Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.8 Norfolk Vanguard Water Resources, Flood Risk, and Ground Conditions outgoing documents

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Photo: Ormonde Offshore Wind Farm

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Norfolk Vanguard Offshore Wind Farm

Environmental Impact Assessment

Ground Conditions and Contamination Method Statement

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Author: Royal HaskoningDHV
Date: 13th January 2017
Client: Vattenfall Wind Power Ltd

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This method statement has been prepared by Royal HaskoningDHV on behalf of Vattenfall Wind Power Limited (VWPL) in order to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report. It has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate. All content and material within this document is draft for stakeholder consultation purposes, within the Evidence Plan Process.

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1 INTRODUCTION

1. The purpose of this method statement is to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report, in outlining the proposed approach to be taken and considerations to be made in the assessment of the onshore ground conditions and contamination effects of the proposed development.

2. This method statement has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate.

1.1 Background

3. A Scoping Report for the Norfolk Vanguard Environmental Impact Assessment (EIA) was submitted to the Planning Inspectorate on the 3rd October 2016. Further background information on the project can be found in the Scoping Report which is available at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000022-Scoping%20Report.pdf

4. The Scoping Opinion was received on the 11th November 2016 and can be found at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000018-Scoping%20Opinion.pdf

1.2 Norfolk Vanguard Programme

5. This section provides an overview of key project milestone dates for Norfolk Vanguard.

1.2.1 DCO Programme

- Scoping Request submission - 03/10/16 (complete)
- Preliminary Environmental Information submission - Q4 2017
- Environmental Statement and Development Consent Order (DCO) submission - Q2 2018

1.2.2 Evidence Plan Process Programme

6. The Evidence Plan Terms of Reference (Royal HaskoningDHV, 2017) provides an overview of the proposed Evidence Plan Process and expected logistics, below is a summary of anticipated meetings:

- Steering Group meeting -21/03/16

(complete)

- Steering Group meeting - 20/09/16 (complete)
- Post-scoping Expert Topic Group meetings - Q1 2017
  - Discuss method statements and Project Design Statement
- Expert Topic Group and Steering Group meetings as required - 2017
  - To be determined by the relevant groups based on issues raised
- PEIR Expert Topic Group and Steering Group meetings - Q4 2017/ - Q1 2018
  - To discuss the findings of the PEI (before or after submission)
- Pre-submission Expert Topic Group and Steering Group meetings - Q1/Q2 2018
  - To discuss updates to the ES following PEI consultation

1.2.3 Survey Programme

7. As discussed in **Section 3.2**, a walkover survey is proposed as part of the Phase 1 assessment of contaminated land. This survey will be undertaken during Q1 or Q2 2017 to provide sufficient time to inform the preparation of the PEIR.

2 PROJECT DESCRIPTION

2.1 Site Selection Update

8. Further to the site selection information provided within the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016), additional site selection work has been undertaken to refine the locations of the onshore infrastructure. The Norfolk Vanguard EIA Scoping Report identified search areas for the onshore infrastructure which were identified following constraints mapping to avoid or minimise potential impacts (e.g. noise, visual, landscape, traffic, human health and socio-economic impacts). Further data review has been undertaken to understand the engineering and environmental constraints within the search areas identified. The public drop-in-exhibitions in October 2016 and Scoping Opinion have also contributed to our broader understanding of local constraints and opportunities, feeding into the ongoing site selection and development of the EIA strategy. The project areas shown in Figure 1 are a draft for stakeholder consultation only and are provided in confidence. Equivalent information will be presented during open drop-in-exhibitions in March 2017, providing an opportunity for local people and the wider public to understand the way in which their feedback, as well as the Scoping Opinion and has influenced our design. Given the broad range and complexity of the factors influencing site selection and the scale of the area under discussion, it is our intention that local people and interested parties view the map for the first time, with Vattenfall and suitably qualified experts on hand. This enables a meaningful discussion of the proposed options and enables participants to refer directly to points of reference they may wish to discuss. During the March drop-in exhibitions, participants will also be invited to provide feedback on the latest design.

