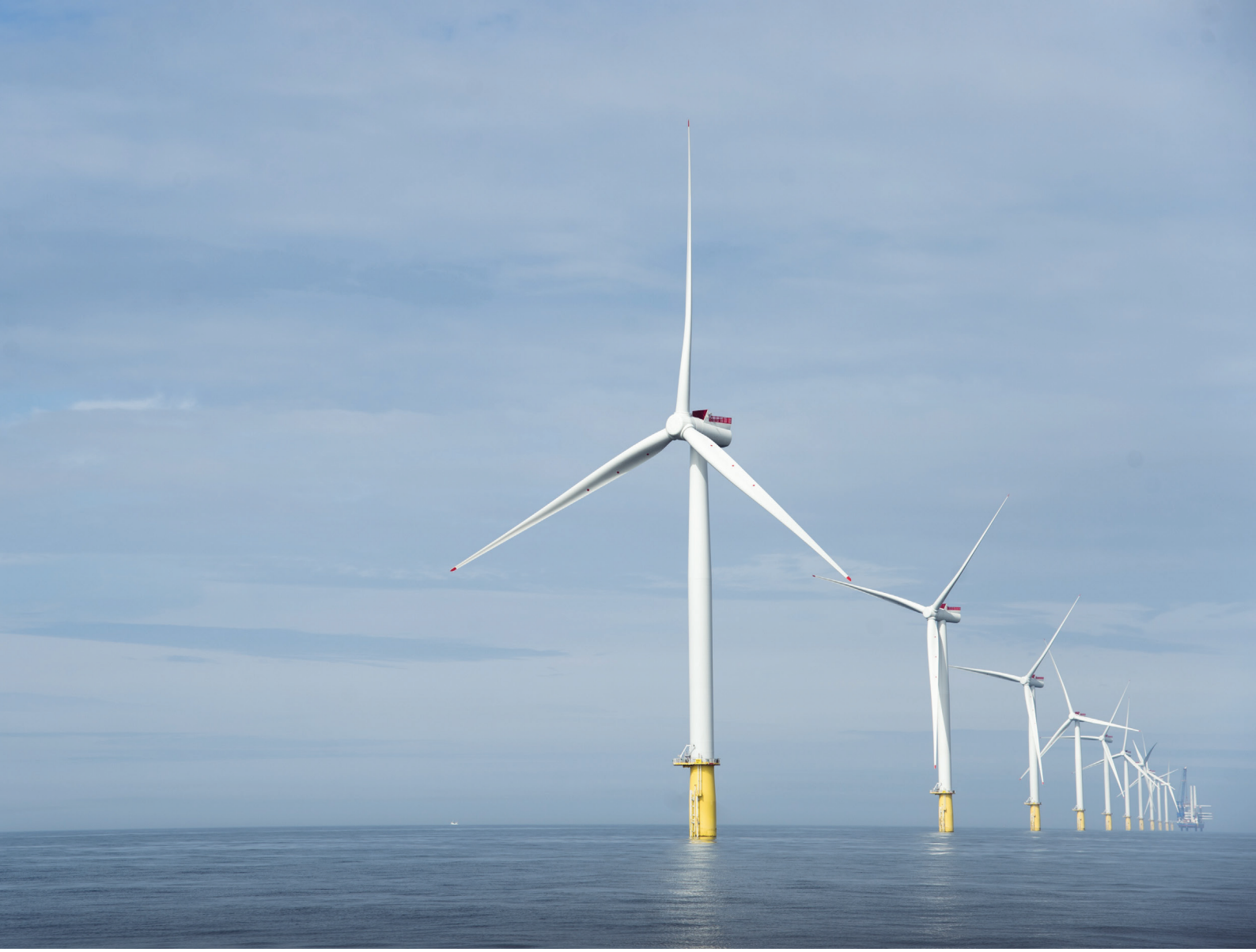

Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 1

Chapter 17 - Ground Conditions and Contamination

August 2022
Document Reference: 6.1.17
APFP Regulation: 5(2)(a)

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Title**:**	
Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Environmental Statement **Chapter 17: Ground Conditions and Contamination**	
PINS Document no.: 6.1.17	
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Prepared by:	
Royal HaskoningDHV	
Approved by:	Date:
Johiris Rodriguez Tablante, Equinor	August 2022

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Glossary of Acronyms

BGS	British Geological Survey
BEIS	Department for Business Energy and Industrial Strategy
BMV	Best and Most Versatile
BRE	British Research Establishment
CBS	Cement bound sand
CDM	Construction Design Management
CEMP	Construction Environmental Management Plan
CFA	Continuous Flight Auger
CIA	Cumulative Impact Assessment
CLR11	Contaminated Land Report 11
CoCP	Code of Construction Practice
COSHH	Control of Substances Hazardous to Health
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEFRA	Department for the Environment and Rural Affairs
DEP	Dudgeon Offshore Wind Farm Extension Project
DPD	Development Plan Document
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ERP	Emergency Response Plan
ES	Environmental Statement
GIS	Geographical Information System
GPCL	Guiding Principles for Contaminated Land
HDD	Horizontal Directional Drilling
km	Kilometre
LNR	Local Nature Reserve
MMP	Materials Management Plan
MSA	Mineral Safeguarding Area
NCC	Norfolk County Council
NFU	National Farmers Union

NNDC	North Norfolk District Council
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NVZ	Nitrate Vulnerable Zone
NWL	Norwich Western Link
OS	Ordnance Survey
OS GR	Ordnance Survey Grid Reference
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCOC	Potential Contaminants of Concern
PEIR	Preliminary Environmental Information Report
PFAS	Polyfluoroalkyl Substances
PINS	Planning Inspectorate
PPE	Personal Protective Equipment
PPG	Pollution Prevention Guidance
PRA	Preliminary Risk Assessment
PRoW	Public Right of Way
SAC	Special Areas of Conservation
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SMP	Soils Management Plan
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SVOC	Semi Volatile Organic Compound
SWMP	Site Waste Management Plan
UK	United Kingdom
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
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.
Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
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 and connected to the onshore export cables.
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.
Separated Grid Option	Transmission infrastructure which allows each project to transmit electricity entirely separately.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension lease area.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including as all onshore and offshore infrastructure.
The Applicant	Equinor New Energy Limited.

17 GROUND CONDITIONS AND CONTAMINATION

17.1 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) in relation to ground conditions and contamination. The chapter provides an overview of the existing environment for the proposed onshore 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 sources are the National Policy Statements (NPS). Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) are presented in **Chapter 5 EIA Methodology** and **Section 17.4**.
3. The assessment should be read in conjunction with following linked chapters:
   - **Chapter 18 Water Resources and Flood Risk**;
   - **Chapter 19 Land Use, Agriculture and Recreation**;
   - **Chapter 20 Onshore Ecology and Ornithology**; and
   - **Chapter 28 Health**.
4. Additional information to support the ground conditions and contamination assessment includes:
   - **Appendix 17.1 Land Quality Desk Study and Preliminary Risk Assessment Report**; and
   - **Appendix 17.2 Waste Assessment (Onshore Development)**.

17.2 Consultation

5. Consultation with regard to ground conditions and contamination 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 ongoing Evidence Plan Process (EPP) and the Preliminary Environmental Information Report (PEIR).
6. 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 17-1** provides a summary of the consultation responses received to date relevant to this topic, and details of how the Project team has had regard to the comments and how these have been addressed within this chapter.

7. The consultation process is described further in **Chapter 5 EIA Methodology**. Full details of the consultation process are presented in the **Consultation Report** (document reference 5.1), which has been submitted as part of the DCO application.

Table 17-1: Consultation Responses

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
Planning Inspectorate (PINS)	Scoping Opinion, 2020	Table 3-2 of the Scoping Report has scoped out all operational impacts on ground conditions and contamination, although the potential for operational impacts is identified in terms of resource extraction and Mineral Safeguarding Areas. Despite the limited justification provided, given the operational nature of the Proposed Development, the Inspectorate does not consider that significant effects to human health are likely during the operational stage and therefore agrees these matters can be scoped out of the ES.	Operational impacts on Mineral Safeguarding Areas have been discussed in **Section 17.6.2**. Although initially scoped out, impacts to human health during the operational phase of SEP or DEP are discussed in **Section 17.7**.
PINS	Scoping Opinion, 2020	With regard to operational impacts to controlled waters, the Water Resources and Flood Risk chapter to the Scoping Report acknowledges the potential for supply of contaminants during the operational phase (paragraph 604). Accordingly, the Inspectorate does not agree that operational impacts to controlled waters from the alterations to exposure pathways and the introduction of new contaminant sources can be scoped out of this aspect chapter.	Existing environment is discussed in **Section 17.5**. Impacts, including the potential to introduce contaminants to the study area, are set out in **Sections 17.6** and **17.7**. **Chapter 19 Water Resources and Flood Risk** also discusses the impacts to controlled waters.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
PINS	Scoping Opinion, 2020	Paragraph 578 identifies geological Sites of Special Scientific Interest (SSSIs) at both landfall search areas and at the edge of the substation search area. No justification has been provided to demonstrate that there would be no significant effects to these sites during operation. As such, the Inspectorate is unable to agree that this matter can be scoped out at this stage. For the same reason, the Inspectorate also does not agree that cumulative impacts during operation can be scoped out.	Existing environment is discussed in **Section 17.5**. Following a refinement of the project boundary between scoping and the DCO application, no geological SSSIs are now located within the DCO order limits. Potential impacts have therefore been avoided.
PINS	Scoping Opinion, 2020	Paragraph 587 states that the decommissioning impacts would be similar in nature to those for construction, although the magnitude of effect is likely to be lower. There is no specific justification for not including impacts to human health or controlled waters during decommissioning within the scope of the assessment.	Impacts associated with decommissioning and the potential impacts to human health and controlled waters are discussed in **Section 17.6.3**. Additional assessments in relation to human health and controlled waters can be found in **Chapter 18 Water Resources and Flood Risk** and **Chapter 28 Health**.
PINS	Scoping Opinion, 2020	Table 3-2 proposes to scope out transboundary impacts to ground conditions and contamination, although no justification is provided within the aspect chapter. Nevertheless, given the nature of the Proposed Development in this regard the	Transboundary effects to ground conditions and contamination are not anticipated as a result of SEP and DEP, therefore they have been scoped out of this chapter.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		Inspectorate agrees that significant transboundary effects are unlikely and therefore this matter can be scoped out of the ES.	
PINS	Scoping Opinion, 2020	Paragraph 574 of the Scoping Report explains that the ground conditions and contamination study area is the same as the onshore scoping area described in section 1.4 of the Scoping Report. The ES should justify the extent of the study areas used in the assessment in relation to the general 500m and 3km buffer zones around the cable corridor and onshore substation respectively used to define the onshore scoping area.	Justification of the ground conditions and contamination study area is given in **Section 17.3.1**.
PINS	Scoping Opinion, 2020	Paragraphs 582 and 586 of the Scoping Report identify potential construction and operational impacts on Mineral Safeguarding Areas; these areas are not identified in Section 3.1.1 'Existing Environment'. The Inspectorate expects these to be identified and mapped in the ES.	Mineral safeguarding data has been reviewed and is considered within the assessment. Details of baseline conditions can be found in **Section 17.5.5**. An assessment relating to the impacts to safeguarded areas during construction and operation can be found in **Sections 17.6.1** and **17.6.2.**
Environment Agency	Scoping Opinion, 2020	We are pleased that impacts detailed in Table 3.2 are scoped into the Assessment. If an area of land contamination is identified within the cable corridor which may affect principal and secondary aquifers a	Existing environment is discussed in **Section 17.5**. Impacts are set out in **Sections 17.6** and **17.7**.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		Preliminary Risk Assessment will need to be undertaken. Sufficient information should be provided the EIA to provide assurance that the risks to the water environment are fully understood and can be addressed through appropriate measures including the need for site investigation, risk assessment and remediation. If significant contamination is found within the Application area, any proposals to undertake piling on site should be accompanied by a piling risk assessment.	
Natural England	Scoping Opinion, 2020	Soils: Impacts from the development should be considered in light of the Government's policy for the protection of the best and most versatile (BMV) agricultural land as set out in paragraph 170 of the NPPF [National Planning Policy Framework]. We also recommend that soils should be considered in the context of the sustainable use of land and the ecosystem services they provide as a natural resource, as also highlighted in paragraph 170 of the NPPF.	An assessment of impacts to soils and agricultural land use is included within **Chapter 19 Land Use, Agriculture and Recreation**.
Norfolk County Council	Scoping Opinion, 2020	The adopted Norfolk Minerals and Waste Core Strategy and Development Management Policies	Mineral safeguarding data has been reviewed and is considered within the assessment. Details of baseline

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		DPD [Development Plan Document] and the Minerals and Waste Site Specific Allocations DPDs are relevant local planning policies and should be taken into account throughout the project.	conditions can be found in **Section 17.5.5**. An assessment relating to the impacts to safeguarded areas during construction and operation can be found in **Sections 17.6.1** and **17.6.2**.
Norfolk County Council	Scoping Opinion, 2020	The inclusion of the NPS requirements EN-1-5.10.9 and EN-5.14.6 regarding mineral safeguarding and waste are welcomed. To ensure mineral safeguarding is appropriately taken into account, the ES should consider how a methodology can be put in place for the reuse of suitable materials extracted as part of the cable construction phases.	An assessment relating to the impacts to safeguarded areas during construction and operation can be found in **Sections 17.6.1** and **17.6.2**. A waste assessment is included as **Appendix 17.2** of this ES report.
Public Health England	Scoping Opinion, 2020	We would expect the applicant to provide details of any hazardous contamination present on site (including ground gas) as part of a site condition report.	Potentially hazardous contamination is discussed in **Section 17.5.** Impacts, as well as mitigation measures, are set out in **Sections 17.6** and **17.7**.
Public Health England	Scoping Opinion, 2020	Emissions to and from the ground should be considered in terms of the previous history of the site and the potential of the site, once operational, to give rise to issues. Public health impacts associated with ground contamination and / or the migration of	Existing environment is discussed in **Section 17.5**. Impacts, as well as mitigation measures, are set out in **Sections 17.6** and **17.7**

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		material off-site should be assessed and the potential impact on nearby receptors and control and mitigation measures should be outlined.	
Public Health England	Scoping Opinion, 2020	Relevant areas outlined in the Government's Good Practice Guide for EIA include: • effects associated with ground contamination that may already exist • effects associated with the potential for polluting substances that are used (during construction / operation) to cause new ground contamination issues on a site, for example introducing / changing the source of contamination • impacts associated with re-use of soils and waste soils, for example, re-use of site-sourced materials on-site or offsite, disposal of site-sourced materials offsite, importation of materials to the site, etc.	Existing environment is discussed in **Section 17.5**. Impacts, as well as mitigation measures, are set out in **Sections 17.6** and **17.7** A waste assessment is included as **Appendix 17.2** of this ES report.
Public Health England	Scoping Opinion, 2020	The applicant should demonstrate compliance with the waste hierarchy (e.g. with respect to re-use, recycling or recovery and disposal).	A waste assessment is included as **Appendix 17.2** of this ES report.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		For wastes arising from the development the ES should assess: • the implications and wider environmental and public health impacts of different waste disposal options • disposal route(s) and transport method(s) and how potential impacts on public health will be mitigated • If the development includes wastes delivered to the installation: • Consider issues associated with waste delivery and acceptance procedures (including delivery of prohibited wastes) and should assess potential off-site impacts and describe their mitigation.	
Section 42 Responses			
North Norfolk District Council (NNDC)	Section 42 response, 2021	Chapter 18 - Onshore Ground Conditions and Contamination The contents of this chapter are noted. NNDC does not have any specific comments to make here other than the key factor is to ensure there is an appropriate strategy in place to deal with contamination should it arise and NNDC would want to see that an	Potential impacts, and mitigation measures, associated with contamination, are discussed in **Sections 17.6** and **17.7**.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
		appropriate strategy can be secured within the DCO.	
National Farmers Union (NFU)	Section 42 response, 2021	Depths of Cables - The PEIR states that the minimum depth of the ducts would be 1.20m from top of duct to the surface. This minimum depth is essential to enable deep farming operations to take place, when necessary, for the growing of certain crops and interaction with land drains. We note it has been stated that the cables will be laid in accordance with National Grid UK Power Networks ECS 02-0019.	Details of realistic worst-case scenarios (including burial depth of cables) is discussed in **Section 17.3.2**. Impacts associated with farming operations are discussed in **Chapter 19 Land Use, Agriculture and Recreation**.

17.3 Scope

17.3.1 Study Area

8. The study area for ground conditions and contamination has been defined on the basis of the distance over which impacts may occur and by the location of any receptors that may be affected by those potential impacts. This has been established using professional judgement and is supported by **Appendix 17.1 Land Quality Desk Study and Preliminary Risk Assessment Report**. The study area is based on the DCO order limits plus a 250m buffer for potential sources of contamination and receptors. A 250m buffer has been chosen as the potential risks associated with contamination sources at distances within 250m are likely to have greatest impact on on-site conditions with potential risks diminishing with distance.
9. A full description of the infrastructure within the DCO order limits is provided in **Chapter 4 Project Description**.

17.3.2 Realistic Worst-Case Scenario

17.3.2.1 General Approach

10. 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**.
11. The realistic worst-case scenarios for the ground conditions and contamination assessment are summarised in **Table 17-2**. These are based on the project parameters described in **Chapter 4 Project Description**, which provides further details regarding specific activities and their durations.
12. In addition to the design parameters set out in **Table 17-2**, consideration is also given to how SEP and DEP will be built out as described in **Section 17.3.2.2** to **Section 17.3.2.4** 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**.

17.3.2.2 Construction Scenarios

13. 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.

14. The impact assessment for ground conditions and contamination 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.

15. Any differences between SEP and DEP, 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 17.6**). For each potential impact, where necessary, 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 17.6**.

17.3.2.3 Operation Scenarios

16. 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.

17. The operational lifetime of each Project is expected to be 40 years.

17.3.2.4 Decommissioning Scenarios

18. 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.

