Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 1

Chapter 28 - Health

August 2022
Document Reference: 6.1.28
APFP Regulation: 5(2)(a)

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Title**:** **Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Environmental Statement** **Chapter 28: Health**	
PINS Document no.: 6.1.28	
Document no.: C282-RH-Z-GA-00045	
Date:	Classification
August 2022	**Final**
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Approved by: **Sarah Chandler, Equinor**	Date: August 2022

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Glossary of Acronyms

AC	Alternating Current
AHAH	Access to Health Assets & Hazards
BEIS	Department for Business, Energy & Industrial Strategy
BDC	Broadland District Council
CCG	Clinical Commissioning Group (now Integrated Care System (ICS))
CCGT	Combined Cycle Gas Turbine
CfD	Contracts for Difference
CIA	Cumulative Impact Assessment
CRCE	Centre for Radiation, Chemical and Environmental Hazards
CTMP	Construction Traffic Management Plan
DC	Direct Current
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEP	Dudgeon Offshore Wind Farm Extension Project
DWPA	Drinking Water Protected Area
EC	European Commission
EIA	Environmental Impact Assessment
ELF	Extremely Low Frequency
EMF	Electromagnetic Field
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
EUPHA	European Public Health Association
GHG	Greenhouse Gas
GP	General Practitioner
GW	Gigawatt
HDD	Horizontal Directional Drilling
HIA	Health Impact Assessment
HPA	Health Protection Agency
HVAC	High-Voltage Alternating Current
IAIA	International Association for Impact Assessment
ICNIRP	International Commission on Non-Ionizing Radiation Protection

IDACI	Income Deprivation in Children
IDAOPI	Income Deprivation in Older People
IEMA	Institute of Environmental Management & Assessment
IMD	Index of Multiple Deprivation
IPC	Infrastructure Planning Commission
JSNA	Norfolk's Joint Strategic Needs Assessment
km	Kilometre
LEP	Local Enterprise Partnership
LSOA	Lower Layer Super Output Area
MARPOL	International Convention for the Prevention of Pollution from Ships
MHCLG	Ministry for Housing, Communities and Local Government
MHRA	The Department of Health's Medicines and Healthcare Products Regulatory Agency
MPS	Marine Policy Statement
MW	Megawatts
NEET	Not in Education, Employment or Training
NHS	National Health Service
NNDC	North Norfolk District Council
NCC	Norwich City Council
NFU	National Farmers Union
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NRMM	Non-Road Mobile Machinery
NRPB	National Radiological Protection Board
NSIP	Nationally Significant Infrastructure Project
OCoCP	Outline Code of Construction Practice
OHID	Office for Health Improvement and Disparities
PEIR	Preliminary Environmental Information Report
PHE	Public Health England
PPG	Planning Practice Guidance
PRoW	Public Rights of Way
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SNC	South Norfolk Council
SPZ	Source Protection Zone

UK	United Kingdom
WFD	Water Framework Directive

Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP offshore site	The Dudgeon Offshore Wind Farm Extension consisting of the DEP wind farm site, interlink cable corridors and offshore export cable corridor (up to mean high water springs).
DEP onshore site	The Dudgeon Offshore Wind Farm Extension onshore area consisting of the DEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Grid option	Mechanism by which SEP and DEP will connect to the existing electricity network. This may either be an integrated grid option providing transmission infrastructure which serves both of the wind farms, or a separated grid option, which allows SEP and DEP to transmit electricity entirely separately.
Horizontal directional drilling (HDD)	Trenchless technique used to install cables – in this case referring to the installation of the export cables at the landfall.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable corridor which would house HDD entry or exit points.
Jointing bays	Underground structures constructed at regular intervals along the onshore cable corridor to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water.
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore Substation	Compound containing electrical equipment to enable connection to the National Grid.

Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
PEIR boundary	The area subject to survey and preliminary impact assessment to inform the PEIR.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP onshore site	The Sheringham Shoal Wind Farm Extension onshore area consisting of the SEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
Study area	Area where potential impacts from the project could occur, as defined for each individual Environmental Impact Assessment (EIA) topic.
The Applicant	Equinor New Energy Limited

28. HEALTH

28.1 Introduction

1. This chapter of the Environmental Statement (ES) describes the potential impacts of the proposed Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP) on human health. The chapter provides an overview of the existing environment for the proposed onshore and offshore development area, followed by an assessment of the potential impacts and associated mitigation for the construction, operation, and decommissioning phases of SEP and DEP.
2. This assessment has been undertaken with specific reference to the relevant legislation and guidance, of which the primary source are the National Policy Statements (NPS) for energy infrastructure. Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) are presented in **Section 28.4**.
3. The assessment should be read in conjunction with following linked chapters:
   - **Chapter 17 Onshore Ground Conditions and Contamination**
   - **Chapter 18 Water Resources and Flood Risk**
   - **Chapter 19 Land Use, Agriculture and Recreation**
   - **Chapter 22 Air Quality**
   - **Chapter 23 Noise and Vibration**
   - **Chapter 24 Traffic and Transport**
   - **Chapter 27 Socio-Economics and Tourism**
4. Additional information to support the health baseline and assessment is provided in:
   - **Appendix 28.1 EMF Assessment**
   - **Appendix 28.2 Health Baseline Statistics**
5. Relevant information on health is brought together in this chapter, including assessing the findings and conclusions of other chapters within this ES. This chapter explains the public health implications of these determinants of health, as well as considering other determinants which may affect health and wellbeing.

28.2 Consultation

6. Consultation with regard to human health has been undertaken in line with the general process described in **Chapter 5 EIA Methodology** and the **Consultation Report** (document reference 5.1). The key elements to date have included scoping, the Preliminary Environmental Information Report (PEIR), Section 42 Responses and an Expert Topic Group (ETG) meeting with Public Health team representative at Norfolk County Council (NCC).

7. The feedback received throughout this process has been considered in preparing the ES. This chapter has been updated following consultation in order to produce the final assessment submitted within the Development Consent Order (DCO) application. **Table 28-1** provides a summary of the consultation responses received to date relevant on this topic, and details of how the SEP and DEP team has had regard to the comments and how these have been addressed within this chapter.
8. Consultation responses by other technical topic area stakeholders that are relevant to human health, e.g. discussing environmental exposures to people as receptors, have been outlined in the applicable chapters of the ES and informed this assessment.
9. The consultation process is described further in **Chapter 5 EIA Methodology**. Full details of the consultation process is presented in the **Consultation Report** (document reference 5.1), which has been submitted as part of the DCO application.

Table 28-1: Consultation Responses

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
The Planning Inspectorate	Scoping Opinion	The Health aspect chapter of the Scoping Report has not provided justification to scope out these impacts from the operational phase. However, the Inspectorate has agreed to scope out these operational impacts from the relevant aspect assessments (see Tables 5.1 of this Opinion) and considers that these potential impacts are unlikely to result in significant effects. As such the Inspectorate agrees that their impact on health can also be scoped out of the ES.	The Planning Inspectorate's agreement to scope out the relevant aspect assessment operational impacts (i.e. scoping out of operational impacts in some of the technical assessments that the health assessment has drawn from, e.g. air quality operational impacts) are noted. Operational impacts that have been scoped out in other technical assessments are detailed in those chapters (as listed in paragraph 3).
		The Health aspect chapter of the Scoping Report has not provided justification to scope out these impacts from the operational phase. However, paragraph 604 of the Water Resources and Flood Risk aspect chapter identifies the potential for accidental spillage or leakage of fuel oils or lubricants during operation, which could impact upon surface water quality and connected groundwaters. As such, the Inspectorate does not agree that subsequent impacts to health can be scoped out of the assessment.	Ground and / or water contamination effects are considered in **Section 28.6.1.3**.
		The Scoping Report does not justify scoping out transboundary health impacts. However, given the nature of the Proposed Development, the Inspectorate does not consider that significant effects are likely; therefore it is agreed that this matter can be scoped out of the ES.	Transboundary health impacts have been scoped out of the assessment.
		The operational matters scoped in to summary Table 4-4 do not accord with those detailed in paragraph 864; Table 4-4 generally identifies more potential impacts, although omits impacts from the generation of electromagnetic fields (EMFs). For the avoidance of doubt, the	EMF impacts are considered in detail in **Appendix 28.1 EMF**

Consultee	Date/ Document	Comment	Project Response
		Inspectorate agrees that the matters scoped in to Table 4-4 are relevant to the Proposed Development and should therefore be assessed in the ES, alongside potential impacts of EMF.	**Assessment** and discussed in **Section 28.6.3.2**. of this chapter.
		The Scoping Report notes that there are no statutory guidelines for assessing health impacts. Public Health England's consultation response provides advice for assessing potential impacts and references a number of guides; the Inspectorate advises the Applicant to consider these comments in developing its methodology. The assessment methodology employed should be clearly described within the ES.	The assessment methodology is described in **Section 28.4.3**. The guidelines used are described in **Section 28.4.1.2**.
The Planning Inspectorate	Scoping Opinion	The Scoping Report states that detailed geophysical survey and investigation would identify any UXO and measures would be taken to mitigate risks of detonation. The Scoping Report considers this is a health and safety risk rather than being an environmental issue and notes that potential impacts to other receptors will be assessed where relevant (e.g. fish and marine mammal ecology). The EIA Regulations 2017 require an assessment of the likely significant effects to population and health, and resulting from the vulnerability of the Proposed Development to risks of major accidents and/or disasters.	The current plan is for a 2025 offshore UXO survey to run prior to UXO clearance. A method statement will be agreed with appropriate consideration given to health and safety.
Public Health England (now the Office for Health Improvement and Disparities (OHID)	Scoping Opinion	When preparing an ES the applicant should give consideration to best practice guidance such as the Government's Handbook for scoping projects: environmental impact assessment, IEMA Guide to Delivering Quality Developments, and Guidance: on Environmental Impact Assessment, The Planning Inspectorate's Advice Note Seven: Environmental Impact Assessment: Process, Preliminary Environmental Information and Environmental Statements also provide guidance to applicants and other persons with interest in the EIA process as it relates to NSIPs. It is important that the submitted ES identifies and assesses the potential public health impacts of the activities at, and emissions from, the development. PHE understands that there may be separate sections of the ES covering the assessment of impacts on air, land, water and so on, but expects an ES to include a specific section summarising potential impacts on population and health. This section should bring together	The guidelines which have been used in this chapter are described in **Section 28.4.1.2** and broadly follow the approach proposed by PHE . Relevant information on health is brought together in this chapter, including assessing the findings and conclusions of other chapters (**Chapter 17 Onshore Ground**

Consultee	Date/ Document	Comment	Project Response
		and interpret the information from other assessments as necessary. The health and population impacts section should address the following steps. Screening: Identify and significant effects. Summarise the methodologies used to identify health impacts, assess significance and sources of information. Evaluate any reference standards used in carrying out the assessment and in evaluating health impacts (e.g., environmental quality standards). Where the applicant proposes the 'scoping out' of any effects a clear rationale and justification should be provided along with any supporting evidence. Baseline Survey: Identify information needed and available, Evaluate quality and applicability of available information. Undertake assessment Alternatives: Identify and evaluate any realistic alternative locations, routes, technology etc. Design and assess possible mitigation: Consider and propose suitable corrective actions should mitigation measures not perform as effectively predicted. Impact Prediction: Quantify and Assess Impacts: Evaluate and assess the extent of any positive and negative effects of the development. Effects should be assessed in terms of likely health outcomes, including those relating to the wider determinants of health such as socio-economic outcomes, in addition to health outcomes resulting from exposure to environmental hazards. Mental health effects should be included and given equivalent weighting to physical effects. Clearly identify any omissions, uncertainties and dependencies (e.g., air quality assessments being dependent on the accuracy of traffic predictions). Evaluate short-term impacts associated with the construction and development phase. Evaluate long-term impacts associated with the operation of the development. Evaluate any impacts associated with decommissioning. Evaluate any potential cumulative impacts as a result of the development, currently approved developments which have yet to be constructed, and proposed developments which do not currently have development consent. Monitoring and Audit (not a statutory requirement):	**Conditions and Contamination**, **Chapter 18 Water Resources and Flood Risk**, **Chapter 19 Land Use, Agriculture and Recreation**, **Chapter 22 Air Quality**, **Chapter 23 Noise and Vibration**, **Chapter 24 Traffic and Transport**, and **Chapter 27 Socio-Economics and Tourism**) within this ES. This chapter explains the public health implications of these determinants of health, as well as considering other determinants which may affect health and wellbeing. The health assessment methodology is presented in **Section 28.4.3** and the impact assessment is presented in **Section 28.6**. Site selection is discussed in **Chapter 3 Site Selection and Assessment of Alternatives**.

Consultee	Date/ Document	Comment	Project Response
		Identify key modelling predictions and mitigation impacts and consider implementing monitoring and audit to assess their accuracy / effectiveness. Any assessments undertaken to inform the ES should be proportionate to the potential impacts of the proposal, therefore we accept that, in some circumstances particular assessments may not be relevant to an application, or that an assessment may be adequately completed using a qualitative rather than quantitative methodology. In cases where this decision is made, the applicant should fully explain and justify their rationale in the submitted documentation. Consideration of alternatives (including alternative sites, choice of process, and the phasing of construction) is widely regarded as good practice. Ideally, the EIA process should start at the stage of site selection, so that the environmental merits of practicable alternatives can be properly considered. Where this is undertaken, the main alternatives considered should be outlined in the ES7.	
		The applicant should clearly identify the development's location and the location and distance from the development of off-site human receptors that may be affected by emissions from, or activities at, the development. Off-site human receptors may include people living in residential premises; people working in commercial, and industrial premises and people using transport infrastructure (such as roads and railways), recreational areas, and publicly-accessible land.	Health receptors considered in relation to potential air quality effects are detailed in **Section 28.6**. Further detail on the impact of SEP and DEP on emissions and local air quality and health is provided in **Chapter 22 Air Quality**.
		Identify and consider impacts on residential areas and sensitive receptors (such as schools, nursing homes and healthcare facilities, as well as other vulnerable population groups such as those who are young, older, with disabilities or long-term conditions, or on low incomes) in the area(s) which may be affected by emissions, this should include consideration of any new receptors arising from future development.	Vulnerable groups have been included in **Section 28.3.2**.
Cawston Parish Council	Scoping Opinion	We consider that any examination of issues around public health and welfare should be far more thorough than is set out in the Scoping Report and should include full long-term costings.	Health impacts are assessed in detail in **Sections 28.6.1** and **28.6.1.4**. An assessment of

Consultee	Date/ Document	Comment	Project Response
			the direct economic benefit, increased employment and disturbance to social, community and health infrastructure is detailed in **Chapter 27 Socio-Economics and Tourism**.
Section 42 Responses			
Public Health England (now OHID)	Section 42 Response	General comments applicable across the PEIR We note that other projects potentially having interactions and relevant cumulative effects have been identified. At this stage, only a brief discussion of each of the developments is presented and the cumulative effects do not appear to have been adequately assessed. We would expect a full evaluation of potential cumulative effects within the Environmental Statement (ES). The applicant may wish to consider a figure within the ES to identify the location of relevant other projects in relation to the proposed project.	The CIA is presented in **Section 28.7**.
		General comments applicable across the PEIR There also appears to be little consideration for decommissioning. While it is assumed by the applicant that any impacts of decommissioning are likely to be no greater than construction, the submitted documents do not provide robust justification in support of this assumption. We would expect to see further information as to the decommissioning in the ES.	Further details on decommissioning are provided in **Chapter 4 Project Description** and **Section 28.6.4**.
		Human Health and Wellbeing This section of PHE's response, identifies the wider determinants of health and wellbeing we expect the ES to address, to demonstrate whether they are likely to give rise to significant effects. PHE has focused its approach on scoping determinants of health and wellbeing under four themes, which have been derived from an analysis of the wider determinants of health mentioned in the National Policy Statements. The four themes are: • Access • Traffic and Transport	These themes have been taken into consideration in **Section 28.6** of this health impact assessment.

Consultee	Date/ Document	Comment	Project Response
		• Socioeconomic • Land Use	
		Having considered the submitted scoping report PHE wish to make the following specific comments and recommendations: <u>Methodology</u> <u>In combination & cumulative effects reporting</u> The local community will experience impacts from a range of factors due to this and other local developments over an extended period. The range of impacts over such a long period may result in minor effects gaining increased significance to local communities and the vulnerable population within. The PEIR notes the number of ongoing NSIP schemes within this area, including other offshore energy generating schemes and the Sizewell C development. In relation to cumulative impact these schemes will have particular importance to the assessment of construction staff accommodation needs, traffic and transport and the impact on the local health care system and community cohesion from the introduction of a large external workforce across a number of infrastructure schemes. These potential impacts have been acknowledged within the PEIR but have not been adequately assessed and considered not significant partly on the basis that any impact or effects are temporary. Chapter 29 identifies 670 non home-based workers and makes a worst-case assumption that half of these workers will require local accommodation. There is no justification for this assumption. The cumulative effects assessment within Chapter 29 does recognise impacts on accommodation but does not assess or use published assessments of accommodation availability (baseline and projected) to determine likely effects. The PEIR also notes the impact of increased in-migration on demographic change during construction is temporary, short-term and reversible in nature. Although temporary the construction period may extend to 24 months, with vulnerable populations being at risk of reduced access to affordable low-cost accommodation.	This comment has been considered and responded to in full in **Chapter 27 Socio-economic and Tourism**.
		<u>Recommendation</u>	

Consultee	Date/ Document	Comment	Project Response
		The final ES should provide greater justification for the number for non-home-based workers and the impact on availability of affordable short-term accommodation and the cumulative effects for the study area. Local knowledge on the potential impact from non-home-based workers should be sought from local stakeholders, such as the local authority, public health and CCG/ICS teams. Should the applicant wish to scope out any of these recommendations from the ES, the applicant must provide adequate justification.	
National Farmers Union (NFU)	Section 42 Response	Electromagnetic Fields There is considerable concern over EMF and the impact on health. The NFU would like to discuss this further with Equinor to understand what mitigation measures they are considering and what if any they believe magnetic fields may be greater at crossing points with the other underground cable schemes being developed by Vattenfall and Orsted. Greater detail is also required on potential interference on Soil Sense Technology, RTK and other agricultural software.	The assessment of EMFs is presented in **Appendix 28.1 EMF Assessment** and summarised in **Section 28.5.9** and **Section 28.6.3.2** of this chapter. The other underground cable schemes being developed by Vattenfall (Norfolk Vanguard and Norfolk Boreas) and Orsted (Hornsea Project Three) are Direct Current (DC) cables and do not contribute to the EMFs associated with the Alternating Current (AC) undergrounds cables proposed under SEP and DEP. Therefore, any underground cable crossing points will not result in EMF increase. In addition, the EMFs associated with SEP and DEP underground

Consultee	Date/ Document	Comment	Project Response
			onshore cables are significantly lower than government guidelines.
North Norfolk District Council (NNDC)	Section 42 Response	Chapter 30 Health The contents of this chapter are noted. NNDC does not have any specific comments to make here.	Noted.
Reepham Town Council	Section 42 Response	It is also understood that the cables produce a significant magnetic field and will cross over other similar cables that are being proposed. This could have implications for people's health and safety.	The assessment of EMFs is presented in **Appendix 28.1 EMF Assessment** and summarised in **Section 28.5.9** and **Section 28.6.3.2** of this chapter. The EMF levels associated with SEP and DEP would be significantly below the relevant exposure limits, therefore no significant EMF effects arise as a result of SEP and DEP. For most designs evaluated, the magnetic fields reduce to a background level at the DCO order limits.
Barford and Wramplingham Parish Council	Section 42 Response	Equinor has NOT provided an objective assessment of mental and physical health risks posed to individuals and the population by its activities. Equinor has provided 106 pages of selective narrative that minimises any potential impacts, makes no mention of the precautionary principle, and justifies all its activities. Who wrote it, and what are their qualifications?	The Health Impact Assessment (HIA) methodology and findings are set out in this chapter. The precautionary principle generally applies where

Consultee	Date/ Document	Comment	Project Response
			there are threats of serious damage to the environment or to health, and a lack of full scientific certainty. It provides decision makers with a framework for considering consenting risks and for application of damage minimisation where such scientific uncertainty may exist. In this case the impact assessment does not identify serious threats to health and scientific literature provides adequate understanding of the relevant determinants of health. The impact assessment is based on the consideration of a conservative approach to aspects of the SEP and DEP. The precautionary principle has therefore been appropriately applied.
Expert Topic Group (ETG)			
NCC Public Health Team Representatives	6th April 2022	An ETG meeting was held with the NCC Public Health team to discuss the SEP and DEP EIA, and to confirm the proposed methodology for the ES which is an update to the methods presented in the PEIR chapter. This update to the health assessment methodology is due to more recently published guidance (i.e. Institute of Public Health (2021) and International Association for the Impact Assessment and European Public Health Assessment (2020)) which aligns with international and national good practice. The methods proposed for, and therefore used in, this Health Chapter were agreed with the NCC Public Health team. The	The updated methodology for the health assessment that was agreed with the NCC Public Health team is presented in **Section 28.4.3**.

Consultee	Date/ Document	Comment	Project Response
		NCC Public Health representatives welcomed the methods as providing a consistent and transparent basis for explaining the public health implications of the SEP and DEP.	

28.3 Scope

10. A summary of the determinants of health that are scoped in and therefore assessed in this chapter is as follows:
    - The construction phase health assessment considers:
        - Noise;
        - Air quality;
        - Ground and/or water contamination;
        - Physical activity;
        - Journey times and access; and
        - Employment.
    - The operational phase health assessment considers:
        - Noise;
        - EMFs; and
        - Employment.
11. The wider societal benefits to health of SEP and DEP are also discussed in **Section 28.6.3**.

28.3.1. Study Area

12. SEP and DEP makes landfall at Weybourne and the onshore cable corridor travels inland in a general southerly direction to the north of Wymondham where it then travels in an easterly direction towards the onshore substation, which will be connected to the existing Norwich Main substation.
13. The onshore boundary passes through the administrative areas of North Norfolk District Council (NNDC), Broadland District Council (BDC) and South Norfolk District Council (SNC). A full description of SEP and DEP is provided in **Chapter 4 Project Description**.
14. The study areas used in other chapters of the ES are of relevance, but do not necessarily define the boundaries of potential health impacts, including physical and mental health. The health chapter uses study areas to broadly define representative population groups, relevant to determining sensitivity, rather than to set boundaries on the extent of potential effects.
15. The study area has been divided into the following geographic area classifications:
    - Site-specific;
    - Local (NNDC, BDC and SNC);
    - Regional (Norfolk County);
    - National (England); and
    - International.

16. The site-specific level considers localised effects through statistics collected for Lower Layer Super Output Areas (LSOAs) (see **Appendix 28.2 Health Baseline Statistics**). The site-specific and local geographic study areas are shown in **Figure 28.1**. The LSOAs presented in **Table 28-2** are the most representative of the population near landfall, in proximity to the onshore cable corridor and the onshore substation. Other LSOAs the onshore cable corridor passes through are also provided, as well as a justification for choosing the representative LSOA as it is not feasible and disproportionate to include all the LSOAs crossed by the onshore cable corridor.