9. There are currently three landfall options with associated cable relay station search zones as well as an onshore substation search zone in proximity to the existing Necton 400kV National Grid substation (the grid connection point). A 200m wide cable corridor has been identified, within which the cable route will be located (see cable route parameters in Section 2.2.1). Ongoing public and stakeholder consultation as well as initial EIA data collection will be used to inform selection of final locations for the EIA and DCO application, with the aim to further avoid sensitive areas. Impacts that cannot be avoided through site selection will aim to be reduced through sensitive siting, alternative engineering solutions (mitigation by design) and additional mitigation measures where possible. Mitigation options will be developed in consultation with stakeholders.

2.1.1 Landfall Zones

10. The landfall search area was presented in the Scoping Report as Figure 1.3. This has been refined to three landfalls options (Zone 8), Bacton Green, Walcott Gap and Happisburgh South, following studies on the engineering feasibility of horizontal directional drilling (HDD). The two northern landfalls have the advantage that related onshore infrastructure (the cable relay station) could be placed close to the existing Bacton gas terminal in what is already an industrialised area thereby reducing landscape impacts, a preference stated by many at the public drop-in exhibitions. Discussions with the owners and operators of the gas terminal will inform the final landfall location.

11. Both northern options would require offshore cabling through the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) and concerns have been expressed by members of the public and a number of statutory authorities about impacts on the MCZ. Information from the offshore cable corridor geophysical and benthic survey from within the Cromer Shoal Chalk Beds MCZ will be reviewed to understand the extent of designated features and therefore the feasibility of installing offshore cables. Data on coastal erosion, including estimates of coastline movement over the life time of the wind farm, and the likelihood of archaeological finds, will be reviewed to understand the feasibility of a landfall south of Happisburgh. This site is outside the MCZ but siting the required onshore infrastructure within a rural location would require careful consideration.

2.1.2 Cable Relay Station Options

12. The cable relay station search area was presented in the Scoping Report as Figure 1.6. Refined search zones (Zone 7) have been defined based on the initial constraints mapping work, the updated landfall site selection and initial consultation. A number of receptors and impacts have been considered during the selection of the scoping search area and the refined search zones, particularly noise and visual impacts, ecology traffic, human health and socio-economic impacts. As with the landfall location, discussions with the owners of the gas terminal will inform the final landfall location.

2.1.3 Onshore Cable Route

13. The onshore cable corridor search area was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.5. The route shown on Figure 1 (Zone 4) is considered to be the shortest possible route (thereby minimising disturbance impacts) whilst also aiming to avoiding main residential areas and impacts to landscape and nature conservation designations where possible.

14. Routes in the north of the scoping search area were discounted owing to the presence of existing gas pipelines and the cables from the Dudgeon Offshore Wind Farm which significantly affected the number of complex crossings that would be required. The proposed route skirts around the main towns of North Walsham, Aylsham, Reepham and Dereham. The route corridor is currently 200m wide thereby allowing for further micro-siting following feedback from the public drop-in-exhibitions planned for March 2017 and information from planned survey work.

2.1.4 Substation Zone

15. The onshore substation search area, comprising five sectors, was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.4. Public consultation during the drop-in exhibitions indicated Sector 5 (to the south of the existing Necton 400kV National Grid substation) and Sector 1 (to the east) would be the best options in this location.

16. Sectors 2, 3 and 4 were discounted due to the proximity of the residential areas of Necton, Little Dunham, Great Fransham and Little Fransham.

17. Sector 1 was maintained as an option due to the existing woodland and topography of this area which could provide screening (in addition to project screening mitigation) which may limit visual impacts. Additional access would however be required for this sector.