Table 17-2: Realistic Worst-Case Scenarios

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
Construction				
Impact 1: Exposure of Work Force, Land Owners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated to Health Impacts.	**Landfall:** • HDD drills: Number: 2, Length: 1,150m • Transition joint bays: Number: 1, Dimensions: 26m (L) x 10m (W) x 3m (D) • HDD compound area: 75m x 75m • Total works area: 48,955m^2 • Approximate quantity of excavated material: Total: 3,250m^3 • Duration: Landfall HDD: 4 months, Landfall cable pull: 2 months	**Landfall**: • HDD drills: Number: 4, Length: 1,150m • Transition joint bays: Number: 2, Dimensions: 26m (L) x 12m (W) x 3m (D) per transition joint bay • HDD compound area: 75m x 75m • Total works area: 48,955m^2 • Approximate quantity of excavated material: Total: 3,450m^3 • Duration: Landfall HDD: 5 months, Landfall cable pull: 4 months	**Landfall**: • HDD drills: Number: 4, Length: 1,150m • Transition joint bays: Number: 2 (adjacent to each other), Dimensions: 26m (L) x 10m (W) x 3m (D) per transition joint bay • HDD compound area: 75m x 75m (per project and overlapping) • Total works area: 48,955m^2 • Approximate quantity of excavated material: Total: 6,500m^3 • Duration: Landfall HDD: 4 months, Landfall cable pull: 2 months (per project)	These parameters represent the maximum footprint of disturbance within the DCO order limits, in which the potential disturbance of existing contamination could occur. SEP and DEP are considered as the worst-case scenario when compared to SEP or DEP in isolation due to the requirement for two trenches. The creation of the onshore cable corridor has the potential to create a preferential pathway which could expose human health receptors to ground gas / vapours. SEP and DEP constructed sequentially is considered as the worst-case of the two-project scenarios due to the longer period of time to which human health receptors could be exposed to potential contamination.
	Onshore Cable Corridor: • Construction corridor: Length: 60km, Width: 45m (100m at trenchless crossings). • Main construction compound: Number: 1, Area: 30,000m^2, Duration: 48 months. • Secondary construction compounds with CBS batching: Number: 2, Area: 7,500m^2, Operational life: 18 - 24 months • Secondary construction compounds without CBS batching: Number: 6, Area: 2,500m^2, Operational life: 12 – 18 months • Trenchless crossing compounds: Area: 1,500m^2 – 4,500m^2, Duration: duration of HDD works • HDD depth: dependent on ground conditions and feature crossed • Total works area (incl. compounds and accesses): 4,566,251m^2 • Cable trench: Number: 1, Width at base: 0.85m, Width at surface: 3m, Depth: 2m. • Haul road: Number :1, Length: 55km, Width: 5m (8m at passing places), Total area: 315,640m^2. • Jointing bays: Typical frequency: Every 1000m, Approximate number: 60, Dimensions: 16m (L) x 3.5m (W) x 2m (D). • Link boxes: Typical frequency: Every 1000m, Approximate number: 60, Dimensions: 2.6m (L) x 2m (W) x 1.5m (D).	**Onshore Cable Corridor:** • Construction corridor: Length: 60km, Width: 60m (100m at trenchless crossings). • Main construction compound: Number: 1, Area: 30,000m^2, Duration: 48 months. • Secondary construction compounds with CBS batching: Number: 2, Area: 7,500m^2, Operational life: 18 - 24 months • Secondary construction compounds without CBS batching: Number: 6, Area: 2,500m^2, Operational life: 12 – 18 months • Trenchless crossing compounds: Area: 1,500m^2 – 4,500m^2, Duration: duration of HDD works • HDD depth: dependent on ground conditions and feature crossed • Total works area (incl. compounds and accesses): 4,566,251m^2 • Cable trench: Number: 2, Width at base: 0.85m, Width at surface: 3m, Depth: 2m. • Haul road: Number :1, Length: 55km, Width: 5m (8m at passing places), Total area: 315,640m^2. • Jointing bays: Typical frequency: Every 1000m, Approximate number: 120, Dimensions: 16m (L) x 3.5m (W) x 2m (D) (per circuit).	**Onshore Cable Corridor:** • Construction corridor: Length: 60km, Width: 60m (100m at trenchless crossings). • Main construction compound: Number: 1, Area: 30,000m^2, Duration: 48 months. • Secondary construction compounds with CBS batching: Number: 2 per project, Area: 7,500m^2, Operational life: 18 - 24 months • Secondary construction compounds without CBS batching: Number: 6 per project, Area: 2,500m^2, Operational life: 12 – 18 months • Trenchless crossing compounds: Area: 1,500m^2 – 4,500m^2, Duration: duration of HDD works • HDD depth: dependent on ground conditions and feature crossed • Total works area (incl. compounds and accesses): 4,566,251m^2 • Cable trench: Number: 2, Width at base: 0.85m, Width at surface: 3m, Depth: 2m. • Haul road: Number :1 per project, Length: 55km, Width: 5m (8m at passing places), Total area per project: 315,640m^2. • Jointing bays: Typical frequency: Every 1000m, Approximate number: 120, Dimensions: 16m (L) x 3.5m (W) x 2m (D) (per circuit).	

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
Construction				
	• Approximate quantities of excavated material: Cable trench: 180,000m^3, Haul Road: 123,000m^3, Jointing bays and link boxes: 18,480m^3, Temporary Compounds: 21,450m^3, **Total: 342,930m^3** • Duration: Onshore cable ducting and installation (incl. reinstatement): 24 months	• Link boxes: Typical frequency: Every 1000m, Approximate number: 120, Dimensions: 2.6m (L) x 2m (W) x 1.5m (D) (per circuit). • Approximate quantities of excavated material: Cable trench: 360,000m^3, Haul Road: 123,000m^3, Jointing bays and link boxes: 36,960m^3, Temporary Compounds: 21,450m^3, **Total: 541,410m^3** • Duration: Onshore cable ducting and installation (incl. reinstatement): 26 months	• Link boxes: Typical frequency: Every 1000m, Approximate number: 120, Dimensions: 2.6m (L) x 2m (W) x 1.5m (D) (per circuit). • Approximate quantities of excavated material: Cable trench: 360,000m^3, Haul Road: 246,000m^3, Jointing bays and link boxes: 36,960m^3, Temporary Compounds: 42,900m^3, **Total: 685,860m^3** • Duration: Onshore cable ducting and installation (incl. reinstatement): 24 months per project	
	Onshore Substation and 400kv connection: • Substation platform: Area: 3.25ha, Depth of topsoil strip: 300mm • Substation compounds: Number: 2, Total area: 12,500m^2, Duration: 22 months • Permanent access road: Number: 1, Length: 850m: Width: 6m, Area: 5,100m^2 • Quantities of excavated material (approximate): Topsoil for substation platform: 11,250m^3, Platform cut volume (post topsoil strip): 23,968m^3, Flood attenuation area: 0m^3, Compounds and Access: 7,375m^3. • Foundations: Subject to detailed design. Potential for Continuous Flight Auger (CFA) piles is assumed. • 400kv connection: Approximate length: 850m, Width at base: 0.85m, Width at surface: 2m, Cable trench depth: 2m • Duration: 22 months	**Onshore Substation and 400kv connection:** • Substation platform: Area: 6.0ha, Depth of topsoil strip: 300mm • Substation compounds: Number: 2, Total area: 12,500m^2, Duration: 24 months • Permanent access road: Number: 1, Length: 850m: Width: 6m, Area: 5,100m^2 • Quantities of excavated material (approximate): Topsoil for substation platform: 21,851m^3, Platform cut volume (post topsoil strip): 52,533m^3, Flood attenuation area: 0m^3, Compounds and Access: 7,375m^3. • Foundations: Subject to detailed design. Potential for Continuous Flight Auger (CFA) piles is assumed. • 400kv connection: Approximate length: 850m, Width at base: 0.85m, Width at surface: 2m, Cable trench depth: 2m • Duration: 24 months	**Onshore Substation and 400kv connection:** • Substation platform: Area: 6.0ha, Depth of topsoil strip: 300mm • Substation compounds: Number: 2, Total area: 12,500m^2, Duration: 22 months per project • Permanent access road: Number: 1, Length: 850m: Width: 6m, Area: 5,100m^2 • Quantities of excavated material (approximate): Topsoil for substation platform: 21,851m^3, Platform cut volume (post topsoil strip): 52,533m^3, Flood attenuation area: 0m^3, Compounds and Access: 7,375m^3. • Foundations: Subject to detailed design. Potential for Continuous Flight Auger (CFA) piles is assumed. • 400kv connection: Approximate length: 850, Width at base: 0.85m, Width at surface: 2m, Cable trench depth: 2m • Duration: 22 months per project	
Impact 2: Impacts on Groundwater Quality and Groundwater Resources. **Impact 3**: Impacts on Surface Water Quality and the ecological Habitats they Support.	**Landfall:** • See Impact 1.	**Landfall:** • See Impact 1.	**Landfall:** • See Impact 1.	These parameters represent the maximum footprint of disturbance within the DCO order limits, in which the potential disturbance of existing contamination could occur.
	Onshore Cable corridor: • See **Impact 1**, and in addition: • Cable duct bedding material (if required): Cement Bound Sand (CBS).	**Onshore Cable corridor:** • See **Impact 1**, and in addition: • Cable duct bedding material (if required): Cement Bound Sand (CBS).	**Onshore Cable corridor:** • See **Impact 1**, and in addition: • Cable duct bedding material (if required): Cement Bound Sand (CBS).	

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
Construction				
	• Watercourse crossings: Trenchless crossing methods for all main rivers and IDB watercourses. Open cut with temporary dam and divert for most minor watercourses and temporary use of bridges where appropriate. • Road crossings: Trenchless crossing methods for all A and B roads. Open cut for most minor roads. • Drill fluid disposal: Disposed of as waste via a licensed waste carrier. **Onshore Substation and 400kv connection:** • See **Impact 1**, and in addition: • Total impermeable area (including access road): 21,350m^2.	• Watercourse crossings: Trenchless crossing methods for all main rivers and IDB watercourses. Open cut with temporary dam and divert for most minor watercourses and temporary use of bridges where appropriate. • Road crossings: Trenchless crossing methods for all A and B roads. Open cut for most minor roads. • Drill fluid disposal: Disposed of as waste via a licensed waste carrier. **Onshore Substation and 400kv connection:** • See **Impact 1**, and in addition: • Total impermeable area (including access road): 35,100m^2.	• Watercourse crossings: Trenchless crossing methods for all main rivers and IDB watercourses. Open cut with temporary dam and divert for most minor watercourses and temporary use of bridges where appropriate. • Road crossings: Trenchless crossing methods for all A and B roads. Open cut for most minor roads. • Drill fluid disposal: Disposed of as waste via a licensed waste carrier. **Onshore Substation and 400kv connection:** • See **Impact 1**, and in addition: • Total impermeable area (including access road): 35,100m^2.	SEP and DEP constructed sequentially is considered as the worst-case of the two-project scenarios due to the increased volume of material that would be excavated over a larger footprint and increased number of trenchless crossings required when compared to the construction of SEP and DEP concurrently. If piles are used, there would also be an increased number required associated with the onshore substation and a greater number of trenchless crossings if constructed sequentially relative to the number required if SEP or DEP were constructed in isolation.
Impact 4: Sterilisation of Future Mineral Resources.	**Landfall:** • See Impact 1. **Onshore Cable Corridor:** • See Impact 1. **Onshore Substation and 400kv connection:** • See Impact 1.	**Landfall:** • See Impact 1. **Onshore Cable Corridor:** • See Impact 1. **Onshore Substation and 400kv connection:** • See Impact 1.	**Landfall:** • See Impact 1. **Onshore Cable Corridor:** • See Impact 1. **Onshore Substation and 400kv connection:** • See Impact 1.	These parameters represent the maximum footprint of disturbance within the DCO order limits, in which the potential disturbance of existing contamination could occur. The construction of SEP and DEP sequentially is considered to be the worst-case of the two-project scenarios as it has the potential to impact a greater area due the requirement for additional land during construction of each project. The sequential construction of SEP and DEP therefore has the potential to sterilise a larger area within the Mineral Safeguarding Area.
Impact 5: Built Environment.	**Landfall**: • See Impact 1 **Onshore Cable corridor:** • See Impact 2 **Onshore Substation and 400kv connection:** • See **Impact 2**, and in addition: • Main buildings: Number: 2, Maximum dimensions: 30m (L) x 14m (W) x 15m (H). • Main building fabric: Steel framed building with cladding. • Main ancillary infrastructures: carpark, control room, welfare facilities.	**Landfall**: • See Impact 1 **Onshore Cable corridor:** • See Impact 2 **Onshore Substation and 400kv connection:** • See **Impact 2**, and in addition: • Main buildings: Number: 4, Maximum dimensions: 50m (L) x 25m (W) x 15m (H). • Main building fabric: Steel framed building with cladding. • Main ancillary infrastructures: carpark, control room, welfare facilities.	**Landfall**: • See Impact 1 **Onshore Cable corridor:** • See Impact 2 **Onshore Substation and 400kv connection:** • See **Impact 2**, and in addition: • Main buildings: Number: 4, Maximum dimensions: 30m (L) x 14m (W) x 15m (H) for each project. • Main building fabric: Steel framed building with cladding. • Main ancillary infrastructures: carpark, control room, welfare facilities.	These parameters represent the maximum footprint of disturbance within the DCO order limits, in which the potential disturbance of existing contamination could occur. The construction of SEP and DEP sequentially is considered to be the worst-case of the two-project scenarios as it has the potential to impact a greater area due the requirement for additional land during construction of each project.

Impact	SEP or DEP in Isolation	SEP and DEP Concurrently	SEP and DEP Sequentially	Notes and Rationale
Construction				
	• Substation utility requirements: mains water, electricity, telecoms, broadband, sewage and drainage.	• Substation utility requirements: mains water, electricity, telecoms, broadband, sewage and drainage.	• Substation utility requirements: mains water, electricity, telecoms, broadband, sewage and drainage.	
Operational				
Impact 1: Exposure of Work Force, Landowners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated to Health Impacts.	**Landfall / Onshore Cable Corridor:** • Maintenance activity: No ongoing requirement for regular maintenance. Excavation at joint bay locations would be required to conduct emergency repairs, if necessary. • Duration: 40 years.	**Landfall / Onshore Cable Corridor:** • Maintenance activity: No ongoing requirement for regular maintenance. Excavation at joint bay locations would be required to conduct emergency repairs, if necessary. • Duration: 40 years.	**Landfall / Onshore Cable Corridor:** • Maintenance activity: No ongoing requirement for regular maintenance. Excavation at joint bay locations would be required to conduct emergency repairs, if necessary. • Duration: 40 years.	The realistic worst-case scenario is considered to be the same for all three scenarios.
	Onshore Substation and 400kv connection: • Maintenance activity: Approximately 1 visit per week for maintenance staff and visitors. • Duration: 40 years.	**Onshore Substation and 400kv connection:** • Maintenance activity: Approximately 1 visit per week for maintenance staff and visitors. • Duration: 40 years.	**Onshore Substation and 400kv connection:** • Maintenance activity: Approximately 1 visit per week for maintenance staff and visitors. • Duration: 40 years.	
Impact 2: Impact on Controlled Waters (Groundwater and Surface Waters).	**Landfall / Onshore Cable Corridor:** • See Impact 1	**Landfall / Onshore Cable Corridor:** • See Impact 1	**Landfall / Onshore Cable Corridor:** • See Impact 1	The realistic worst-case scenario is considered to be the same for all three scenarios.
	Substation: • Hazardous substances: Small quantities of liquid hazardous waste (used oil, solvents, paints etc.) and solid hazardous waste (oil-contaminated wipes, absorbent, and some specialist electrical equipment and batteries etc.)	**Substation:** • Hazardous substances: Small quantities of liquid hazardous waste (used oil, solvents, paints etc.) and solid hazardous waste (oil-contaminated wipes, absorbent, and some specialist electrical equipment and batteries etc.)	**Substation:** • Hazardous substances: Small quantities of liquid hazardous waste (used oil, solvents, paints etc.) and solid hazardous waste (oil-contaminated wipes, absorbent, and some specialist electrical equipment and batteries etc.)	
Impact 3: Sterilisation of Future Mineral Resources.	**Landfall / Onshore Cable corridor:** • Permanent easement: Length: 60km, Width: 10m.	**Landfall / Onshore Cable corridor:** • Permanent easement: Length: 60km, Width: 20m.	**Landfall / Onshore Cable corridor:** • Permanent easement: Length: 60km, Width: 20m.	If SEP and DEP were to be constructed, the realistic worst-case scenario would involve the sterilisation of mineral resources along the 20m permanent easement along the 60km cable corridor and the 6.0ha substation area.
	Substation: • Substation platform: 3.25ha, Access road: 0.51ha, Landscaping (approximate): 13.25ha, (approximate) • Duration: 40 years	**Substation:** • Substation platform: Area: 6.0ha • Permanent access road: Area: 0.51ha, • Landscaping (approximate): 13.25ha, • Duration: 40 years	**Substation:** • Substation platform: Area: 6.0ha • Permanent access road: Area: 0.51ha, • Landscaping (approximate): 13.25ha, • Duration: 40 years	
Impact 4: Built Environment.	**Substation:** • Substation platform: Area: 3.25ha • Duration: 40 years.	**Substation:** • Substation platform: Area: 6.0ha • Duration: 40 years.	**Substation:** • Substation platform: Area: 6.0ha • Duration: 40 years.	If SEP and DEP were to be constructed, the realistic worst-case scenario would involve a greater area of the built environment being potentially impacted.

17.3.3 Summary of Mitigation Embedded in the Design

19. This section outlines the embedded mitigation relevant to the ground conditions and contamination assessment, which has been incorporated into the design of SEP and DEP **(Table 17-3**). Where other mitigation measures are proposed, these are detailed in the impact assessment (**Section 17.6**).

Table 17-3: Embedded Mitigation Measures

Parameter	Mitigation Measures Embedded into the Project Design
Contaminated land	
Cable routing	Trenchless crossing techniques (e.g. HDD) have been committed to where the cable corridor crosses Main Rivers and some smaller watercourses. This will minimise the potential for contamination (if present) from excavation works by limiting the potential for contaminated material to enter surface waters via surface run off.
Groundwater quality and abstractions for public water supply	
Cable routing	The DCO order limit has been developed to avoid interaction with Groundwater Source Protection Zone 1, and therefore minimise the potential for impact on abstractions for public water supply.
Onshore substation	The use of an oil water sump within the onshore substation to reduce the potential for leaks and spills impacting groundwater quality.

17.4 Impact Assessment Methodology

17.4.1 Policy, Legislation and Guidance

20. 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**.

17.4.1.1 National Policy

17.4.1.1.1 National Policy Statements

21. The assessment of potential impacts upon ground conditions and contamination has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision-making policy 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).