Table 28-2: Representative LSOAs for the Various Onshore Elements

Onshore Infrastructure Element	LSOAs crossed by SEP and DEP Element	Representative LSOA of Population	Justification
Landfall	North Norfolk 004A	North Norfolk 004A	Only LSOA at landfall.
Onshore cable corridor	North Norfolk: 006B 006C Broadland: 001D 002B 002C 002D South Norfolk: 002D 002E 003B 009B 009D 005C	North Norfolk 006C	North Norfolk 006C covers a large area of the onshore cable corridor (approximately 6.8km of the cable corridor run through 006C) and contains construction compounds, different crossing types (i.e., trenchless and open cut), access routes and a representative spread of dwelling. North Norfolk is typically more deprived (Index Multiple Deprivation (IMD) rank of 11,999 and IMD decile of 4*) than the other LSOAs through which the onshore cable corridor passes, and therefore its consideration is consistent with assessing the worst-case scenario (MHCLG, 2019a).
Onshore substation area	South Norfolk: 009B 006G	South Norfolk 006G	The onshore substation is located within South Norfolk 006G and 009B, with a larger proportion of the onshore DCO order limits at the onshore substation located within 006G. South Norfolk 006G is more deprived (IMD rank of 21,617 and decile of 7) than South Norfolk 009B, and therefore its consideration is consistent with assessing the worst-case scenario (MHCLG, 2019a).
*Decile 1 represents the most deprived and decile 10 represents the least deprived.			

17. The LSOAs selected are not intended to indicate the area of effect, but rather the profile of the population potentially affected. Using North Norfolk 004A and 006C and South Norfolk 006G to characterise the population at landfall, along the cable corridor and at the substation, respectively, is consistent with proportionately assessing a representative worst-case, and so potential effects in other LSOAs will be no greater than those assessed.

28.3.2. Population Groups

18. Ten broadly defined population groups have been identified within the study areas adopted by this ES. The population groups have been split into geographic and potentially vulnerable population groups. The intention of grouping populations is to allow for consistent discussion across health issues. People falling into more than one group may be especially sensitive.

28.3.2.1. Geographic Population Groups

19. A total of six geographic population groups have been identified along the entire length of the onshore study area. These range in scale from site-specific to national scale. The identified geographic locations are as follows:
    - The population near landfall at Weybourne (site-specific);
    - The population along the onshore cable corridor (site-specific);
    - The population near the onshore substation site and the existing Norwich Main substation (site-specific);
    - The population of NNDC, BDC and SNC (local);
    - The population of Norfolk County (regional); and
    - The population of England and neighbouring countries (national and international).

20. The most relevant geographic scale is used for each determinant of health. For localised effects this is the site-specific level, where data availably allows this. For wider more diffuse effects, such as employment opportunities a broader geographic scale is the most appropriate basis for assessment.

28.3.2.2. Vulnerable Population Groups

21. Potentially vulnerable population groups are defined as those who are sensitive to changes associated with SEP and DEP[1]. The following four population groups were identified within the study area:
    - Children and young people;
    - Older people (particularly those suffering with dementia);
    - People living in deprivation (including those experiencing income and/or access/geographic vulnerability); and

[1] 'Social disadvantage (social isolation or discrimination)' was also considered but is judged not applicable to the impacts associated with SEP and DEP.

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

28.3.3. Temporal Scope

22. The temporal scope has been defined in **Table 28-3**.

Table 28-3: Definitions of Timescales Used Within this Chapter

Timescale	Definition	Example
Very short term	Effects measured in hours, days or weeks	Effects close to a particular dwelling, associated with duct installation or cable pulling activity.
Short term	Effects measured in months	The construction stage accommodation for construction workforce
Medium term	Effects measured in years	Local employment during construction
Long term	Effects measured in decades	The operational stage

28.3.4. Realistic Worst-case Scenario

28.3.4.1. General Approach

23. The final design of SEP and DEP will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine: Rochdale Envelope (v3, 2018). The Rochdale Envelope for a project outlines the realistic worst-case scenario for each individual impact, so that it can be safely assumed that all lesser options will have less impact. Further details are provided in **Chapter 5 EIA Methodology**.

24. The realistic worst-case scenarios for the health assessment are summarised in **Table 28-4**. These are based on the project parameters described in **Chapter 4 Project Description**, which provides further details regarding specific activities and their durations.

25. In addition to the design parameters set out in **Table 28-4**, consideration is also given to how SEP and DEP will be built out as described in **Section 28.3.4.2** to **Section 28.3.4.4** below. This accounts for the fact that whilst SEP and DEP are the subject of one DCO application, it is possible that either one or both of the projects will be developed, and if both are developed, that construction may be undertaken either concurrently or sequentially. Further details are provided in **Chapter 4 Project Description**.

Table 28-4: Realistic Worst-Case Scenarios

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
Construction				
Impact 28.1 – 28.6: Noise Air Quality Ground and/or Water Contamination Physical Activity Journey Times and/or Reduced Access Effects Employment	**Landfall:** Temporary Horizontal Directional Drilling (HDD) works: Compound area = 75m x 75m Joint transition bay size = 26m x 10m HDD Horizontal length = approximately 1,150m Total construction space required = 48,955m^2 Offshore cable laying vessels at least 1km from the shore Duration: 4 months, followed by cable pull (2 months) Temporary access route from the existing road system	**Landfall:** Temporary HDD works: Compound area = 75m x 75m Joint transition bay size = 2x (26m x 10m) if adjacent to each other or 26m x 12m if combined HDD Horizontal length = approximately 1,150m Total construction space required = 48,955m^2 Offshore cable laying vessels at least 1km from the shore Duration: 5 months, followed by cable pull (4 months) Temporary access route from the existing road system	**Landfall:** Temporary HDD works: Compound area = 75m x 75m per project Joint transition bay size = 2x (26m x 10m) – adjacent to each other HDD Horizontal length = approximately 1,150m Total construction space required = 48,955m^2 Offshore cable laying vessels at least 1km from the shore Duration: 4 months, followed by cable pull (2 months) per project Temporary access route from the existing road system	Relevant information on health is brought together in this chapter, including assessing the findings and conclusions of other chapters within this ES. The worst case parameters presented here represent worst case parameter that informed the assessments made in those other ES chapters, but are included here for completeness. This chapter explains the public health implications of these determinants of health, as well as considering other determinants which may affect health and wellbeing.

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
	Onshore Cable Corridor: Total width: 45m Minimum cable burial depth: 1.2m Temporary access (various) from public highway (6m wide) to single tracks (3m wide) Duration: 24 months in total	**Onshore Cable Corridor:** Total width: 60m Minimum cable burial depth: 1.2m Temporary access (various) from public highway (6m wide) to single tracks (3m wide) Duration: 26 months in total	**Onshore Cable Corridor:** Total width: 60m Minimum cable burial depth: 1.2m Temporary access (various) from public highway (6m wide) to single tracks (3m wide) Duration: 24 months in total per project	
	Onshore Substation and 400kv connection: Maximum operational area: 32,500m^2 Substation construction compound: 10,000m^2 Main buildings: Number – 2, Dimensions (max.) –30m x 14m x 15m (L x W x H) Permanent access road: 850m x 6m (L x W) Permanent access road construction compound: 2,500m^2 Duration: site preparation – 6 months, construction – 22 months.	**Onshore Substation and 400kv connection:** Maximum operational area: 60,000m^2 Substation construction compound: 10,000m^2 Main buildings: Number – 2, Dimensions (max.) –30m x 14m x 15m (L x W x H) Permanent access road: 850m x 6m (L x W) Permanent access road construction compound: 2,500m^2 Duration: site preparation – 6 months, construction – 24 months.	**Onshore Substation and 400kv connection:** Maximum operational area: 60,000m^2 Substation construction compound: 10,000m^2 Main buildings: Number –2, Dimensions (max.) –30m x 14m x 15m (L x W x H) Permanent access road: 850m x 6m (L x W) Permanent access road construction compound: 2,500m^2 Duration per project: site preparation – 6 months, construction –22 months.	
Operation				
Impacts 28.6, 28.7 and **28.8**: Employment Noise EMF	**Onshore Substation**: Operational area footprint: 32,500m^2 Indicative capacity: 400 MW	**Onshore Substation**: Operational area footprint: 60,000m^2 Indicative capacity: 800 MW	**Onshore Substation**: Operational area footprint: 60,000m^2 Indicative capacity: 800 MW Access from extension to existing National Grid access road	Relevant information on health is brought together in this chapter, including assessing the findings and

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
	Access from extension to existing National Grid access road Operational duration: 40 years Unmanned, only visits for maintenance staff and visitors (approximately 1 per week) Cable corridor parameters – length: 60 km, depth: minimum 1.2 m	Access from extension to existing National Grid access road Operational duration: 40 years Unmanned, only visits for maintenance staff and visitors (approximately 1 per week) Cable corridor parameters – length: 60 km, depth: minimum 1.2 m	Operational duration: 40 years Unmanned, only visits for maintenance staff and visitors (approximately 1 per week) Cable corridor parameters – length: 60 km, depth: minimum 1.2 m	conclusions of other chapters within this ES. The worst case parameters presented here represent worst case parameter that informed the assessments made in those other ES chapters, but are included here for completeness. This chapter explains the public health implications of these determinants of health, as well as considering other determinants which may affect health and wellbeing.
Decommissioning				
No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable corridor and onshore substation. It is also recognised that legislation and industry best practice change over time. However, it is likely that the onshore project equipment, including the cable, will be removed, reused or recycled where possible and the transition bays and cable ducts being left in place. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the purposes of a worst-case scenario, the impacts will be no greater than those identified for the construction phase.				

28.3.4.2. Construction Scenarios

26. In the event that both SEP and DEP are built, the following principles set out the framework for how SEP and DEP may be constructed:
    - SEP and DEP may be constructed at the same time, or at different times;
    - If built at the same time both SEP and DEP could be constructed in four years;
    - If built at different times, either Project could be built first;
    - If built at different times, each Project would require a four year period of construction;
    - If built at different times, the offset between the start of construction of the first Project, and the start of construction of the second Project may vary from two to four years;
    - Taking the above into account, the total maximum period during which construction could take place is eight years for both Projects; and
    - The earliest construction start date is 2025.
27. The impact assessment for Health considers the following development scenarios in determining the worst-case scenario for each topic:
    - Build SEP or build DEP in isolation;
    - Build SEP and DEP sequentially with a gap of up to four years between the start of construction of each Project – reflecting the maximum duration of effects; and
    - Build SEP and DEP concurrently – reflecting the maximum peak effects.
28. Any differences between the two projects, or differences that could result from the manner in which the first and the second projects are built (concurrent or sequential and the length of any gap) are identified and discussed where relevant in the impact assessment section of this chapter (**Section 28.6**). For each potential impact only the worst-case construction scenario for two projects is presented, i.e. either concurrent or sequential. The justification for what constitutes the worst-case is provided, where necessary, in **Section 28.6**.

28.3.4.3. Operation Scenarios

29. Operation scenarios are described in detail in **Chapter 4 Project Description**. Where necessary, the assessment considers the following three scenarios:
    - Only SEP in operation;
    - Only DEP in operation; and
    - The two Projects operating at the same time, with a gap of two to four years between each Project commencing operation.
30. The operational lifetime of each Project is expected to be 40 years.

28.3.4.4. Decommissioning Scenarios

31. Decommissioning scenarios are described in detail in **Chapter 4 Project Description**. Decommissioning arrangements for the onshore elements of SEP and DEP will be agreed through the submission of an onshore decommissioning plan to the relevant planning authority for approval within six months of the permanent cessation of commercial operation (unless otherwise agreed in writing by the relevant planning authority), however for the purpose of this assessment it is assumed that decommissioning of SEP and DEP could be conducted separately, or at the same time.

28.3.5. Summary of Mitigation Embedded in the Design

32. This site selection process for SEP and DEP had the approach of mitigation by design (i.e. embedded mitigation). This means that during the course of the design development of the DCO order limits for SEP and/or DEP, there were a number of multidisciplinary workshops that sought to integrate technical, land, community, environmental, ecology and landscape constraints in the final design for the DCO Application. This section outlines the embedded mitigation relevant to the health assessment, which has been incorporated into the design of SEP and DEP (see **Table 28-5**). Where other mitigation measures are proposed, these are detailed in the impact assessment (see **Section 28.6**).

33. This health assessment takes as its starting point the residual effects as assessed and determined in other relevant EIA topic chapters, in order to prevent duplication of information. This includes taking into account relevant embedded and standard good practice mitigation. The embedded mitigation measures which have been identified within the topic specific chapters and further details of additional mitigation measures (i.e. those not embedded) are described in the relevant topic chapters (as identified in paragraph 3).

34. The Applicant will seek to work with local authorities and stakeholders to (whenever possible) prevent and minimise the health impacts on local communities and specifically vulnerable groups.

Table 28-5: Embedded Mitigation Measures

Parameter	Mitigation Measures Embedded into the Project Design
Site selection	SEP and DEP have undertaken extensive site selection process which has involved the prevention or minimisation of potential disturbance effects, such as: Wherever possible, avoid proximity to residential dwellings, schools, care homes, retirement homes, hospitals, doctors' surgeries, travellers' sites; Wherever possible, avoid proximity to public open space, public rights of way, or facilities that can form part of the health regimen of residents; and Wherever possible, minimise impacts to local residents and vulnerable groups in relation to access to services and road use (including footpath closure). One of the main aspects considered during the site selection process was to avoid populated areas, where possible. The best example of this is at Weybourne Woods, where a longer, more complex and costly option of drilling under the woodland was chosen over a trenchless crossing at Sandy Hill Lane (to avoid installing cables under a caravan park, where there are permanent dwellings).

Parameter	Mitigation Measures Embedded into the Project Design
	Other examples of embedded mitigation to avoid populated areas through site selection, include the commitment to keeping recreational routes (including PRoWs) open by providing diversions, where possible (see **Chapter 19 Land Use, Agriculture and Recreation** for further details) and vehicle routing which prohibits SEP and/or DEP HGV traffic from routing through certain areas and/or villages, at the request of highway stakeholders and the local community (see **Chapter 24 Traffic and Transport** for further details).
Trenchless crossing (HDD) at landfall	HDD will be used at landfall in order to avoid disturbances to the public. This will retain access to coastal paths and the beach during construction.
Roads	Potential impacts to journey times and access have been minimised through the following: Avoiding key constraints (e.g. height or weight restrictions on the highway network), where possible; Avoiding populated areas, where possible; Avoiding proximity to residential dwellings; and Minimising impacts to local residents in relation to access to services and road usage, including road and footpath closures. Through site selection, the project generally avoids disruption to emergency and routine health care, as well as general access to employment, amenities, services and goods.
Onshore substation	Site selection for the onshore substation ensured that the location of the substation will include appropriate separation distance from areas where people spend extended periods of time (i.e. residential dwellings, schools and places of work) and includes fencing to provide a separation distance to avoid exposure that could be of concern to bypassers.
EMF	Embedded design for EMF comprises the shielding part of the cable which is designed to the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines (1998) 'Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)' and guidelines (2010) 'Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz – 100 kHz)'. Embedded mitigation through the burial of cables instead of using overhead cables for SEP and DEP, as EMF decreases rapidly with distance and by burying the cables, eliminates the magnetic field and creates distance between any receptor at the surface (even directly above the cables), resulting in a lower field than what the cable itself generates. As stated in **Appendix 28.1 EMF Assessment**, for most designs evaluated, the magnetic fields reduce to a background level at the DCO order limits.

28.4 Impact Assessment Methodology

28.4.1. Policy, Legislation and Guidance

35. The following sections detail information on the key pieces of UK legislation, policy and guidance relevant to the assessment within this chapter. Further detail where relevant is provided in **Chapter 2 Policy and Legislative Context**.

28.4.1.1. National Policy Statements

36. The assessment of potential impacts upon health has been made with specific reference to the relevant NPS. These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to SEP and DEP are:
    - Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a);
    - NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b); and
    - NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c).
37. The specific assessment requirements for health, as detailed in the NPS, are summarised in **Table 28-6** together with an indication of the section of the ES chapter where each is addressed.
38. It is noted that the NPS EN-1, EN-3 and EN-5 are in the process of being revised. A draft version of each NPS was published for consultation in September 2021 (Department for Business, Energy and Industrial Strategy (BEIS), 2021a; 2021b; 2021c). A review of these draft versions has been undertaken in the context of the ES chapter.
39. **Table 28-6** includes a section for the draft version of the NPS, where relevant, in which additional NPS requirements not presented within the current NPS EN-1 have been included. A reference to the particular requirement's location within the draft NPS and to where within this ES chapter or wider ES it has been addressed has also been provided.
40. Minor word changes within the draft version which do not materially influence the NPS requirements have not been reflected in **Table 28-6**.
41. EN-3 (current or draft version) does not specifically include details on the assessment of health in relation to offshore wind farm projects.

Table 28-6: NPS Assessment Requirements

NPS Requirement	NPS Reference	Section Reference
NPS for Energy (EN-1)		
The energy NPSs are likely to contribute positively towards improving the vitality and competitiveness of the UK energy market by providing greater clarity for developers which should improve the UK's security of supply and, less directly, have positive effects for health and well-being in the medium to longer term through helping to secure affordable supplies of energy and minimising fuel poverty; positive medium and long term effects are also likely for equalities.	EN-1 paragraph 1.7.2	Noted. Wider societal benefits have been assessed in **Section 28.6.3.3**.
To consider the potential effects, including benefits, of a proposal for a project, the Infrastructure Planning Commission (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	EN-1 paragraph 4.2.2	Employment is considered within this chapter, as well as **Chapter 27 Socio-Economics and Tourism**. Well-being is considered throughout this chapter.

NPS Requirement	NPS Reference	Section Reference
matters such as employment, equality, community cohesion and well-being.		
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.	EN-1 paragraph 4.10.1	Potential discharges and emissions are considered in this chapter, as well as **Chapter 7 Marine Water and Sediment Quality**, **Chapter 17 Onshore Ground Conditions and Contamination**, **Chapter 18 Water Resources and Flood Risk**, **Chapter 22 Air Quality** and **Chapter 23 Noise and Vibration**.
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.	EN-1 paragraph 4.10.2	The effects to human health are considered in **Section 28.6**.
Energy production has the potential to impact on the health and well-being ("health") of the population. Access to energy is clearly beneficial to society and to our health as a whole. However, the production, distribution and use of energy may have negative impacts on some people's health. 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.	EN-1 paragraphs 4.13.1 and 4.13.2	The effects to human health are considered in **Sections 28.6** and **28.7**. The wider societal benefits of SEP and DEP are discussed in **Section 28.6.3.3**.
The direct impacts on health may include increased traffic, air or water pollution, dust, odour, hazardous waste and substances, noise, exposure to radiation, and increases in pests.	EN-1 paragraph 4.13.3	Direct impacts to health are considered in **Chapter 17 Onshore Ground Conditions and Contamination**, **Chapter 18 Water Resources and Flood Risk**, **Chapter 22 Air Quality**, **Chapter 23 Noise and Vibration**, **Chapter 24 Traffic and Transport** and the **Waste Assessment** (**Appendix 17.2**) and this chapter summarises the results from these assessments and explains

NPS Requirement	NPS Reference	Section Reference
		the public health implications.
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 key public services, transport or the use of open space for recreation and physical activity. 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 air pollution) which will constitute effective mitigation of them, so that it is unlikely that health concerns will either constitute a reason to refused consents or require specific mitigation under the Planning Act 2008. However, the IPC will want to take account of health concerns when setting requirements relating to a range of impacts such as noise.	EN-1 paragraph 4.13.4 and 4.13.5	These type of human health effects are considered in **Section 28.6**, and **Chapter 19 Land Use, Agriculture and Recreation** and **Chapter 24 Traffic and Transport**.
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. 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.	EN-1 paragraph 5.10.2 and paragraph 5.10.6	Within the current DCO order limits, there is no plan to build on any open space, sports or recreational buildings and land. Effects on local communities are considered in this chapter in relation to physical activity and mental health, as well as in **Chapter 19 Land Use, Agriculture and Recreation** and **Chapter 27 Socio-Economics and Tourism**.
Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. 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.	EN-1 paragraph 5.11.6 and paragraph 5.11.9	Operational health effects are considered in **Section 28.6.3** and **Chapter 23 Noise and Vibration**. Potential health effects are considered in **Sections 28.6.1** and **28.6.3**.
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	EN-1 paragraph 5.14.1	Potential health effects are considered in **Section 28.6.1** and **Chapter 17**

NPS Requirement	NPS Reference	Section Reference
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.		**Onshore Ground Conditions and Contamination**.
During the construction, operation and decommissioning phases, developments 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.	EN-1 paragraph 5.15.1	Potential health effects are considered in **Sections 28.6.1** and **Chapter 18 Water Resources and Flood Risk**.
NPS for Electricity Networks Infrastructure (EN-5)		
All overhead power lines produce EMFs, and these tend to be highest directly under a line, and decrease to the sides at increasing distance. Although putting cables underground eliminates the electric field, they still produce magnetic fields, which are highest directly above the cable (see para 2.10.12). EMFs can have both direct and indirect effects on human health. The direct effects occur in terms of impacts on the central nervous system resulting in its normal functioning being affected. Indirect effects occur through electric charges building up on the surface of the body producing a microshock on contact with a grounded object, or vice versa, which, depending on the field strength and other exposure factors, can range from barely perceptible to being an annoyance or even painful To prevent these known effects, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) developed health protection guidelines in 1998 for both public and occupational exposure… The reference levels are such that compliance with them will ensure that the basic restrictions are not reached or exceeded. However, exceeding the reference levels does not necessarily mean that the basic restrictions will not be met; this would be a trigger for further investigation into the specific circumstances. For protecting against indirect effects, the ICNIRP 1998 guidelines give an electric field reference of 5kV m^{-1} for the general public, and keeping electric fields below this level would reduce the occurrence of adverse indirect effects for most individuals to acceptable levels. When this level is exceeded, there is a suite of measures that may be called upon in particular situations, including provision of information, earthing and screening, alongside limiting the field. In some situations there may be no reasonable way of eliminating indirect effects.	EN-5 paragraphs 2.10.2 to 2.10.8	The EMF assessment is presented in **Appendix 28.1 EMF Assessment** and **Section 28.6.3.2**.

NPS Requirement	NPS Reference	Section Reference
The Health Protection Agency's (HPA) *[now UK Health Security Agency (UKHSA]* Centre for Radiation, Chemical and Environmental Hazards (CRCE) provides advice on standards of protection for exposure to non-ionizing radiation, including the ELF EMFs arising from the transmission and use of electricity. In March 2004, the National Radiological Protection Board (NRPB) (now part of HPA CRCE), published advice on limiting public exposure to electromagnetic fields. The advice recommended the adoption in the UK of the EMF exposure guidelines published by ICNIRP in 1998. These guidelines also form the basis of a 1999 EU Recommendation on public exposure and a Directive on occupational exposure [*and Control of Electromagnetic Fields at Work Regulations 2016*]. Resulting from these recommendations, Government policy is that exposure of the public should comply with the ICNIRP (1998) guidelines [in terms of the EU Recommendation]. The electricity industry has agreed to follow this policy. Applications should show evidence of this compliance as specified in 2.10.9 below. 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 HPA CRCE 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. The Department of Health's Medicines and Healthcare Products Regulatory Agency (MHRA) [*now Department of Health and Social Care's Medicines and Healthcare Products Regulatory Agency (MHRA)*] does not consider that transmission line EMFs constitute a significant hazard to the operation of pacemakers. There is little evidence that exposure of crops, farm animals or natural ecosystems to transmission line EMFs has any agriculturally significant consequences.		
Draft NPS for Energy (EN-1)		
All proposals for projects that are subject to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) must be accompanied by an Environmental Statement (ES) describing the aspects of the environment likely to be significantly affected by the project. The Regulations specifically refer to effects on population, human health, biodiversity, land, soil, water, air, climate, the landscape, material assets	EN-1 paragraph 4.2.1	This chapter provides the health assessment for SEP and DEP.