18. Sector 5 was maintained as an option on the basis of keeping all existing and proposed development together, the lack of housing in this sector and good access from the A47. However concerns were raised regarding the ongoing industrialisation of the area.

19. The refined substation search zone (Zone 3) includes the parts of Sectors 1 and 5, south of the A47 and south of the existing overhead line.

20. A search area for underground cables has also been delineated (the western end of Zone 4) which is required to connect the substation located within Zone 3 to the existing Necton 400kV National Grid substation.

2.1.5 Extension to the Existing Necton 400kV National Grid Extension

21. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a decision has been made by the VWPL to include the required extension works to the existing Necton 400kV National Grid substation within the EIA and DCO application for Norfolk Vanguard. The aim of this approach is to enable a more transparent impact assessment and allow the development of more effective mitigation.

22. Appropriate search zones for the extension works have been developed in consultation with National Grid, including:

- Zone 1 - Land adjacent to the existing substation which could accommodate extension to the existing busbars (see Section 2.2.1.5).
- Zone 2 - Land where overhead line realignment works maybe required adjacent to the existing National Grid substation (see Section 2.2.1.5).

23. VWPL will work closely with National Grid to ensure the design of the extension works is appropriate.

2.1.6 Norfolk Boreas

24. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a grid connection agreement has been granted by National Grid for Norfolk Boreas at the existing Necton 400kV National Grid substation. Therefore the Norfolk Vanguard EIA will include the option for Norfolk Boreas cable ducts to be installed at the same time as Norfolk Vanguard.

2.2 Indicative Worst Case Scenarios

25. The following sections set out the indicative worst case scenarios for ground conditions and contamination. The PEIR/ES will provide a detailed Project Description describing the final Rochdale envelope for the Norfolk Vanguard DCO application. Each chapter of the PEIR/ES will define the worst case scenario arising from the construction, operation and decommissioning phases of the Norfolk Vanguard project for the relevant receptors and impacts. Additionally, each chapter will consider separately the anticipated cumulative impacts of Norfolk Vanguard with other relevant projects which could have a cumulative impact on the receptors under consideration.

2.2.1 Infrastructure Parameters

26. Two electrical solutions are being considered for Norfolk Vanguard, a High Voltage Alternating Current (HVAC) and a High Voltage Direct Current (HVDC) scheme. The decision as to which option will be used for the project will be agreed post consent and will depend on availability, technical considerations and cost. Both electrical solutions will have implications on the required onshore infrastructure. Typically the HVAC scenario involves a greater area of land take and additional infrastructure, and as such the HVAC scenario is assumed as the worst case in the remainder of this section. Where the worst case assumes the HVDC scenario, this is stated in the text.

27. The following key onshore project parameters are considered:

- Landfall (Horizontal Directional Drilling (HDD) and associated compounds);

- Cable relay station if required (HVAC only) within the cable relay station search zones;
- Cable corridor (with associated construction compounds and mobilisation areas);
- Onshore substation (within the substation search zone); and
- Extension to the existing Necton 400kV National Grid Substation, including overhead line modification.

28. There is an option for the cable ducts for Norfolk Boreas, (the sister project to Norfolk Vanguard) to be constructed and installed simultaneously with Norfolk Vanguard within a single cable corridor (see parameters in Section 2.2.1.3). Therefore this scenario will be considered within the Norfolk Vanguard EIA as associated development as part of the DCO application. There is also the scenario that the ducts for Norfolk Boreas cannot be installed at the same time as Norfolk Vanguard and therefore this scenario will be considered within the Cumulative Impact Assessment (CIA), together with the parameters of Norfolk Vanguard (as listed in the bullet points above).

29. All other components of Norfolk Boreas will be considered as part of the Norfolk Vanguard CIA.

2.2.1.1 Landfall

30. There are three potential landfall locations for Norfolk Vanguard:

- Bacton Green;
- Walcott Gap; and
- Happisburgh South.