22. The specific assessment requirements for ground conditions and contamination, as detailed in the NPS, are summarised in **Table 17-4** together with an indication of the section of the ES chapter where each is addressed.

23. It is noted that 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), 2021). A review of the draft versions has been undertaken in the context of this ES chapter.

Table 17-4: NPS Assessment Requirements

NPS Requirement	NPS Reference	Section Reference
NPS for Energy (EN-1)		
Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the IPC consider thoroughly the potential effects of a proposed project.	Paragraph 5.3.3	The geological designated sites are listed in **Section 17.5.4**. Impacts on geological SSSIs are set out in **Sections 17.6** and **17.7**. Impacts on ecological SSSIs are discussed in **Chapter 20 Onshore Ecology and Ornithology**.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.	Paragraph 5.3.4	Existing environment is discussed in **Section 17.5**. Impacts are set out in **Sections 17.6** and **17.7**. Impacts to ecological receptors are discussed in **Chapter 20 Onshore Ecology and Ornithology.**
In having regard to the aim of the Government's biodiversity strategy the IPC should take account of the context of the challenge of climate change: failure to address this challenge will result in significant adverse impacts to biodiversity. The policy set out in the following sections recognises the need to protect the most important biodiversity and geological conservation interests. The benefits to nationally significant low carbon energy infrastructure development may include benefits may outweigh harm to these interests. The IPC may take account of any such net benefit in cases where it can be demonstrated.	Paragraph 5.3.6	The geological designated sites and impacts relating to climate change are discussed in **Sections 17.5.4** and **17.5.8** respectively. Impacts on geological SSSIs are set out in **Sections 17.6** and **17.7**. Impacts to ecological receptors are discussed in **Chapter 20 Onshore Ecology and Ornithology**.
[The] development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives; where significant harm cannot be	Paragraph 5.3.7	Geological designated sites are discussed in **Sections 17.5.4**. Impacts on geological SSSIs are set out in **Sections 17.6** and **17.7**. Impacts to

NPS Requirement	NPS Reference	Section Reference
avoided, then appropriate compensation measures should be sought.		ecological receptors are discussed in **Chapter 20 Onshore Ecology and Ornithology**.
In taking decisions, the IPC should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment.	Paragraph 5.3.8	The geological designated sites are listed in **Sections 17.5.4**. Impacts on geological SSSIs are set out in **Sections 17.6** and **17.7**. Impacts on ecological receptors are discussed in **Chapter 20 Onshore Ecology and Ornithology**.
Applicants should safeguard any mineral resources on the proposed site as far as possible, taking into account the long-term potential of the land use after any future decommissioning has taken place.	Paragraph 5.10.9	Mineral Safeguarding Areas are discussed in **Section 17.5.5**. Impacts relating to Mineral Safeguarding Areas are set out in **Sections 17.6** and **17.7**.
NPS for Energy EN-1 draft (BEIS 2021)		
For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination, and where contamination is present, applicants should consider opportunities for remediation where possible. Applicants are encouraged to develop and implement a Soil Management Plan which could help minimise potential land contamination.	Paragraph 5.11.8	Risks posed by potential land contamination and been identified and assessed as part of a Preliminary Risk Assessment (PRA) (**Appendix 17.1**). Potential impacts associated with contamination to identified receptors (and mitigation measures) are discussed in **Sections 17.6** and **17.7**.

17.4.1.1.2 National Planning Policy Framework

24. The specific assessment requirements for ground conditions and contamination, as detailed in the National Planning Policy Framework Guidance (NPPF) (Ministry of Housing, Communities and Local Government, updated 2021) are detailed **Table 17-5**.

Table 17-5: National Planning Policy Framework Guidance Relevant to Ground Conditions and Contamination

NPPF Requirement	NPPF Reference	Section Reference
Planning policies and decisions should contribute to and enhance the natural local environment by:	NPPF15-174	Existing environment in relation to sensitive sites is discussed in **Section 17.5.4**. Impacts and mitigation measures aimed

NPPF Requirement	NPPF Reference	Section Reference
protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan); preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.		at minimising the potential impacts to the receptors identified, including remediation, are set out in **Sections 17.6** and **17.7**.
Planning policies and decisions should ensure that: • a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); • after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and • adequate site investigation information, prepared by a competent person, is available to inform these assessments.	NPFF15-183	Existing ground conditions and potential sources of contamination are discussed within **Section 17.5**. The impacts of SEP and DEP, and mitigation measures (including site investigation works), are set out in **Sections 17.6** and **17.7**.
Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and / or landowner. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.	NPFF15-184 and NPPF15-185	Existing ground conditions and potential sources of contamination are discussed within **Section 17.5**. The impacts of SEP and DEP, and mitigation measures (including site investigation works), are set out in **Sections 17.6** and **17.7**.

NPPF Requirement	NPPF Reference	Section Reference
The focus of planning policies and decisions should be whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.	NPPF15-188	Existing environment is discussed in **Section 17.5**. Impacts are set out in **Sections 17.6** and **17.7**.
It is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs. Since minerals are a finite natural resource, and can only be worked where they are found, best use needs to be made of them to secure their long-term conservation. Planning policies should: • safeguard mineral resources by defining Mineral Safeguarding Areas and Mineral Consultation Areas; and adopt appropriate policies so that known locations of specific minerals resources of local and national importance are not sterilised by non-mineral development where this should be avoided (whilst not creating a presumption that the resources defined will be worked); • set out policies to encourage the prior extraction of minerals, where practical and environmentally feasible, if it is necessary for non-mineral development to take place.	NPPF17-209 and NPFF17-210	Mineral Safeguarding Areas are discussed in **Section 17.5.5**. Impacts relating to Mineral Safeguarding Areas are set out in **Sections 17.6** and **17.7**.

17.4.1.2 Local Policy

25. The following local policies relevant to the assessment within this chapter are:

17.4.1.2.1 North Norfolk Local Plan: Policy EN13 Pollution and Hazard Prevention and Minimisation

26. 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:

- The natural environment and general amenity;

- Health and safety of the public;
- Air quality;
- Surface and groundwater quality;
- Land quality and condition; and
- The need for compliance with statutory environmental quality standards.'
- It also states that 'developments on contaminated land (or where there is reason to suspect contamination) must include an assessment of the extent of contamination and any possible risks'.

17.4.1.2.2 The Broadland District Council and South Norfolk District Council Contaminated Land Strategy

27. This strategy is designed to complement the Environmental Protection Act 1990 (Part 2A): Contaminated Land Statutory Guidance. The aim of the approach adopted by both councils is to:

- Protect human health;
- Protect controlled waters;
- Protect designated ecosystems;
- Prevent damage to property;
- Prevent further contamination of land;
- Ensure contaminated land is returned to beneficial use;
- Encourage voluntary remediation; and
- Support re-use of brownfield land ensuring that contaminated land is given due consideration in all land development acquisition decisions.

17.4.1.3 Legislation and Guidance

28. There are a number of pieces of legislation applicable to the assessment of ground conditions and contamination. These include:

17.4.1.3.1 Environmental Protection Act 1990 (Part 2A): Contaminated Land Statutory Guidance.

29. The Environmental Protection Act 1990 makes provision for the improved control of pollution arising from certain industrial and other processes. Part 2A of the Act provides the statutory definition of contaminated land: "Contaminated Land is any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reasons of substances in, on or under the land that:

- Significant harm is being caused or there is a significant possibility of such harm being caused; or
- Significant pollution of controlled waters is being or is likely to be caused."

30. The Act also provided the regulatory basis for the identification, designation and remediation of contaminated land. SEP and DEP could be located on land potentially affected by contamination. This requires assessment to ensure that the land is suitable for use following the construction of SEP and DEP, and that the land cannot be determined as contaminated land under Part 2A of the Act.

17.4.1.3.2 Environmental Permitting (England and Wales) Regulations 2016.

31. The 2016 Regulations (as amended) set out an environmental permitting and compliance regime that applies to various activities and industries. The environmental permitting regime is a common framework for applying for, receiving, varying or transferring and surrendering permits, along with compliance, enforcement and appeals arrangements. It rationalises the previous permitting and compliance regimes into a common framework that is easier to understand and simpler to use. The framework introduces different levels of control, based on risk:

- Exclusions (lower risk activities which may be undertaken without any permit), standard rules permit (standard requirements and conditions for the relevant activities are set out so applicants can determine in advance whether the permit is applicable to their proposals) and bespoke permits (permits written specifically for activities which are unique or higher risk).

17.4.1.3.3 Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

32. The aim of the directive is for all waterbodies to achieve Good Status by 2027 (which is comprised of scoring of both Ecological and Chemical Status) and to ensure no deterioration from current status. This legislation is relevant to ground conditions and contamination as it will assist in determining the sensitivity of water bodies within the SEP and DEP study area. Water quality is assessed within **Chapter 18 Water Resources and Flood Risk**.

17.4.1.3.4 Groundwater (Water Framework Directive) (England) Directive 2016.

33. The aim of the directive is to set out instructions and obligations for the Environment Agency to protect groundwater, including monitoring and setting threshold values for both existing and new pollutants in groundwater. This legislation is relevant to ground conditions and contamination as it will assist in determining the sensitivity of groundwater resources within the SEP and DEP study area.

17.4.1.3.5 Water Resources Act. The Water Resources Act (1991) as amended by the Water Act (2003)

34. The Act provides the definition of and regulatory controls for the protection of water resources including the quality standards expected for controlled waters. This legislation is relevant to ground conditions and contamination as it will assist in determining the sensitivity of controlled waters within the SEP and DEP study area, particularly when assessing the effects during construction and operational activities.

17.4.1.3.6 Environment Act 1995.

35. The act established the Environment Agency and gave it responsibility for environmental protection of controlled waters. This legislation is relevant to ground conditions and contamination as it will help assess the sensitivity and potential effects of the construction and operational phases of SEP and DEP. It will also aid in the identification of suitable mitigation measures to provide protection of the controlled waters present.

17.4.1.3.7 Environmental Damage (Prevention and Remediation) (England Regulations (2015)

36. The regulations transpose into domestic law the EU Directive 2004/35/EC on environmental liability with regards to the prevention and remedying of environmental damage. This legislation is relevant to ground conditions and contamination as it will aid in the identification of suitable preventative measures and mitigation techniques for the construction and operational phases of SEP and DEP.

17.4.1.3.8 Construction (Design and Management) Regulations 2015.

37. The regulations are the main set of regulations used to manage the health, safety and welfare of construction projects. The legislation is relevant to ground conditions and contamination as it ensures the safety of human receptors involved in the construction phase.

17.4.1.3.9 Land Contamination Risk Management Framework 2021.

38. The Environment Agency guidance provides an update to the former Environment Agency Model Procedures for the Management of Land Contamination, Contaminated Land Report 11 (CLR11). The guidance aims to help those assessing potentially contaminated site to identify and assess the risks posed to sensitive receptors from potentially contaminated sites, make appropriate decisions in relation to the outcome of the assessment and identify the required actions necessary e.g., implement remediation if deemed necessary.

17.4.1.3.10 Guiding Principles for Contaminated Land.

39. The Guiding Principles for Contaminated Land (GPCL) comprise three documents produced by the Environment Agency. The documents include GPCL 1 –Guiding principles for land contamination introduction, GPCL 2 – Frequently Asked Questions, technical information, detailed advice and references, and GPCL 3 –reporting checklist. The aims of these documents are to provide guidance to those who are involved with contaminated land, encourage good practice, promote compliance with regulatory requirements and to provide reference to applicable guidance.

17.4.1.3.11 The Environment Agency's Approach to Groundwater Protection Position Statements 2018,

40. These position statements provide information relating to the Environment Agency's approach to managing and protecting groundwater. They detail how the Environment Agency delivers government policy for groundwater and adopts a risk-based approach where legislation allows. The primary aim of all of the position statements is the prevention of pollution of groundwater and protection of it as a resource.

17.4.1.3.12 Minerals Policy Statement 1: Planning and Minerals (MPS1)

41. MPS1 aims to secure adequate and steady supplies of the minerals needed by society and the economy. This publication has been withdrawn; however, it is still deemed relevant in the context of this assessment.

17.4.1.3.13 Norfolk County Council (NCC) Guidance Note on the Mineral Safeguarding Process for aggregates – Sand & Gravel and Carstone.

42. The guidance note states that if a proposed development is located on an MSA (Mineral Safeguarding Area) then there are two main issues to be addressed in formulating a safeguarding response:

- The applicant should carry out investigations to identify whether the resource is viable for mineral extraction, and
- If the mineral resource is viable, the applicant considers whether it could be extracted economically prior to development taking place.

43. The guidance note states that the Environmental Statement (ES) should address relevant mineral safeguarding issues for the proposed development and that the potential for prior extraction be recognised and built into the master planning process.

17.4.2 Data and Information Sources

17.4.2.1 Site Specific Surveys

44. In order to provide site specific and up to date information on which to base the impact assessment, a site characterisation survey was conducted, which consisted of reviewing available desk-based information related to ground conditions and contamination. The assessment is provided in the Land Quality Desk Study and Preliminary Risk Assessment (PRA) report (**Appendix 17.1**). The PRA provides an assessment of ground conditions for SEP and DEP and follows a risk-based approach including consideration of potential sources, pathways and receptors to identify potential pollutant linkages that may result in unacceptable risks to receptors from ground contamination.

45. The local authorities and Environment Agency whose area the SEP and DEP study area crosses have also been contacted in order to obtain information relating to groundwater and surface water abstractions.

17.4.2.2 Other Available Sources

46. Other sources that have been used to inform the assessment are listed in **Table 17-6**.

Table 17-6: Other Available Data and Information Sources

Data set	Spatial coverage	Year	Notes
British Geological Survey (BGS)	Full	2021	BGS onshore Geoindex map ([redacted])
Department for Environment, Food and Rural Affairs (DEFRA)	Full	2021	MAGIC map (www.magic.defra.gov.uk)
Coal Authority	Full	2021	Interactive online viewer ([redacted])
Ministry of Defence	Partial	2021	Freedom of Information documents (Weybourne military camp)
Public Health England	Full	2021	UK Radon Website ([redacted])
Google Earth	Full	2021	Publicly available aerial imagery
Envirocheck Geographical Information System (GIS) data	Full	2021	Historical maps, environmental sensitivity data and permitting records
Zetica	Full	2021	Unexploded ordnance (UXO) risk [redacted]

17.4.3 Impact Assessment Methodology

47. **Chapter 5 EIA Methodology** provides a summary of the general impact assessment methodology applied to SEP and DEP. The following sections confirm the methodology used to assess the potential impacts on ground conditions and contamination.

17.4.3.1 Definitions of Sensitivity and Magnitude

48. For each effect, the assessment identifies receptors sensitive to that effect and implements a systematic approach to understanding the impact pathways and the level of impacts on given receptors. The definitions of sensitivity and magnitude for the purpose of the ground conditions and contamination assessment are provided in **Table 17-7** and **Table 17-8**.

17.4.3.1.1 Sensitivity

49. Receptor sensitivity has been defined with reference to the adaptability, tolerance, recoverability and value of individual receptors. **Table 17-7** provides an example of the likely criteria for appraisal of sensitivity for identified ground conditions and contamination receptors based on professional judgement.

50. Receptor sensitivity considers, for example, whether the receptor:

- Is rare;
- Has protected or threatened status;
- Has importance at a local, regional or national scale; or
- Has a key role in ecosystem function (in the case of biological receptors).

51. Generic receptor sensitivity examples based on the above criteria are presented below in **Table 17-7**.

Table 17-7: Receptor Sensitivity Criteria

Sensitivity	Examples
High - has very limited or no capacity to accommodate physical or chemical changes.	**General** • Receptor is internationally or nationally important / rare with limited potential for offsetting / compensation.
	Land quality – human health • Construction workers involved in below ground construction works / ground breaking activities; • Public and local residents / children (on and off-site within 50m); and • Future end users (residential or allotment end use).
	Land quality – controlled waters and ecology • Groundwater source protection zones (SPZ) 1;

Sensitivity	Examples
	• Public water supplies/ licensed surface water and groundwater abstractions for potable use; • Private water supplies for potable use (on and off-site within 50m); • Supports habitats or species that are highly sensitive to change in surface hydrology or water quality; and • Surface and groundwaters supporting internationally designated sites (e.g. Site of Special Scientific Interest (SSSI), Ramsar sites).
	Land quality – geological sites and mineral resources • Mineral Safeguarding Area – nationally important resource; and • Designated geological sites of international importance.
	Built environment • Sites of international importance, World Heritage Sites and Scheduled Monuments.
Medium - has limited capacity to accommodate physical or chemical changes.	**General** • Receptor is regionally important / rare with limited potential for offsetting / compensation.
	Land quality – human health • Future end users (commercial / industrial end use / open space / farmers and workers on agricultural land); • Public and local residents / children (off-site at distances >50m but <250m); • Commercial / industrial workers (off-site within 50m); and • Construction workers (above ground).
	Land quality – controlled waters and ecology • Groundwater SPZ 2 and SPZ 3; • Principal Aquifers; • Secondary A and B Aquifers with private potable groundwater abstractions; • Private water supplies for potable groundwater abstraction (off site within 250m) and • Surface and groundwaters supporting nationally designated sites (SSSI).

Sensitivity	Examples
	Land quality – geological sites and mineral resources • Mineral Safeguarding Areas – regionally important resource; and • Designated geological site of national importance e.g. SSSIs.
	Built environment • Commercial or residential buildings.
Low - has moderate capacity to accommodate physical or chemical changes.	**General** • Receptor is locally important / rare.
	Land quality – human health • Future end users (transport end use such as car parks or highways); • Public and local residents / children (off-site >250m); and • Commercial / industrial workers (off-site at distances >50m but <250m).
	Land quality – controlled waters and ecology • Secondary A and B Aquifers without groundwater abstractions; and • Groundwater or surface waters supporting locally important sites (e.g. Local Nature Reserve LNR).
	Land quality – geological sites and mineral resources • Adjacent to a Mineral Safeguarding Area; and • Low economically viable mineral resource.
	Built environment • Car parks, highways, transport infrastructure and utilities.
Negligible - is generally tolerant of physical or chemical changes.	**General** • Receptor is not considered to be particularly important / rare.
	Land Quality – Human Health • Commercial / industrial workers (off-site >250m).
	Land Quality – Controlled Waters • Unproductive strata; and • Supports or contributes to habitats that are not sensitive to changes in surface hydrology or water quality.