NPS Requirement	NPS Reference	Section Reference
and cultural heritage, and the interaction between them. The Regulations require an assessment of the likely significant effects of the proposed project on the environment, covering the direct effects and any indirect, secondary, cumulative, transboundary, short, medium, and long-term, permanent and temporary, positive and negative effects at all stages of the project, and also of the measures envisaged for avoiding or mitigating significant adverse effects.		
…Opportunities should also be taken to mitigate indirect impacts, by promoting local improvements to encourage health and wellbeing, this includes potential impacts on vulnerable groups within society i.e. those groups within society which may be differentially impacted by a development compared to wider society as a whole.	EN-1 paragraph 4.3.5 (slight addition to end of paragraph 4.13.5 of current EN-1 (DECC, 2011a))	The site selection process for SEP and DEP had the approach of mitigation by design (i.e. embedded mitigation). This means that during the course of the design development of the DCO order limits for SEP and DEP, there were a number of multidisciplinary workshops that sought to integrate technical, land, community, environmental, ecology and landscape constraints in the final design for the DCO Application. This is detailed further in Chapter 3 Site Selection and Assessment of Alternatives and the embedded mitigation section (**Section 28.3.5**) of each chapter. Where relevant, additional mitigation measures have been recommended in this chapter.

28.4.1.2. Other Policy and Guidance

42. In addition to the NPS, there are a number of legislative, policy and guidance documents applicable to the assessment of human health. A summary of the key national policy considerations outside of the NPS is provided in **Table 28-7**.

Table 28-7: Additional Relevant National and / or Local legislation, Policy and Guidance

Policy Consideration	Relevance to Health Assessment
National Legislation, Policy and Guidance	
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations 2017)	The 2017 update of the EIA Regulations clarified that 'population and human health' was to be included in the list of topics to be considered in an EIA: *"The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on the following factors – population and human health".*

Policy Consideration	Relevance to Health Assessment
Health and Safety at Work Act 1974	The act sets a duty on employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all their employees. Similarly, employers must also ensure, so far as is reasonably practicable, that persons not in their employment are not exposed to risks to their health or safety as a result of activities being undertaken.
The Health Protection (Notification) Regulations 2010	Under the Public Health (Control of Disease) Act 1984, as amended by the Health and Social Care Act 2008, a suite of new regulations, The Health Protection (Notification) Regulations came into effect in April 2010, covering notifications, local authority powers and Part 2A Orders.
Clean Air Act 1993	The Act establishes measures 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).
Environmental Protection Act 1990 (EPA 1990)	Established a system of industrial process regulation and control on emissions. Part III of the EPA 1990 sets out 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). Led to the UK's first Air Quality Strategy in 1997.
Environment Act 1995	Placed duties on Local Authorities to review air quality and to designate Air Quality Management Areas where health-based standards are not met. The Air Quality (England) Regulations 2000 laid down ambient air quality standards for a range of air pollutants.
International Convention for the Prevention of Pollution from Ships (MARPOL) 1973	Regulations aimed at preventing and minimising, both accidental and operational, pollution from ships are included in the MARPOL (International Maritime Organisation, 1973).
Bathing Water Directive 2006/7/EC	The revised Bathing Water Directive 2006/7/EC safeguards public health and clean bathing waters (European Parliament and Council of the European Union, 2006).
Water Framework Directive 2000/60/EC (WFD)	The WFD sets out a commitment to protecting water bodies, including bodies of water designated as recreational waters (European Parliament and Council of the European Union, 2000).
Planning Practice Guidance (PPG) on EIA	The guidance explains the requirements of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.
PPG on Healthy and Safe Communities	The guidance encourages the promotion of healthy and safe communities.
Institute of Environmental Management and Assessment (IEMA) (2017): Health in Environmental Impact Assessment	The guidance raises awareness of the implications of the 2017 revisions to the Environmental Impact Assessment legislation, in relation to population and human health in EIA (Cave *et al.*, 2017a).
IEMA, 2020 – Health Impact Assessment in Planning	The guidance brings together a selection of articles on health impact assessment in planning. It explores mechanisms by which health may be better integrated into the planning system as an integral part of EIA (Bagley *et al.*, 2020).
Institute of Public Health – Health Impact	This is Northern Irish and Republic of Ireland guidance, but it has relevance as a UK HIA guidance document as it provides relevant reference assessment methods.

Policy Consideration	Relevance to Health Assessment
Assessment Guidance (2021)	
International Association for Impact Assessment (IAIA) and European Public Health Association (EUPHA) – Human health: Ensuring a high level of protection (2020)	A reference paper on addressing human health in EIA, as per EU Directive 2011/92/EU amended by 2014/52/EU. This is the international consensus position from public health and impact assessment on the coverage of human health in EIA.
Public Health England (PHE) Health and Environmental Impact Assessment	PHE issued a briefing note on health in EIA for public health teams (Cave *et al.*, 2017b).
Department of Health and Social Care, 2010 – Health Impact Assessment of Government Policy	The specialist guidance provides general principles and is used as contextual guidance in the production of this chapter.
Environmental, Health and Safety Guidelines for Wind Energy. World Bank Group, 2015	The guidance advises that community health and safety hazards specific to wind energy include blade or ice throw, aviation impacts, marine navigation, electromagnetic fields, public access, and abnormal load transportation. Blade or ice throw impacts are unlikely to impact on local populations along the onshore cable corridor due to the distance of the projects from the coast (see **Chapter 4 Project Description**).
PHE (2013) Electric and magnetic fields: health effects of exposure	This guidance has been used to consider the effects of electromagnetic fields (EMFs).
PHE (2020) Health Impact Assessment in spatial planning	This guide is for local authority public health and planning teams, however, supports the use of health impact assessment in the spatial planning process.
Review of the scientific evidence for limiting exposure to electromagnetic fields (0-300 GHz). NRPB, 2004	The NRPB published advice on limiting public exposure to electromagnetic fields and recommended the adoption in the UK of the EMF exposure guidelines published by the ICNIRP.
UK Stakeholder Advisory Group on Extremely Low Frequency Electric and Magnetic Fields (SAGE), 2010	This guidance has been used to consider the effects of EMFs.
Guidance Demonstrating compliance with EMF public exposure guidelines: voluntary code of practice (DECC, 2012)	The voluntary code of practice concerns situation where it is necessary to demonstrate compliance with the exposure guidelines that apply to public exposure to power frequency EMFs in the UK.

Policy Consideration	Relevance to Health Assessment
Industrial Strategy White Paper - Building a Britain fit for the future (HMSO, 2017b)	Sets out the government's vision for the UK economy, with the strategy's underlying motivation '*to create an economy that boosts the productivity and earning power throughout the UK'*. The Industrial Strategy identifies five foundations, including investment in digital, transport, housing, low carbon and other infrastructure. Identifies clean growth as one of the main opportunities for the UK economy to take advantage of, through the '*development, manufacture and use of low carbon technologies, systems and services*'. Offshore wind is one of the areas where the UK has world-leading capabilities. The Industrial Strategy aims to maximise the share of global markets taken up by UK businesses in the sector.
The Clean Growth Strategy, Leading the way to a low carbon future (HMSO, 2017c)	Connected to the UK Industrial Strategy, the Clean Growth Strategy seeks to ensure that economic growth goes hand in hand with greater protection for the natural environment. Within this is a commitment to help businesses and entrepreneurs seize opportunities of a low carbon economy, and specifically offshore wind. Under its ambition to deliver clean, smart and flexible power the Clean Growth Strategy seeks to deliver a diverse electricity system that supplies homes and businesses with secure, affordable and clean power. The Strategy seeks to deliver this through the development of low carbon sources of electricity (including renewables) and acknowledges that the UK is well-paced to benefit and become one of the most advanced economies for smart energy and technologies.
Offshore Wind: Sector Deal (HMSO, 2019a)	The Offshore Wind Sector Deal commits to help the industry raise the productivity and competitiveness of UK companies to ensure the UK continues to play a leading role as the global market grows in the decades to 2050. Key commitments include: Increasing UK Content to 60% of value associated with offshore wind farm activity by 2030; £250 million industry investment in building a stronger UK supply chain to support productivity and increase competitiveness; Provide forward visibility of future Contracts for Difference (CfD) rounds with support of up to £557 million; Increasing exports fivefold to £2.6 billion by 2030; and Increasing the representation of women in the offshore wind workforce to at least a third by 2030.
National Planning Policy Framework (NPPF)	Emphasises that one of the overarching objectives of the planning system is to contribute to the achievement of sustainable development. In paragraph 148, NPPF explains that the planning system should support the transition to a low carbon future, and states that the planning system should shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and provide resilience to the impacts of climate change, whilst also supporting the delivery of renewable and low carbon energy and associated infrastructure. Section 8 (Promoting healthy and safe communities) is the key policy text for EIA health assessments in the NPPF. Paragraph 92 states: *"Planning policies and decisions should aim to achieve healthy, inclusive and safe places …."*

Policy Consideration	Relevance to Health Assessment
	Paragraph 100 states that *"Planning policies and decisions should protect and enhance public rights of way and access…."*
UK Marine Policy Statement (MPS) (HMSO, 2011)	The MPS states that properly planned developments in the marine area can provide both environmental and social benefits, whilst also driving economic development, providing opportunities for investment and generating export and tax revenues. This includes the '*obvious'* social and economic benefits from such an increase in network capacity, most notably the facilitation of offshore renewable energy.
Joint Core Strategy for Broadland, Norwich and South Norfolk (2014)	The Joint Core Strategy for Broadland, Norwich and South Norfolk is relevant to local planning policy of BDC and SNC. The Strategy sets out the long-term vision and objectives for the area, including strategic policies for steering and shaping development. The spatial vision section of the Strategy reference health as follows*: "All communities will be safer, healthier, more prosperous, sustainable and inclusive… people will enjoy healthy, safe and fulfilling lifestyles, have equitable access to high standards of health and social care and make informed choices about their own health"*. Outlines the ambition to ensure more energy is sourced from renewable sources (including offshore wind), with the following identified as being pertinent to the health assessment: **Policy 3**: Energy and water – aims to minimise reliance on non-renewable energy sources and maximise the use of low carbon sources; **Policy 5**: The economy – states that *"the local economy will be developed in a sustainable way to support jobs and economic growth in both urban and rural locations"*. **Policy 7**: Supporting communities – states that "*healthier lifestyles will be promoted by maximising access by walking and cycling and providing opportunities for social interaction and greater access to green space and the countryside"*. **Policy 21**: Implementations of proposals in the Broadland part of the Norwich Policy Area – states that the Broadland District Council will *"work proactively with applicants jointly to find solutions [and] secure development that improves economic, social and environmental conditions in the area*".
North Norfolk Core Strategy	The Strategy is relevant to the local planning policy of NNDC and sees an increasing role for renewable energy generation (including offshore wind): **Core Aim 2** – focusses on mitigating and adapting the effects of climate change by encouraging renewable energy production. **Policy EN7** – states that renewable energy proposals will be supported, and that for large-scale projects proposals should seek to deliver economic, social, environmental and/ or community benefits of a reasonable scale to the local area. **Policy EN13** – states that "*All development proposals should minimise, and where possible reduce, all emissions and other forms of pollution, including light and noise pollution, and ensure no deterioration in water quality. Proposals will only be permitted where, individually or cumulatively, there are no unacceptable impacts on; … health and safety of the public…*".
Norfolk's Joint Strategic Needs Assessment	The local health priorities of focus in Norfolk, as identified in the JSNA, are:

Policy Consideration	Relevance to Health Assessment
(JSNA) (NCC, 2014) and Norfolk Health and Wellbeing Strategy (Health and Wellbeing Board Norfolk and Waveney, 2018)	*"Starting well – promoting the social and emotional wellbeing of pre-school children* *Living well – reducing obesity* *Ageing well – making Norfolk a better place to live for people with dementia and their carers"* The Strategy focuses the on a single sustainable system which prioritises: • Prevention by supporting people to be healthy, independent and resilient • Tackles health inequalities in communities by providing most support for those who are most in need; and • Integrates ways of working in delivering people centred care.

43. Further detail where relevant is provided in **Chapter 2 Policy and Legislative Context**.

28.4.1.3. EMFs

44. A High Voltage Alternating Current (HVAC) transmission system will be used for the transmission of the power from the wind farm site/s to the onshore substation as part of SEP and/or DEP. Due to the fact that EMF from AC induces a current in a conducting medium and EMF from Direct Current (DC) does not, two different exposure limits are considered under UK regulations.

45. The NRPB, in March 2004, provided new advice to Government, replacing previously published advice, which recommended the adoption of the ICNIRP 'Guidelines for Limits of Exposure to Static magnetic fields' guidance (1998). The NRPB joined the HPA in April 2005, becoming the Radiation Protection Division, which then later became Public Health England in 2013 and UKHSA in 2021. The recommended values are summarised in **Table 28-8**.

Table 28-8: Recommended Values for Power Frequencies

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

46. The ICNIRP guidelines (ICNIRP, 1998) are designed to prevent external exposure to EMFs, with a large safety margin, that could cause currents to be induced in the body that are large enough to cause effects on nerves. The guidelines are based on current density. The ICNIRP guidelines recommend that the general public are not exposed to levels of EMFs able to cause a current density of more than $2mA/m^2$ within the

human central nervous system (**Table 28-8**). This recommendation is described as the "basic restriction".

47. 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).

48. Under the ICNIRP guidelines, the limits adopted are the basic restrictions. The reference levels are used as guides to when detailed investigation of compliance with the basic restrictions is required. If the reference level is not exceeded, the basic restriction cannot be exceeded, and no further investigation is required. If the reference level is exceeded, the basic restriction may or may not be exceeded.

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

50. Further details on EMFs and the EMF assessment for SEP and DEP are provided in **Appendix 28.1 EMF Assessment**.

28.4.2. Data and Information Sources

51. This chapter has drawn information from the following chapters and the data sources presented within them:

- **Chapter 17 Onshore Ground Conditions and Contamination**;
- **Chapter 18 Water Resources and Flood Risk**;
- **Chapter 19 Land Use, Agriculture and Recreation**;
- **Chapter 22 Air Quality**;
- **Chapter 23 Noise and Vibration**;
- **Chapter 24 Traffic and Transport**; and
- **Chapter 27 Socio-Economics and Tourism**.

52. Other sources that have been used to inform the assessment are listed in **Table 28-9**.

Table 28-9: Other Available Data and Information Sources

Source	Dataset/Source	Spatial Coverage	Year (Released)
PHE (now OHID)	Wider Determinants of Health (OHID, 2022a)	England, Norfolk and Local Authority Districts within Norfolk	Variable
	Local Authority Health Profiles (OHID, 2022b)		Variable
	Public Health Outcome Framework (OHID 2022c)		Variable
	Local Health (OHID, 2022d)	England, Norfolk, local and site-specific areas	Variable
Ministry for Housing, Communities and Local Government (MHCLG)	Indices of Deprivation (MHCLG, 2019a to 2019e)	Neighbourhoods (LSOAs) aggregated to the UK, local authority district level	2019

Source	Dataset/Source	Spatial Coverage	Year (Released)
Norfolk Insight	Area Reports (Norfolk Insight, 2022)	Site-specific, local and regional areas	2022
ONS	Census data	UK	2011
	Population projections for local authorities (2020)	District, regional	2020
	Mid-2020 population estimate (2021a)	District, regional, national	2021
	LSOA population estimates (supporting information) (2021b)	Neighbourhoods (Lower Super Output Areas) aggregated to the UK, local authority district level	2021

28.4.3. Impact Assessment Methodology

28.4.3.1. General Approach

53. This section outlines the methodology used for the identification and assessment of any likely significant effects by SEP and DEP on human health, as is required by the EIA Regulations 2017.

54. The methods identify effects that either provide, or fail to provide, a high level of protection to human health. This includes reasoned conclusions in relation to health protection, health improvement and/or improving services.

55. A framework is presented to determine the 'likelihood' of a project having an effect on health, and the 'significance' of an effect in terms of the EIA Regulations.

56. Effects are considered with regard to the general population and vulnerable groups.

28.4.3.1.1. Population Conclusions

57. In line with relevant guidance set out in **Section 28.4.1**, 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 (or for a defined area); and
- A second separate sub-population conclusion for relevant vulnerable group (as a single defined class of sensitivities for that issue).

28.4.3.2. Health Determinants

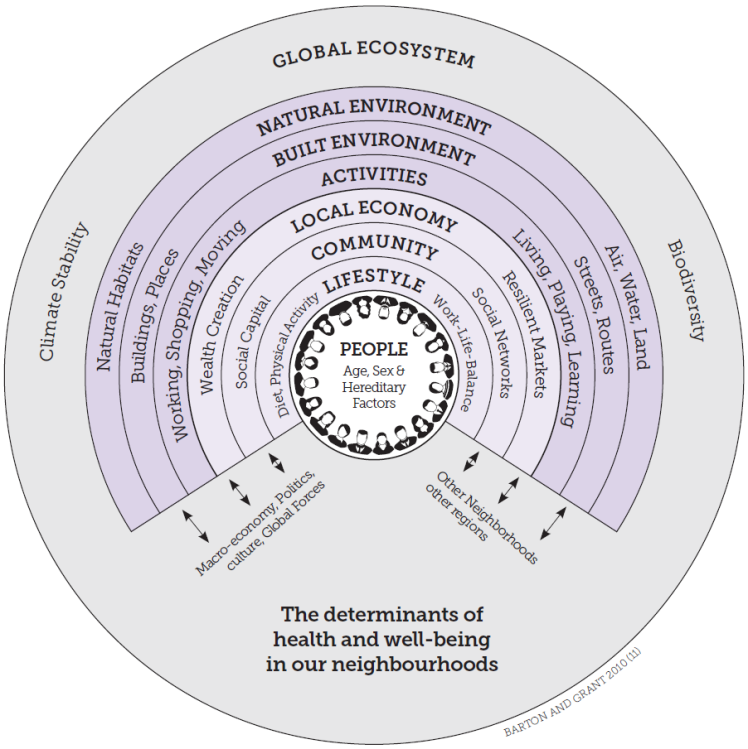
58. Health determinants are considered in order to understand the effects on human health and wellbeing. The methodology adopted in this chapter uses the emerging best practice by IEMA (Cave et al., 2017a), IAIA & EUPHA (2020), PHE (2020) and IPH (2021).

59. A wide variety of direct and indirect factors can influence human health, from controllable factors such as lifestyle to uncontrollable factors such as genetics. The effects are often wide-ranging and are likely to vary between individuals.

60. In determining 'physical, mental and social wellbeing', external contributory factors, known as 'determinants', are considered. Determinants are made up of a combination of influences from an individual's society and environment.

61. This chapter adopts the 'wider determinants of health' model, illustrated in **Plate 28.1** which is used to conceptualise how human health spans across environmental, social, behavioural, economic and institutional components.

Plate 28.1: Wider determinants of public health



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

62. Changes 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, and are dependent upon the degree of personal choice, location, mobility, and exposure.

63. An increase in air pollution is an example of a change in determinants leading to an adverse effect on health. Evidence suggests that exposure to fine particulate matter ($PM_{2.5}$) increases mortality risk, particularly from heart and lung conditions (Air Quality Expert Group, 2012). On the other hand, reductions in noise from traffic may lead to decreased stress and have a beneficial effect on health.

64. It is important to note the relationship between determinants of health, risk factors and health outcomes, i.e. a change in a determinant of health may affect a risk factor for a particular health condition. However, a change in a determinant of health does not necessarily mean that all people will experience a change in their health outcomes.

28.4.3.3. Likelihood

65. The likelihood of a project having an effect is the first issue to consider as part of an assessment. A likely effect should be both probable and plausible:

- Plausible means there is a relevant source, pathway and receptor. Plausible effects relate to whether a causal relationship is adequately supported by the scientific literature.
- Probable relates to a qualitative judgement to exclude those effects that could only occur under certain very rare conditions, except where these relate to SEP and DEP's vulnerability to major accidents or disasters (as required by regulation 5(4) of the EIA Regulations 2017).

66. Likelihood considers the strength of evidence for there to be a source-pathway-receptor linkage in the particular circumstance of the project.

67. The definitions of a source, pathway and receptor are as follows:

- A 'source' represents the features of the SEP and DEP from which change originates (i.e. facility, structure, process, activity, vehicle fleet or workforce) and could lead to 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'.

68. **Table 28-10** presents the 'Source-Pathway-Receptor' criteria, based on the definitions above, adapted from IEMA (2017), Box 5,which is used to identify plausible health effects.

Table 28-10: The 'Source-Pathway-Receptor' Model Used to Identify Plausible Health Effects

Source	Pathway	Receptor	Is there a plausible effect?	Justification
✓	✓	×	No	No receptors which would be sensitive and vulnerable are present.
✓	×	✓	No	There is no means of transmission from the source to a population.
×	✓	✓	No	There is no source from which a potential effect could instigate.
✓	✓	✓	Yes	Identifying a source, pathway and receptor does not mean a health impact is a likely significant effect. The particular circumstance of the project

Source	Pathway	Receptor	Is there a plausible effect?	Justification
				should also be considered, as should the potential significance of the effect.

28.4.3.4. Significance – Sensitivity and Magnitude

69. Where a potential effect is considered to be likely, the determination of the significance of the effect is required.

70. The determination of significance has two stages:

- Firstly, the sensitivity of the receptor affected, and the magnitude of the impact upon it are characterised. This establishes whether there is a relevant population and a relevant change to consider; and
- Secondly, a professional judgement is made (considering the sensitivity and magnitude conclusions together) as to whether the expected change in a population's health outcomes would be significant in public health terms. This judgement is explained using an evidence-based narrative setting out reasoned conclusions.

71. The following methods presented in this, and subsequent, sections are a refinement of the approach presented at the PEIR. The refinement reflects guidance developments within the field. These methods are consistent with those used at PEIR but add additional detail that improves the transparency with which scores on health significance are reached. The use of this assessment methodology was agreed with the Public Health team at Norfolk County Council.

72. **Table 28-11** and **Table 28-12** summarise the EIA health assessment methodology scoring of sensitivity and magnitude. This good practice approach is based on recent guidance (IPH, 2021; IAIA/EUPHA, 2020) and can be applied consistently to all determinants of health. The tables support narrative conclusions. This approach shows how the general EIA methods of using sensitivity and magnitude to inform a judgement of significance are applied for human health.

73. The approach uses professional judgement, drawing on consistent and transparent criteria for sensitivity and magnitude. It also references relevant contextual evidence to explain what significance means for human health in terms of the importance, desirability or acceptability of a change in population health outcomes. This follows the European Commission definition of EIA significance that *"the assessment of significance relies on informed experts' judgements about what is important, desirable or acceptable with regards to changes triggered by the Project in question. These judgements are relative and must always be understood in their context…"* (EC,2017).

74. The following general characteristics of how the 'general population' may differ from 'vulnerable group population' was considered when scoring sensitivity. These statements were not duplicated in each assessment and apply (as relevant) to the issues discussed for both construction and operation.

- In terms of life stage, the general population can be characterised as including a high proportion of people who are independent, as well as those who are providing some care. By contrast, the vulnerable group population can be characterised as including a high proportion of people who are providing a lot of care, as well as those who are dependant.
- The general population can be characterised as experiencing low deprivation. However, the professional judgment is that the vulnerable group population experiences high deprivation (including where this is due to pockets of higher deprivation within low deprivation areas).
- The general population can be characterised as broadly comprised of people with good health status. Vulnerable groups, however, tend to include those parts of the population reporting bad or very bad health status.
- The general population tends to include a large majority of people who characterise their day-to-day activities as not limited. The vulnerable group population tends to represent those who rate their day-to-day activities as limited a little or limited a lot.
- Based on a professional judgement the general population's resilience (capacity to adapt to change) can be characterised as high, whilst the vulnerable group population can be characterised as having limited resilience.
- Regarding the usage of affected infrastructure or facilities, the professional judgement is that the general population are more likely to have many alternatives to resources shared with the SEP and DEP. For the vulnerable group population, the professional judgement is that they are more likely to have a reliance on shared resources.

