negligible** traffic impacts and no corresponding health implications are predicted for operations.

Health impacts from project infrastructure

5.3.7 During consultation, NHS Public Health raised the potential issue of impact associated with EMF around substations and the connecting cables or lines. The publications of the HPA are a primary source of advice on limiting public exposure to EMFs. The HPA supports the view that precautionary measures should address solely the possible association with childhood leukaemia, as opposed to other more speculative effects on human health.

For the general public, there may be concern that even low levels of magnetic field, despite being within acceptable ICNIRP reference levels, could interfere with the operation of implanted medical devices, such as pacemakers. The National Grid advises that magnetic field levels in the range 100μT to 1,200μT may produce interference. However, the peak levels expected for the buried cable systems of Dogger Bank Teesside A & B will be much lower than the guidance levels.

EMFs associated with the onshore cable systems

5.3.8 Forewind has proposed to use high voltage direct current (HVDC) cables to connect Dogger Bank Teesside A & B with the onshore converter stations. High voltage alternating current (HVAC) cables would be used to connect the converter stations with the existing NGET substation at Lackenby. For both onshore and offshore, all cables would be buried at least one metre under the ground or below the seabed. Cables going under roads will have a minimum depth of 900mm.

5.3.9 Unlike overhead power lines, which do produce electric fields, buried cables, such as those proposed for Dogger Bank Teesside A & B, will be covered with metallic screens and therefore neither the HVDC nor HVAC cable will emit any external electric fields.

5.3.10 In terms of magnetic fields, the proposed HVDC cable system for each project would be made up of a pair of cables operating as a bipole system. This means that the current in one cable flows in the opposite direction to the current in the second cable, largely causing the magnetic field from one cable to cancel out the magnetic field from the other cable. Therefore magnetic fields emitted by the HVDC cable system would be very low.

5.3.11 The proposed HVAC cable system for each project would be made up of three cables, which would produce magnetic fields that would not cancel each other out. Determining the exact size of the magnetic field generated by a three HVAC cable system is a complex calculation and needs to be based on data specific to each cable's materials and construction layers.

On similar projects involving buried cables, the maximum magnetic fields at ground level and at 1m above ground, i.e., the approximate height of the centre of mass for an average person, have peak values well below the recommended maximum level of 100μT. The fields rapidly fall away either side of the cable trench and down to 2 – 3μT at a distance of 5m, which are well within acceptable limits.

Magnetic fields and health

5.3.12 The magnetic fields for HVAC cable systems vary with power frequency but are typically between 5 and 10 μT one metre above the surface of the ground.

5.3.13 It is important to remember that the strength of a magnetic field decreases dramatically with increasing distance from the source. Examples were shown in Section 4.2.9 above.

5.3.14 The magnetic fields produced by the HVDC and HVAC cables on Dogger Bank Teesside A & B will be very low and well within industry guidelines.

5.3.15 Forewind has stated that it is committed to best practice health and safety in all of its activities. In relation to EMF, this means ensuring that its proposed electrical infrastructure for all projects comply with Government policy and with exposure guidelines. By specifying the cable systems described above, the resultant EMFs generated would be extremely low, or negligible, and will fall well under the accepted UK guidelines on exposure levels. As a result, no health impacts are anticipated to occur.

Lifestyle and physical activity

5.3.16 Minor adverse residual impacts have been identified for offshore tourism and recreation receptors in inshore and coastal areas (in respect of diving and watersport, and recreational angling). Impacts are reduced to negligible further offshore, reflecting the lower levels of activity in these areas. The operational plant and equipment will be subject to legal HSE and security requirements which will go a long way to isolate the project asserts from access to the public. It is envisaged that there will be **no impact** on human health.

5.3.17 Short-term minor adverse residual impacts have been identified for these access impacts, but these will have no significant effect on public health.

Employment and income

5.3.18 Potential beneficial impacts to the region have been identified during the construction, operation and decommissioning phases of Dogger Bank Teesside A & B (and indeed in combination with other wind farms); these relate to capital expenditure and direct and indirect job creation (**Chapter 22**), which includes references to this and examples of education engagement initiatives).

5.3.19 Maintenance, administrative roles and vessel operators will all feature in the operational life of Dogger Bank Teesside A & B.

5.3.20 An estimated 396 FTE direct and indirect jobs are expected to be created during the operation of either Dogger Bank Teesside A or B (i.e. for a single project); refer to **Table 5.2** relating to socio-economics (**Chapter 22**). Such an increase would nonetheless represent a **potential beneficial impact**. This additional employment is insufficient by itself to claim a significant benefit to regional health but it will have small positive effects

for individuals (see also Section 0). The effects of job creation in individual households across the region are conservatively considered to be of **negligible to minor** benefit.

5.4 Decommissioning

5.4.1 The impacts during decommissioning will be similar to those during construction and will be subject to a Decommissioning Plan and associated EIA at the relevant time.

6 SUMMARY

6.1 Health impacts from project infrastructure

6.1.1 The onshore buried cables to be installed as part of Dogger Bank Teesside A & B will only produce magnetic fields, as the cable shielding will prevent any electric field external to the cable itself.

6.1.2 The magnetic fields, even at their peak values and directly above the buried cables, are appreciably lower than the guideline limits adopted by the UK Government. They are indeed lower than those occurring naturally, and lower than the values associated with being in close to many household appliances. Furthermore, the magnetic field falls to only a few microteslas within a few metres from the cable route alignment; which is a fraction of the guideline lower limit.

6.1.3 On this basis, the magnetic and electric fields associated with the buried cables will have no effect on public health.

6.1.4 In respect of EMFs, the project will be compliant with the ICNIRP guidelines (2009). In relation to possible long-term health effects and precaution, the project also complies with HPA advice and Government policy.

6.2 Health impacts

6.2.1 The individual technical chapters within the ES cover a comprehensive range of parameters that have interactions with potential public health issues. In terms of normal construction activities involving traffic related pollution, air emissions, emissions to water and conservation of water quality, contaminated land and the creation of waste and/or its reuse/recycling, no significant impacts are predicted. None of these are of a scale of magnitude to demonstrate that there will be a risk to public health.

6.3 Health benefits

6.3.1 During consultation relevant stakeholders outlined that mitigation measures should be employed for acute health risks. However, no significant acute health risks have been identified. Once operational, however, Dogger Bank Teesside A & B will play a vital role in the network of energy provision in the UK. At the local and regional level, there are no significant repercussions for public health associated with the operational wind farm.

6.3.2 Socio-economic impacts (positive and negative) for local communities within range of the proposals are also assessed.

6.4 Conclusions

6.4.1 Energy generation, distribution and usage in more sustainable formats are features of a lower-carbon UK. To some who live and work in locations where this development is sited, there are mixed reactions to the new infrastructure being constructed (and operated) in their local environment.

6.4.2 A robust economy is often held up as a powerful driver of good health in the same way as healthy workers are critical to a sustainably robust economy. Sometimes in the heat of controversy about development projects, economic development and health protection are portrayed in opposition to each other.

6.4.3 This report has provided the background to health aspects in the region of Dogger Bank Teesside A & B. The potential interactions between the project components and the human health of communities were outlined. The components and specification of the project will not generate significant health risks. The cables will be buried at the correct depths to avoid interactions with humans. Furthermore, the routing of the cable has undergone extensive investigation to avoid impacts upon receptors.

6.4.4 The EMFs generated by these types of cables are very low and inherently contain mitigated in design through insulation properties, format and configuration.

6.4.5 There will be **no impact** from the project upon human health.

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