Sensitivity	Examples
	Land quality – geological sites and mineral resources • No economically viable minerals.
	Built environment • Locally important roads and footpaths.

17.4.3.1.2 Magnitude of Change/Effect

52. Potential effects may be adverse, beneficial or neutral. The magnitude of an effect is assessed qualitatively, according to the criteria set out in **Table 17-8**. The following definitions apply to the time periods used in the magnitude assessment:
    - Long-term: >5 years;
    - Medium-term: 1 to 5 years; and
    - Short-term: <1 year.

53. For effects related to human health, magnitude reflects the likely increase or decrease in exposure risk for a receptor. For controlled waters, magnitude represents the likely effect that an activity would have on resource availability or value, at the receptor. Magnitude is therefore affected by the distance and connectivity between an impact source and the receptor.

Table 17-8: Definition of Magnitude Levels for Ground Conditions and Contamination.

Magnitude	Definition
High - permanent or large-scale change affecting usability, risk or, value over a wide area, or certain to affect regulatory compliance.	**Land quality – human health** • Permanent or major change to existing risk exposure (adverse / beneficial); • Unacceptable risks / severe harm to one of more receptors with a long-term or permanent effect (adverse); or • Remediation and complete source removal (beneficial).
	Land quality – controlled waters • Permanent, long-term or wide scale effects on water quality or availability (adverse / beneficial); • Permanent loss or long-term derogation of a water supply source resulting in prosecution (adverse); • Change in WFD water body status / potential or its ability to achieve WFD objectives in the future (adverse / beneficial); • Permanent habitat creation or complete loss (adverse / beneficial); or

Magnitude	Definition
	• Measurable habitat change that is sustainable / recoverable over the long-term (adverse / beneficial).
	Land quality – geological sites and mineral resources • Complete loss of designated sites; or • Complete sterilisation of mineral resource.
	Built environment • Catastrophic damage to buildings or structures.
Medium - Reversible change affecting usability, value, or risk, over the medium-term or local area: possibly affecting regulatory compliance.	**Land quality – human health** • Medium-term or moderate change to existing risk of exposure (adverse / beneficial); • Unacceptable risks to one or more of the receptors with a medium-term effect (adverse); or • Serious concerns or opposition from Statutory Consultees (adverse).
	Land quality – controlled waters • Medium-term or local scale effects on water quality or availability (adverse / beneficial); • Medium-term derogation of a water supply source, possibly resulting in prosecution (adverse); • Observable habitat change that is sustainable / recoverable over the medium-term (adverse / beneficial); or • Temporary change in status / potential of a WFD water body or its ability to meet objectives (adverse / beneficial).
	Land quality – geological sites and mineral resources • Partial loss of the designated geological sites; or • Medium-term or local scale loss of mineral resources.
	Built environment • Damage to buildings or structures.
Low - temporary change affecting usability, risk or value over the short-term or within the study area; measurable permanent	**Land quality – human health** • Short-term temporary or minor change to existing risk exposure (adverse / beneficial); or

Magnitude	Definition
change with minimal effect, usability, risk or value; no effect on regulatory compliance.	• Unacceptable risks to one or more receptors with a short-term effect (adverse).
	Land quality – controlled waters • Short-term or very localised effects on water quality or availability (adverse / beneficial); • Short-term derogation of a water supply source (adverse); • Measurable permanent effects on a water supply source that do not impact on its operations (adverse); • Observable habitat change that is sustainable / recoverable over the short-term (adverse / beneficial); or • No change in status / potential of a WFD water body or its ability to meet objectives (neutral).
	Land quality – geological sites and mineral resources • Temporary change in status of designated geological sites; or • Short-term or very localised effects on mineral resources.
	Built environment • Easily repairable damage to buildings or structures.
Negligible - minor permanent or temporary change, indiscernible over the medium to long-term. Short-term, with no effect on usability.	**Land quality – human health** • Negligible change to existing risk of exposure; or • Activity is unlikely to result in unacceptable risks to receptors (neutral).
	Land quality – controlled waters • Very minor or intermittent impact on local water quality or availability (adverse / beneficial); • Usability of a water supply source will be unaffected (neutral); • Very slight local changes that have no observable impact on dependent receptors (neutral); or • No change in status / potential of a WFD water body or its ability to meet objectives (neutral).
	Land quality – geological sites and mineral resources

Magnitude	Definition
	• No change in status of designated geological site; or • Very minor impact on mineral resources.
	Built environment • Very slight non-structural damage or cosmetic harm to buildings or structures.

17.4.3.2 Impact Significance

54. In basic terms, the potential significance of an impact is a function of the sensitivity of the receptor and the magnitude of the effect (see **Chapter 5 EIA Methodology** for further details). The determination of significance is guided by the use of an impact significance matrix, as shown in **Table 17-9**. Definitions of each level of significance are provided in **Table 17-10**.

55. Potential impacts identified within the assessment as major or moderate are regarded as significant in terms of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (herein referred to as the 'EIA Regulations'). Potential impacts should be described using impact significance, followed by a statement of whether the impact significance is significant in terms of the EIA regulations, e.g. "*minor adverse impact, not significant in EIA terms / moderate adverse impact, significant in EIA terms*". Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall impact in order to determine a residual impact upon a given receptor.

Table 17-9: Impact Significance Matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 17-10: Definition of Impact Significance

Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could

Significance	Definition
	result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore, no change in receptor condition.

17.4.4 Cumulative Impact Assessment Methodology

56. The cumulative impact assessment (CIA) considers other plans, projects and activities that may impact cumulatively with SEP and DEP. As part of this process, the assessment considers which of the residual impacts assessed for SEP and / or DEP on their own have the potential to contribute to a cumulative impact, the data and information available to inform the cumulative assessment and the resulting confidence in any assessment that is undertaken. **Chapter 5 EIA Methodology** provides further details of the general framework and approach to the CIA.

57. For ground conditions and contamination, these activities include the onshore elements of other offshore wind farm projects, construction projects (commercial, residential and transport developments) and remediation projects.

17.4.5 Assumptions and Limitations

58. The desk-based Land Quality PRA (**Appendix 17.1**) is based on a range of publicly available information. No ground investigation data from within the study area has been used to inform the Land Quality PRA or the impact assessment presented in this chapter. The assessments therefore adopt a precautionary approach i.e., if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage exists. The impact assessment presented in this chapter is therefore limited by the finite data on which it is based. There is a level of uncertainty associated with extrapolation of site-specific data or non-site data to other locations within the study area.

17.5 Existing Environment

17.5.1 Geology

59. Information on the geological conditions within the study area has been collated from BGS datasets, including 1:50,000 scale geological mapping. The anticipated geological sequence within the study area as shown on the BGS online viewer is outlined in **Table 17-11** below (see also **Figure 17.1.3, Appendix 17.1**).

Table 17-11: Geological Sequence for the Ground Conditions and Contamination Study Area.

Stratum	Unit	Description
Topsoil	-	Very soft to soft organic clay and peat.
Made Ground	-	Manmade or re-worked ground of variable description.
Superficial Deposits	Marine Beach Deposits	Shingle, sand, silt and clay; may bedded or chaotic; beach deposits may be in the form of dunes, sheets or banks; in association with the marine environment.
	River Terrace Deposits	Sand and Gravel, locally with lenses of silt, clay or peat.
	Head Deposits	Poorly sorted and poorly stratified, angular rock debris and / or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. Gravel, sand and clay depending on upslope source and distance from source. Locally with lenses of silt, clay or peat and organic material.
	Alluvium	Clay, silt, sand and gravel. Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.
	Sheringham Cliffs Formation	Consists of a thick glacial sequence that contains several distinctive subdivisions varying from stratified fine-grained sands, matrix-supported diamictons, clay and sand.
	Briton's Lane Sand and Gravel Member	Horizontal, massive and low angle planar cross-bedded gravels and cobble gravels with thin seams of horizontal and rippled sand. The lithology has a distinctive high flint content (c.85-89%) of which the majority is of non-chatter marked variety (c.78-85%). The gravels also contain a wide range of far-travelled crystalline erratics including rocks of British and Scandinavian provenance.
	Weybourne Town Till Member	A highly calcareous silt and chalk-rich matrix supported diamicton.
	Lowestoft Formation	Chalky till, together with outwash sands and gravels, silts and clays. The till is characterised by its chalk and flint content.
	Happisburgh Glacial Formation	A range of diamictons, sands and gravels, sands and laminated silts and clays.

Stratum	Unit	Description
	Bacton Green Till Member	An extensive diamicton complex that consists of a stratified assemblage of stony diamicton with beds / laminae of sorted material including sand, silt and clay.
Bedrock	Wroxham Crag Formation	Interbedded gravels, sands, silts and clays. The gravels are dominated by flint (up to c.80%) and by quartz and quartzite (up to c.60%).
	White Chalk Subgroup (Lewes Nodular Chalk, Seaford Formation, Newhaven Chalk Formation, Culver Chalk Formation, Portsdown Chalk Formation)	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

60. A geophysical survey was conducted by Terradat on behalf of Geotechnics within the area of the onshore substation (Terradat, 2022). Ground investigations, including trial pits and boreholes, also within the onshore substation area were undertaken by Geotechnics in 2021 and 2022.

61. The geophysical survey identified the presence of a potential buried granular channel with more cohesive clays present adjacent to the channel. The ground investigations encountered a gravel layer (associated with the potential buried channel) overlying a chalk bedrock. More generally, shallow sands overlying clays were encountered across the onshore substation area.

17.5.2 Hydrogeology

62. The baseline presented in the PRA (**Appendix 17.1**) indicates that the superficial Marine Beach Deposits, River Terrace Deposits, Alluvium, parts of the Happisburgh Glacial Formation and Briton's Lane Sand and Gravel Member are classified by the Environment Agency as Secondary A Aquifers (**Figure 17.1.3, Appendix 17.1**).

63. Secondary A Aquifers are defined as permeable strata capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

64. The Happisburgh Glacial Formation and Bacton Green Till are classified by the Environment Agency as Secondary B Aquifers / Unproductive Strata.

65. A Secondary B Aquifer comprises predominantly lower permeability strata which may in part have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

66. Unproductive Strata are defined by the Environment Agency as comprising of predominantly rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

67. The Head Deposits, Sheringham Cliffs Formation, Weybourne Town Till Member and Lowestoft Formation are classified as Secondary Undifferentiated Aquifers.

68. Secondary Undifferentiated Aquifers are defined by the Environment Agency as being assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

69. The underlying bedrock comprising the Wroxham Crag Formation and White Chalk Supergroup are classified by the Environment Agency as Principal Aquifers. This geology exhibits high permeability and / or provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale.

70. The PRA (**Appendix 17.1**) indicates that the study area has been assigned, by the Environment Agency, a medium to high groundwater vulnerability risk. A high groundwater vulnerability designation indicates that the soil is easily able to transmit pollution to groundwater, which is characterised by high leaching potential in soils and the absence of low permeability superficial deposits.

71. Information received from local authorities indicates that there are four private groundwater abstractions (for domestic purposes) located within the onshore cable corridor. An additional 28 domestic groundwater abstractions are located within the 250m study area. Eight of these are recorded within 50m of the onshore cable corridor. No domestic groundwater abstractions are located within 50m of the onshore substation. Twelve deregulated abstractions are located within 250m of the onshore cable corridor (five within 50m) and onshore substation area (none within 50m).

72. SPZs are defined around abstraction boreholes used for potable water supply, to delineate the area where release of a contaminant into the aquifer could impact on the abstraction[1].

[1] **SPZ1** –Inner protection zone -defined as the 50-day travel time from any point below the water table to the abstraction source. This zone has a minimum radius of 50 metres. **SPZ2** –Outer protection zone -defined by a 400-day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the abstraction source, depending on the size of the abstraction. **SPZ3** – Source catchment protection zone -defined as the area around an abstraction source within which all groundwater recharge is presumed to be discharged at the abstraction source.

73. A large proportion of the DCO order limit is located within a total catchment (SPZ 3) (see **Figure 17.1.3, Appendix 17.1**), with the exception of the area between Landfall and north of the village of Weybourne and the area between the villages of Matlaske and Oulton. The site encroaches very minimally into an SPZ 2 at the very end of the cable corridor adjacent to the substation location. It is likely that the SPZ is protecting groundwater within the Principal Bedrock Aquifers that underly the study area. The study area does not lie within a SPZ 1.

74. Due to the presence of domestic and licensed groundwater abstraction points, alterations in SPZ classifications need to be considered, for example the area (50m) surrounding a domestic abstraction for potable water would be considered to be located in a SPZ 1 due to its sensitivity and potential impacts to human health if it were to become contaminated.

17.5.3 Hydrology and Surface Drainage

75. Information provided within the PRA (**Appendix 17.1**) indicates that the DCO order limit crosses six Environment Agency main rivers. These are the River Bure, River Wensum, River Yare, River Tiffey, River Tud and an unnamed river.

76. In addition to the larger named rivers mentioned above, there are a number of unnamed watercourses, agricultural drains and drainage channels as well as ponds that are located either wholly or partially within the study area.

77. Information within the PRA indicates that there are three licensed surface water abstraction points located within the onshore cable corridor. The use of the abstracted water is not indicated in the information received, however the surface waters from which the abstractions are permitted include the River Yare and River Bure.

78. Further information with regards to hydrology is located within **Chapter 18 Water Resources and Flood Risk**.

17.5.4 Sensitive Land Use

79. Sensitive land use sites are considered, by statutory agencies, to be of special importance due to their intrinsic qualities which are unique to those areas. The following designated sites are located within the DCO order limits:

- The onshore cable corridor crosses the River Wensum, which is designated as a Special Area of Conservation (SAC) and SSSI, for its status as an enriched, calcareous lowland river (see **Figure 17.1.4, Appendix 17.1**).

80. The following designated sites are located within the 250m buffer zone of the DCO order limit (see **Figure 17.1.4, Appendix 17.1**):

- Weybourne Cliffs (located to the east of landfall), designated as a geological SSSI categorised as an historic site with an outstanding Pleistocene section of national importance;

- Greater Wash (located immediately adjacent to the northern edge of landfall), designated as a Special Protection Area (SPA) due to mosaic habitats present and bird species it supports;
- Alderford Common (located 164m west of the onshore cable corridor at Ordnance Survey Grid Reference (OS GR): 613196 E, 318348 N at its closest point), designated as a SSSI due to wide range of habitats that have developed there in response to variations in soils and topography; and
- Kelling Heath (located approximately 210m west of the onshore cable corridor at OS GR: 610485 E, 342053 N at its closest point) designated as a SSSI due to the area containing the best example of a glacial outwash plain in England.

81. Parts of the study area are located within the following Nitrate Vulnerable Zones (NVZ):

- Landfall
  - Anglia Chalk (groundwater).
- Onshore cable corridor
  - Anglia Chalk (groundwater);
  - Glaven NVZ (surface water);
  - Saxthorpe (groundwater);
  - Bure Broads Eutrophic Lake (eutrophic water);
  - Norwich Crag and Gravels (groundwater);
  - Tud NVZ (surface water); and
  - Yare NVZ (surface water).

82. There are no direct overlaps between the landfall location and onshore cable corridor and any geological SSSI sites. As such, no impacts to designated geological sites are anticipated as a result of SEP and DEP and are not considered further in the impact assessment.

83. Further information regarding ecological designated sites can be found in **Chapter 20 Onshore Ecology**.

17.5.5 Mineral Safeguarding Areas

84. The land within the study area is underlain by clay, sand and gravel resources associated with the glacial deposits and Lowestoft Formation. The study area crosses several Mineral Safeguarding Areas (**Figure 17.1.2, Appendix 17.1**). These are areas of known deposits of minerals designated by a Mineral Planning Authority for safeguarding against unnecessary sterilisation by non-mineral development. An area of 0.01km^2 and 2.25km^2 are designated as a Mineral Safeguarding Area within the landfall area and onshore cable corridor respectively. An area of 0.03km^2 is designated as a Mineral Safeguarding Area within the onshore substation area, these are located along the access road to the onshore substation (0.02km^2) and within the substation 400kv cable easement area (0.01km^2).

85. The onshore substation area is also located in the same area as two sites identified for strategic mineral extraction in the NCC Minerals and Waste Local Plan review in October 2019.These include 'land north of Hickling Lane, Swardeston' which is located within the substation 400kv cable easement areas and 'land south of Mangreen Hall Farm, Swardeston' which is located along the access road to the onshore substation. It is understood from NCC that these two sites have now been withdrawn from the plan for proposed mineral abstraction.

86. An assessment of BGS recorded mineral sites conducted during the production of the PRA (**Appendix 17.1**) identified three records of ceased mineral extraction sites within the study area (sand and gravel extraction sites). A review of active extraction sites recorded on the NCC website indicates that there are two active mineral extraction sites within the study area. Part of Mangreen Quarry is located within the DCO order limits surrounding north of the onshore substation area, adjacent to the A140. Ketteringham Quarry is located 200m west of an access road to the onshore cable corridor (OS GR: 617289, 302567 at its closest point).

17.5.6 Human Health

87. The required onshore infrastructure comprises landfall works, onshore cable corridor, onshore substation as set out in **Chapter 4 Project Description**. Haul and access roads will also be required during the construction period as will construction compounds.

88. During the installation of the onshore infrastructure, the critical human health receptors would be those involved with construction activities, adjacent off-site residents, nearby workers (e.g. agricultural workers) and visitors (e.g. where Public Rights of Way (PRoW) might be in use). During the operational phase of SEP and DEP, the human health receptors will be site users and workers at the substation.

89. Impacts on human health as a result of the construction and operational phases, other than those associated with contamination which are discussed within this chapter, are discussed in **Chapter 28 Health**.

17.5.7 Historical Setting

90. The research undertaken to inform the PRA (**Appendix 17.1**) indicates that the majority of the study area comprised agricultural land and woodland from the earliest available Ordnance Survey (OS) maps (1883-1887) and has the same use to date.

91. The study area has been used for mineral extraction with multiple pits dispersed throughout the area in the earliest available OS maps (1893 - 1897). Some of the pits are no longer shown on recent OS maps suggesting they may have been infilled. Bodham Street Gravel Pit is shown to have been used as a refuse tip from the 1970s (located immediately adjacent to the onshore cable corridor).

92. The Midland and Great Northern Railway, Eastern and Midlands Railway and East Norfolk Railway lines are shown to cross the study area from the late 1800s to date, with some of the lines shown as being dismantled on recent maps. A camp used by the military is shown on maps from the 1950s to the 1990s to the north west of Weybourne. It is known from a Freedom of Information request that the military camp was first formed in the late 1930s to early 1940s and demolished in the 2000s.