Table 28-11: Health Sensitivity Methodology Criteria

Category/Score	**Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories)** The narrative explains that the population or sub-population's sensitivity is driven by (select as appropriate):
High	**high** levels of deprivation (including pockets of deprivation); **reliance** on resources shared (between the population and the project); existing **wide** inequalities between the most and least healthy; a community whose outlook is predominantly anxiety or **concern**; people who are **prevented** from undertaking daily activities; **dependants**; people with **very poor** health status; and/or people with a **very low** capacity to adapt.
Medium	**moderate** levels of deprivation; **few alternatives** to shared resources; existing **widening** inequalities between the most and least healthy; a community whose outlook is predominantly **uncertainty** with some concern; people who are **highly limited** from undertaking daily activities; people providing or requiring **a lot of care**; people with **poor** health status; and/or people with a **limited** capacity to adapt.
Low	**low** levels of deprivation; **many alternatives** to shared resources; existing **narrowing** inequalities between the most and least healthy; a community whose outlook is predominantly **ambivalence** with some concern; people who are **slightly limited** from

	undertaking daily activities; people providing or requiring **some care**; people with **fair** health status; and/or people with a **high** capacity to adapt.
Negligible	**very low** levels of deprivation; **no** shared resources; existing **narrow** inequalities between the most and least healthy; a community whose outlook is predominantly **support** with some concern; people who are **not limited** from undertaking daily activities; people who are independent (not a carer or dependant); people with **good** health status; and/or people with a **very high** capacity to adapt.

Table 28-12: Health Impact Magnitude Methodology Criteria

Category/Score	**Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories)** The narrative explains that the project change has (select as appropriate):
High	**High** exposure or scale; **long-term** duration; **continuous** frequency; severity predominantly related to **mortality** or changes in morbidity (physical or mental health) for very severe illness/injury outcomes; **majority** of population affected; **permanent** change; **substantial** service quality implications.
Medium	**Low** exposure or **medium** scale; **medium-term** duration; **frequent** events; severity predominantly related to moderate changes in **morbidity** or major change in quality-of-life; **large minority** of population affected; **gradual** reversal; **small** service quality implications.
Low	**Very low** exposure or **small** scale; **short-term** duration; **occasional** events; severity predominantly related to minor change in **morbidity** or moderate change in quality-of-life; **small minority** of population affected; **rapid** reversal; **slight** service quality implications.
Negligible	**Negligible** exposure or scale; **very short-term** duration; **one-off** frequency; severity predominantly relates to a minor change in **quality-of-life**; very few people affected; immediate reversal once activity complete; no service quality implication.

75. The EIA human health assessment is a qualitative analysis, following the IPH (2021) guidance approach, which draws on qualitative and quantitative inputs from other EIA topic chapters. This is considered the most appropriate methodology for assessing wider determinants of health proportionately, consistently and transparently.

76. The EIA health chapter conclusions are both EIA scores, such as major, moderate, minor or negligible; and a narrative explaining this score with reference to evidence, local context and any inequalities.

28.4.3.5. Judgement Framework for Significance

77. Having established that a source, pathway and receptor for a plausible health effect exists (as set out in **Section 28.4.3.3**), the magnitude/sensitivity criteria are used to consider whether there is a relevant population to consider and a relevant change in health outcomes, a decision is made as to whether or not the change in a population's health is significant or not, as set out in **Section 28.4.3.4**.

78. The consideration of the sensitivity of the receptor and magnitude of the impact 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.

79. 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.

80. **Table 28-13** and **Table 28-14** summarise the EIA health assessment methodology scoring of significance.

Table 28-13: Indicative EIA health significance matrix

		Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Magnitude	**High**	Major	Major/moderate	Moderate/minor	Minor/negligible
	Medium	Major/moderate	Moderate	Minor	Minor/negligible
	Low	Moderate/minor	Minor	Minor	Negligible
	Negligible	Minor/negligible	Minor/negligible	Negligible	Negligible

81. Where the matrix offers more than one significance option, professional judgement is used to decide which option is most appropriate.

Table 28-14: Health Significance Methodology Criteria

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories)
Major	The narrative explains that this is significant for public health because (select as appropriate): Changes, due to the project, have a **substantial** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size (magnitude and sensitivity scores), and as informed by consultation themes among stakeholders, particularly public health stakeholders, that show **consensus** on the importance of the effect. Change, due to the project, could result in a regulatory threshold or statutory standard being **crossed** (if applicable). There is likely to be a **substantial** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **causal** relationship between changes that would result from the project and changes to health outcomes.

	In addition, health priorities for the relevant study area are of **specific** relevance to the determinant of health or population group affected by the project.
Moderate	The narrative explains that this is significant for public health because (select as appropriate): Changes, due to the project, have an **influential** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size, and as informed by consultation themes among stakeholders, which may show **mixed views**. Change, due to the project, could result in a regulatory threshold or statutory standard being **approached** (if applicable). There is likely to be a **small** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **clear** relationship between changes that would result from the project and changes to health outcomes. In addition, health priorities for the relevant study area are of **general** relevance to the determinant of health or population group affected by the project.
Minor	The narrative explains that this is not significant for public health because (select as appropriate): Changes, due to the project, have a **marginal** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size of limited policy influence and/or that **no** relevant consultation themes emerge among stakeholders. Change, due to the project, would be **well within** a regulatory threshold or statutory standard (if applicable); but could result in a guideline being crossed (if applicable). There is likely to be a **slight** change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is only a **suggestive** relationship between changes that would result from the project and changes to health outcomes. In addition, health priorities for the relevant study area are of **low** relevance to the determinant of health or population group affected by the project.
Negligible	The narrative explains that this is not significant for public health because (select as appropriate): Changes, due to the project, are **not related** to the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size or lack of relevant policy, and as informed by the project having **no responses** on this issue among stakeholders. Change, due to the project, would **not affect** a regulatory threshold, statutory standard or guideline (if applicable). There is likely to be a **very limited** change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is an **unsupported** relationship between changes that would result from the project and changes to health outcomes. In addition, health priorities for the relevant study area are **not** relevant to the determinant of health or population group affected by the project.

82. The assessment provides reasoned conclusions for the professional judgement as to whether in EIA terms an effect 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.

83. For the purposes of the EIA, major and moderate effects are considered 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.

84. Mitigation has been considered to reduce the significance where significant adverse effects are identified. Additionally, enhancements have been considered where significant and proportionate opportunities to benefit population health have been identified.

85. The residual effects represent the output of iterative assessment, taking into consideration the mitigation measures.

86. The health assessment 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.

28.4.3.6. Cumulative Impact Assessment Methodology

87. The human health impact assessment takes a different approach to the methodology used for the CIA described in **Chapter 5 EIA Methodology**.

88. The cumulative assessment considers the inter-relationships between health effects both from SEP and DEP and in combination with effects from other projects. These are considered for the following project geographies:

- Landfall;
- Onshore cable corridor;
- Onshore substation site options;
- Locally, regional, and nationally.

89. The potential effects are also considered for the following vulnerable populations:

- Children and young people;
- Older people (particularly those with dementia);
- People living in deprivation (including those experiencing income and/or access/geographic vulnerability); and
- People with existing poor health (physical and mental health).

90. Firstly, the intra-project cumulative effects are considered. The aim of this step is to understand if different effects on health determinants from SEP and DEP would cumulatively create a larger health effect. For example, at a specific location of the project would changes to noise levels, traffic density, air quality, water contamination and reduced access combine to provide a more significant effect than as individual impacts.

91. Secondly, the inter-project cumulative effects are considered. As with other chapters, projects are screened for assessment based on a list agreed with local authorities. Then projects are considered for cumulative effect at different locations and for different vulnerable populations listed above.

28.4.4. Transboundary Impact Assessment Methodology

92. As detailed in **Table 28-1**, the Secretary of State agreed as part of the scoping opinion that transboundary health effects are unlikely to occur, and that this topic can be scoped out of the assessment.

28.5 Existing Environment

93. The existing environment has been categorised into the following eight themes that are likely to have an effect on human health:
    - General;
    - Noise;
    - Air quality;
    - Ground and/or water contamination;
    - Physical activity;
    - Journey times and/or reduced access;
    - Employment; and
    - EMFs.
94. Details of the statistics used in this assessment are provided in **Appendix 28.2 Health Baseline Statistics**. Data sources outlined in **Table 28-9** have been used to inform the baseline for this HIA.
95. The IMD (2019), has been consulted and referenced as appropriate, including sub-domains and underlying indicators (MHCLG 2019a); the 2019 Index is the most recent information available.

28.5.1. General

96. Details of the statistics used in this assessment are provided in **Appendix 28.2 Health Baseline Statistics**.
97. The land within the onshore DCO order limits is predominantly rural and the local area is typified by small villages and individual residential properties. The onshore substation is located south of the Norwich Main substation, north west of the village of Swainsthorpe. This area is also rural in nature with the nearby village of Mulbarton, containing the largest concentration of residential properties.
98. The populations within North Norfolk, Broadland and South Norfolk have demonstrated moderate to low population growth between mid-2019 to mid-2020 of 0.3%, 0.9% and 1.6% respectively (ONS, 2021a). The projected population increases for North Norfolk (5.7%), Broadland (7.6%) and South Norfolk (13.9%), between 2019 and 2029 are higher than the England National average (4.7%) over the same time period (ONS, 2020a).
99. The LSOAs that are most representative of the landfall, onshore cable corridor and onshore substation (see **Table 28-2**) are used where possible in this section. All representative LSOAs and local authority areas mentioned above are considered above have a higher percentage of retirement-aged people when compared with the national UK average (18.5%) (Norfolk Insight, 2022).

100. Baseline statistics (provided in **Appendix 28.2 Health Baseline Statistics** and discussed further in **Sections 28.5.3** to **28.5.9**) show how near landfall, the general population are providing some care and a higher proportion of people report their health as fair (18.8%), bad or very bad (6.6%) compared to the regional (15.1% and 5.6% respectively) and national (13.1% and 5.4% respectively) averages. Health inequalities are narrow, i.e. not significantly different for people in the most deprived areas of North Norfolk than in the least deprived (PHE, 2020a), and are better than the regional and national averages. Life expectancy for women and men is higher than the local, regional and national averages. The representative populations at landfall considered in this assessment are slightly below the median for overall deprivation and a higher proportion of people report their day-to-day activities as limited a little (15%) and a lot (11.6%) compared to the regional (11% and 9.1% respectively) and national (9.3% and 8.3% respectively) average.

101. The general population along the cable corridor are providing some care (that is, usually unpaid care to dependents), and a higher proportion of people report their health as fair (15.6%) than regionally (15.1%) and nationally (13.1%). Health inequalities are narrowing (PHE, 2020b) and are better than the regional and national averages. Life expectancy for women and men is higher than the local, regional and national averages. The representative populations along the cable corridor considered in this assessment are slightly below the median for overall deprivation and a high proportion of people report their day-to-day activities as limited ‘a little’ (12.2%).

102. The general population near the onshore substation are providing some care and a high proportion of people report their health as good or very good (86.1%). Health inequalities are narrowing (PHE, 2020c) and are better than the regional and national averages. Life expectancy for women and men is higher than the local, regional and national averages. The representative populations near the onshore substation considered in this assessment are well above the median for overall deprivation and a high proportion of people report their day-to-day activities as ‘not limited’ (85.6%).

103. The majority of the onshore infrastructure is largely routed through agricultural land. The onshore cable corridor passes close to the built-up areas of Weybourne and Attlebridge; and passes close to some individual properties elsewhere along the route.

104. Individual community infrastructure receptors that are sensitive and could potentially influence population health from the construction phase have been discussed in the other chapters (e.g. air quality). Such receptors include residential properties, schools, hospitals, footpaths, cycleways, etc. This health chapter considers populations rather than community infrastructure receptors.

105. The health priorities identified in the Norfolk Health and Wellbeing Strategy (Norfolk and Waveney Health and Wellbeing Board, 2018) are the social and emotional wellbeing of children aged 0-5, obesity, and dementia (see **Table 28-7** for more details). The overall health of people locally is generally better than both Norfolk region and England averages (see **Table 28.1.2** of **Appendix 28.2 Health Baseline Statistics** for further details).

106. Health deprivation can increase sensitivity to change and can affect all the topics detailed in **Sections 28.5.2** to **28.5.8**. Deprivation statistics for site-specific, local, regional and national level are provided in **Table 28-15**.

Table 28-15: 2019 Health Deprivation Statistics (MHCLG, 2019a to 2019e)

Deprivation Statistic	Site-Specific			Local (District)			Region	National
	Landfall	Onshore Cable Corridor	Onshore Substation	North Norfolk	Broadland	South Norfolk	Norfolk	England
	North Norfolk 004A	North Norfolk 006C	South Norfolk 006G	Rank of Average Rank				Context
For overall deprivation*	13,124	11,999	21,617	94	257	225	81	32,488 LSOAs 317 Local Districts 151 Regions
Income rank*	18,699	17,833	23,499	122	246	229	89	
Relative deprivation by neighbourhoods in England**	4	4	7	-	-	-	-	
Income deprivation in children (IDACI)*	19,091	16,474	28,575	143	262	246	92	
Relative IDACI by neighbourhoods in England**	6	6	9	-	-	-	-	
Income deprivation in older people (IDAOPI)*	23,092	21,755	18,950	167	250	230	96	
Relative IDAOPI by neighbourhoods in England**	8	7	6	-	-	-	-	
Employment rank*	14,000	20,060	23,877	99	208	218	75	
Education, Skills and Training rank*	17,734	13,508	27,833	66	168	197	31	
Health Deprivation and Disability rank*	20,140	24,207	25,827	135	226	253	77	
Crime rank*	31,126	31,844	21,114	307	306	293	131	
Barriers to Housing and Services rank*	1,029	704	10,125	24	165	88	63	
Living Environment rank*	4,239	1,138	3,554	63	206	126	81	

*Where 1 is the most deprived
**Where 1 is most deprived 10% of LSOAs and 10 is least deprived 10% of LSOAs

107. For overall deprivation, site-specific LSOAs are among the 40% most deprived (landfall and onshore cable corridor) and 40% least deprived (onshore substation) LSOAs. At a site-specific level, IDACI is among the 20-50% least deprived LSOAs and IDAOPI is among the 30-50% least deprived LSOAs.

108. At a local level, North Norfolk is generally more deprived, and Broadland is the least deprived of the three local authority areas.

109. The sensitivity of the affected population to potential health effects has given regard to site specific (i.e. LSOA) data where possible. In some cases, health effects are presented at a local and regional level only as they are not reported on the site-specific level.

28.5.2. Climate Change and Natural Trends

110. Paragraph 3, Schedule 4 of the EIA Regulations 2017 require that *"an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge"* is included within the ES. From the point of assessment, over the course of the development and operational lifetime of the SEP and/or DEP (the operational lifetime of which is anticipated to be 40 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the anticipated evolution of the baseline environment, on the assumption that SEP and/or DEP are/is not constructed, using available information and specialist technical knowledge of health.

111. The health assessment draws from several ES chapters (as listed in **paragraph 3**) and a detailed discussion of the predicted future baseline of each topic can be found in their respective chapters. A brief summary (of each topic) has been included below for completeness; these statements refer to the lifetime of SEP and/or DEP.

112. Noise and Vibration

- A general steady baseline soundscape would be maintained within the study area.

113. Air Quality

- Air quality in North Norfolk, Broadland and South Norfolk is expected to improve over time with the evolution of the vehicle fleet exhaust specifications and the increasing proportion of alternative fuelled vehicles in the fleet, combined with measures implemented by NNDC, BDC, SNC and NCC and future road improvements; and
- Future pollutant concentrations are anticipated to reduce from baseline levels.

114. Geology and Ground Conditions

- Geology: no major changes to the geology underlying the study area are anticipated;
- Hydrogeology: baseline groundwater is likely to improve over time through the natural breakdown of chemicals that may currently be present in groundwater bodies;

- Hydrology and surface drainage: the surface drainage network could change, with higher winter flows, lower summer flows and a greater number of storm-related flood flows due to climate change. The risk of flooding will be amplified as a result of the predicted increase in rainfall, with an increase in peak river flows and an increase in the magnitude of surface water flooding.

115. Land Quality

- Contamination sources: potential to increase exposure risks to pre-existing sources due to increased rates of infiltration due to heavier rainfalls or dust generation through drier summers. There will be a general improvement in land quality over time due to the breakdown of some contaminants.

116. Hydrology and Flood Risk

- Geomorphology and water quality: ongoing measures to reduce existing pressures on geomorphology and water quality as part of the implementation of the Water Framework Directive and restoration of the Wensum are likely to improve its condition over time, therefore a steady improvement in the baseline condition is expected.
- Hydrology and surface drainage: the surface drainage network is expected to change, with higher winter flows, lower summer flows and a greater number of storm-related flood flows due to climate change. The risk of flooding will be amplified as a result of the predicted increase in rainfall, with an increase in peak river flows and an increase in the magnitude of surface water flooding. Therefore, the drainage network is unlikely to remain stable over time and may revert to more natural river types in future.
- Groundwater: ongoing initiatives are in place to reduce pressures on groundwater and would suggest that quality and quantity of groundwater is likely to improve in the future, although this would occur over long timescales.

117. Land Use

- Climate change could lead to greater rates of soil erosion. There could be a decline in the quality and availability of agricultural land over time as a through the addressing of issues and opportunities of Norfolk's Rural Development Strategy.
- Recreational demand is unlikely to change significantly.

118. Traffic and Transport

- Given the rate of technological advancement in decarbonisation of transport, and legal commitments to net-zero, it is anticipated that greenhouse gas (GHG) emissions will be reduced from current baseline levels.

- The contribution of decarbonisation from model shift is harder to forecast, especially given the significant ongoing travel choices changes related to the Covid-19 pandemic. The forecast for future traffic growth within the traffic and transport study area (see **Chapter 24 Traffic and Transport** for further details) TTSA has a basis in pre-Covid-19 travel patterns and is considered to be an upper bound of total traffic flows and a cautious application of model shirt. The forecast for future traffic growth presented in **Chapter 24 Traffic and Transport**, and subsequently used in the air quality (**Chapter 22 Air Quality**) and noise (**Chapter 23 Noise and Vibration**) assessments, are considered to be representative of a worst-case scenario in terms of total traffic on the highway network.

119. Socio-Economics

- Under a moderate climate change scenario, the health of the wider population may be adversely affected by increased risk of overheating and other heat-related illnesses, drought as well as decreased water and food security. This would be partially offset against a reduced risk of cold weather-related illness during winter, particularly in vulnerable groups such as the elderly. As such, health infrastructure within the local area could expect to see increased levels of demand, with potentially increasing ill-health, along with an ageing population.
- That said, the changes in demography in addition to the loss of/ disruption to local and social infrastructure brought about as a result of SEP and DEP could be expected to be small in magnitude and of no implications when considered in relation to climate change and natural trends.
- Furthermore, changes in climate are likely to impact on overall volume and value of the tourism economy. However, at this stage it is not clear whether these impacts would be adverse or beneficial.
- Within the context of socio-economics and tourism, it is believed that climate factors will have little or no influence on the receptors assessed in **Chapter 27 Socio-Economics and Tourism**. This needs to be considered within the overall magnitude of impact created, which for the operation phase (assumed to be 40-years) will be minimal, and which need to be weighed against the long-term environmental benefits.

120. SEP and/or DEP will contribute to a reduction in climate change, as it will lead to a reduction in greenhouse gas (GHG) emissions compared to equivalent power generation from fossil fuel combustion (especially without carbon capture), and will contribute significantly to the decarbonisation of the UK energy supply. This is discussed and detailed further in the Greenhouse Gas Footprint Assessment for SEP and DEP (document reference 9.2). The GHG assessment concluded that SEP and/or DEP would have a **beneficial impact** in reducing GHG emissions, when compared to the relevant baseline scenario (i.e. assuming electricity is produced by combined cycle gas turbine, which is the most common form of new plant in terms of fossil fuel combustion) and will provide a renewable source of electricity which contributes beneficially to the UK's goal of achieving net zero emissions by 2050 – the role of the offshore wind sector is a focus of action to contribute to meeting this target.

121. The current baseline description in the section above and in the following sections (**Sections 28.5.2** to **28.5.9**) provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of construction for the onshore elements of SEP and/or DEP is 2025, with an anticipated operational life of 40 years, and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to health usually occur over an extended period of time.

122. Based on current information regarding reasonably foreseeable events over the next three years, the baseline environment is not anticipated to have fundamentally changed from its current state at the point in time when impacts occur.

123. It is acknowledged that the majority of the health statistics referenced in this chapter (and in **Appendix 28.2 Health Baseline Statistics**) predate the Covid-19 pandemic. Longer term trends and interventions in population health may influence the future baseline. NHS and social care, public health initiatives and government policies, aim to reduce inequalities and improve the quality of life. The historic success of such interventions is increasingly challenged by national trends such as an aging population, rising levels of obesity and the Covid-19 pandemic.

124. It would not be proportionate (or consistent with the qualitative assessment approach taken) to quantitatively model the population's future health. This reflects the complexities of interactions between the wider determinants of health, as well as the potential for macro-economic changes in the next decade that are hard to predict, any predication would have such wide error margins that it would greatly limit the value of the exercise. Annual national population health trend forecasting is undertaken by the 'Health profile for England' publication series and was taken into account in qualitatively describing future trends relevant to the SEP and DEP.

125. The baseline environment for operational/decommissioning impacts is expected to evolve as described below in **Section 28.5.2** , with the additional consideration that any changes during the construction phase will have altered the baseline environment to a degree (as set out in this chapter).

28.5.3. Noise

126. The environmental baseline for noise has been provided in **Chapter 23 Noise and Vibration**. The baseline and assessment for noise takes account of the existing quiet, rural nature of much of the surrounding environment.

127. The sensitivity of the affected population to noise effects has taken regard to site specific (i.e. LSOA) data (representative of landfall, cable corridor and onshore substation, see **Section 28.3.1**) where possible. Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate, and the human health baseline relevant to this topic is provided in **Appendix 28.2 Health Baseline Statistics**.

128. People who live near to the onshore DCO order limits and who spend extended periods at home may experience greater exposure duration (to SEP and/or DEP-related noise) than those who are absent during normal working hours. Baseline environmental data (see **Table 28.1.1** of **Appendix 28.2 Health Baseline Statistics**) show that near landfall and along the onshore cable corridor, a slightly higher proportion of people in general spend extended periods at home, than at the local, regional or national level. This refers to households with no adults in employment, one person in the household with a long-term problem or disability, people aged over 65 and retired people. Near the onshore substation, people generally spend less (or approximately the same amount of) time at home than at the local, regional or national level. This refers to the same parameters as previously mentioned.

129. **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics** provides the measure indicators that are available for noise effects. Some of these are not available at the site-specific or local level; therefore, local or regional level statistics were considered to be representative. The proportion of people regionally exposed to road, rail and air transport noise of 65dB(A) or more during the day and night is less than half of those nationally (day: 2.2% and 5.5% respectively, night: 3.1% and 8.5% respectively). The rate of complaint about noise (per 1,000 people) near landfall (3.8), along the cable corridor (3.3) and near the onshore substation (2.5) are less than regionally (4.1) and approximately half of the national complaint rate (6.4).

28.5.4. Air Quality

130. The environmental baseline for air quality is provided in **Chapter 22 Air Quality**. Air quality effects are expected at the site-specific level (see **Section 28.3.1**). Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate and the human health baseline relevant to this topic is provided in **Appendix 28.2 Health Baseline Statistics**.

131. As for noise, people who live adjacent to the onshore DCO order limits and who spend extended periods at home may experience greater exposure durations (to SEP and/or DEP-related air pollution) than those who are absent during normal working hours, therefore some of the information provided in **Section 28.5.3** is also of relevance to air quality.

132. Background air pollutant concentrations of $PM_{2.5}$ in Norfolk are 'well below' (i.e. less than 75% of) the UK air quality $PM_{2.5}$ target of 25µg/m^3, at 7.0µg/m^3 (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**). As detailed in **Chapter 22 Air Quality**, background pollutant concentrations of NO_2, PM_{10} and $PM_{2.5}$ are well below the health-based air quality Objectives and are anticipated to decrease further into the future. As detailed in **Table 28.1.2** in **Appendix 28.2 Health Baseline Statistics**, the under-75 mortality rate from respiratory diseases (per 100,000) locally (North Norfolk: 26.2, Broadland: 18.9, and South Norfolk: 16.7) is lower than the regional (29.0) and national rate (33.6).

28.5.5. Ground and/or Water Contamination

133. The environmental baseline for ground conditions and water contamination is provided in **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk** respectively.

134. The potential for ground disturbance of historic contamination of 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.

135. Children are more vulnerable to water contamination compared to adults as, in proportion to their body weight, they would ingest comparatively more contaminant than adults. Thus, the proportion of the population who are children and the overall population density was considered.

136. The proportion of the population who are under the age of 16 and the population density estimate (mid-2020 population estimates) are detailed in **Table 28.1.1** of **Appendix 28.2 Health Baseline Statistics**, and provided below for the different geographic levels is provided below:

- Site-specific:
  - Near landfall: 8%, 55 people/km^2
  - Along the onshore cable corridor: 17.2%, 41 people/km^2
  - Near the onshore substation: 17.1%, 79 people/km^2
- Local:
- North Norfolk: 13.6%, 109 people/km^2
- Broadland: 16.4%, 239 people/km^2
- South Norfolk: 18.1%, 158 people/km^2
- Regional (Norfolk): 16.9%, 170 people/km^2
- National (England): 19.2%, 434 people/km^2

137. The proportion of the population under 16 near landfall is much lower than locally, regionally and nationally. The proportion of the population under 16 along the onshore cable corridor and near the substation is similar to the local and regional proportion, but lower than nationally. Population density estimate also show a much lower population density at a site-specific level in comparison to the local, regional and national average.

28.5.6. Physical Activity

138. Physical activity effects are expected at the site-specific level (see **Section 28.3.1**). Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate. The human health baseline relevant to this topic is provided in **Appendix 28.2 Health Baseline Statistics**.

139. On a site-specific level, the health statistics reflect the older age profile (i.e. those over the age of 65) near landfall (49.6%), along the cable corridor (30.3%) and near the onshore substation (21.2%) compared to the average for England (18.5%) (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**).

140. The proportion of people reporting their health as good or very good near landfall (74.6%), along the cable corridor (79.5%) and near the onshore substation (86.1%) varies with location, when compared with the Norfolk (79.3%) and England (81.4%) averages. A similar variability is shown for people reporting their day-to-day activities as not being limited (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**). This is potentially due to the higher proportion of people over 65, which decreases from near landfall, along the onshore cable corridor, to near the onshore substation.

141. At a county level, the percentage of physically active adults (67.9%) is marginally higher than the England average (67.2%). Although the number of people aged 16+ with a sports club membership is lower for Norfolk (19.3%) than it is for England (22%), the utilisation of outdoor space for exercise / health reasons is higher (18.8%) compared to England (17.9%) (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**). This likely reflects the rural nature and outdoor available spaces of Norfolk.

142. The representative populations around the onshore DCO order limits area are around the median and better than the average for relative health deprivation (approximately 20,140 to 25,827 out of 32,844) (see **Table 28-15**). A higher proportion of households have access to a vehicle (88.5 to 92.4%) compared to the Norfolk (81.1%) and England (74.3%) averages, which would allow them to access wider physical activity opportunities (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**). However, the higher vehicle numbers may be associated with the rural nature of Norfolk, and may influence people away from exercise.

28.5.7. Journey Times and/or Reduced Access

143. The environmental baseline for traffic and transport has been provided in **Chapter 24 Traffic and Transport**. Potential effects are considered at a local level. Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate, and the human health baseline relevant to this topic is provided in **Appendix 28.2 Health Baseline Statistics**.

144. The journey times and/or access effects are limited when reporting on smaller area statistics (**Table 28-16**). Therefore, effects are discussed at a local level.

Table 28-16: AHAH Baseline Site-Specific Statistics (Source: Consumer Data Research Centre, 2020)

Factor	Landfall	Onshore Cable corridor	Onshore Substation
Representative LSOA	**North Norfolk LSOA 004A**	**North Norfolk LSOA 006C**	**South Norfolk LSOA 006G**
Access to Health Assets & Hazards (AHAH) Index (1-10 decile)[2]	10th	10th	8th

145. People in North and South Norfolk tend to travel further to work (20.9km and 18.1km respectively), compared to those in Broadland (14.9km) and nationally (14.9km) (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**). The proportion of people killed and seriously injured on roads is also higher for North and South Norfolk (45.2 and 54.4 people per 100,000) than in Broadland (40.5) and nationally (42.6) (see **Table 28.1.2** in **Appendix 28.2 Health Baseline Statistics**). This may be reflective of the rural nature of the location with generally higher speed limits than in more built-up conurbations.

146. The proportion of people walking and cycling for travel at least three days per week is lower on the district level when compared to the regional and national averages (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**), which may suggest that people use other forms of transport for travel (i.e. private vehicle or public transport) and may also reflect the age profile of the local population.

147. The minimum journey time people at the local level have to travel to eight key services by car, public transport, walking or by bicycle is longer than the regional and national minimum journey times (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**). The eight key services are medium sized centres of employment (500 to 4,999 jobs), primary schools, secondary schools, further education, GPs, hospitals, food stores and town centres. Again, this may be as a result of the rural nature of the study area.

[2] This factor is driven by the health domain, and specifically by access to healthcare services. This demonstrates the sensitivity of the local area to healthcare access disruption. 1st decile has the best access to health care, down to 10th decile which has the worst access to healthcare services.

28.5.8. Employment

148. The environmental baseline for employment is provided in **Chapter 27 Socio-Economics and Tourism**. Potential employment effects were considered at a site-specific and regional level. Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate, and the human health baseline relevant to this topic is provided in **Appendix 28.2 Health Baseline Statistics**.

149. The proportion of people aged between 16 and 64 in employment is varied at a local level (North Norfolk (73.4%), Broadland (81.5%) and South Norfolk (71.5%)) when compared to the Norfolk (75.4%) and England (75.1%) averages (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**). The representative populations considered in this assessment are below average of relative employment deprivation at landfall and in North Norfolk, but above average along the cable corridor and at the substation as well as locally in Broadland and South Norfolk (see **Table 28-15**).

150. The proportion of part-time employees locally, which ranges from 31.5% to 33.5%, is slightly higher than the regional (30.5%) and much higher than the national (22.7%) averages. Unemployment at a local level is varied (North Norfolk (3.2%), Broadland (5.1%) and South Norfolk (7.0%)) when compared to regional and national averages, which are similar (4.2% and 4.6% respectively).

151. The proportion of people in skilled trades occupations in North and South Norfolk (17.8% and 14.4% respectively) is higher than those in Broadland (7.6%), regionally in Norfolk (12.1%) and nationally (8.7%). The proportion of people working as process, plant and machine operatives is higher in Broadland and South Norfolk (9.3% and 9.5% respectively) than in North Norfolk (4.6%), regionally in Norfolk (7.5%) and nationally (5.4%) (see **Table 28.1.1** in **Appendix 28.2 Health Baseline Statistics**).

152. As shown in **Table 28-15**, the representative populations considered in this assessment are above average of relative income deprivation in children at a site-specific (16,474 to 28,575 out of 32,488 LSOAs), local (excluding North Norfolk) and regional level. Income deprivation among older people is also above average at a site-specific (18,950 to 23,092 out of 32,488 LSOAs), local and regional level. The proportion of children living in absolute low income families is lower than the Norfolk (14.0%) and regional (15.6%) average in Broadland (10.3%) and South Norfolk (9.8%) but comparable to the regional and national averages in North Norfolk (15.0%) (see **Table 28.1.2** in **Appendix 28.2 Health Baseline Statistics**).

153. Average weekly earnings are lower in North Norfolk (£394.40) than regionally in Norfolk (£453.20) and nationally (£496.00). Average earnings in Broadland (£458.20) are comparable to the regional average, while South Norfolk (£492.70) has the highest average weekly earnings of the three districts and is comparable to the England average (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**).

154. The gender pay gap in North Norfolk (14.0%) is comparable to the regional (14.1%) and national (16.6%) averages; however, the pay gap in Broadland (19.3%) and South Norfolk (22.8%) is greater than regionally and nationally (see **Table 28.1.3** in **Appendix 28.2 Health Baseline Statistics**). The proportion of long term claimants of Jobseeker's allowance (per 1,000) is lower locally (0.9 to 1.2) than regionally (1.9) and nationally (2.6) (see **Table 28.1.2** in **Appendix 28.2 Health Baseline Statistics**).

28.5.9. Electric and Magnetic Fields (EMFs)

155. EMFs are common and an essential part of the physical world and of life itself. Their sources are the fundamental particles of matter with charge (typically electrons and protons). EMFs occur naturally within the body and are associated with nerve and muscle activity. Other examples of EMFs include the natural magnetic field of the Earth and natural electric fields in the atmosphere.

156. Electric fields are produced by voltage and measured in volts per metre (V/m). Atmospheric static electric field at ground level is typically around 100 V/m in fine weather and during thunderstorms can rise to many thousands of volts per metre. Electricity within homes is at a voltage of 230 V. However, outside of houses, electricity is distributed at much higher voltages ranging from 11,000 V (11 kV) up to 400,000 V (400 kV). Generally, the higher the voltage the higher the electric field. Most buildings materials and trees are effective at screening electric fields.

157. Magnetic fields are produced by current and measured in microteslas (μT). The Earth's static magnetic field varies over the surface of the globe and is about 50 μT in the UK. Anything which uses or carries mains electricity is a potential source of power-frequency magnetic fields, which modulate the Earth's steady natural fields. The strength of the magnetic-field modulation depends on the current carried by the equipment. In the case of a power line, this varies according to the demand for power at any given time. Unlike electric fields, magnetic fields are little affected by trees and ordinary building materials.

158. Both AC and DC fields exist in addition to the Earth's steady natural fields. In AC, the voltage, current and corresponding EMF switches direction. Most transmission infrastructure in the UK uses AC. Within the UK, the frequency of AC mains electricity is 50 hertz (Hz, or 50 cycles per second). Any alternating magnetic field will induce an electric field, which in turn produces a current in a conducting medium. The human body is conducting and will therefore have a current induced in it – albeit, usually, a very small one.

159. Mains-powered AC appliances produce elevated magnetic fields whenever they draw current. Such fields generally fall as the inverse cube of distance, and thus are significant only within a metre or two of the appliance, as shown in **Table 28-17**.

Table 28-17: Typical Magnetic Field Levels from Common Household Mains Appliances (Source: National Grid, EMFs.Info)

Factor	Magnetic Field (μT)	
	Close to Appliance	1m distant
Electric razor	2000	0.3
Vacuum cleaner	800	2

Factor	Magnetic Field (µT)	
	Close to Appliance	1m distant
TV	50	0.2
Washing machine	50	0.2
Bedside clock	50	0.02
Fridge	2	0.01

160. The high-voltage underground cables to be installed in SEP and/or DEP will be surrounded by a metal sheath/screen to provide mechanical protection. This also eliminates the electric field outside the cable, but it has no effect on the magnetic field.

161. Large electrical substations do not produce significant electric fields outside their boundary because the perimeter fence screens the electric field generated by any sources within the substation. There is equipment inside substations which produces magnetic fields. But the field falls rapidly with distance, and at the perimeter fence the magnetic field from inside the substation is usually approaching background levels.

162. The magnetic field of a buried AC system has a strength of 20-24 µT (National Grid, EMFs.info, 2020) when standing directly over it. This is equivalent to approximately half of what is expected from a TV, washing machine or bedside clock (**Table 28-17**) at the same distance. The strength drops to 0.46 – 0.90 µT at 10m and to 0.12 – 0.23 µT at a 20m distance.

28.6 Potential Impacts

28.6.1. Potential Impacts during Construction

163. This section details the potential impacts resulting from the construction phase of SEP and/or DEP. The sensitivity of general population and vulnerable groups detailed in the following sections is regarded as the most conservative sensitivity, unless otherwise stated.

164. Further detail on the temporal scope (i.e. construction timeframes) is provided in **Chapter 4 Project Description**. The sensitivity, magnitude and significance have been determined based on the methodology presented in **Section 28.4.3**.

28.6.1.1. Impact 28.1 Noise Effects

165. During the construction phase of SEP and/or DEP, there is a potential for noise to arise from construction activities and movement of Heavy Goods Vehicles (HGVs) across the onshore DCO order limits.

166. The population groups relevant to this assessment, due to either proximity or vulnerability, are (as defined in **Section 28.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);

- The population near the onshore substation (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

167. The key health outcomes relevant to noise as a determinant of health are:
    - cardiovascular health (associated with chronic noise effects);
    - mental health (including stress, anxiety or depression associated with chronic noise effects); and
    - cognitive performance of school children (Basner *et al.,* 2014; Münzel *et al*., 2018; Dzhambov & Dimitrova, 2018).

168. This is particularly relevant to two of the health priorities (**Section 28.5.1**) outlined by NCC, as being care for the elderly and support to young children.

169. The temporal scope for this potential effect (as described in **Section 28.3.3**) varies depending on the area of the project and the construction scenario, this is explained below in the discussion of magnitude.

170. The conclusions of **Chapter 23 Noise and Vibration** are summarised below under the different construction scenarios. The mitigation measures taken into consideration during the assessment are described in **Chapter 23 Noise and Vibration**.

28.6.1.1.1. Source-Pathway-Receptor

171. A potential health effect is considered *likely* because, based on the methods described in **Section 28.4.3**, there is a plausible source-pathway-receptor relationship where:
    - Source – the construction areas and transport operations;
    - Pathway – noise transmission via pressure waves through the air; and
    - Receptors – communities of people.

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

28.6.1.1.2. Sensitivity of the Receptor

173. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 28.4.3.4,** and specifically paragraph 74, i.e. the general characteristics of how the ‘general population’ may differ from ‘vulnerable group population’ when scoring sensitivity).

174. The onshore DCO order limits area has an ageing population, especially near landfall, with a high proportion of retired people who may spend longer periods at home in affected dwellings. However, there is also a marginally lower number of children as a proportion of the population. Income deprivation in children and older people at a site-specific level is better than the median for England.

175. Based on the baseline statistics provided in **Section 28.5.1** and **28.5.3**, the general population near landfall, along the cable corridor and near the onshore substation may be sensitive to change with a *low* sensitivity ranking. Any more sensitive individuals are covered within the vulnerable group population below.

176. Some people are more sensitive to changes in noise and in consideration of this, and the site-specific baseline population profile in **Section 28.5.2**, sensitivity is considered to be *medium to high*. Vulnerability in this case is particularly linked to:

- 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, home working, shift work, retirement, or ill health);
- Vulnerability due to deprivation or health inequalities; or
- Having strong views or high degrees of uncertainty about SEP and/or DEP (which may be associated with health effects, in some cases below thresholds that are generally considered to be acceptable).

28.6.1.1.3. Magnitude of Effect – All Scenarios

177. The conclusions of **Chapter 23 Noise and Vibration** can be summarised as follows (for all scenarios):

- Negligible impact at all noise sensitive receptors near landfall and near the onshore substation (the nearest receptors to the Order limits at the onshore substation are greater than 500m away);
- Minor adverse residual impact (i.e. not significant), at worst, is predicted at noise sensitive receptors along the onshore cable corridor after implementation of mitigation;
- Minor adverse residual impact (i.e. not significant) due to construction road traffic noise (during the worst-case SEP and DEP concurrently traffic scenario) after implementation of mitigation; and
- Minor adverse residual impact (i.e. not significant), at worst, is predicted due to construction vibration after implementation of mitigation.

178. The temporal scope for potential noise effects varies depending on the location along the onshore DCO order limits:

- At landfall, there is a short-term temporal scope due to HDD and the presence of the landfall compound. Landfall HDD and cable pull would be over a period of 4 months and 2 months respectively for the construction of SEP or DEP in isolation or as a single project in the sequentially construction scenario. Landfall HDD would be over a period of 5 months and cable pull would be over a period of 2 months for the SEP and DEP concurrent construction scenario. Noise from offshore construction works associated with the SEP and DEP has been scoped out of the assessment in **Chapter 23 Noise and Vibration**, as offshore cable laying vessels will be greater than 1km from the shore and given this distance of separation, no noise impacts would be experienced from these sources at onshore (i.e. landfall) sensitive receptors;
- Along the onshore cable corridor, there is a very short term temporal scope as works will be undertaken in sections. Therefore, any noise generated as a result of construction works along the cable corridor would be along 1km intervals, with a typical construction presence of up to four weeks before moving along the corridor. Works are proposed to be undertaken during the day time;
- At the onshore substation, there is a medium term temporal scope of between 28 and 30 months (depending on the scenario); and
- There is a medium term temporal scope for noise related to SEP and DEP-generated traffic, as traffic will be generated throughout the whole construction phase of SEP and/or DEP. However, locally, the impacts will be short term as the works move along the cable corridor.

179. Construction related noise close to particular dwellings or other community receptors near landfall and along the cable corridor would be of a very-short to short-term duration (predominantly limited to periods of passing trench work or associated vehicle traffic) and at small scale. Construction related noise close to particular dwellings or other community infrastructure near the onshore substation would be of a medium-term duration, however, no noise sensitive receptors are within 500m of the DCO order limits at the onshore substation and a negligible impact was predicted at the closest receptors considered in **Chapter 23 Noise and Vibration**.

180. The level of noise experienced would be within working noise limits for temporary disruption, undertaken in accordance with the relevant British Standards identified in **Chapter 23 Noise and Vibration**, and as detailed above residual impacts were either negligible or minor adverse, i.e. not significant in EIA terms. The extent of effects would be localised, and therefore only experienced by a small number of people in local populations. The severity of noise effects would result in a minor change to quality of life and very few receptors would be affected at the same time as the cable corridor construction sections are progressed. Once construction is complete, noise impacts would immediately cease. Therefore, under all construction scenarios, the magnitude of change due to SEP and/or DEP can be characterised as *low*. At these levels, it is unlikely that there would be changes in the risk of developing a new health condition (morbidity) or of exacerbating an existing condition. Reductions in wellbeing associated with very short- to short-term, noise levels would be unlikely to persist beyond the period of elevated exposure.

28.6.1.1.4. Significance of Impact – All Scenarios

181. Under all construction scenarios, the conclusion of the assessment for population health is that any change due to SEP and DEP would be a low magnitude of change on a receptor of medium to high sensitivity. This represents an impact of **minor adverse significance**, , i.e. not significant for the general population or 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 SEP and/or DEP. Although sensitivity is medium to high, there is only expected to be a low magnitude of change that is on the very short, short or medium term (depending on the construction activity), localised and fully reversible. In line with the NPS EN-1 (DECC, 2011a), it is considered that (based on the assessment in **Chapter 23 Noise and Vibration**), SEP and/or DEP has avoided significant impacts for noise and vibration, has proposed additional mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control noise. Therefore, there would be no residual long-term change in population health outcomes related to noise.

182. As such, change due to SEP and DEP, would be well within a statutory guidelines for construction noise impacts. In addition, health priorities for the relevant study area are of low relevance to the determinant of health or population group affected by the project.

183. Although the scientific evidence indicates a relationship between changes to noise and health outcomes, any changes that would result from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst an adverse effect, it would have only a marginal effect on delivering health policy linked to noise and on contributing to narrowing health inequalities.

28.6.1.2. Impact 28.2: Air Quality Effects

184. During the construction phase of SEP and/or DEP there is a potential for air quality to be temporarily affected by dust and fine particulate from construction activities and emissions from construction vehicles and non-road mobile machinery (NRMM).

185. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

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

187. The temporal scope for this effect (as described in **Section 28.3.3**) varies depending on the area of the project and construction scenario. These are discussed below.

188. The conclusions of **Chapter 22 Air Quality** are outlined in section below discussed for each scenario. The mitigation measures taken into consideration during the assessment are as described in **Chapter 22 Air Quality**.

28.6.1.2.1. Source-Pathway-Receptor

189. The potential health effect is considered *likely* because (based on the methods described in **Section 28.4.3**) there is a plausible source-pathway-receptor relationship:

- Sources – excavated materials (dust) and particulate or emissions (construction traffic or NRMM);
- Pathway – dispersion through the air and inhalation; and
- Receptors – communities of people.

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

28.6.1.2.2. Sensitivity of the Receptor

191. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised (based on the methods described in **Section 28.4.3,** and specifically paragraph 74, and information in **Section 28.5.4**) as the same as for noise, as detailed in **Section 28.6.1.1.2**.

192. The sensitivity of the general population is considered to be *low*. The sensitivity of vulnerable groups is considered to be *medium to high*.

28.6.1.2.3. Magnitude of the Effects – All Scenarios

193. The conclusions of **Chapter 22 Air Quality** can be summarised as follows:

- Impacts due to construction dust and particulate matter are not significant with appropriate mitigation, which will be applied across the full onshore DCO order limits construction area;
- Emissions from NRMM after implementation of mitigation measures are considered not significant;
- Emissions from road vehicle exhausts at human receptors were predicted to be negligible at all receptors considered (i.e. not significant);
- Predicted pollutant concentrations were well below (i.e. less than 75% of) the relevant air quality Objectives at all considered human receptor locations; and
- SEP and/or DEP-generated construction traffic was not predicted to cause a breach of any of the air quality objectives at any identified sensitive human receptor location.

194. The temporal scope for potential air quality effects varies depending on the location along the onshore DCO order limits:

- At landfall, there is a short-term temporal scope due to HDD and the presence of NRMM in the landfall compound. Landfall HDD and cable pull would be over a period of 4 months and 2 months respectively for the construction of SEP or DEP in isolation or as a single project in the sequential construction scenario. Landfall HDD would be over a period of 5 months and cable pull would be over a period of 2 months for the SEP and DEP concurrent construction scenario;
- Along the onshore cable corridor, there is a very short term temporal scope as works will be undertaken in sections. Therefore, any dust or emissions generated as a result of construction works along the cable corridor would be along 1km intervals, with a typical construction presence of up to four weeks before moving along the corridor. Works are proposed to be undertaken during the day time;
- At the onshore substation, there is a medium term temporal scope of between 28 and 30 months (depending on the scenario); and
- There is a medium term temporal scope for noise related to SEP and/or DEP-generated traffic, as traffic will be generated throughout the whole construction phase of SEP and/or DEP. However, locally, the impacts will be short term as the works move along the cable corridor.

195. Any potential construction-related air quality impacts close to particular dwellings or other community receptors would be of a short-term duration (predominantly limited to periods of passing trench work or associated vehicle traffic) and on a very localised scale. For particles of non-respirable size, coarser (larger and heavier) fractions of dust are expected to rapidly reduce in airborne concentration with distance from source due to deposition, and site-selection of the onshore works has ensured construction related works are at a suitable separation distance from nearby human (i.e. residential) receptors. The potential for nuisance-type dust effects is therefore expected to be occasional and limited and will be mitigated through the control and management measures recommended in **Chapter 22 Air Quality**. As detailed above and in **Chapter 22 Air Quality**, the changes would be below all recognised statutory thresholds for health protection and residual impacts would be negligible, and therefore not significant.