93. A sewage works is recorded from 1972 to date adjacent to the military camp in the landfall area. The 1957 OS map records a disused airfield bisecting the onshore cable corridor at Brandiston. A second disused airfield is shown to the north of Bluestone station during the same period. A small airstrip (approximately 550m in length) is recorded on Google Earth Imagery dated 1999 onwards (images prior to this date were not available) immediately adjacent to the onshore cable corridor near Weybourne.

94. A summary of the historical features that may give rise to potential sources of contamination is provided in **Table 17-12** and are illustrated on **Figure 17.1.5** (**Appendix 17.1**).

Table 17-12: Potential Sources of Contamination

Potential Source	Potential Contaminants of Concern
Onsite	
Railway land	Railway land (both current and historical) is a potential source of contamination and Made Ground. Contaminants associated with railway land include herbicides, metals, fuel hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), glycols and sulphates. Asbestos can also be associated with the materials used within the track bedding, the fill used in the formation of embankments and within the trains themselves.
Sewage Works	The processing of sewage could release contaminants into the environment depending on the site's full operational history and usage. Potential contaminants could include metals, cyanides, nitrates, sulphates, asbestos, fuel hydrocarbons, semi volatile organic compounds (SVOCs), volatile organic compounds (VOCs), PCBs and polyfluoroalkyl substances (PFAS). Biological

Potential Source	Potential Contaminants of Concern
	contaminants, such as pathogens, may also be associated with the sewage works.
Airfields and Military Camps.	Potential contaminants may include metals, VOCs and SVOCs, glycols, fuel and oil hydrocarbons, phenols, PFAS and PCBs. Explosive residues and other associated chemicals may be associated with the former armoury located within the military camp. Asbestos had also been identified within the buildings associated with the former military camp.
Potentially infilled land (former pits)	Many former pits are located throughout the study area, some of which may have been infilled through unregulated waste disposal activity or as a licensed landfill. Contaminants of concern associated with the infilling of land are dependent on the age of emplacement of materials and the nature of materials used. Potential contaminants can include ground gas, SVOCs and VOCs, metals, asbestos, sulphates, fuel hydrocarbons, PAHs, phenols, cyanides, PCBs, dioxins, furans and asbestos.
Pipe line	During a site selection workshop, it was brought to the attention of the Applicant that a potential pipe line which may contain asbestos may be located within the onshore cable corridor near the village of Little Barningham.
Offsite	
Railway land	Asbestos, metals and metalloids, PAHs, fuel and oil hydrocarbons, VOCs and SVOCs, glycols, inorganic and organic contaminants, herbicides, PCBs, PFAS, explosive residues. Ground gas.
Brick works	
Potentially infilled land / refuse sites	
Airfield and military camp	
Sewage works	
Electricity substation	
Filling station	

17.5.8 Climate Change and Natural Trends

17.5.8.1 Geology

95. No major changes to the geology underlying the study area in relation to climate change and natural trends are anticipated to occur over the lifetime of the projects.

17.5.8.2 Hydrogeology

96. There is increased regulation of agricultural chemicals and catchment wide initiatives to reduce pressures on groundwater to achieve compliance with the WFD. Therefore, baseline groundwater quality is likely to improve over time through the natural breakdown of chemicals that may currently be present in groundwater bodies.

17.5.8.3 Hydrology and Surface Drainage

97. Climate change is expected to result in wetter winters, drier summers and a greater number of convectional rainstorms. This means that the hydrology of the surface drainage network could change, with higher winter flows, lower summer flows and a greater number of storm-related flood flows. The risk of flooding will also be amplified as a result of the predicted increase in rainfall associated with climate change, with an increase in peak river flows and an increase in the magnitude of surface water flooding. Detailed information on the anticipated trends associated with surface water is provided in **Chapter 18 Water Resources and Flood Risk**.

17.5.8.4 Possible Sources of Contamination

98. Climate change is expected to result in wetter winters and drier summers, which has the potential to mobilise pre-existing sources of contamination either through increased rates of infiltration due to heavier rainfalls or dust generation through drier summers. These changes have the potential to increase the exposure risks of receptors to pre-existing sources. Natural degradation of contaminants over time may result in a general improvement in ground conditions.

17.5.8.5 Mineral Safeguarding Areas

99. Climate change and natural trends are not anticipated to impact Mineral Safeguarding Areas present within the study area.

17.6 Potential Impacts

100. The following section describes the potential impacts upon the receptors that have the potential to arise as a result of the construction, operational and decommissioning phases of SEP and DEP. The assessment is based upon the worst-case scenario for both the single project and two-project scenarios, with regards to receptor sensitivity and value (with embedded mitigation), and the magnitude of the potential impact (as detailed in **Section 17.4**). Any mitigation measures discussed in this section are considered to be additional to those embedded within the design of SEP and DEP.

17.6.1 Potential Impacts During Construction

17.6.1.1 Impact 1: Exposure of Workforce, Land Owners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated Health Impacts

101. The excavation of cable trenches, earthworks and piling (if required) as well as the movement and stockpiling of soils have the potential to mobilise existing ground contamination (where present). This could result in impacts to human health through dermal contact, inhalation and ingestion of contaminants.

102. A PRA (**Appendix 17.1**) has been undertaken for the study area to identify plausible contaminant linkages as a result of the potential presence of contaminants within the soils and groundwater. The PRA identified that the majority of land within the study area has an agricultural use where unacceptable risks from contamination are not anticipated.

103. The PRA also identified localised areas within the study area with a history of potential contaminative uses. This includes former mineral extraction sites which may have been infilled, anecdotal landfill sites, former airfields, military land, railway land and a sewage works.

104. The PRA identified potential contaminants of concern (PCOC) that could be present in the study area and could represent a risk to construction workers, land owners, land users and neighbouring land users if exposed during construction activities. Construction activities, particularly earthworks could disturb and expose construction workers and other site users to localised Made Ground soils and potential soil and / or groundwater contamination associated with historical and current land uses within the study area. Construction activities could create pollutant linkages through ingestion, inhalation and direct dermal contact pathways.

105. In the event of exposing soils and stockpiling construction waste (including excavated soils), dust could be generated during dry and windy conditions. Under these conditions, construction workers and land owners, land users and neighbouring land users could temporarily be exposed to contamination via the inhalation of potentially contaminated dusts.

106. Additionally, the risk associated with soil contamination sources to human health could be altered by a change in the migration pathways by construction activities. A specific risk of concern is ground gases. Excavation of the onshore cable corridor and piling work (if required) for the onshore substation have the potential to create a preferential pathway for any gases or vapours to migrate and accumulate in confined spaces. The ground gas and vapour risk for the proposed onshore development area is unknown. The potential risk from ground gas and vapours, could represent a risk to human health through asphyxiation and explosion.

107. Construction workers are considered to be the most sensitive receptors as the activities they are engaged in constitute more direct exposure routes over longer periods of time.

17.6.1.1.1 Receptor Sensitivity

108. The sensitivity of construction workers and land owners, land users and neighbouring land users is considered to be high.

17.6.1.1.2 Magnitude of Effect – SEP or DEP in Isolation

109. If SEP or DEP were to be constructed in isolation, the realistic worst-case scenario would involve the excavation of up to 180,000m^3 of material within the onshore cable corridor over a distance of 60km and a width of 45m. Earthworks will also be required to construct the haul road (123,000m^3), joint bays and link boxes (18,480m^3), temporary compounds (21,450m^3), landfall (3,250m^3) and at the onshore substation (23,968m^3).

110. A maximum construction period of SEP or DEP in isolation is four years (as reported within **Section 17.3.2** of this chapter). Earthworks, however, would not be operating continuously and in the same location during the whole construction phase. It is anticipated that the cable corridor construction rate will be on average 400m per day and that the extent of open cut trenches per work front will be typically 50 to 100m in length at any one time.

111. The impacts are predicted to be of local spatial extent (localised to the work areas and areas where contamination may be present), of short-term duration, of intermittent occurrence and high reversibility (occurring only during the works). The magnitude is therefore, considered to be low for SEP or DEP in isolation.

112. In relation to risks associated with the migration of ground gases and / or vapours along the onshore cable corridor, the impacts could be present over the length of the onshore cable corridor for the duration of the works and represent acute or chronic health effects to workers. The magnitude is therefore, considered to be high for SEP or DEP in isolation in relation to ground gas and vapours. However, this is subject to the plausibility of a ground gas / vapour source of contamination and receptor linkage.

17.6.1.1.3 Magnitude of Effect – SEP and DEP

113. SEP and DEP constructed sequentially is considered as the worst-case scenario due to both the longer period of time to which human health receptors could be exposed to potential contamination.

114. If SEP and DEP were constructed sequentially, the realistic worst-case scenario associated with excavation would involve removing up to 360,000m^3 of material from within the onshore cable corridor, 246,000m^3 from within the haul road, 36,960m^3 from joint bays and link boxes, 42,900m^3 for the temporary compound and 6,500m^3 at landfall. The total volume of material that will require excavation for the onshore substation area is yet to be confirmed. It is assumed that the maximum period of construction for either SEP or DEP would be four years followed by a two to four year gap prior to the commencement of the second project which would last a maximum of four years (**Section 17.3.2**).

115. Although stretching over a period of three to four years for each construction phase, any earthworks taking place within areas of potential contamination are not anticipated to be continuous throughout the construction period. It is anticipated that the cable corridor construction rate will be on average 400m per day per crew and that open trenches will be typically 50 to 100m in length at any one time. As such, the impacts to human health associated with excavation are predicted to be of short-term duration, of local spatial extent (localised to the work areas and areas of contamination) of intermittent occurrence and high reversibility (occurring only during the works). The magnitude is therefore, considered to be low.

116. In relation to risks associated with the migration of ground gases and / or vapours along the two trenches of the onshore cable corridor, the impacts could be present over the length of the onshore cable corridor for the duration of the works and represent acute or chronic health effects to workers. The magnitude is therefore, considered to be high for SEP and DEP in relation to ground gas and vapours.

17.6.1.1.4 Impact Significance – All Scenarios

117. For all scenarios the potential impact on human health associated with the excavations works for SEP and DEP is low on a high sensitivity receptor. Therefore, resulting in an impact of **moderate adverse** significance in the absence of mitigation.

118. In relation to potential impacts associated with the migration of ground gases and / or vapours to human health is considered to be of high magnitude. Therefore, representing an impact of **major adverse** significance in the absence of mitigation.

17.6.1.1.5 Mitigation

119. Where areas of potential contamination cannot be avoided, such as the areas that cross the entire width of the onshore cable corridor (e.g. the disused airfield at Brandiston and railways lines (both historical and active), targeted ground investigations may be required. The ground investigation may include, but is not limited to, the collection of soil samples for laboratory analysis. This would characterise the site conditions, identify unacceptable risks and determine whether remediation is required. If areas of potential concern are identified, then a remediation strategy would be developed and agreed with the relevant bodies prior to the commencement of remedial works and construction activity. The ground investigation, risk assessment and remediation would follow guidance provided within the 2021 Environment Agency Land Contamination Risk Management Framework.

120. The development of, and adherence to, a Code of Construction Practice (CoCP) would also be undertaken. The CoCP will be regularly reviewed and updated post consent, prior to and during the constructed period. The CoCP will be informed by the findings of pre-construction site investigation and include an assessment of the potential risks to human health and controlled waters receptors from SEP and / or DEP. Based on that risk assessment appropriate working methods would be developed to avoid, minimise or mitigate impacts relating to construction. The risk mitigation strategies incorporated into the CoCP would also include appropriate Personal Protective Equipment (PPE), provision of welfare facilities, monitoring of works including air quality and odour and implementation of relevant good working practices applied including stockpile management and dust suppression activities to reduce the risk relating to the creation and inhalation of wind-blown dusts.

121. The CoCP would incorporate legislation requirements including the Construction Design Management (CDM) Regulations (2015), Health and Safety at Work Act (1974), CoCP and Control of Substances Hazardous to Health (COSHH) Regulations.

122. In addition, a plan for dealing with unexpected contamination would be developed as part of the CoCP. This plan would also incorporate the Environment Agency best practice guidelines for pollution prevention which have been withdrawn from use but still provide a useful best practice guide and include:

- Environment Agency Pollution Prevention Guidance (PPG) 01 - Understanding your environmental responsibilities;
- Environment Agency PPG 05 - Works and maintenance near water;
- Environment Agency PPG 06 - Working at construction and demolition: preventing pollution guidance;
- Environment Agency PPG 08 - Safe storage and disposal of used oils; and
- Environment Agency PPG 21 - Pollution incident response planning.

123. Adoption of a CL:AIRE Industry Code of Practice to manage the re-use and disposal of excavated soils on site would also be incorporated as an additional mitigation measure to protect human health, this would aid in maximising sustainability and providing an audit trail to demonstrate the appropriate use of materials. A Materials Management Plan (MMP) would be drafted in advance of any construction works, this would include chemical screening criteria in order to ensure that imported and / or reused materials are chemically suitable for use. If materials identified as containing asbestos are identified, then a specialist contractor should be employed to aid in its removal from site, in line with current legislation.

124. The MMP would form part of the final CoCP to be submitted for approval with the relevant bodies in advance of implementation.

125. Risks associated with the creation of a preferential pathway for ground gas and vapours via the onshore cable corridor can be mitigated via re-instating excavated materials following the installation of the onshore cables, however if this is to change or a significant source of gas / vapour generating material is encountered during construction further consideration will be required.

126. Risks to construction workers in relation to ground gas and vapours would be mitigated by the use of appropriate working methods incorporated within the CoCP and use of PPE.

17.6.1.1.6 Residual Impacts

127. For all scenarios, with the incorporation of outlined mitigation measures, the risk to human health from exposure to potentially contaminated soils, ground gas and vapours during construction, would be minimised as far as is reasonably possible. This would effectively reduce the magnitude of effect from high to negligible, on a high sensitivity receptor, representing a residual impact of **minor adverse** significance, which is not significant in EIA terms.

17.6.1.2 Impact 2: Direct Impacts on Groundwater Quality and Groundwater Resources

128. Direct impacts to the Secondary A, Secondary B and Secondary Undifferentiated Aquifers within the superficial deposits may occur due to the intrusive nature of trenching (trench depth 2m). The significance of the disturbance will be dependent on the depth of the aquifer unit in relation to the proposed depth of the excavation, with superficial aquifers present at the surface at greater risk of direct impacts.

129. During construction, surface layers would be excavated, which could allow increased infiltration of rainwater and surface run-off to the subsurface. This could potentially mobilise any residual contamination already present in the overlying strata which could potentially migrate into the underlying shallow superficial aquifers impacting groundwater quality and associated groundwater abstractions. Whilst significant areas of contamination are not expected across the majority of the SEP and DEP study area, there are parts within the study area where crossing potentially contaminated land may be unavoidable.

130. Direct impacts to the Secondary Aquifers, Principal Aquifers of the Wroxham Crag Formation and White Chalk Subgroup and SPZs may occur from deep ground workings related to trenchless crossing (e.g. HDD) operations for cable installation beneath surface infrastructure (e.g. railways) and watercourses. There is potential for creating preferential pathways, for drilling mud / other contaminants to leak along the drill path, which could cause contamination of groundwater. The volume of drilling fluid that could be released is dependent on a number of factors, including the size of the fracture, the permeability of the geological material, the viscosity of the drilling fluid and the pressure of the hydraulic drilling system. Piling may be required for the foundations of substations and has the potential to create preferential pathways through a low permeability layer, allowing potential contamination to migrate into underlying Secondary, Principal Aquifers and SPZs, impacting water quality and associated groundwater abstractions.

131. If required, dewatering of perched water or groundwater within excavations could also affect groundwater flow and water quality, resulting in impacts to base flow of local watercourses or impact on groundwater abstractions.

132. In addition, during construction there is the potential for the accidental release of lubricants, fuels and oils from construction machinery. This can occur as a result of spillages, leakage or storage. These can enter into the ground and subsequently into groundwater impacting groundwater quality and associated groundwater abstractions.

17.6.1.2.1 Receptor Sensitivity

133. There are five domestic groundwater abstractions recorded within the study area, however, it is not known whether these groundwater abstractions are from within the superficial deposits. As such, the sensitivity of the underlying Secondary Aquifers has been assessed conservatively by assuming that private abstractions are taken from the superficial deposits. Therefore, the sensitivity of the superficial Secondary Aquifers (A, B and Undifferentiated) is considered to be high.

134. The Principal Aquifer which underlies the superficial deposits beneath the whole of the SEP and DEP study area and is partly designated as a SPZ 3 and SPZ 2 is deemed to be of high sensitivity.

17.6.1.2.2 Magnitude of Effect – SEP or DEP in Isolation

135. If SEP or DEP were constructed in isolation, the realistic worst-case scenario would involve the excavation of up to 180,000m^3 of material within the onshore cable corridor over a distance of 60km and a width of 45m. Earthworks will also be required to construct the haul road (123,000m^3), joint bays and link boxes (18,480m^3), temporary compounds (21,450m^3), landfall (3,250m^3) and at the onshore substation (42,593 m^3).

136. A maximum construction period of SEP or DEP in isolation is four years (as set out within **Section 17.3.2** of this chapter). Earthworks, however, would not be operating continuously during the whole construction period.

137. Any changes to infiltration rates, surface runoff or dewatering that may occur as a direct result of earthworks activities and direct impacts to the underlying superficial aquifers is predicted to be of local spatial extent within each aquifer unit, of short-term duration (related to the working areas only), of intermittent occurrence and high reversibility (occurring only during the works and returning to baseline conditions following completion of the works). The magnitude of effect associated with earthworks is therefore considered to be low.

138. The number of trenchless crossings (e.g. HDD) required as part of the construction works associated with either SEP or DEP in isolation is 62 with an additional 14 potential trenchless crossings. The foundation design of the onshore substation, i.e. whether piling is required, and the total number of piles is yet to be determined. The impacts of either trenchless crossings or piling on the underlying Principal Aquifer is predicted to be of local spatial extent (occurring only at trenchless crossing locations and at the substation if piling is required) and of intermittent occurrence. The magnitude of effect associated with trenchless crossings and piling activities is therefore considered to be low.

17.6.1.2.3 Magnitude of Effect – SEP and DEP

139. If SEP and DEP were constructed, the realistic worst-case scenario would be sequential construction and involve removing up to 360,000m^3 of material from within the onshore cable corridor, 246,000m^3 from the haul road, 36,960m^3 from joint bays and link boxes, 42,900m^3 from temporary compounds and 6,500m^3. The total volume of material to be excavated from the onshore substation area would be 81,759m^3.