196. Finer fractions of generated particles would remain airborne for longer, and deposition 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 with increased distance, and as stated above, construction works within the onshore DCO order limits have been sited at a suitable separation distance from sensitive receptors. In addition, background pollutant concentrations across the study area are well below the relevant air quality Objectives (as detailed in **Chapter 22 Air Quality**). At these levels it is unlikely that there would be changes in the risk of developing a new health condition (morbidity) or of exacerbating an existing condition. Given the baseline air quality is good (see **Chapter 22 Air Quality**), it is unlikely that there would be a significant change in population health outcomes for the neighbouring community during these periods.

197. The severity of any population health effects associated with air quality would result in a negligible change to quality of life for a small minority of the population at the same time as the cable corridor construction sections are progressed. Once construction is complete, any population health effects associated with a slight reduction in quality of life would be expected to reverse. Therefore, under all three construction scenarios, the magnitude of change due to SEP and/or DEP can be characterised as low.

28.6.1.2.4. Significance of Impact – All Scenarios

198. Under all construction scenarios the conclusion of the assessment for population health is that any change due to SEP and DEP be a low magnitude of effect on a receptor of medium to high sensitivity. This represents an impact of **minor adverse significance**, i.e., i.e. not significant for the general population or 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 SEP and/or DEP. Any effects would be below all recognised statutory thresholds for health protection, and would be short-term, temporary and would cease on completion of the works.

199. 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 potential for non-threshold effects of pollutants to population health is noted and has been taken into account in determining the significance of potential air quality effects.

200. In line with the NPS EN-1 (DECC, 2011a), it is considered that (based on the assessment in **Chapter 22 Air Quality**) SEP and DEP has avoided significant impacts for dust, NRMM and vehicle emissions, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control dust and vehicle emissions. Therefore, there would be no residual long-term change in population health outcomes related to air quality.

201. Although the scientific evidence indicates a relationship between changes to air quality and health outcomes, any changes that would result from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst an adverse effect, it would have only a marginal effect on delivering health policy linked to air quality and on contributing to narrowing health inequalities.

28.6.1.3. Impact 28.3: Ground and/or Water Contamination Effects

202. During the construction phase of SEP and/or DEP there is a potential for water quality to be temporarily affected by the accidental release of potentially polluting substances or mobilisation of existing contamination as a result of intrusive works such as excavation of soils, piling at the onshore substation or trenchless drilling techniques. There is also potential for accidental leakages of foul water from welfare facilities, and construction materials including concrete and inert drilling fluids. These can enter surface waters and connected groundwaters through run-off, especially following rainfall.

203. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

204. The key health outcomes relevant to this determinant of health relate to potential toxicological exposure associated with release of substances and contaminated bathing water. Effects may relate to either biological or chemical contaminants. Potential examples of contaminant pathways include accidental spillage from site amenities (i.e. biological contaminants); accidental spillage from machinery or construction processes (i.e. chemical contaminants); or exposure of buried contaminants (e.g. from contaminated soil).

205. The temporal scope for this effect (as described in **Section 28.3.3**) varies depending on the area of the project and scenario. These are discussed below.

206. The conclusions of **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk** are discussed for each scenario.

28.6.1.3.1. Source-Pathway-Receptor

207. The potential health effect is considered plausible but *unlikely* (based on the methods described in **Section 28.4.3**):

- Sources – increased water turbidity, accidental fuel spill, or mobilisation of historic contamination;
- Pathway – mobilisation or remobilisation of contaminants into bathing waters or ground/surface water sources used as drinking water supplies; and
- Receptors – users of the beach near landfall and watercourses, and people within the Drinking Water Protected Area (DWPA) (Surface Water).

208. The plausibility of the potential effect occurring largely depends on unusual conditions (i.e. combination of undetected human error and certain weather conditions) to make the source-pathway-receptor linkage, as the source of contamination is unlikely to be present for the duration of construction. Other than increased water turbidity (which has limited potential to affect health), the sources related to accidental releases of pollutants, or the unexpected encountering of historic contamination, are unlikely. Mitigation measures are described in **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk** to reduce the probability of a risk occurring in the first place. Should an incident occur, further mitigation to reduce the risk of widespread contamination that could affect the public is also outlined.

28.6.1.3.2. Sensitivity of the Receptor

209. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised (based on the methods described in **Section 28.4.3** and specifically paragraph 74).

210. As detailed in **Section 28.5.5**, younger people are considered to be more vulnerable to ground or water contamination due to having a lower body mass and a higher likelihood of exposure to water bodies during recreational activities. There are fewer people under 16 compared to the national average, especially near landfall and population density estimates show a much lower population density at a site-specific level, in comparison to the local, regional and national average. There are fewer dependent children in households near landfall and along the onshore cable corridor, when compared to the national average. Relative IDACI (i.e. income deprivation in children) by neighbourhood shows near landfall and along the cable corridor, income deprivation in children is within the 40% least deprived and near the onshore substation within the 10% least deprived.

211. Sensitivity is considered to be *low* for the general population and *medium* for vulnerable groups. This reflects population sensitivity due to part of the onshore study area passing through a Drinking Water Protected Area and Source Protection Zone (SPZ) 3, as well as the limited likelihood that people would interact with bodies of inland surface water for recreational purposes.

28.6.1.3.3. Magnitude of the Effects – SEP or DEP in Isolation

212. If SEP or DEP were to be constructed in isolation, the realistic worst-case scenario would involve up to two trenchless drills at landfall, an onshore cable corridor total construction corridor width of 45m and have an onshore substation site works footprint of 4.25ha. A maximum construction period of SEP or DEP in isolation would be three years. However, onshore aspects are expected to be complete within approximately 2.6 years. The onshore cable duct will be installed in sections of up to 1km at a time, with a typical construction presence of up to four weeks along each 1km section.

213. The conclusions of **Chapter 17 Onshore Ground Conditions and Contamination** can be summarised as follows:

- Minor adverse residual impact (i.e. not significant) to work force, land owners, land users and neighbouring land users exposure to contaminated soils and groundwater and associated to health impacts;
- Minor adverse residual impact (i.e. not significant) on groundwater quality and resources; and
- Minor adverse residual impact (i.e. not significant) on surface water quality.

214. The conclusions of **Chapter 18 Water Resources and Flood Risk** can be summarised as follows:

- No impact to minor adverse (at one waterbody receptor, majority of residual impacts were no impact with the implementation of mitigation measures) residual impact for increased sediment supply; and
- No impact to minor adverse (at one waterbody receptor, again majority of residual impacts were no impact with the implementation of mitigation measures) residual impact for supply of contaminants.

215. **Chapter 17 Onshore Ground Conditions and Contamination** indicates that residual impacts are likely to be minor adverse (i.e. not significant). At points such as crossing of small scale watercourses, the public would not have access to any impounded water. HDD at main rivers is proposed to avoid impacts to the watercourses. The conclusions of **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk** indicate that following the implementation of mitigation measures to prevent pollution of groundwater and surface water, SEP and DEP is predicted to have no impact to a minor adverse (at one waterbody receptor, with the majority having no residual impacts) impact in relation to water quality.

216. The impacts are predicted to be of local spatial extent associated with accidental spillage, of short-term duration, and of highly infrequent occurrence. 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. Increased turbidity in coastal water as a result of 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. Furthermore, the likelihood of the effect would reduce outside of the main recreational seasons due to a reduction in potential receptors. The marine activities would mitigate against, and monitor for, any spills or historic contamination as described in **Chapter 7 Marine Water and Sediment Quality**. The general water related pollutant exposure (if any) implication for public health would be a minor change in morbidity or quality of life for a small minority of the population. The magnitude is therefore, considered to be low for SEP or DEP in isolation (based on the methods described in **Section 28.4.3**).

28.6.1.3.4. Magnitude of the Effects – SEP and DEP Sequentially

217. SEP and DEP construction sequentially is considered as the worst-case together scenario, due to the increased volume of material that would be excavated over a larger footprint and longer period of time during which human health receptors could be exposed to potential contamination, as such it is considered the scale of the two projects being constructed concurrently are such that the magnitude of impacts will be no greater than that of the two projects constructed sequentially.

218. If SEP and DEP were to be constructed sequentially, the realistic worst-case scenario would involve up to four trenchless drills at landfall, an onshore cable corridor total construction corridor width of 60m and have an onshore substation site works footprint of 7.25ha. A maximum construction period of SEP and DEP sequentially would be three years per individual project, with a gap of between two to four years where no construction activities would occur. However, onshore aspects are expected to be complete within approximately 2.6 years per individual project. Onshore cable ducts would still be installed in sections of up to 1km at a time for SEP and DEP sequentially, with a typical construction presence of up to four weeks along each 1km section.

219. The conclusions from **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk**, as detailed in the section above, were concluded to be the same for all construction scenarios. The magnitude is considered to be low for SEP and DEP sequentially (based on the methods described in **Section 28.4.3**, for the same reasons provided for the SEP or DEP in isolation scenario).

28.6.1.3.5. Significance of Impact – All Scenarios

220. The following discussion sets out the reasoned conclusions for professional judgement reached on significant significance of any potential ground and/or water contamination impacts on health.

221. The conclusion of the assessment for population health is that any change associated with SEP and DEP would be a low magnitude of effect on a receptor of low to medium sensitivity. This represents an impact of **minor adverse significance**, i.e., not significant for the general population or 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.

222. The temporal scope for any effects would be short-term due to the duration of the different elements of construction, and most likely pathways are at points where the offshore export cable makes landfall, or where the onshore cable corridor crosses small watercourses using temporary dam and diversion.

223. In accordance with NPS EN-1 (DECC, 2011a), it is considered that (based on the assessments presented in **Chapter 17 Onshore Ground Conditions and Contamination** and **Chapter 18 Water Resources and Flood Risk**) SEP and DEP has avoided significant impacts for contamination, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control contamination. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term change in population health outcomes.

224. Scientific literature (Koreiviene *et al*., 2014; Andrade *et al*., 2018; Testai *et al*., 2016) 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 within the onshore study area typically have a lower than average percentage of children and young people and significantly lower population density when compared to averages for England.

225. A review of the regional public health strategy indicates that water quality, as a determinant of health, is not a key public health priority issue. However, the regional health priorities do focus on young people specifically.

226. The temporal scope for any effects would be short-term due to the duration of the different elements of construction, and most likely pathways are at points where the offshore export cable makes landfall, or where the onshore cable corridor crosses small watercourses using temporary dam and diversion.

227. Any change due to SEP and DEP would be well within a regulatory threshold or statutory standard. In addition, a review of the regional public health strategy indicates that water quality, as a determinant of health, is not a key public health priority issue.

228. Although the scientific evidence indicates a relationship between changes to water quality and health outcomes, any changes that would result from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst an adverse effect, it would have only a marginal effect on delivering health policy linked to water quality and on contributing to narrowing health inequalities.

28.6.1.4. Impact 28.4: Physical Activity Effects

229. During the construction phase SEP and/or DEP, there is a potential for physical activity to be temporarily affected by the temporary diversion of National Trails, Public Rights of Ways (PRoWs), cycle routes and long distance walking routes (herein referred to as ‘routes’) as well as some reduced access to the coast, as a result of the temporary disruption and/or restricted access (no greater than one week) to small portions of Weybourne Beach at landfall. All other interaction with public spaces, such as playing fields and common land, has been avoided through careful site selection as part of the embedded mitigation for SEP and/or DEP.

230. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

231. The key health outcomes relevant to this determinant of health, associated with levels of physical activity and obesity levels are:

- physical health conditions (e.g. cardiovascular health) (Nystoriak & Bhatnagar, 2018); and
- mental health conditions (e.g. stress, anxiety or depression) (Lubens *et al.*, 2016; Mochcovitch *et al.*, 2016).

232. The temporal scope for this effect (as described in **Section 28.3.3**) varies depending on the area of the project and scenario. These are discussed below.

233. The potential effect is considered per scenario for outdoor activities (based on the methods described in **Section 28.4.3**)

234. The mitigation measures taken into consideration during the assessment are as described in **Chapter 19 Land Use, Agriculture and Recreation** and **Chapter 27 Socio-Economics and Tourism**. Any alternative routes and management practices of route impacts would be agreed with NCC prior to construction in accordance with the **Outline Public Rights of Way Strategy** (document reference 9.22) and **Outline COCP** (document reference 9.17) which will accompany the DCO Application.

28.6.1.4.1. Source-Pathway-Receptor

235. The potential health effect is considered *likely* because (based on the methods described in **Section 28.4.3**) there is a plausible source-pathway-receptor:

- Sources – construction works at landfall and along the onshore cable corridor and vehicles/plant operations increasing disturbance on routes or the beach;
- Pathway – people's understanding of change in the usability of the routes or the beach; and
- Receptors – users of the routes or the beach, resulting in a lower level of active travel or outdoor recreation.

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

28.6.1.4.2. Sensitivity of the Receptor

237. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised (based on the methods described in **Section 28.4.3** and specifically paragraph 74).

238. The general population is considered to be of *low* sensitivity. This reflects the site-specific baseline population profile presented in **Section 28.5.6**. The representative baseline of neighbourhoods around the onshore cable corridor and onshore substation reports a marginally lower level of poor or very poor health than the average for England. The representative baseline of the neighbourhood around the landfall, report a marginally higher level of poor or very poor health compared to the average for England. This reflects the higher proportion of people aged over 65 (nearly 50% of the population). This indicates that the number of physically active adults at the North Norfolk (i.e. landfall and portion of the cable corridor) and South Norfolk (i.e. onshore substation and portion of cable corridor) is similar to (66.7% and 66.4% respectively) to the regional (66.2%) and national (66.4%) averages, and is much higher in Broadland (75.5%). Physical activity is known to be an important factor for many health and quality of life outcomes.

239. Some people would be more sensitive to changes in physical activity. For this population, the sensitivity is considered *medium to 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.

240. 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. The proportion of physically active children and young people regionally (36.6%) is lower than the national average (44.6%). The proportion of adults (aged over 18) classified as overweight or obese is approximately the same or better in North Norfolk (62.3%) and South Norfolk (58.7%) but is higher in Broadland (66.1%) when compared to the regional (62.3%) and national (62.8%) averages.

241. However, child obesity in Year 6 of school is lower on a district level (14.6% to 18.8%) when compared to the regional (19.7%) and national (21%) averages. Norfolk shows a lower level of childhood obesity than the average for England. NCC key health priorities include obesity reduction, improvements in mental health and creating a healthier physical environment. However, there are no regulatory standards regarding physical activity.

242. 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.

28.6.1.4.3. Magnitude of the Effects – All Scenarios

243. The conclusions of **Chapter 19 Land Use, Agriculture and Recreation** to physical activity assets can be summarised as follows:

- No impact to Blue Flag beaches under any scenario;

- No impact as a result of disruption to onshore coastal recreational assets (i.e. beach access). Any areas subject to short-term restricted access would be agreed in advance with the Countryside Access Officer at NCC prior to construction; and
- Minor adverse significant residual impact as a result to disruption to users of inland recreational assets and routes (i.e. National Trails, PRoWs, cycle and walking routes).

244. The use of long HDD at landfall under all scenarios is not anticipated to require closure of the Norfolk Coastal Path, Peddars Way or the small portion of Weybourne Beach affected by construction works. The HDD works should not require any prolonged periods of restrictions or closures to the beach for public access, although it is possible that some activities will be required to be performed on the beach that may require very short periods (less than a week) of restricted access. For example, use of a temporary seawater pipe and pump to supply seawater to the onshore HDD temporary works compound for use with the drilling fluid, as well as the use of vehicles to transport the ducting across the beach. As stated above and in **Chapter 19 Land Use, Agriculture and Recreation**, any areas subject to very short-term restricted access would be agreed in advance with the Countryside Access Officer at NCC prior to construction.

245. There is a potential for physical activity to be temporarily affected by the temporary management or diversion of routes during duct installation and cable pulling activities along the onshore cable corridor or construction activities near the onshore substation. The temporal scope for these effects along the cable corridor is very short-term. This is because the cable corridor will have a minimal level of disruption on community infrastructure (such as sports and recreation venues, see **Chapter 27 Socio-Economics and Tourism**). However, temporary and reversible impacts to routes and coastal waters are discussed in **Chapter 19 Land Use, Agriculture and Recreation**. This could lead to a change in the tranquillity and perceived quality of physical activity opportunities.

246. The effects would be due to duct installation along the onshore cable corridor. Approximately 1km of duct will be installed over a four week period and during this time any route served by the works would be temporarily managed and/or diverted for approximately four weeks. Alternative methods include appropriately fenced (unmanned) crossing points or manned crossing points. After this, the site would be reinstated except for the temporary haul road which would have a controlled crossing until the haul road was no longer in use. The area would then be reinstated but some time would be required before the same level of natural coverage (such as grass, shrubs, and hedgerows) returns.

247. As stated above, **Chapter 19 Land Use, Agriculture and Recreation** concludes that residual impacts on routes are expected to be minor adverse, with the implementation of mitigation measures detailed in the chapter.

248. There is no residual impact on community infrastructure (such as sports facilities) predicted due to site selection avoiding interaction with these sites. The potential effect is considered likely for outdoor activities but not for sports activities using community infrastructure.

249. The installation of the cable within the ducts will require cable pulling works at jointing bays located along the cable corridor. The locations of the jointing bays are yet to be determined but will be chosen to avoid sensitive features, including the presence of routes, wherever possible and engineering considerations. Parts or all of the haul road will also be retained to facilitate access to the jointing bay locations and therefore could potentially interact with routes. Therefore, as a worst-case it is assumed there will be a requirement for temporary diversions and / or controlled crossing to be in place during cable pulling works as outlined above at a limited number of locations.

250. If SEP and/or DEP were to be constructed under any scenario, the impacts are predicted to be of a site-specific spatial extent, of short-term duration (due to the sequential linear nature of construction) and immediately reversible once construction works are completed. Temporary diversions may marginally increase the length of a routes, 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, and would lead to a minor change in quality of life to a very small population. Therefore, the magnitude is considered to be low for SEP and/or DEP (based on the methods described in **Section 28.4.3.4**).

28.6.1.4.4. Significance of Impact – All Scenarios

251. 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. Temporary diversions may marginally increase the length of routes, 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.

252. The conclusion of the assessment for population health is that any changes in health outcomes associated with access disruption of, or reduced environmental quality (noise, dust, air quality and views) along routes would be a low magnitude of effect on a receptor of medium to high sensitivity. This represents an impact of **minor adverse significance**, i.e. not significant for the general population or vulnerable groups. This is because the only direct impact on access of physical activity would be in relation to diversion of routes which will be temporary, localised and reversible. In line with the NPS EN-1 (DECC 2011a), it is considered that SEP and DEP (based on the assessment in **Chapter 19 Land Use, Agriculture and Recreation**) has avoided significant impacts for obstruction to recreational activities, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control temporary obstructions.

253. Additional recommended mitigation measures to ensure minimising the risk of any behavioural change are detailed in **Section 28.6.1.4.5**. All effects would be short-term, temporary, fully reversible and would cease on completion of the works. Therefore, there would be no residual long-term change in population health outcomes.

254. Although the scientific evidence indicates a relationship between changes to environmental quality and health outcomes, any changes that would result from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst an adverse effect, it would have only a marginal effect on delivering health policy linked to environmental quality and on contributing to narrowing health inequalities.

28.6.1.4.5. Additional Recommended Mitigation Measures

255. Mitigation measures recommended as part of the diversion to help minimise the risk of any behavioural change as a result of unexpected or unknown duration changes include:

- Providing diversions signs and advertising notices locally in advance of time that will explain the new route and duration of the diversion;
- Providing diversions that are suitable in terms of providing equivalent levels of access; and
- Providing reopening signs and notices that advertise the reopening of the route and promote active travel connectivity to destinations.

28.6.1.5. Impact 28.5: Journey Times and/or Reduced Access Effects

256. During the construction phase of SEP and/or DEP, there is a 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 a potential to lead to temporary delays and to temporarily reduce access to local services.

257. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The local populations of North Norfolk, Broadland and South Norfolk Districts;
- People living in deprivation (including those experiencing income and/or access/geographic vulnerability); and
- People with existing poor health (physical and mental health).

258. Vulnerability in this case relates to people living in deprived areas in the vicinity of the landfall, onshore cable corridor and onshore substation, particularly people with long-term illnesses (and their carers) and users of ambulance services.

259. 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 SEP and/or DEP traffic.

260. The temporal scope for this effect varies depending on the area of the Project and scenario. The conclusions of **Chapter 24 Traffic and Transport** are summarised below.

261. As part of the SEP and/or DEP site selection process, built up areas and locations where health care facilities are located have been avoided. 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 an **Outline Construction Traffic Management Plan** (CTMP) (document reference 9.16), including travel plan measures, which will be developed further in consultation with NCC and National Highways prior to the commencement of the authorised project.

28.6.1.5.1. Source-Pathway-Receptor

262. The potential effect is considered *likely* because (based on the methods described in **Section 28.4.3**) there is a potential source-pathway-receptor relationship as follows:

- Source – increased number of vehicles on the road network or temporary traffic management measures due to SEP and/or DEP;
- Pathway – journey times or accessibility to amenities/services being affected, particularly healthcare (emergency and non-emergency); and
- Receptors – local road users.

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

28.6.1.5.2. Sensitivity of the Receptor

264. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 28.4.3** and specifically paragraph 74).

265. Baseline statistics (provided in **Appendix 28.2 Health Baseline Statistics** and discussed in **Section 28.5**) show that journey times to eight key services (medium sized centres of employment (500-4,999 jobs), primary schools, secondary schools, further education, GPs, hospitals, food stores and town centres) by car, public transport, walking and/or by bicycle are similar to the regional average in Broadland and South Norfolk, but are longer than the regional average by 5 to 12 minutes (depending on the mode of transport) in North Norfolk. Average distances travelled to work in Broadland are similar to the national average (14.9 km) but further in North (20.9 km) and South Norfolk (18.1 km); this is representative of the rural nature of the study area. The AHAH index ranges from 8th to 10th decile. The sensitivity of the general population is therefore considered to be *low*. Any more sensitive individuals are covered within the vulnerable group population below.

266. It is relevant to note for this determinant of health resource sharing with SEP and DEP (i.e. shared use of the road network by communities and the SEP and DEP) and the capacity to adapt (e.g. whether the road network inherently provides alternative routes that most people, and emergency services, would be able to use to achieve similar journey times) has been assessed in the driver delay assessment of **Chapter 24 Traffic and Transport**. 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 show some neighbourhoods around the landfall and onshore cable corridor are amongst the 40% most deprived in England. Deprived populations may already face more access barriers than the general population (refer to **Section 28.5.7**) 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. Similarly, ambulance services, and the recipients of their care, are particularly sensitive to delays.

28.6.1.5.3. Magnitude of the Effect – All Scenarios

267. Under all construction scenarios, the temporal scope for these effects are as follows:

- With regard to delays due to traffic management along routes:
  - At landfall, there is a short-term temporal scope due to HDD and presence of a temporary onshore works area. Export cable installation at the landfall would be over a period of approximately five months. HDD at landfall has been selected to minimise impacts and avoid restrictions or closures to the Weybourne Beach. Furthermore, landfall is accessed via a private road.
  - Along the onshore cable corridor there is a short-term temporal scope because (as described in **Chapter 4 Project Description**) the cable corridor will be constructed in sections of 1,000m intervals with a typical construction presence of up to four weeks before moving along the corridor.
  - At the onshore substation, there is a medium-term temporal scope because the works are planned across several months.
- With regard to traffic movement, the temporal scope would be short-term. Although SEP and/or DEP 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 of impacts is measured in the short-term (months), intermittent and fully reversible on completion of the SEP and DEP.

268. The magnitude of the change due to SEP and/or DEP can be characterised as *low* based on the following:

- Only small changes in journey times would be expected, largely relating to short delays at certain junctions. The delay from alternative routes ranges from no delay in travel time (for the majority of routes) to a delay of up to six minutes;

- The frequency of any delays is likely to be low because works are linear, and delays would be temporary, intermittent and fully reversible. Any change is considered unlikely to be of a scale that would affect quality of life or morbidity or receipt of time-critical healthcare;
- Commitment to trenchless crossing techniques is proposed for a number of major roads in order to minimise impacts;
- Residual impact significance for the impacts (i.e. severance, amenity, pedestrian delay, road safety and driver delay) considered in **Chapter 24 Traffic and Transport** are negligible (for the majority of links) to minor adverse (at worst) (i.e. not significant) with the implementation of mitigation measures recommended in the chapter and the CTMP;
- Any change in journey times would be reversible as SEP and/or DEP does not make any permanent change to the road network; and
- Although a large number of people use the road network and therefore may be affected, the change experienced by local communities is expected to be small. Thus a minor change in risk factors for road safety and journey-time related health outcomes would be expected for a large minority of the population.

28.6.1.5.4. Significance of Impact – All Scenarios

269. The conclusion of the assessment for population health is that any change due to SEP and DEP would be a low magnitude of effect on a receptor of high sensitivity. This represents an impact of **minor adverse significance**, i.e. not significant for the general population or vulnerable groups. Vulnerability in this case relates to people who are more likely to require urgent medical care and/or are required to make frequent use of the road networks primarily due to medical access needs and those who require at home medical assistance. People over the age of 60 and those with existing health conditions would be particularly sensitive to any change. All effects would be short term, temporary and would cease on completion of the works. In line with NPS EN-1 (DECC, 2011a), it is considered that SEP and DEP has avoided significant impacts for obstruction to health services. **Chapter 24 Traffic and Transport** has proposed mitigation in place where impacts are predicted and will put in place measures to effectively manage and control temporary obstructions. Therefore, there would be no residual long-term change in population health outcomes.

28.6.2. Potential Impacts during Construction and Operation

28.6.2.1. Impact 28.6: Employment Effects

270. Employment has been considered across both construction and operation. As discussed in **Chapter 27 Socio-Economics and Tourism**, the development of SEP and/or DEP is part of a wider process of developing an offshore wind supply chain in the New Anglia LEP region. Therefore, from a human health perspective, 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 SEP and/or DEP also creates indirect employment in the supply chain and induced employment due to expenditure.

271. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The local populations of North Norfolk, Broadland and South Norfolk Districts;
- The population of Norfolk County (regional);
- People living in deprivation (including those experiencing income and/or access/geographic vulnerability); and
- Children and young people, older people and people in poor health for indirect effects as dependants.

272. The key health outcomes relevant to this determinant of health are:

- indirect influences on physical health (e.g. cardiovascular conditions) Sommer *et al*., 2015); and
- mental health conditions (e.g. stress, anxiety or depression) (van der Noordt *et al*., 2014).

273. These are due to potential 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).

274. The temporal scope for these effects (see **Section 28.3.3**) is variable:

- 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; and
- 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.

275. The Applicant has also committed to take a proactive, collaborative, and open approach to identifying opportunities to maximise local skills development, training and jobs, see the **Outline Skills and Employment Strategy** for more details (document reference 9.23). The conclusions of **Chapter 27 Socio-Economics and Tourism** show that East Anglia and the UK have the potential to benefit through increased employment opportunities and direct economic benefit. However these benefits should be weighed against any potential adverse impacts that SEP and/or DEP may cause.

28.6.2.1.1. Source-Pathway-Receptor

276. The potential effect is considered *likely* because (based on the methods described in **Section 28.4.3**) this is a potential source-pathway-impact relationship as follows:

- Source – direct and indirect job creation due to the development of SEP and/or DEP
- Pathway – employment, with increased probability of effect due to supply chain and skills development
- Receptors – people of working age in the regional labour market (and their dependants)

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

28.6.2.1.2. Sensitivity of the Receptor

278. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 28.4.3** and specifically paragraph 74). Sensitivity in this case is related to how likely it is a population could benefit from being employed.

279. The baseline shows that the labour market in the New Anglia region is relatively strong (see **Chapter 27 Socio-Economics and Tourism**). The employment deprivation score for Norfolk is similar to the national average. However, there are some more economically deprived areas (within 40% of the most deprived in England), with high retirement rates, close to the landfall and onshore cable corridor that may struggle to benefit from employment opportunities.

280. The number of people in Norfolk County at working age (16-64) and in employment is marginally higher (75.4%) than the England (75.1%) average. The regional population also has an employment deprivation score that is similar to the average for England. As a result, many people in the region are already in stable employment that would not be affected by SEP and/or DEP (or are a dependant of such a person). Regionally, a higher proportion of people are in a skilled trades occupation (12.1%) and are process, plant and machine operatives (7.5%) when compared to the national (8.7% and 5.4% respectively) average. However, the average attainment 8 scores (49.2%) and pupil absence percentage (5.1%) show education deprivation is slightly higher compared to the rest of England (50.2% and 4.7% respectively). 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 *low to medium*.

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

28.6.2.1.3. Magnitude of the Effects – All Scenarios

282. **Chapter 27 Socio-Economics and Tourism** concluded that residual impacts on direct economic benefit on increased employment would be **minor beneficial** (both for the UK and East Anglia) in both construction and operational phases.

283. The magnitude of the change due to SEP and/or DEP can be characterised as follows:

- There would be direct and indirect employment opportunities both during construction and operation;
- Construction jobs would be short- to medium-term, and benefits would be maintained, through knowledge and transferable skills gained during construction, which in turn would have longer term benefits;
- Operational jobs could provide several decades (around 40 years) of benefit to those employed and their dependants;
- The operational/maintenance workforce will be much smaller than construction, and the potential for local people to access employment opportunities created as a result of the O&M of SEP and/or DEP is dependent on the location of the O&M bases and the match between the type of employment created and the skills and occupational profile of local residents;
- The majority of the jobs are expected to be drawn from the regional level, providing benefits to those employed as well as their dependants; and
- 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.

284. SEP and/or DEP's contribution to direct employment (as a proportion of the regional labour market) under a best case scenario, the impact is estimated to represent less than 0.01% of the UK's current baseline and approximately 0.08% of the East Anglia employment baseline, as detailed **Chapter 27 Socio-Economics and Tourism**), will be relatively small. The potential change, whilst positive, is unlikely to be associated with a widespread reduction in inequalities or a widespread increase in prosperity or quality of life. However, those employed directly and indirectly through either the construction or operation of SEP and/or DEP would experience overall improvements in socio-economic status and this is likely to lead to improvements in general well-being. The magnitude (from the health perspective) is considered *low to medium*, driven by the longer-term regional benefits to upskilling and employment. A low beneficial effect on physical and mental health morbidity and quality of life outcomes for a small minority of the local and regional population would also be expected.

28.6.2.1.4. Significance of Impact – All Scenarios

285. The conclusion of the assessment for population health is that any change associated with SEP and DEP would be a low beneficial magnitude of effect on a receptor of medium to high sensitivity. This represents an impact of **minor beneficial significance**, i.e. not significant for the general population or vulnerable groups. The score is driven by effects to vulnerable groups, including as employees and dependants. Vulnerability in this case relates to direct and indirect employment opportunities for people living who are of working age and on low incomes or unemployed. The Applicant specifically sets out an approach to identifying opportunities to maximise local skills development, training and jobs, see the **Outline Skills and Employment Strategy** for more details (document reference 9.23).

286. 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).

287. There are no regulatory standards with regard to 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 in **Chapter 27 Socio-Economics and Tourism**.

288. Although the scientific evidence indicates a clear relationship between changes to employment and changes to health outcomes, the level of employment from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst a positive effect, it would have only a marginal effect on delivering health policy linked to good quality employment and on contributing to narrowing health inequalities.

28.6.3. Potential Impacts during Operation

28.6.3.1. Impact 28.7: Noise

289. The potential for noise impacts during operation of the onshore substation has been considered in **Chapter 23 Noise and Vibration**.

290. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 28.3.2**):

- The population near the onshore substation (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

291. The key health outcomes are the same as those discussed in **Section 28.6.1.1**, in relation to potential noise effects during construction.

28.6.3.1.1. Source-Pathway-Receptor

292. A potential health effect is considered likely because, based on the methods described in **Section 28.4.3**, there is a plausible source-pathway-receptor relationship where:
    - Source – the operation of the onshore substation;
    - Pathway – noise transmission through the air; and
    - Receptors – communities of people local to the onshore substation.

293. The potential effect is probable (however this is low) as no unusual conditions are required for the source-pathway-receptor linkage.

28.6.3.1.2. Sensitivity of the Receptor

294. The sensitivity of the general population and vulnerable groups are the same as those discussed in **Section 28.6.1.1**, in relation to potential noise effects during construction at the onshore substation.

28.6.3.1.3. Magnitude of Effect – All Scenarios

295. Under all SEP and/or DEP operational scenarios, the conclusions of **Chapter 23 Onshore Noise and Vibration** summarised that with mitigation:
    - negligible residual impact at all receptor locations near the onshore substation.

296. The mitigation measures taken into consideration during the assessment are described in **Chapter 23 Onshore Noise and Vibration** and **Appendix 23.4 Onshore Substation Operational Noise Assessment**.

297. The temporal scope for this effect is long-term as it relates to the operational phase of SEP and/or DEP. Noise effects would be localised to the onshore substation and therefore experienced by few people, and therefore exposure would be one of low exposure by a small population.

298. Under all three scenarios the magnitude of change due to SEP and/or DEP can be characterised as *low*. At these levels, it is unlikely that there would be changes in the risk of developing a new health condition (morbidity) or of exacerbating an existing condition.

28.6.3.1.4. Significance of Impact – All Scenarios

299. Under all scenarios, i.e. the conclusions of the assessment for population health is that any change due to SEP and DEP would be a low magnitude of change on a receptor of medium to high sensitivity. This represents an impact of **minor adverse significance**, i.e. not significant for the general population or 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 near to the onshore substation. It should be noted that there are no properties within 500m of the onshore substation. In line with the NPS EN-1 (DECC 2011a), it is considered that (based on the assessment in **Chapter 23 Noise and Vibration**) SEP and/or DEP has avoided significant impacts for noise and vibration, has proposed additional mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control noise.

300. Although the scientific evidence indicates a relationship between changes to noise and health outcomes, any changes that would result from SEP and DEP would likely contribute to only a slight change in the health baseline of the population. Whilst an adverse effect, it would have only a marginal effect on delivering health policy linked to noise and on contributing to narrowing health inequalities.

28.6.3.2. Impact 28.8: EMF Effects

301. The onshore buried cable systems will generate EMFs when SEP and/or DEP is in operation. The 50 Hz EMFs generated by this type of electricity transmission are often referred to as power frequency or extremely low frequency (ELF) EMFs. ELF EMFs are produced wherever electricity is generated, transmitted or used.

302. The population groups relevant to this assessment, due to either proximity or other sensitivity are:

- The population along the onshore cable corridor (site-specific); and
- 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 experiencing income and/or access/geographic vulnerability).

303. The temporal scope for potential effects would likely to be long term due to the operation of the infrastructure being at least 40 years.

304. SEP and/or DEP will only design and install equipment that is compliant with the relevant exposure limits. To ensure this, all of the equipment for SEP and/or DEP capable of producing EMFs will be assessed in accordance with the provisions of the UK Government's Code of Practice on Compliance, which is compliant with ICNIRP guidance (ICNIRP, 1998).

305. The government, acting on the advice of the authoritative scientific bodies, has put in place appropriate measures to protect the public from EMFs. **Appendix 28.1 EMF Assessment** assessed all of the proposed technology options for the SEP and/or DEP export cables and third-party crossing points, even under worst case conditions where circuits were carrying the maximum load producing the highest magnetic fields possible, would be fully compliant with the government policy. Specifically, all the fields produced would be significantly below the relevant exposure limits. Therefore, there would be no significant EMF effect resulting from SEP and/or DEP. For most designs evaluated, the magnetic fields reduce to a background level at the DCO order limits. This is detailed in full in **Appendix 28.1 EMF Assessment**.

28.6.3.2.1. Source-Pathway-Receptor

306. Based on the methods described in **Section 28.4.3**, there is not a plausible source-pathway-receptor relationship as:

- The source of EMF are the onshore cable corridor, cable crossing points, and onshore substation. These sources are all below regulatory exposure limits.
- The pathway is electric and magnetic fields. However, such fields will be designed within regulatory standards, avoid a plausible pathway of effect.
- Receptors would be people living close to the onshore substation and cable corridor.

307. As there is no plausible source-pathway-receptor relationship, there would be no likely significant population health effects, for the general population or for vulnerable groups, from EMF from the onshore cable corridor or onshore substation under the any scenario.

308. While there may be some concerned about EMF risk (i.e. a person's understanding or views of the risk to their health, or in other words their outlook) and that such concerns may influence their mental health and quality of life even where the exposure levels are well within health protection good practice standards, the information set out in this chapter and **Appendix 28.1 EMF Assessment** provides reassurance for those who may be concerned. Resource sharing with SEP and DEP, i.e. use of routes that go past or over transmission infrastructure, is limited due to the narrow width of the cable corridor and separation distance from areas where people spend extended periods of time.

309. In order to avoid adverse health outcomes from the public's understanding of EMF risk, which may negatively impact mental health, additional mitigation is recommended which includes providing clear and non-technical information about the electrical infrastructure and its compliance with UK guidance. This information will explain that any potential EMF risks have been assessed and do not pose a risk to public health.

28.6.3.3. Impact 28.9: Wider Societal Benefits

310. There are potential wider society gains as a result of the operation of SEP and DEP. The population groups relevant to this assessment, due to either proximity or vulnerability, are (as defined in **Section 28.3.2**):

- The site-specific, local, regional, national and international populations;
- People with existing poor health (physical and mental health);
- Children and young people;
- Older people; and
- People living in deprivation (including those experiencing income and/or access/geographic vulnerability).

311. SEP and DEP would increase energy independence and reduce air pollutants and greenhouse gas emissions that are produced from the generation of electricity from other non-renewable sources of energy (i.e. coal, oil, gas, etc.). The associated key health outcomes are reducing premature deaths, heart attacks, asthma exacerbations, and hospitalizations for cardiovascular or respiratory issues (Harvard Chan School, 2022). The temporal scope is long term as it relates to the operational phase of SEP and/or DEP.

28.6.3.3.1. Source-Pathway-Receptor

312. The potential effect is considered likely, because (based on methods described in **Section 28.4.3**) there is a potential source-pathway-receptor relationship as follows:
    - Source – renewable energy created during the operation of SEP and/or DEP
    - Pathway – (national) energy security, potential to contribute to affordable energy and reduction in air pollutant and greenhouse gas emissions
    - Receptor – all population groups listed in the section above

28.6.3.3.2. Sensitivity of the Receptor

313. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 28.4.3** and specifically paragraph 74). Sensitivity in this case is related to how likely it is a population could benefit from energy security and from the generation of renewable energy as part of SEP and/or DEP.

314. The baseline shows that in North Norfolk, fuel poverty is higher than the regional and national averages, while in Broadland and South Norfolk, fuel poverty is less than the regional and national averages. The proportion of people experiencing fuel poverty regionally in Norfolk is higher than the national average (**Appendix 28.2 Health Baseline Statistics**).

315. As detailed in the **Greenhouse Gas Footprint Assessment** (document reference 6.3.4.2), during 2021, approximately 43% of the energy generation share in 2021 was from fossil fuels, which primarily comprised gas. While energy demand fell in 2020 to levels not seen since the 1950s due to the Covid-19 pandemic, they increased slightly in 2021, but were still down 9% on 2019. Renewable generation (as a percentage of generation) continued to grow and reached a record proportion of 43% in 2020, but dropped again slightly in 2021 to 40% (second only to 2021), and both recent years were an increase on 2019 (37%). 2020 was also the first time where renewable generation outpaced annual fossil fuel generation. UK's electricity generation landscape continues to evolve towards more renewable alternatives (BEIS, 2022).

316. Therefore, the sensitivity of the general population can be characterised as *medium*, and the sensitivity of vulnerable population groups can be characterised as *high*.

28.6.3.3.3. Magnitude of the Effects – All Scenarios

317. As stated in both the current and draft NPS for Overarching Energy (EN-1), energy production has the potential to impact on the health of the population as access to energy is clearly beneficial to society and to health as a whole. Provision of renewable energy infrastructure through SEP and/or DEP would provide benefits to public health, including inherent improvements in energy provision, energy security and potentially to energy prices. The renewable energy produced as part of SEP and DEP would reduce air pollutant and greenhouse gas emissions associated with the production of less green energy.

318. As detailed in the **Greenhouse Gas Footprint Assessment** (document reference 6.3.4.2), the current installed generating capacity of onshore and offshore wind farms is 24.4 gigawatts (GW) – 13.9GW and 10.5GW of onshore and offshore capacity respectively (RenewableUK, 2021). SEP and DEP will have a maximum export capacity of up to 448 megawatts (MW) and 338 MW respectively (up to 786 MW in total), therefore SEP and/or DEP would contribute significantly to the decarbonisation of the UK energy supply.

319. The **Greenhouse Gas Footprint Assessment** (document reference 6.3.4.2) concluded that SEP and DEP were predicted to lead to a reduction in atmospheric GHG concentrations compared to the without-SEP and/or DEP baseline (i.e. electricity produced by Combined Cycle Gas Turbine (CCGT), as CCGT is the most common form of new plant in terms of fossil fuel combustion). It was considered that SEP and/or DEP will provide a renewable source of electricity and therefore will have a beneficial impact to reducing GHG emissions and assist in the UK's trajectory towards net zero emissions by 2050.

320. The magnitude from a health perspective is considered *low to medium (beneficial),* driven by the longer term regional, national and international wider benefits to society, which could contribute to minor to moderate beneficial changes in quality of life for a large proportion of the population. The benefits of providing renewable infrastructure through SEP and DEP would add to national energy security, which is relevant to wider public health supporting technologies, services and living standards as well as the potential contribution to affordable energy which is relevant to those on low incomes. In addition, renewable sources of energy reduce the adverse health effects of climate change experienced internationally, particularly in low and middle income countries.

28.6.3.3.4. Significance of Impact – All Scenarios

321. The conclusion of the assessment for population health is that any change due to SEP and DEP would be a low to medium beneficial magnitude of change on a receptor of medium to high sensitivity. This represents an impact of **minor beneficial significance**, i.e. not significant for both the general population and vulnerable groups. Vulnerability in this case may particularly relate to people on low incomes or who are experiencing fuel poverty.

322. Scientific literature shows that decarbonising the energy sector and switching to renewable energy helps to reduce air pollution and greenhouse gas emissions, which are associated with premature deaths, heart attacks, asthma exacerbation and hospitalisation for cardiovascular or respiratory issues.

323. There are no regulatory standards with regard to wider societal benefits as a determinant of health. The NPS for Overarching Energy (EN-1) (DECC, 2011c) states that *"energy production has the potential to impact on the health and well-being ("health") of the population. Access to energy is clearly beneficial to society and to our health as a whole. However, the production, distribution and use of energy may have negative impacts on some people's health".*

324. SEP and DEP is likely to have a positive, albeit marginal, effect on delivering health policy on standards of living and fuel poverty, as well as supporting a marginal reduction in inequalities. Overall, a slight beneficial effect on the population health baseline would be expected.

28.6.4. Potential Impacts During Decommissioning

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

326. In relation to the 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 would be expected to include:

- dismantling and removal of outside electrical equipment from site located outside of the substation(s) buildings;
- removal of cabling from site;

- dismantling and removal of electrical equipment from within the substation(s) buildings;
- removal of main substation(s) building and minor services equipment;
- demolition of support buildings and removal of fencing;
- landscaping and reinstatement of the site (including land drainage); and
- removal of areas of hard standing.

327. Whilst details regarding the decommissioning of the substation are currently unknown, considering a worst-case scenario, which would be the removal and reinstatement of the current land use, it is anticipated that the impacts would be no greater than those during construction. This is because any areas of identified contamination would have been remediated during the construction phase.

328. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of SEP and/or DEP so as to be in line with current guidance, policy and legalisation 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 licencing and consenting approach.

28.7 Cumulative Impacts

329. The health assessment takes a different topic-specific approach to the methodology used for the CIA described in **Chapter 5 EIA Methodology**, and is described further in **Section 28.4.3.6**.

330. There are many inter-relationships between determinants of health and health outcomes. This section considers inter-project cumulative effects, and intra-project cumulative effects are considered in **Section 28.8**.

28.7.1. Identification of Potential Cumulative Impacts

331. The first step in the cumulative assessment is the identification of which residual impacts assessed for SEP and / or DEP on their own have the potential for a cumulative impact with other plans, projects and activities (described as ‘impact screening’). All impacts considered in this chapter have the potential for cumulative impacts on health in combination with other projects (i.e. inter-project effects) occurring at a similar time with effects to the same populations.

332. Only potential impacts assessed in **Section 28.6** as negligible or above are included in the CIA (i.e. those assessed as ‘no impact’ are not taken forward as there is no potential for them to contribute to a cumulative impact).

28.7.2. Other Plans, Projects and Activities

333. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative impacts for inclusion in the CIA (described as 'project screening'). This information is set out in **Table 28-18**, together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to SEP and DEP, status of available data and rationale for including or excluding from the assessment. Commentary specific to each of the EIA receptor topics is detailed in the technical chapter references in this chapter.

334. Sub-regional growth in housing and employment, as adopted by the region's Local Plans, has been captured within future year growth factors applied to the forecast traffic flows (further detail is provided in **Chapter 24 Traffic and Transport**). The cumulative effect of housing and employment projects is therefore inherent in the traffic and transport impact assessment, and consequently also within the traffic-related aspects of the air quality and noise impact assessments (as traffic flows from the traffic and transport impact assessment were used in the impact assessments for air quality and noise (see **Chapter 22 Air Quality** and **Chapter 23 Noise and Vibration** for further details)). Therefore, the cumulative health effects on journey times, reduced access, air quality or noise for any housing and employment projects listed in **Table 28-18** have been included within the impact assessments provided in **Chapter 24 Traffic and Transport**, **Chapter 22 Air Quality** and **Chapter 23 Noise and Vibration**.

335. Any cumulative project identified and included in the CIA of the technical chapters (as listed in paragraph 3) have been considered in the CIA for this chapter, with the exception of potential cumulative effects that have been determined to be insignificant when compared to the same health criterion as in this chapter. For example, the cumulative effects of projects on air quality screened into the air quality CIA (see **Chapter 22 Air Quality**) have been compared against health based Objectives (i.e. the same as in this chapter), and if the cumulative effect has been determined to be not significant as a result, the potential cumulative effect has not been included in **Table 28-18** as it has been considered already. Other potential cumulative effects on air quality (i.e. construction dust) were included in the health assessment CIA, where applicable. Small scale developments (i.e. few dwellings, etc.) have also not been included in **Table 28-18** due to the localised, small and temporary nature of construction works associated with these developments and therefore would be unlikely to cumulatively affect any of the receptors identified for SEP and DEP.

336. The CIA is based on information available on each potential project and it is noted that the project details available may either change in the period up to construction or may not be available in detail at all. The assessment presented here is therefore considered to be precautionary, with the level of impacts expected to be conservative.