140. The two-project scenario is expected to require twice the number of piles (if piling is indeed required) for the construction of the substation and twice the number of drills at trenchless crossings when compared to SEP or DEP in isolation.

141. Similar to the impacts discussed in relation to SEP or DEP in isolation, the potential impacts to the superficial Secondary Aquifers and Principal Aquifers are predicted to be of local spatial extent within each aquifer unit, of short-term duration (related to the working areas only) of intermittent occurrence and high reversibility. The magnitude of effect is therefore considered to be low.

17.6.1.2.4 Impact Significance

142. For all scenarios, prior to mitigation, the overall significance of disturbance causing impacts to water quality or the resource potential of the Secondary Aquifers during construction is low magnitude on a high sensitivity receptor, representing an impact of **moderate adverse** significance. The overall significance on groundwater quality within the Principal Aquifers, as a result of trenchless crossings and piling, is low magnitude on a high sensitivity receptor, representing an impact of **moderate adverse** significance.

17.6.1.2.5 Mitigation

143. As discussed in **Section 17.6.1.1.5**, mitigation includes measures such as investigations to characterise ground conditions. Should contamination be encountered that is considered to pose an unacceptable risk to groundwater and groundwater resources, a remediation strategy proportionate to the level of risk would be developed and agreed with the relevant bodies. Once agreed, any required remediation works, which will be dependent on the type and level of contamination encountered, would be undertaken to mitigate the potential risks posed. In addition, a CoCP would be developed which would include specific measures relevant to the storage of fuels, oils, lubricants, waste water and other chemicals during the works. This will include:

- Storing all fuels, oils, lubricants, waste water and other chemicals in impermeable bunds with at least 110% of the stored capacity, with any damaged containers being removed from site.
- Refuelling would take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils to be used where possible.
- Ensuring that spill kits are available on site at all times as well as sand bags and stop logs for deployment in case of emergency spillages.

144. In addition, mitigation measures relating specifically to impacts to groundwater may include the development of a hydrogeological risk assessment where earthworks / excavations are within 50m (or 250m dependent upon volume abstracted) of private potable groundwater abstractions. The risk assessment, would be desk-based and follow a tiered approach with more detailed assessments carried out in areas considered to be a potentially greater risk to groundwater. The production of the hydrogeological risk assessment would be undertaken prior to the commencement of construction works (should one be deemed necessary) and meet the requirements of Environment Agency's Approach to Groundwater Protection 2018 Framework. Furthermore, a piling risk assessment would be undertaken if piles are to be used (e.g. the onshore substation area) in areas of potential contamination, in line with the Environment Agency's Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (Environment Agency, 2001). The mitigation measures and monitoring requirements recommended by these assessments, would be implemented during construction works.

17.6.1.2.6 Residual Impacts

145. For all scenarios, following the implementation of the mitigation measures described, the overall risk to groundwaters within the Secondary Aquifers during construction would be minimised as far as is reasonably possible. This would effectively reduce the magnitude of the effect to the Secondary Aquifers to negligible on a high sensitivity receptor, representing a residual impact of **minor adverse** significance.

146. For groundwaters within the Principal Aquifers, following the adoption of mitigation measures, the magnitude of effect would be negligible on a high sensitivity receptor, representing a residual impact of **minor adverse** significance. An impact of **minor adverse** significance is not significant in EIA terms.

17.6.1.3 Impact 3: Impacts on Surface Water Quality and the Ecological Habitats they Support from Contamination

147. The study area crosses six main rivers, including the River Bure, River Wensum, River Yare, River Tiffey, River Tud and an unnamed river.

148. In addition to these larger rivers, there are a large number of unnamed watercourses, agricultural drains, drainage channels and ponds that are located either wholly or partially within the study area.

149. As described in **Table 17-12** and the PRA (**Appendix 17.1)**, potential sources of contamination have been identified within the study area. Installation of the onshore export cables and construction of the onshore substation would require substantial earthworks, as well as the potential for piling at the onshore substation site. These activities have the potential to disturb potential contamination which could migrate and be released into surface water via the following pathways:

- Mobilisation and migration of free phase hydrocarbons, soil contaminants or dissolved phase contaminants in groundwater by construction activities with subsequent release into surface waters;
- Surface water runoff from contaminated Made Ground soils brought to surface during construction;
- Runoff from stockpiles of potentially contaminated soils;
- Migration of soil or groundwater contaminants into surface water drains during construction activities which then enter surface water;
- Accidental spillage whilst handling, storage or treatment of contaminated water or fuels or other chemicals used during construction; and
- The hydraulic regime of the local area could also be affected by the construction of SEP and / or DEP for example backfilling excavated areas with less compacted soil / material could potentially create preferential flow paths into surface water receptors.

17.6.1.3.1 Receptor Sensitivity

150. Any migration and discharge of contamination into surface waters could lead to a reduction in surface water quality and impact on the ecological habitats they support. As the SEP and DEP study area crosses the River Wensum, which is a statutory designated site (SSSI and SAC) the sensitivity of surface waters is considered to be high.

151. Additional impacts relating to surface water quality and ecological habitats are provided in **Chapter 18 Water Resources and Flood Risk** and **Chapter 20 Onshore Ecology and Ornithology**.

17.6.1.3.2 Magnitude of Effect

152. It is possible that there would be multiple sources of contamination within a river catchment for both SEP or DEP in isolation and SEP and DEP. As such, the magnitude of effect is assessed as medium for both scenarios.

17.6.1.3.3 Impact Significance

153. Prior to mitigation the overall effect on surface water quality from contamination during construction works of SEP or DEP in isolation or SEP and DEP, is medium magnitude on a high sensitivity receptor, representing an impact of **major adverse** significance.

17.6.1.3.4 Mitigation

154. The mitigation measures set out in **Sections 17.6.1.1.5** and **17.6.1.2.5** would also serve to prevent the migration of contamination into surface water bodies.

155. In addition, in areas that have been identified as potential areas of contamination within the PRA or encountered during construction works, perched waters within Made Ground or groundwater from dewatering activities would be collected within a tank or lagoon prior to any treatment or discharge. This waste water shall either be:

- Discharged to foul sewer under a trade effluent consent agreed with the local water company / supplier; and / or
- Discharged to surface water under an environmental permit issued from the Environment Agency.

156. On site treatment plant may be required to treat the waste water prior to disposal in order to meet discharge limits set by either the Environment Agency or local water company.

17.6.1.3.5 Residual Impacts

157. Following the adoption of the mitigation measures outlined, the risk to surface water bodies during construction of SEP or DEP in isolation or SEP and DEP, would be minimised as far as reasonably possible. This would effectively reduce the magnitude of effect to negligible, on a high sensitivity receptor, representing a residual impact of **minor adverse** significance, which is not significant in EIA terms.

17.6.1.4 Impact 4: Sterilisation of Future Mineral Resources

158. As described in **Section 17.5.5**, there are numerous Mineral Safeguarding Areas within the landfall area (0.01km^2), onshore cable corridor (2.25km^2) and onshore substation area (including access roads and 400kv cable easement) (0.03km^2). Construction activities and installation of cables within these areas would prevent extraction of sands, gravels, clays and shale over the whole construction area of SEP and DEP.

17.6.1.4.1 Receptor Sensitivity

159. Mineral Safeguarding Areas are considered to be of regional importance and therefore the sensitivity of the receptor is considered to be medium.

17.6.1.4.2 Magnitude of Effect – SEP or DEP in Isolation

160. The installation of a single trench for SEP or DEP in isolation within the onshore cable corridor, which runs a length of 60km and a width of 45m (increasing in width to 100m at trenchless crossings), has the potential to sterilise the resources present within the narrow linear route of the onshore cable corridor during construction. In all cases, where the onshore cable corridor intersects a Mineral Safeguarding Area only part of each area is impacted and not the whole protected area.

161. The onshore substation area will be 3.25ha (plus a 1ha construction compound) and has the potential to temporarily sterilise mineral resources within its footprint during construction works. The substation area is not located within a mineral extraction site; however it is located immediately adjacent to Min 79 - Land north of Hickling Lane, Swardeston mineral extraction site and so any standoff areas associated with construction activities may temporally halt extraction at the neighbouring site.

162. The impacts of sterilisation are considered to be temporary during construction, as such the magnitude of effect is considered to be low.

17.6.1.4.3 Magnitude of Effect – SEP and DEP

163. The construction of SEP and DEP is considered to be the worst-case scenario as it has the potential to impact a greater proportion of any Mineral Safeguarding Areas present. As such, there is the potential to temporarily sterilise a larger volume of mineral resources when compared to SEP or DEP in isolation during the construction phase. However, the impacts of sterilisation are still considered to be temporary during construction, and as such the magnitude of effect is considered to be low**.**

17.6.1.4.4 Impact Significance

164. Without mitigation, the potential effect on mineral resources associated with the construction of SEP or DEP in isolation or SEP and DEP is low magnitude on a medium sensitivity receptor, representing an impact of **minor adverse** significance.

17.6.1.4.5 Mitigation

165. As discussed in **Section 17.5.1**, ground investigations and a geophysical survey have been conducted within the onshore substation area. The investigations identified the presence of a potential buried granular channel beneath the onshore substation footprint. . The potential channel comprised of granular materials with more cohesive clays and silts present surrounding the potential channel. The granular materials present within the potential buried channel are being considered as a sustainable drainage option for the onshore substation area and it is not proposed that the material is extracted as a mineral resource.

166. For the remainder of the onshore study area, mitigation measures would include consultation with NCC Mineral Planning Authority regarding the practicality and viability of extraction of mineral resources present within the works footprint. Supporting information would include, for example, additional assessments prior to construction to better understand the characteristics of the mineral resource and enable a quantification of the amount of the mineral that may be sterilised should it be required by NCC Mineral Planning Authority. If it was determined that extraction of the resource was reasonably practical, it may be extracted prior to the commencement of construction works and therefore reduces the area that may be potentially sterilised.

167. A Mineral Resource Assessment would be undertaken if required to provide an indication of the likely quality and extent of the mineral resource, the commercial viability of extraction and environmental impact. This may also aid in determining whether it is reasonably practical for the resource to be extracted prior to the commencement of construction works and therefore, reduce the area that may be potentially sterilised.

17.6.1.4.6 Residual Impacts

168. Following the mitigation described above, it is considered that the magnitude of the impact from SEP or DEP in isolation or SEP and DEP to mineral resources during construction would remain low on the medium sensitivity receptor. Therefore, the residual impact would be of **minor adverse** significance, which is not significant in EIA terms.

17.6.1.5 Impact 5: Built Environment

169. The construction phase has the potential to impact the existing built environment. This may be through creating new preferential pathways for contaminants or gases to migrate that may lead to degradation of utilities and concrete from aggressive attack. This could potentially compromise the integrity of buildings or utilities, or the migration of ground gases into buildings could cause explosion.

17.6.1.5.1 Receptor Sensitivity

170. Although no buildings are present within the study area, a number of both commercial, residential properties and a primary school are located within 250m of construction works. Therefore, the sensitivity of the built environment is considered to be high.

17.6.1.5.2 Magnitude of Effect – SEP or DEP in Isolation

171. Commercial, residential properties and a school are located within 250m of the construction works. However, the impacts are likely to be of local spatial extent (localised to the work areas and areas of contamination). The magnitude of effect is considered to be medium.

17.6.1.5.3 Magnitude of Effect – SEP and DEP

172. Whilst the two-project scenario has the potential to impact a larger area of the built environment compared to SEP or DEP in isolation, the magnitude of effect is still considered to be medium.

17.6.1.5.4 Impact Significance

173. Without mitigation, the potential effect on the built environment associated with the construction of SEP or DEP in isolation or SEP and DEP is medium magnitude on a high sensitivity receptor, representing an impact of **major adverse** significance.

17.6.1.5.5 Mitigation

174. Mitigation includes the reduction of construction activities in proximity to commercial, residential properties and the school where possible. However, where this isn't possible pre-construction site characterisation works in areas identified as potential sources of contamination may be required. This would allow for the identification of potential contamination and the risks these may present to the built environment during construction works. Should it be determined that risks to the built environment are present, appropriate remediation works would be undertaken to mitigate the potential impacts.

17.6.1.5.6 Residual Impacts

175. Following the implementation of the mitigation measures described above, the risk to the built environment during the construction of both SEP or DEP in isolation or SEP and DEP would be reduced. The reduced risk lowers the magnitude of effect to negligible on the high sensitivity receptor, representing a residual impact of **minor adverse** significance, which is not significant in EIA terms.

17.6.2 Potential Impacts During Operation

17.6.2.1 Impact 1: Exposure of Workforce, Land Owners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated Health Impacts

176. During the operation of SEP and DEP there would be no planned maintenance along the onshore cable corridor which would require the excavation of soils. In the unlikely event of a cable failure then that stretch of cable between two joint bays may need to be replaced. This would require excavation at the two joint locations to expose the joint bays and allow the cable to be pulled out and replaced. If contaminated materials are brought to the surface during maintenance works and no mitigation measures are implemented, these materials would permanently be exposed at surface. This creates the potential for maintenance workers, land owners, land users and neighbouring land users to come in to direct contact with contaminated soils left in-situ via direct contact pathways.

177. Materials excavated during the installation of the onshore cables would be re-instated following completion. If however, a different source of material is used to backfill excavations within the onshore cable corridor that is not of a similar porosity as the surrounding environment (e.g. a more porous material such as coarse hardcore is used), there is the potential for ground gases and/or vapours to migrate along the length of the corridor. This may lead to the accumulation of ground gas and vapours within the onshore substation accessed by maintenance workers during the operational phase. Therefore, risks associated with asphyxia and explosion may be present.

17.6.2.1.1 Receptor Sensitivity

178. The sensitivity of maintenance workers and land owners, land users and neighbouring land users is considered to be high.

17.6.2.1.2 Magnitude of Effect

179. There may be a need for ground excavations to be undertaken at joint bays as part of the maintenance for both SEP or DEP in isolation or SEP and DEP. The impacts are predicted to be of local spatial extent (localised to areas where contamination may be present and to areas where excavation works are required), of short-term duration, of intermittent occurrence and high reversibility (occurring only during the maintenance works). The magnitude is therefore considered to be low for the operation of SEP or DEP in isolation or SEP and DEP.

180. In areas where there is the potential for ground gases and / or vapours to accumulate (e.g. within the onshore substation building) which may potentially lead to asphyxiation or explosion the magnitude of effect would be high for both SEP or DEP in isolation or SEP and DEP during operation.

17.6.2.1.3 Impact Significance

181. Without mitigation, the potential impact on human health associated with the operation of SEP and DEP in isolation or SEP and DEP is high magnitude (based on a worst-case scenario) on a high sensitivity receptor, representing a **major adverse** significance.

17.6.2.1.4 Mitigation

182. As discussed in **Section 17.6.1.2.5**, should remedial works be required in areas of contamination identified during the site characterisation works, these would be conducted prior to the commencement of construction works. If unexpected contamination is identified during construction, remedial works will be undertaken should these areas be considered to pose an unacceptable risk to human health. This would mean that contaminated soils would not be permanently left at surface during the operational phases of SEP and DEP. The remedial works would be undertaken prior to the operation of SEP and / or DEP would reduce the potential for impact to human health.

183. In addition to any remedial works, which may remove potential sources of ground gas or vapour generating material, by re-instating the materials excavation during the installation of the onshore cable corridor the potential impact to human health would be reduced.

184. Maintenance workers that are required to undertake ground excavations or enter confined spaces, such as the onshore substation, during the operation of SEP and DEP would be provided with information regarding the nature of ground conditions within each area so that they can develop site and task specific risk assessment and method statements and implement their recommendations.

17.6.2.1.5 Residual Impact

185. With the incorporation of the mitigation measures described above, the risk to human health during the operation of SEP or DEP in isolation or SEP and DEP would be minimised as far as possible. The residual magnitude of effect is considered to be negligible on the high sensitivity receptor following mitigation. Therefore, the residual impact to human receptors is of **minor adverse** significance, which is not significant in EIA terms.

17.6.2.2 Impact 2: Impact on Controlled Waters (Groundwater and Surface Waters)

186. Maintenance activities at the landfall, along the onshore cable corridor and at the onshore substation have the potential to mobilise pre-existing contamination or create new contamination through the leakage or spillage of fuels, oils or other chemicals from machinery, vehicles or operational equipment. This could affect water quality within the aquifers underlying the site, surface water receptors and the water abstractions they support.

17.6.2.2.1 Receptor Sensitivity

187. The sensitivity of controlled waters is considered to be high.

17.6.2.2.2 Magnitude of Effect

188. For both SEP or DEP in isolation or SEP and DEP, maintenance works could involve soils being exposed at surface during, for example, excavation of joint bay locations. However, it is not anticipated that the entirety of the SEP or DEP footprint would be subject to excavation during maintenance works.

189. The impacts are predicted to be of local spatial extent (localised to areas of excavation / maintenance and where contamination may be present). The magnitude is therefore considered to be low during operation.

17.6.2.2.3 Impact Significance

190. Without mitigation, the potential effect on controlled waters resulting from the operation of SEP or DEP in isolation or SEP and DEP is low magnitude on a high sensitivity receptor, representing an impact of **moderate adverse** significance.

17.6.2.2.4 Mitigation

191. Maintenance workers that are required to undertake ground excavations or maintenance works during the operation of SEP and DEP would be provided with information regarding the nature of ground conditions within each area so that they can develop site and task specific risk assessment and method statements and implement their recommendations to protect controlled waters.

192. During cable repair / maintenance works and at the onshore substation, all fuels, oils lubricants and other chemicals would be stored in an impermeable bund with at least 110% of stored capacity. Spill kits would be available on site at all times and an Emergency Response Plan (ERP) (or similar) would be developed, as part of the final CoCP, which outlines mitigation measures to be undertaken in the event of an uncontrolled release of hazardous materials.

17.6.2.2.5 Residual Impact

193. Following the implementation of mitigation measures described above, the risk to controlled waters during the operation of SEP or DEP in isolation or SEP and DEP would be minimised as far as possible. This would effectively reduce the magnitude of effect to negligible on the high sensitivity receptor. Therefore, the residual impact to controlled water receptors during operation is of **minor adverse** significance, which is not significant in EIA terms.