337. None of the CIAs included in the respective technical chapters (as listed in paragraph 3) and referenced in this chapter, identified any reasonably foreseeable projects or developments where significant cumulative effects on individual environmental aspects would arise. In respect of potential cumulative effects on local population health, this CIA (presented in **Table 28-18**) has not identified impacts that are considered to be of any greater significance than those identified for SEP and/or DEP, and no significant cumulative health effects are predicted.

Table 28-18: Summary of Projects Considered for the CIA in Relation to Human Health

Project	Status	Construction Period	Closest Distance from SEP and DEP (km)	Included in the CIA	Rationale
Norfolk Vanguard (NV) Offshore Wind Farm	DCO consented	Expected construction 2022 to 2025	0 – onshore cable intersects SEP and DEP	Yes	There may be concurrent construction, therefore some cumulative effects on determinants of health (i.e. noise, air quality, ground/water contamination, physical activity, journey times/reduced access and employment) may occur.
Hornsea Project Three (HP3) Offshore Wind Farm	DCO consented	Expected construction 2021 to 2027	0 – onshore cable intersects SEP and DEP 0.8 – between onshore substations	Yes	There is potential that this project could be constructed in two phases meaning that the entire construction period could be either ten years or six years. Therefore, there could be temporal overlap of construction with SEP and DEP which could lead to cumulative effects on health (i.e. noise, air quality, ground/water contamination, physical activity, journey times/reduced access and employment). The onshore infrastructure for this project follows a very similar route to that of SEP and DEP, therefore potential impacts would affect the same population groups.
Norfolk Boreas (NB) Offshore Wind Farm	DCO consented	Expected construction 2026 to 2027 (if Norfolk Vanguard lay ducts as part of project)	0 – onshore cable intersects SEP and DEP	Yes	There may be concurrent construction, therefore some cumulative effects on determinants of health (i.e. noise, air quality, ground/water contamination, physical activity, journey times/reduced access and employment) may occur.
A47 North Tuddenham to Easton (road investment scheme)	DCO consented	Expected to be completed by 2025 (see **Chapter 24 Traffic and Transport** for further details on this scheme))	0 – RIS intersects onshore boundary	No	As detailed in **Chapter 24 Traffic and Transport**, an overview of the latest forecast for the construction programmes for the highway schemes (based upon the latest publicly available information) identifies that the schemes are currently scheduled to be complete by 2025, and as such there may be no overlap with the construction phase of SEP and DEP, which is scheduled to commence summer 2025 (at the earliest).
A47 Blofield to North Burlington (road investment scheme)	DCO consented		14.3 – onshore substation	No	

Project	Status	Construction Period	Closest Distance from SEP and DEP (km)	Included in the CIA	Rationale
A47/A11 Thickthorn Junction (road investment scheme)	Awaiting decision (Examination closed)		0.73 – onshore cable corridor	No	
A47 Great Yarmouth Junction Improvements Including Reconstruction of the Vauxhall Roundabout RIS	Pre-application	Anticipated operational from 2025	30.2 – onshore substation	No	The construction of the proposed improvements should be completed prior to the commencement of the construction of SEP and DEP.
Application Reference 20211249 – Ground mounted solar farm	Full planning	Commence before February 2025	~0 – onshore cable corridor	No	Although there is a potential spatial overlap between the two projects, this proposed solar farm will require minimal construction works and is not anticipated to have any effects associated with health.

28.7.3. Assessment of Cumulative Impacts

338. The following projects will be assessed for potential direct cumulative effects under all scenarios for SEP and DEP:

- HP3 Offshore Wind Farm;
- NV Offshore Wind Farm; and
- NB Offshore Wind Farm.

339. Summaries of the effects relevant to each population group and concludes with a professional judgement of the inter-project cumulative effect are presented in **Table 28-19** and **Table 28-20**.

340. Prior to construction, SEP and DEP will produce a CoCP and CTMP that will be submitted to the relevant Local Planning Authorities for approval to discharge requirements of the draft DCO. It is therefore considered that any cumulative effects will be mitigated through compliance with these approved documents, following best practice guidance and an outlined suite of mitigation to manage risks during construction.

341. Similarly, **Table 28-21** summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the inter-project cumulative effect.

Table 28-19: Inter-Project Cumulative Effects for Site-Specific Geographic Population Groups

	Description of Cumulative Effects		
	Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
Cumulative project(s) and impacts considered	Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm. The HP3 Offshore Wind Farm will make landfall at Weybourne to the west of the SEP and DEP landfall. Therefore, potential impacts would affect the same population groups. The CIAs presented in **Chapter 19 Land Use, Agriculture and Recreation**, **Chapter 22 Air Quality**, **Chapter 23 Noise and Vibration** and **Chapter 24 Traffic and Transport** concluded that after the implementation of mitigation measures (as detailed where relevant in each technical chapter)	Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm; • NV Offshore Wind Farm; and • NB Offshore Wind Farm. There could be a degree of temporal and spatial overlap of NV, NB and HP3 with the construction of SEP and DEP. **Chapter 23 Noise and Vibration** identifies that significant cumulative impacts are considered unlikely as a result of on-site construction noise along the onshore cable corridor. The implementation of mitigation measures outlined in the CTMP for cumulative construction traffic noise would result in a residual impact of minor adverse significance (i.e. not significant in EIA terms). As detailed in the CIA in **Chapter 22 Air Quality**, cumulative traffic associated with the other three offshore windfarm projects was included within the impact assessment of road traffic emissions during construction, and as air quality impacts at human receptors were well below relevant Objectives, no significant cumulative impacts are anticipated. If in the highly unlikely situation where DCO boundaries intersect and construction activities are occurring at the same time, any cumulative dust and NRMM emissions impacts would be managed through mitigation measures (identified in **Chapter 22 Air Quality**) and through inter-project engagement to avoid temporal overlap. With relation to ground and/or water contamination cumulative effects, the CIA in **Chapter 17 Ground Conditions and Contamination** conclude that no cumulative impacts are likely to occur with SEP and DEP construction, given	Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm. The onshore substation infrastructure for this project will connect to the National Grid at the Norwich Main 400 kV substation, which SEP and DEP will also connect to. Therefore, potential impacts would affect the same population groups. The construction timescale for the HP3 onshore substation and SEP and DEP onshore substation are not programmed to overlap, therefore no cumulative impacts would occur during construction.

	Description of Cumulative Effects		
	Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
	significant cumulative construction physical activity, air quality, noise and traffic (i.e. journey times and/or reduced access) impacts on health at the landfall location are not considered likely or no higher than when assessed for SEP and/or DEP (i.e. not significant). Operational impacts in **Chapter 23 Noise and Vibration** relating to near landfall have been scoped out (i.e. no impact) of the assessment and therefore there is no potential for cumulative impact.	the mitigation measures committed to by SEP and DEP and the other projects. **Chapter 18 Water Resources and Flood Risk** identified that overall cumulative impacts remain not greater than for SEP and DEP (minor adverse, i.e. not significant in EIA terms). With regard to physical activity cumulative impacts, **Chapter 19 Land Use, Agriculture and Recreation** identified that cumulative impacts on inland recreational assets and route (i.e. physical activity) were no greater than assessed for SEP and DEP (i.e. minor adverse, not significant in EIA terms), with the implementation recommended in the chapter. The CIA presented in **Chapter 24 Traffic and Transport** concluded that after the implementation of mitigation measures, such as those contained and committed to within the OCTMP, including liaising with HP3 and NV (and NB) to co-ordinate the implantation of mitigation measures to ensure timely delivery, reduce abortive work and minimise delays to highway users, as well as traffic capping, cumulative impacts as a result of the offshore windfarm projects in the area would be no greater than those individually assessed (i.e. not significance). **Chapter 27 Socio-Economics and Tourism** concluded that the cumulative impact of increased construction employment to be major beneficial and increased operational employment to be moderate beneficial, as a result of these three offshore windfarm projects, in additional to further afield projects such as East Anglia ONE North/TWO/THREE, Sizewell C in either construction or operation (these were only screened in for this topic).	During the operational phase of the onshore substation, **Chapter 23 Noise and Vibration** identified that no cumulative noise impact is expected at nearby noise sensitive receptors.

	Description of Cumulative Effects		
	Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
General population	There could be temporal overlap of construction with HP3 Offshore Wind Farm and SEP and DEP which could lead to cumulative effects on health. The general population inter-project cumulative effect is considered to be **negligible** because the various works at HP3 would not lead to health effects near landfall, as both projects have committed to use of HDD to limit impacts.	HP3 is reported to undertake onshore cable works between 2023-2025 (single phase build out) and additional in 2028 (for the two phase build out). NV and NB are reported to have onshore cable works occurring between 2022-2024. Based on these timings it is considered unlikely that construction works would be undertaken concurrently for SEP and/or DEP and these projects. However, it is recognised that sequential effects can also give rise to cumulative effects by extending the periods of exposure, disruption and disturbance to dwellings that each of the cable corridors would pass nearby. General population inter-project cumulative effect is considered to be **negligible**.	There are shared road links between these HP3 and SEP and DEP that are required for the respective construction phases. However, with implementation of best available practices potential cumulative impacts can be managed and therefore general population inter-project cumulative effect is considered to be **negligible**.

	Description of Cumulative Effects		
	Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
Vulnerable groups	HDD at landfall has been selected to minimise impacts and avoid restrictions or closures to the Weybourne Beach. However, some residual impacts for relevant vulnerable groups from noise, air quality and journey times may occur as a result of SEP and DEP. For these vulnerable groups, combined proximity and increased sensitivity may also result in a **minor adverse** inter-project cumulative effect.	Vulnerable groups along the cable corridor may be more sensitive to noise effects, air quality effects and alterations to journey time due to the higher levels of deprivation, age and long-term illness. For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.	Vulnerable groups near the onshore substation may be more sensitive to noise effects, air quality effects and alterations to journey time due to the higher levels of deprivation, age and long-term illness. For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.

Table 28-20: Inter-Project Cumulative Effects for Local, Regional and National Geographic Population Groups

Description of Cumulative effects		
Local population of North Norfolk, Broadland and South Norfolk districts	**Regional population of Norfolk County**	**National and international population of the England and beyond borders**
Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm; • NV Offshore Wind Farm; and	Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm; • NV Offshore Wind Farm; and	Cumulative effects relate to the combined population health influences from: • HP3 Offshore Wind Farm; • NV Offshore Wind Farm; and

Description of Cumulative effects		
Local population of North Norfolk, Broadland and South Norfolk districts	**Regional population of Norfolk County**	**National and international population of the England and beyond borders**
• NB Offshore Wind Farm.	• NB Offshore Wind Farm.	• NB Offshore Wind Farm.
General population: Due to the projects being distributed across the area the cumulative effects due to noise or air quality are likely to be **negligible**. The effect on increased employment may be **minor beneficial** but the increase in traffic may be **minor adverse**.	General population: Due to the projects being distributed across the area the cumulative effects due to noise or air quality are likely to be **negligible**. The effect on increased employment may be **minor beneficial** but the increase in traffic may be **minor adverse**.	The general population inter-project cumulative effect is considered to be **minor beneficial** due to the reduction in carbon dioxide emissions as a result of constructing utility scale renewable energy generation (this is detailed further in the Greenhouse Gas Footprint Assessment (document reference 9.2)). This leads to a myriad of environmental and health benefits to support a more sustainable society.
For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect. There is however a potentially **minor** to **moderate beneficial** effect at the local level from employment, particularly where there is specific mitigation to help target training and jobs to young people NEET.	For relevant vulnerable groups, combined proximity and increased sensitivity may also result in a **negligible** inter-project cumulative effect, as adverse effects are generally experienced at a much more localised scale. There is a potentially **moderate beneficial** effect at the regional from employment, particularly where there is specific mitigation to help target training and jobs to young people NEET. 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.	The benefits of providing renewable infrastructure through this Project would add to national energy security, which is relevant to wider public health supporting technologies, services and living standards as well as the potential contribution to affordable energy which is relevant to those on low incomes. In addition renewable sources reduce the adverse health effects of climate change experienced international, particularly deprived populations in low and middle income counties. For relevant vulnerable groups, increased sensitivity may result in a **moderate beneficial** inter-project cumulative effect.

Table 28-21: Inter-Project Cumulative Effect for Potentially Vulnerable Groups within Geographic Populations

Description of Cumulative effects			
Potentially vulnerable groups Children and young people	**Older people**	**People with existing poor health (physical and mental health)**	**People living in deprivation (including those experiencing income and/or access/geographic vulnerability**
Cumulative effects relate to the combined population health influences across the projects (assuming similar effects from each project):			
• Construction noise; • Construction air quality; • Construction physical activities disruption; • Operational noise at substation site; • Construction and operational employment; • Operational EMF; and • Operational wider societal benefits.	• Construction noise; • Construction air quality; • Construction physical activities disruption; • Operational noise at substation site; • Construction and operational employment; • Operational EMF; and • Operational wider societal benefits.	• Construction noise; • Construction air quality; • Construction physical activities disruption; • Construction journey times or reduced access; • Operational noise at substation site; • Construction and operational employment; • Operational EMF;	• Construction journey times or reduced access; • Construction and operational employment; • Operational EMF; and • Operational wider societal benefits.

For children and young people there are unlikely to be combined biophysical determinant of health (air quality, noise or EMF) effects between the projects due to the localised nature of such exposures and the expectation of sufficient geographical and/or temporal separation of projects. This is also the case due to the temporary nature of construction effects and the design and mitigating measures discussed in this chapter (e.g. operational EMF guideline compliance). Such cumulative adverse effects are therefore expected to be remain **minor adverse** (not significant), reflecting individual determinant effects discussed in this chapter. The most influential driver of cumulative effects to children and young people are the indirect employment benefits to this group as dependants, as well as the wider societal benefits from the operation of the renewable energy generation. Such effects support good health through the life course and are therefore cumulatively **moderate beneficial** (significant).	For older people the same assessment logic as for children and young people applies, with limited potential for biophysical determinants to cumulatively result in additive effects between projects. Such effects are also considered **minor adverse** (not significant). Whilst there would also be cumulative benefits to older people from indirect employment benefits and wider societal benefits, due to only influencing part of the life course such effects are considered **minor beneficial** (not significant).	For people with existing poor health the same assessment logic as for children and young people applies, with limited potential for biophysical determinants to cumulatively result in additive effects between projects. Such effects are also considered **minor adverse** (not significant). Similar to children and young people, this group may particularly benefit as dependants, with potential for cumulative long-term benefits. The particular sensitivity of such groups to climate change health effects and their reliance on social infrastructures that are underpinned by stable and affordable energy supplies increases this groups benefits from large-scale renewable energy projects. Such beneficial effects are therefore cumulatively **moderate beneficial** (significant).	For people living in deprivation, particularly due to limited access, the combined projects may contribute to increased access challenges. However, the expectation is that the projects would not exceed local route capacities and would provide appropriate diversions and other mitigations. On this basis additive or synergistic effects are not expected, effects remain **minor adverse** (not significant). For people living in deprivation, particularly due to low incomes, the employment opportunities cumulatively across the projects are likely to be beneficial. Equitable access to good quality employment can act to reduce poverty and inequalities. Local employment opportunities across the projects, particularly targeting low income groups including NEETS, would contribute to a **moderate beneficial** (significant) effect.

342. The overall conclusions set out in **Table 28-18** to **Table 28-21** are that there are no likely significant negative health impacts and some moderate beneficial impacts when SEP and/or DEP is considered cumulatively with other relevant development projects, in respect of the environmental aspects which were assessed., In consideration of those aspects in-combination, there would be some associated cumulative health benefit on local population and vulnerable groups primarily related to wider societal benefits and employment and the national / regional level.

28.8 Interactions

343. The population health effects of individual determinants of health identified and assessed in this chapter have the potential to be experienced by the same populations, potentially given rise to additive or synergistic effects.

344. This assessment includes populations geographically defined within the onshore DCO order limits (see **Section 28.3.2.1**), as well as those defined for other sensitivities (see **Section 28.3.2.2**).

345. Under all construction and operation scenarios, cumulative intra-project effects are found to be no greater than **minor adverse** for the general population and vulnerable groups due to the commitments made as part of the embedded mitigation as a result of consultation and design decisions that have avoided impacts on health determinants.

346. Where a few individuals have greater sensitivity due to multiple vulnerabilities, such as age, poor health and low income (known as intersectionality), these individuals may be particularly sensitive and experience greater changes in health outcomes, beneficial and adverse compared to the general population. Such intersectionality effects are noted, but are not expected to be sufficiently widespread in terms of their overlap with the projects activities to result in population level likely significant impacts

347. **Table 28-22** summarises effects under all three scenarios for each geographic population and concludes with a professional judgement on the likely intra-project cumulative effect. Similarly, **Table 28-23** summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the intra-project cumulative effect.

Table 28-22: Intra-Project Cumulative Effects for Site-Specific Population Groups for All Scenarios

Impact	Population near landfall	Population along the onshore cable corridor (including the main construction compound)	Population near the onshore substation
Effects related to location	Cumulative effects relate to the combined population health influences from the following: • Noise (during construction and operation at onshore substation); • Air quality (during construction); • Physical activity (during construction); • Journey times or reduced access (during construction); and		

Impact	Population near landfall	Population along the onshore cable corridor (including the main construction compound)	Population near the onshore substation
	• Employment (during construction and operation).		
Outcome for general population at location	Upon implementing the mitigation set out in the topic specific assessment of the ES, the general population intra-project cumulative effect is considered to be no greater than **minor adverse**, i.e. not significant due to the very short temporal scope of negligible effects and the avoidance of significant impacts through design decisions taken during the site selection process.		
Outcome for vulnerable population at location	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a cumulative effect. This is because of the likelihood that vulnerable groups will be at home during the day and are more likely to experience the effects in combination. This reflects that most individual effects are **negligible** or **minor adverse**, i.e. not significant and although potentially additive, the combined effects would still be unlikely to have significant adverse effect on population health, due to the low magnitude and localised, short-term, reversible and transient nature of effects. These conclusions remain the case where some population groups are considered sensitive across multiple determinants of health.		

Table 28-23: Intra-Project Cumulative Effect for Potentially Vulnerable Groups within Site-Specific Populations

Impact	Children and young people	Older people	People with existing poor health (physical and mental health)	People living in deprivation (including those experiencing income and/or access/geographic vulnerability)
Effects related to vulnerable group	Cumulative effects relate to the combined population health influences from: • Noise (during construction and operation of the onshore substation); • Air quality (during construction); • Employment; • Physical activity (during construction); and • Journey times or reduced access (during construction – children and older people only).			Cumulative effects relate to the combined population health influences from: • • Air quality; • Physical activities; • Journey times or reduced access; and • Employment.

Outcome for vulnerable population at location	For children and young people there are unlikely to be intra-project biophysical determinant of health (air quality, noise or EMF) additive effects of SEP and DEP due to the localised nature of such exposures. This is also the case due to the temporary nature of construction effects and the design and mitigating measures discussed in this chapter (e.g. operational EMF guideline compliance). Such adverse effects are therefore expected to no greater than **minor adverse** (not significant), reflecting individual determinant effects discussed in this chapter. The most influential driver of effects to children and young people are the indirect employment benefits to this group as dependants, as well as the wider societal benefits from the operation of the renewable energy generation.	For older people the same assessment logic as for children and young people applies, with limited potential for intra-project biophysical determinants to result in additive effects. Such effects are also considered **minor adverse** (not significant). Whilst there would also be benefits to older people from indirect employment benefits and wider societal benefits, due to only influencing part of the life course such effects are considered **minor beneficial** (not significant).	For people with existing poor health the same assessment logic as for children and young people applies, with limited potential for intra-project biophysical determinants to result in additive effects. Such effects are also considered **minor adverse** (not significant). Similar to children and young people, this group may particularly benefit as dependants, with potential for long-term benefits. The particular sensitivity of such groups to climate change health effects and their reliance on social infrastructures that are underpinned by stable and affordable energy supplies increases this groups benefits from large-scale renewable energy projects. However, at an intra-project level such beneficial effects are no greater than **minor beneficial** (not significant).	For people living in deprivation, particularly due to limited access, the intra-project effects are not expected to contribute to increased access challenges. The expectation is that the SEP and DEP would not exceed local route capacities and would provide appropriate diversions and other mitigations. On this basis additive or synergistic effects are not expected, impacts remain **minor adverse** (not significant). For people living in deprivation, particularly due to low incomes, the employment opportunities are likely to be beneficial. But not influenced by intra-project additive effects Equitable access to good quality employment can act to reduce poverty and inequalities. Impacts would be no greater than to a **minor beneficial** (not significant).

Impact	Children and young people	Older people	People with existing poor health (physical and mental health)	People living in deprivation (including those experiencing income and/or access/geographic vulnerability)
	Such effects support good health through the life course and are therefore **minor beneficial** (not significant).			

28.9 Potential Monitoring Requirements

348. No future monitoring is proposed as part of this health impact assessment. All potential adverse impacts on health were determined to be not significant in EIA terms, provided that the mitigation measures (both embedded and additional) detailed in the relevant technical chapters referenced in this chapter, are in place or are implemented.

349. The **Outline Code of Construction Practice** (OCoCP) (document reference 9.17) submitted in support of the DCO application for SEP and DEP, contains commitments to monitoring and enforcement measures that have been recommended by other specific ES chapters (e.g. **Chapter 23 Noise and Vibration**, **Chapter 24 Traffic and Transport**, etc.). Any additional monitoring requirements will be further developed and agreed with stakeholders prior to construction, taking account of the final detailed design of SEP and DEP.

28.10 Assessment Summary

350. **Table 28-24** below presents a summary of the health effects assessed within this chapter, any mitigation and the residual effects.

Table 28-24: Summary of Potential Effects Identified

Potential impact	Temporal scope	Likelihood of effect	Sensitivity of		Magnitude of effect	Significance of impact	Cumulative redisual impact
			General population	Vulnerable population		General / vulnerable population	General / vulnerable population
Construction							
Impact 28.1: Noise effects	Short/medium term	Plausible	Low	Medium to high	Low	**Not significant**	**Not significant**
Impact 28.2: Air Quality effects	Short/medium term	Plausible	Low	Medium to high	Low	**Not significant**	**Not significant**
Impact 28.3: Ground and / or water contamination effects	Very short term	Plausible but improbable	Low	Medium	Low	**Not significant**	**Not significant**
Impact 28.4: Physical Activity effects	Short/medium term	Plausible	Low	Medium to high	Low	**Not significant**	**Not significant**
Impact 28.5: Journey times and / or reduced access effects	Short/medium term	Plausible	Low	High	Low	**Not significant**	**Not significant**
Construction and Operation							

Potential impact	Temporal scope	Likelihood of effect	Sensitivity of		Magnitude of effect	Significance of impact	Cumulative redisual impact
			General population	Vulnerable population		General / vulnerable population	General / vulnerable population
Impact 28.6: Employment	Medium to long term	Plausible	Low to medium	High	Low to medium (beneficial)	**Not significant (minor beneficial)**	**Significant (moderate beneficial)**
Operation							
Impact 28.7: Noise	Long term	Low probability	Low	Medium to high	Low	**Not significant**	**Not significant**
Impact 28.8: EMFs	Medium term	None	-	-	-	**No impact**	**No effect**
Impact 28.9: Wider societal benefits	Long term	Likely	Medium	High	Low to medium (beneficial)	**Not significant (minor beneficial)**	**Significant (moderate beneficial)**
Decommissioning							
Given the uncertainty associated with the approach to decommissioning and the position of the sector nationally and locally, it is not possible to undertake a detailed assessment of this phase. Decommissioning activities of the proposed SEP and DEP are anticipated to be similar to, but no worse than the impacts identified during the construction phase.							

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