17.6.2.3 Impact 3: Sterilisation of Future Mineral Resources

194. Future extraction of resources from within Mineral Safeguarding Areas would be prevented within the permanent easement for the onshore export cables, within the substation 400kv cable easement (0.01km^2) and within the area of the permanent access road (0.02km^2) . This would prevent extraction within these areas for the duration of the operational period (40 years).

195. The impacts are predicted to be permanent and could affect the receptor directly, however, the proportion of the total Mineral Safeguarding Areas that would effectively be sterilised is considered to be small.

17.6.2.3.1 Receptor Sensitivity

196. The sensitivity of future mineral resources is considered to be medium.

17.6.2.3.2 Magnitude of Effect – SEP or DEP in Isolation

197. If SEP or DEP were to be constructed in isolation, the realistic worst-case scenario would result in the prevention of future extraction of resources from within Mineral Safeguarding Areas within the permanent easement for the onshore export cables (10m wide easement along the 60km cable corridor), within the substation 400kv cable easement and within the area of the permanent access road up to 3.25ha.

198. The impacts are predicted to be of local spatial extent the magnitude is therefore, considered to be medium for the operation of SEP or DEP in isolation.

17.6.2.3.3 Magnitude of Effect – SEP and DEP

199. If SEP and DEP were to be constructed this would result in the prevention of future extraction of resources from within Mineral Safeguarding Areas within the permanent easement for the onshore export cables (20m wide easement along the 60km cable corridor), within the substation 400kv cable easement and within the area of the permanent access road up to 6.0ha.

200. The impacts are predicted to be of local spatial extent the magnitude is therefore, considered to be medium for the operation of SEP and DEP.

17.6.2.3.4 Impact Significance

201. Without mitigation, the potential effect on the mineral resource resulting from the operation of SEP or DEP in isolation or SEP and DEP is of medium magnitude on a medium sensitivity receptor, representing an impact of **moderate adverse** significance.

17.6.2.3.5 Mitigation

202. As discussed in **Section 17.6.1.4** prior to construction and operation consultation with NCC Mineral Planning Authority will be undertaken to determine the feasibility of mineral extraction within the area that would be sterilised. It may be necessary for a minerals resource assessment to be undertaken to determine the amount of mineral at risk from sterilisation and the viability of extraction. Where viable, consideration will be given to the extraction of the mineral resource during construction.

17.6.2.3.6 Residual Impact

203. Following the implementation of mitigation measures described above, the magnitude of effect is considered to be negligible on the medium sensitivity receptor. Therefore, the residual impact to mineral resources during operation is of **minor adverse** significance.

17.6.2.4 Impact 4: Built Environment

204. Materials such as concrete used in the infrastructure associated with SEP and DEP have the potential to undergo degradation, such as chemical attack, from aggressive ground conditions due to the presence of acids or sulphates. This has the potential to compromise the integrity of structures associated with the substation.

205. In addition, the presence of contaminants in soils could also result in a risk of corrosion and permeation of utilities such as plastic water supply pipes that may be installed at the onshore substation.

206. Buildings built on or near sources of ground gas (such as infilled land) could also be at risk from the accumulation of gases potentially causing explosion.

17.6.2.4.1 Receptor Sensitivity

207. Due to the presence of the substation and ancillary structures as well as neighbouring commercial and residential properties within the study area, the sensitivity of the built environment is considered to be high.

17.6.2.4.2 Magnitude of Effect

208. Desk based information indicates that the substation is not situated on or near potential sources of ground gases, such as infilled land. However, if an unexpected source of ground gas is identified prior to or during construction works, without mitigation, the potential impact on the surrounding built environment resulting from the operation of SEP and DEP in isolation or SEP and DEP is medium magnitude on a high sensitivity receptor, representing an impact of **major adverse** significance.

17.6.2.4.3 Mitigation

209. Should unexpected sources of ground gas be identified prior to or during construction works, a ground investigation will be undertaken to characterise ground conditions and assessment of potential risks. Depending on the outcome of the assessment, mitigation measures such as the use of gas protection measures within the substation design will be implemented.

210. If utilities corridors are within land affected by contamination, construction of clean or lined service corridors will be installed to protect land users and utilities. This would include, for example, the use of soils deemed not to contain contamination above human health generic assessment criteria appropriate for the end use within the study area.

211. In line with BRE Special Digest 1, materials suitable for the identified ground conditions would be used to ensure that the correct concrete type for the environment has been selected. This will mitigate against the potential for ongoing material degradation of infrastructure and utilities during the operational life of SEP and DEP.

17.6.2.4.4 Residual Impact

212. Following the implementation of mitigation measures described above, the risk to the built environment during the operation of SEP or DEP in isolation or SEP and DEP would be minimised as far as possible. This would effectively reduce the magnitude of effect to negligible on the high sensitivity receptor. Therefore, the residual impact to the built environment during operation is of **minor adverse** significance, which is not significant in EIA terms.

17.6.3 Potential Impacts During Decommissioning

213. No decision has been made regarding the final decommissioning policy for the onshore export 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.

214. 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 lifetime of SEP and DEP, but are 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.

215. 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 similar or less than those during construction. This is because areas of identified contamination would have been remediated during the construction phase.

216. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of SEP and 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.

17.7 Cumulative Impacts

17.7.1 Identification of Potential Cumulative Impacts

217. 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'). This information is set out in **Table 17-13** below. Only potential impacts assessed in **Section 17.6** 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).

218. **Table 17-13** concludes that in relation to ground conditions and contamination.

Table 17-13: Potential Cumulative Impacts (Impact Screening)

Impact	Potential for Cumulative Impact	Rationale
Construction		
Impact 1: Exposure of Workforce, Landowners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated Health Impacts	Yes	The impacts to construction workers will be confined to the work area for all scenarios. Impacts to landowners, land users and neighbouring land users may be exacerbated by other projects for all scenarios.
Impact 2: Direct Impacts on Groundwater Quality and Groundwater Resources	Yes	Impacts to Secondary and Principal Aquifers may be exacerbated by other projects for all scenarios which are located within the same aquifer and / or SPZ.
Impact 3: Impacts on Surface Water Quality and the	Yes	Impacts to surface water and the ecological habitats they

Impact	Potential for Cumulative Impact	Rationale
Ecological Habitats they Support.		support may be exacerbated by other projects for all scenarios that are within the same river catchment.
Impact 4: Sterilisation of Future Mineral Resources	Yes	Impacts to Mineral Safeguarding Areas may be exacerbated by other projects for all scenarios if they are located within the same safeguarding area.
Impact 5: Built Environment	Yes	Impacts to the built environment may be exacerbated by other projects for all scenarios if located near the same buildings. The greatest potential for cumulative impacts are associated with those projects immediately adjacent to the onshore elements of SEP and DEP.
Operation		
Impact 1: Exposure of Workforce, Landowners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated Health Impacts	Yes	The impacts to maintenance workers will be confined to the work area for all scenarios. Impacts to landowners, land users and neighbouring land users may be exacerbated by other projects for all scenarios.
Impact 2: Impact on Controlled Waters (Groundwater and Surface Waters)	Yes	Impacts to Secondary and Principal Aquifers may be exacerbated by other projects for all scenarios which are located within the same aquifer and / or SPZ.
Impact 3: Sterilisation of Future Mineral Resources	Yes	Impacts to Mineral Safeguarding Areas may be exacerbated by other projects for all scenarios if they are located within the same safeguarding area.
Impact 4: Built Environment	Yes	Impacts to the built environment may be exacerbated by other projects for all scenarios if located near the same buildings. The greatest potential for cumulative impacts are

Impact	Potential for Cumulative Impact	Rationale
		associated with those projects immediately adjacent to the onshore elements of SEP and DEP.
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A Decommissioning Programme will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.		

17.7.2 Other Plans, Projects and Activities

219. 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 17-14** below, 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.

220. The project screening has been informed by the development of a CIA Project List which forms an exhaustive list of plans, projects and activities in a very large study area relevant to SEP and DEP. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

221. Projects that have not been included within the CIA, and the rationale as to why, are included as an appendix to this chapter.

Table 17-14: Summary of Projects Considered for the CIA in Relation to Ground Conditions and Contamination (Project Screening)

Project	Status	Construction Period	Closest Distance from the Project (km)	Confidence in Data	Rationale
Hornsea Project Three Offshore Wind Farm	DCO consented	2023-2025 (single phase) 2023-2031 (two phase)	0 (Export cable corridor - ECC)	High	The Hornsea Project Three ES identified impacts to Mineral Safeguarding Areas, secondary aquifers, groundwater quality and flow within principal aquifers and SPZs as of negligible to minor adverse significance due to designed-in mitigation measures. Due to the nature and scale of the development there is the potential for the onshore elements of the project to have direct and / or indirect cumulative effects on the receptors identified. There is likely to be a temporal overlap during the construction and operational phases of both Hornsea Three and SEP and DEP. However, due to the mitigation measures incorporated into the design of Hornsea Three, the potential for cumulative effects to occur is limited.
Norfolk Vanguard Offshore Wind Farm	DCO consented	Expected construction 2023 to 2029	0 (ECC)	High	The Norfolk Vanguard ES identified impacts to the coastline (including designated geological sites), secondary aquifers, principal aquifer (including SPZs), surface waters, human health and mineral resources as negligible to moderate adverse significance. Mitigation measures, additional to those embedded within the project, were proposed that reduced moderate adverse impacts to minor adverse. Due to the nature and scale of the development there is the potential for the onshore elements of the project to have direct and / or indirect cumulative effects on the receptors identified. There is likely to be a temporal overlap during the construction and operational phases of both Norfolk Vanguard and SEP and DEP. The potential for cumulative effects to occur is considered to be limited. This is due to the mitigation measures incorporated into the Norfolk Vanguard project.
Norfolk Boreas Offshore Wind Farm	DCO consented	Expected construction 2023-2029	0 (ECC)	High	The Norfolk Boreas ES identified impacts to the coastline (including designated geological sites), secondary aquifers, principal aquifers (including SPZs), surface waters, human health and mineral resources as negligible to major adverse. Mitigation measures, additional to those embedded within the project, were proposed that reduced the impacts to the receptors to minor adverse. Due to the nature and scale of the development there is the potential for the onshore elements of the project to have direct and / or indirect cumulative effects on the receptors identified. There is likely to be a temporal overlap during the construction and operational phases of both Norfolk Boreas and SEP and DEP. The potential for cumulative effects to occur is considered to be limited. This is due to the mitigation measures incorporated into the Norfolk Boreas project.
Proposed Norwich Western Link road (NWL)	Scoping opinion given	2023	0 (EEC)	High	Due to the nature and scale of the development there is the potential for the onshore elements of the project to have direct and / or indirect cumulative effects on the receptors identified. There is a possibility that there will be a temporal overlap between the NWL project and SEP and DEP during the construction phase. However, the NWL project will be subject to a planning process requiring appropriate mitigation measures to be implemented. It is expected that these will be incorporated into a CoCP (or similar), therefore limiting the potential for cumulative effects to occur.
A47 North Tuddenham to Easton	Examination	2022/23-2024/25	0 (EEC)	High	Due to the nature and scale of the development there is the potential for the onshore elements of the project to have direct and / or indirect cumulative effects on the receptors identified. There is a possibility that there will be a temporal overlap between the A47 project and SEP and DEP during the construction phase. However, the works will be subject to a DCO requiring appropriate mitigation measures to be implemented. It is expected that these will be incorporated into a CoCP (or similar), therefore limiting the potential for cumulative effects to occur.
East Anglia GREEN	Site selection / pre-scoping	2027-2031	-	Low	Screened out as insufficient details available about this proposal to undertake any meaningful cumulative impact assessment.

17.7.3 Assessment of Cumulative Impacts

222. Having established the residual impacts from SEP and / or DEP with the potential for a cumulative impact, along with the other relevant plans, projects and activities, the following sections provide an assessment of the level of impact that may arise.

17.7.3.1 Cumulative Impact 1: Exposure of Workforce, Land Owners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated Health Impacts

223. Hornsea Project Three landfall overlaps with access routes and duct preparation areas associated with the SEP and DEP landfall, to the north west of the village of Weybourne. The onshore cable corridor follows a similar route as SEP and DEP, but for the most part, the projects are separated by distances greater than 250m. The Hornsea Project Three onshore cable corridor crosses the SEP and DEP onshore cable corridor to the south of Attlebridge, near the village of Easton. The Hornsea Project Three onshore substation is located approximately 1.4km north west of the SEP and DEP onshore substation.

224. The impact assessment within the geology and ground conditions chapter for the Hornsea Project Three did not include an assessment of the impacts to human health. Within the Outline CoCP, however, it is noted that a written scheme for dealing with contamination of either soils or groundwater will be prepared and submitted to the Environmental Health Officer for approval. The scheme will reduce the potential cumulative impacts as any potential contamination will be managed in a way as to not cause harm to human receptors.

225. The onshore cable corridor for both the Norfolk Boreas and Norfolk Vanguard projects crosses the SEP and DEP onshore cable corridor to the north east of the village of Southgate. The impact assessment for both projects identified that short term risks to construction workers would be managed through the use of appropriate working practices and the use of PPE. In addition to these measures a written scheme would be produced outlining the procedures for the management of contaminated soils and groundwaters and submitted to the local authority for approval. A Site Waste Management Plan (SWMP) would be developed for both projects as part of the final CoCP.

226. The A47 project will cross the SEP and DEP onshore cable corridor to the west of the village of Easton. The impact assessment identified that there would be a negligible to minor adverse impact on human health receptors during the construction phase. Risks associated with the project and mitigation measures are to be outlined within the final CoCP which will also incorporate a Soil Management Plan (SMP) and an MMP.

227. The proposed NWL project will cross the SEP and DEP onshore cable corridor to the east of the village of Weston Green. An EIA has yet to be produced for the NWL project. A scoping report for the project, submitted in 2020, indicated that mitigation measures would be secured for the project via a Construction Environmental Management Plan (CEMP).

228. Given the mitigation measures committed to by the projects discussed above and considering that any alteration to ground conditions would be highly localised it is considered that no cumulative impacts are likely to occur during both the construction and operational phases with SEP and DEP. Therefore, the residual impact to human health is not considered to increase from the **minor adverse** impact predicted for SEP and DEP.

17.7.3.2 Cumulative Impact 2: Impacts on Groundwater Quality and Groundwater Resources

229. The potential cumulative impacts to superficial aquifers are likely to occur as a result of accidental spillages of fuels or chemicals during construction and mobilisation of existing contamination (if present). Given the proximity of the other developments to the SEP and DEP onshore cable corridor there is the potential for multiple projects to be present in the same aquifer.

230. Impacts to the underlying aquifers as part of the construction phases of Hornsea Project Three, Norfolk Vanguard, Norfolk Boreas and the A47 project would be managed through identified mitigation measures. The projects demonstrate within their respective EIA submissions that with the implementation of their mitigation measures, they commit to reducing residual impacts to levels not considered significant in EIA terms. These measures include, for example, following good environmental practices based on guidance such as CIRIA C532 Control of Water Pollution from Constructions Sites - Guidance for Consultants and Contractors (2001) (Hornsea Project Three). As mentioned previously, an EIA has yet to be produced for the NWL project and so comments on the proposed mitigation measures cannot be made at this stage. It is, however anticipated that best practice and appropriate mitigation measures will be implemented within the project, therefore reducing the potential for cumulative impacts to occur.

231. Although multiple projects would be present within the same aquifer, given the mitigation measures committed to by the projects discussed above, as well as the localised nature of the effects in isolation, the potential for effects to act cumulatively on the aquifer is low.

232. Impacts to the Principal Aquifer and SPZs may occur where there is piling or trenchless crossings within the same aquifer and / or SPZ. Hornsea Project Three and SEP and DEP both propose piling at their respective substation sites which are located within the White Chalk Subgroup Principal Aquifer. Where construction is undertaken at the same time there is potential for cumulative impacts which could lead to additional contamination of the Principal Aquifer, SPZs and the abstractions they protect. The impacts could result in reduced groundwater quality or disruption to flow.

233. However, the construction timescale for Hornsea Project Three onshore substation and the SEP or DEP onshore substation are not programmed to overlap. Should construction be delayed, and an overlap occur, due to the localised nature of potential effects, the residual impact to the aquifers is considered to be minor adverse and therefore does not represent an increase in the predicted impacts of SEP and DEP during construction.

234. Operational phases of each of the projects are considered to run concurrently, and so have the potential to impact underlying aquifers. Given the mitigation measures of each of the projects identified within their respective EIA documents, and the anticipated mitigation measures for the NWL project, it is not considered likely that the significance of impact will increase from what is predicted for SEP and DEP.

17.7.3.3 Cumulative Impact 3: Impacts on Surface Water Quality and the Ecological Habitats they Support

235. Direct cumulative impacts on surface waters are likely to occur if there are spatial or temporal overlaps between SEP and DEP and other offshore wind farm cable corridors or works associated within the A47 and NWL projects. The cumulative direct impacts to surface waters from accidental discharge would be likely to occur as a result of accidental spillages of fuel or chemicals, as well as mobilisation of existing contamination via large scale excavations (and piling if required) during construction and / or operation.

236. Given the mitigation measures committed to by the other wind farm projects and the road improvement schemes, described in cumulative impact 2 above, it is considered unlikely that there would be a cumulative change to the magnitude of effects to surface waters from that described for SEP and DEP.

237. The cumulative indirect impacts to groundwater and subsequent surface water discharge are likely to be highly localised and would be unlikely to have long term impacts on groundwater discharge to surface water if spatial overlap between projects was present. Therefore, the residual cumulative impact is not considered to increase from the **minor adverse** impact predicted for SEP and DEP.

17.7.3.4 Cumulative Impact 4: Sterilisation of Future Mineral Resources

238. The SEP and DEP onshore work and Hornsea Project Three, Norfolk Vanguard, Norfolk Boreas or roadworks associated within the A47 and NWL projects have the potential to lead to increased cumulative impacts on strategic mineral resources. Additional areas designated as MSAs would be affected and represents the potential for additional losses of strategic resources through mineral sterilisation. However, these are all linear projects and the areas impacted are spread along narrow linear routes rather than sterilising large areas, i.e. only a very small proportion of each mineral resource safeguarding area is potentially at risk of sterilisation. It is therefore considered that the combined footprint of all these projects would not represent an increase to the magnitude of effect and the cumulative residual impact along cable corridor routes would remain minor adverse.

239. There is a small overlap between Hornsea Project Three and SEP and DEP , and a mineral resource safeguarding area. The area is located in proximity to the existing Norwich Main substation. Should these projects all proceed to construction, this has the potential to generate cumulative impacts upon this mineral resource safeguarding area.

240. Both Hornsea Project Three and SEP and DEP have committed to consultation with the NCC Mineral Planning Authority to investigate the quality of the resource and feasibility of extraction prior to construction to reduce impacts down to **minor adverse** significance. Should the identified resources be deemed of good quality, these could potentially be utilised within the construction of either project.

241. These mitigation measures would also ensure that cumulative impacts remain not higher than **minor adverse** significance during both the construction and operational phases of each project.

17.7.3.5 Cumulative Impact 5: Built Environment

242. Impacts to the built environment are not discussed within the EIAs for the three offshore wind farms or the A47 project. However, given the commitments set out for SEP and DEP, the three offshore wind farms and the A47 and NWL projects, and considering that any alteration to ground conditions would be highly localised it is considered that no cumulative impacts are likely to occur during construction or operational phases. Therefore, the residual impact to the built environment is not considered to increase from the **minor** (construction) or **negligible** (operation) **adverse** impact predicted for SEP and DEP alone.

17.8 Transboundary Impacts

243. There are no transboundary impacts with regard to ground conditions and contamination as the onshore project area would not be sited in proximity to any international boundaries. Transboundary impacts are therefore scoped out of this assessment and are not considered further.

17.9 Inter-relationships

244. The receptors identified within this chapter (including human health, controlled waters, the built environment, mineral resources and ecological habitats) are intrinsically linked to:

- Water resources (including surface waters and groundwaters), which are influenced by ground conditions and contamination through the quality of groundwater, groundwater flow within the subsurface strata and interactions with surface waters.
- Ecology, which is influenced by ground conditions and contamination through the chemical quality of groundwater, surface waters and soils.

245. A summary of the potential inter-relationships between ground conditions and contamination receptors and water resources and onshore ecology is provided in **Table 17-15**.

Table 17-15: Ground Conditions and Contamination Inter-Relationships

Impact / receptor	Related Chapter	Where Addressed in this Chapter	Rationale
Construction			
Impact 1: Exposure to contaminated soils (workforce, landowners and land users)	N/A	N/A	No additional inter-related effects on human health have been identified for these receptors during construction, which would increase the standalone assessment from **minor adverse** (and not significant in EIA terms).
Impact 2: Direct impacts on groundwater quality and quantity.	**Chapter 18 Water Resources and Flood Risk**	**Section 17.6** and **17.7**.	Any project-related changes to ground conditions (both physically and chemically) during construction could impact the quality and quantity of groundwater resources and any hydrologically connected surface water receptors. This is assessed in full within the **Section 17.6** and **17.7**.
Impact 3: Impacts on surface water quality and ecological habitats.	**Chapter 20 Onshore Ecology**	**Section 17.6** and **17.7**.	Potential changes to the quality and quantity of groundwater resources and any hydrologically connected surface water during construction could impact upon water dependent biological features, inclusive of designated sites. This is assessed in full within the **Section 17.6** and **17.7**.

Impact / receptor	Related Chapter	Where Addressed in this Chapter	Rationale
Impact 4: Sterilisation of future mineral resource	N/A	N/A	No additional inter-related effects on mineral resources have been identified.
Impact 5: Built environment (users of existing buildings)	N/A	N/A	No additional inter-related effects on the existing built environment have been identified.
Operation			
Impact 1: Exposure to contaminated soils (workforce, landowners and land users)	N/A	N/A	No additional inter-related effects on human health have been identified for these receptors during operation, which would increase the standalone assessment from **minor adverse** (and not significant in EIA terms).
Impact 2: Impact on controlled waters	N/A	N/A	No additional inter-related effects on controlled waters have been identified.
Impact 3: Sterilisation of future mineral resource	N/A	N/A	No additional inter-related effects on mineral resources have been identified.
Impact 4: Built environment (users of existing buildings)	N/A	N/A	No additional inter-related effects on mineral resources have been identified.
Decommissioning			
Impacts associated with the decommissioning phase would be no greater than those identified for the construction phase.			

17.10 Interactions

246. The impacts identified and assessed in this chapter have the potential to interact with each other. The areas of potential interaction between impacts are presented in **Table 17-16**. This provides a screening tool for which impacts have the potential to interact. **Table 17-17** provides an assessment for each receptor (or receptor group) as related to these impacts.

247. Within **Table 17-17** the impacts are assessed relative to each development phase (Phase assessment, i.e. construction, operation or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the level of impact upon that receptor. Following this, a lifetime assessment is undertaken which considers the potential for impacts to affect receptors across all development phases.

Table 17-16: Interaction Between Impacts - Screening

Potential Interactions between Impacts					
Construction					
	Impact 1: Exposure to contaminated soils (human health)	**Impact 2**: Impacts on groundwater	**Impact 3:** Impacts on surface waters	**Impact 4**: Sterilisation of mineral resource	**Impact 5**: Built environment (users of existing buildings)
Impact 1: Exposure to contaminated soils (human health)	-	Yes	No	No	No
Impact 2: Impacts on groundwater	Yes	-	Yes	No	No
Impact 3: Impacts on surface waters	No	Yes	-	No	No
Impact 4: Sterilisation of mineral resource	No	No	No	-	No
Impact 5: Built environment (users of existing buildings)	No	No	No	No	-
Operation					
	Impact 1: Exposure to contaminated soils (human health)	**Impact 2:** Impact on groundwater and surface water	**Impact 3:** Sterilisation of mineral resource	**Impact 4:** Built environment (users of existing buildings)	
Impact 1: Exposure to contaminated soils (human health)	-	Yes	No	No	
Impact 2: Impact on groundwater and surface water	Yes	-	No	No	
Impact 3: Sterilisation of mineral resource	No	No	-	No	
Impact 4: Built environment (users of existing buildings)	No	No	No	-	

Table 17-17: Interaction Between Impacts – Phase and Lifetime Assessment

Receptor	**Highest Significance Level**				
	Construction	Operation	Decommissioning	Phase Assessment	Lifetime Assessment
Human health	**Minor adverse**	**Minor adverse**	**Minor adverse**	**No greater than individually assessed impact** The impacts to human health are assessed as **minor adverse** significance on receptors deemed to be of high sensitivity, with the most sensitive receptors identified as construction workers. Impacts to human health during construction, operation and decommissioning phases will be managed through standard and best practice methodologies. Given the proposed	**No greater than individually assessed impact** The impacts to human health are considered a potential risk during the construction, operation and decommissioning phases. Risks associated with each of the phases of SEP and DEP will be managed through best practice and adoption of appropriate mitigation measures discussed within this chapter.

Receptor	Highest Significance Level				
	Construction	Operation	Decommissioning	Phase Assessment	Lifetime Assessment
				mitigation measures and the **minor adverse** significance, it is considered that there would either be no interactions between impacts during the construction, operational and decommissioning phases of SEP and DEP or that interactions would be no greater than when assessed individually.	Therefore, no lifetime effects for receptors are anticipated.
Groundwater	**Minor adverse**	**Minor adverse**	**Minor adverse**	**No greater than individually assessed impact** The impacts to groundwater are assessed as **minor adverse** significance on receptors of high sensitivity. Impacts to groundwater during construction, operation and decommissioning phases will be managed through standard and best practice methodologies. Given the proposed mitigation measures and the **minor adverse** significance, it is considered that there would either be no interactions between impacts during the construction, operational and decommissioning phases of SEP and DEP or that interactions would be no greater than when assessed individually.	**No greater than individually assessed impact** The impacts to groundwater quality in the superficial aquifers during earthworks are only considered a potential risk during the construction and decommissioning phases. It is considered unlikely that earthworks activities will be required during the operational phase of SEP and DEP, if earthworks are required, they are anticipated to be managed in line with best practice with appropriate risk assessments conducted and submitted to the relevant agency.
Surface water	**Minor adverse**	**Minor adverse**	**Minor adverse**	**No greater than individually assessed impact** The impacts to surface waters are assessed as **minor adverse** significance on receptors of high sensitivity. Impacts to surface waters during construction, operation and decommissioning phases will be managed through standard and best practice methodologies. Given the proposed mitigation measures and the **minor adverse** significance, it is considered that there would either be no interactions between impacts during the construction, operational and decommissioning phases of SEP and DEP or that interactions would be no greater than when assessed individually.	**No greater than individually assessed impact** The impacts to surface water quality from contamination of groundwater are only considered a potential risk during the construction and decommissioning phases. Risks associated with the operational phase of SEP and DEP will be managed through best practice. Therefore, no lifetime effects for receptors are anticipated.
Mineral resources	**Minor adverse**	**Minor adverse**	**Minor adverse**	**No greater than individually assessed impact** The impacts to mineral resources are assessed as **minor adverse** significance on receptors of medium sensitivity. Loss	**No greater than individually assessed impact** Impacts to Mineral Safeguarding Areas are considered a potential risk during the construction, operational

Receptor	Highest Significance Level				
	Construction	Operation	Decommissioning	Phase Assessment	Lifetime Assessment
				of mineral resources during construction, operation and decommissioning phases will be managed by undertaking an assessment of the feasibility of extraction prior to development and, where viable, undertaking extraction prior to development. Given the proposed mitigation measures and the **minor adverse** significance, it is considered that there would either be no interactions between impacts during the construction, operational and decommissioning phases of SEP and DEP or that interactions would be no greater than when assessed individually.	and decommissioning phases of SEP and DEP. Therefore, no lifetime effects for the receptors are considered likely.
Built environment (users of existing buildings)	**Minor adverse**	**Negligible adverse**	**Negligible adverse**	**No greater than individually assessed impact** The impacts to the built environment are assessed as **negligible** to **minor adverse** significance on receptors of high (construction) and low (operation) sensitivity. Impacts to the built environment during construction, operation and decommissioning phases will be managed through standard and best practice methodologies. Given the proposed mitigation measures and the **negligible** to **minor adverse** significance, it is considered that there would either be no interactions between impacts during the construction, operational and decommissioning phases of SEP and DEP or that interactions would be no greater than when assessed individually.	**No greater than individually assessed impact** The impacts to the built environment are considered a potential risk during construction, operation and decommissioning of SEP and DEP. Risks associated with the operational phase of SEP and DEP will be managed through best practice thereby reducing the potential impacts to the built environment. Therefore, no lifetime effects for the receptors are considered likely.

17.11 Potential Monitoring Requirements

248. Groundwater and ground gas monitoring may be required as part of any targeted ground investigations that may be required in order to determine the site characteristics and if they pose a potential risk to human health, groundwater and surface water receptors identified within this chapter.

17.12 Assessment Summary

249. This chapter has provided a characterisation of the existing environment for ground conditions and contamination based on existing data, which has established that there will be some **minor adverse** residual impacts on the receptors associated with ground conditions and contamination during construction, operation and decommissioning phases of SEP and DEP.

250. The assessment has established that the receptors relating to ground conditions and contamination could be affected as a result of direct disturbance and mobilisation of existing contamination, introduction of new sources of contamination and mineral sterilisation during the construction, operation and decommissioning phases. Although the residual impacts on the receptors identified following implementation of mitigation measures would be **minor adverse** and therefore not significant in EIA terms.

251. The assessment has demonstrated that although the scenario involving SEP and DEP has a larger land area and would lead to greater ground disturbance than if SEP and DEP would be undertaken in isolation, there is no difference in the residual impacts on the receptors for each of the scenarios assessed.

Table 17-18: Summary of Potential Impacts on Ground Conditions and Contamination Topic

Potential impact	Project	Receptor	Sensitivity	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
Construction								
Impact 1: Exposure of Work Force, Land Owners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated to Health Impacts	SEP DEP SEP & DEP	Human health	High	High	**Major adverse**	A pre-construction targeted ground investigation would be undertaken in areas identified as potential sources of contamination in order to assess site characteristics. This would then allow for the assessment of contaminated areas and appropriate remediation strategies to be produced should the identified contamination be deemed to represent an unacceptable risk to human health. The strategy would be implemented following approval by the local authorities. The use of materials with a similar porosity, e.g. re-instatement of excavated materials, as the surrounding environment would mitigate the ground gas / vapour risks associated with creating a preferential pathway along the length of the onshore cable corridor. Additional mitigation measures including the implementation of a CoCP, which incorporates a range of best practice and current guidelines in order to help reduce the potential impacts to human health receptors. This would include strategies for dealing with unexpected contamination if encountered during construction. Adoption of a CL:AIRE Industry Code of Practice to manage the re-use and disposal of excavated soils on site would also be incorporated as an additional mitigation measure protective of human health.	**Minor adverse**	None predicted
Impact 2: Impacts on Groundwater Quality and Groundwater Resources	SEP DEP	Secondary A, Secondary B, Secondary Undifferentiated and Principal Aquifers	High	Low	**Moderate adverse**	A pre-construction targeted ground investigation would be undertaken in areas identified as potential sources of contamination in order to assess site characteristics. This would then allow for the identification of contaminated areas and appropriate remediation strategies to be produced should the identified contamination be deemed to represent an unacceptable risk to controlled waters. The strategy would be implemented following approval by the local authorities. Additional mitigation measures, including a hydrogeological risk assessment and a piling risk assessment would be undertaken and the	**Minor adverse**	None predicted

Potential impact	Project	Receptor	Sensitivity	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
	SEP & DEP					recommendations implemented in order to reduce the potential risks. A CoCP would also be developed which would include specific measures relevant to the storage of fuels, oils, lubricants, wastewater and other chemicals during the works.		
Impact 3: Impacts on Surface Water Quality and the ecological Habitats they Support	SEP	Controlled waters	High	Medium	**Major adverse**	A pre-construction targeted ground investigation would be undertaken in areas identified as potential sources of contamination in order to assess site characteristics. This would then allow for the identification of contaminated areas and appropriate remediation strategies to be produced should the identified contamination be deemed to represent an unacceptable risk to controlled waters. The strategy would be implemented following approval by the local authorities. A CoCP would also be produced and approved by the local authority. The measures outlined in the CoCP such as the correct storage fuels, oils and chemicals would be implemented. Furthermore, contaminated waste water within Made Ground or groundwater from dewatering activities in areas of contamination shall be collected within a tank or lagoon prior to any treatment or discharge.	**Minor adverse**	None predicted
	DEP							
	SEP & DEP							
Impact 4: Sterilisation of Future Mineral Resources	SEP	Mineral Safeguarding Areas	Medium	Low	**Minor adverse**	Mitigation would include consultation with the NCC Mineral Planning Authority with regards to the feasibility of mineral extraction prior to development. This would be supported by ground investigations prior to construction to help better determine the depth, accessibility and quality of the mineral resource and enable a quantification of the amount of the mineral that may be sterilised. A Mineral Resource Assessment would be undertaken if required, to provide an indication of the likely quality and extent of the mineral resource, the commercial viability of extraction and environmental impact.	**Minor adverse**	None predicted
	DEP							
	SEP & DEP							
Impact 5: Built Environment	SEP	Buildings and utilities	High	Medium	**Major adverse**	A pre-construction targeted ground investigation would be undertaken in areas identified as potential sources of contamination in order to assess site characteristics. This would then allow for the identification of contaminated areas and appropriate	**Minor adverse**	None predicted
	DEP							

Potential impact	Project	Receptor	Sensitivity	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
	SEP & DEP					remediation strategies to be produced should unacceptable risks be identified in relation to contamination present. The strategy would be implemented following approval by the local authorities.		
Operation								
Impact 1: Exposure of Work Force, Landowners, Land Users and Neighbouring Land Users to Contaminated Soils and Groundwater and Associated to Health Impacts	SEP	Human health	High	High	**Major adverse**	A programme of remedial works would be undertaken if areas of contamination identified during the site characterisation works are deemed to present an unacceptable risk to human health. The works would be undertaken prior to the operation of SEP and / or DEP and would reduce the potential for impact to human health. The use of appropriate material to line the onshore cable corridor would also reduce the potential impacts to human health. Maintenance workers that are required to undertake ground excavations during the operation of SEP and DEP would be provided with information regarding the nature of ground conditions within each area so that they can develop site and task specific risk assessment and method statements and implement their recommendations.	**Minor adverse**	None predicted
	DEP							
	SEP & DEP							
Impact 2: Impact on Controlled Waters (Groundwater and Surface Waters)	SEP	Controlled waters	High	Low	**Moderate adverse**	Maintenance workers that are required to undertake ground excavations or maintenance works during the operation of SEP and DEP would be provided with information regarding the nature of ground conditions within each area so that they can develop site and task specific risk assessment and method statements and implement their recommendations to protect controlled waters. At the onshore substation, all fuels, oils lubricants and other chemicals will be stored in an impermeable bund with at least 110% of stored capacity. Spill kits will be available on site at all times and an ERP will be developed which outlines mitigation measures to be undertaken in the event of an uncontrolled release of hazardous materials.	**Minor adverse**	None predicted
	DEP							
	SEP & DEP							
Impact 3: Sterilisation of Future	SEP	Mineral Safeguarding Areas	Medium	Medium	**Moderate adverse**	Prior to construction and operation, a mineral resource assessment will be undertaken, if required, to determine the amount of mineral at risk from sterilisation and the viability of extraction. Where	**Minor adverse**	None predicted
	DEP							

Potential impact	Project	Receptor	Sensitivity	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
Mineral Resources	SEP & DEP					viable, consideration will be given to the extraction of the mineral resource during construction with use in the Projects.		
Impact 4: Built Environment	SEP	Buildings and utilities	High	Medium	**Major adverse**	The concrete used within the built elements of SEP and DEP will be designed in accordance with BRE Special Digest 1 in order to ensure that the correct concrete is used for the ground conditions present. If the substation is to be situated on or near potential sources of ground gases, such as infilled land, prior to construction a ground investigation would be undertaken to characterise ground conditions and to assess the potential risks. This would then enable the correct ground gas protection measures to be installed, if required. Construction of clean or lined service corridors will be installed to protect land users and utilities.	**Minor adverse**	None predicted
	DEP							
	SEP & DEP							
Decommissioning								
No decision has been made regarding the final decommissioning policies for either SEP or DEP as it is recognised that industry best practice, rules and legislation change over time. The detail and scope of decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator with a Decommissioning Programme provided. However, it is considered likely that the proposed onshore substation would be removed and will be reused or recycled and that the onshore cables would be removed and recycled, with the landfall transition joint bays and cable ducts (where used) left in situ. For the purposes of a worst-case scenario, it is considered that the impacts associated with the decommissioning phase would be no greater than those identified for the construction phase.							

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