31. Initial survey and data collection for the EIA will enable the selection of the landfall location for Norfolk Vanguard. Therefore the approach to baseline characterisation will initially consider all options and will then be refined once a final landfall location is selected. The PEIR and ES will present a single landfall option.

32. The Norfolk Vanguard offshore cables will be jointed to the onshore cables on the landward side of the landfall site. Cable ducts would be installed at the landfall so that the ends of the offshore cables can be pulled through to this joint location. These will be installed using Horizontal Directional Drilling (HDD) which is a trenchless installation technique. The HDD will exit at one of two locations:

- On the beach, above the level of mean low water spring (classified as “short HDD”).
- At an offshore location, away from the beach (up to 1000m in drill length) (classified as “long HDD”).

33. Key parameters:

- A total of 6 ducts for the HVAC option or 2 ducts for the HVDC option would be required at the landfall for Norfolk Vanguard. Therefore the HVAC option represents the worst case scenario for ground conditions and contamination.
- Temporary footprint of works will be up to 3000m^2, of which up to 900m^2 (6 transition pits, based on the HVAC option) will involve excavation for Norfolk Vanguard.

34. If Norfolk Boreas cable ducts are installed concurrently with the Norfolk Vanguard ducts, the Norfolk Boreas ducts will be installed up to the joint pits on the landward site of the landfall works. No landfall works (e.g. transition pits, HDD works) will be undertaken for Norfolk Boreas and therefore the landfall works for Norfolk Boreas do not form part of the Norfolk Vanguard DCO and will be considered in the CIA (see Section 2.2.5).

2.2.1.2 Cable Relay Station

35. A cable relay station is required for an HVAC electrical solution only and would not be included in a HVDC connection solution. Therefore the HVAC option is the worst case scenario for this element of the onshore infrastructure.

36. The cable relay station accommodates the reactive compensation equipment required to compensate the capacitive losses generated by long HVAC power cables, and will be located near to the landfall.

37. There are currently seven cable relay station search zones being considered and a final location will be defined following landfall site selection for the EIA and DCO application. The PEIR and ES will present a single cable relay station location.

38. Key parameters:

- There will be a maximum temporary footprint of 15000m^2 during construction of the cable relay station.
- The operational area of the cable relay station will be approximately 10,500m^2.

2.2.1.3 Cable Route

39. There are several potential scenarios for the cable easement:

- Norfolk Vanguard HVDC: This would require a 35m temporary strip during construction, and a 13m permanent strip (including 8m access) during operation.
- Norfolk Vanguard HVAC: This would require a 50m temporary strip during construction, and a 25m permanent strip (including 8m access) during operation.

- Norfolk Vanguard and Norfolk Boreas HVDC: This would require a 45m temporary strip during construction, and a 20m permanent strip with (including 8m access) during operation.
- Norfolk Vanguard and Norfolk Boreas HVAC: This would require a 100m temporary strip during construction, and a 54m permanent strip (including two separate 8m access tracks and 6m separation between circuits) during operation. This will be the worst case scenario for ground conditions and contamination.

40. Key parameters:

- The length of the onshore cable route will be approximately 60km.
- The main cable installation method will be through the use of open cut trenching with High Density Polyethylene (HDPE) ducts installed, backfilled and cables pulled though the pre-laid ducts.
- Under the worst case scenario cable easement described above, an onshore temporary easement of 100m width corridor will be required. This will result in a temporary loss of a 100m area strip along the full length of the onshore cable corridor during the installation of the cable ducts. This will include a 38m wide strip for cable excavation (up to 12 cable trenches), two 6m wide access tracks either side of the 38m strip, and two 9m and two 13m strips for excavated material storage and topsoil storage respectively.
- The access tracks will be formed of protective matting, temporary metal road or permeable gravel aggregate dependant on the ground conditions.
- Joint pits with a footprint of $90m^2$ will be required every 800m along the cable route (i.e. approximately 75 in total) for installation of cables in the pre-installed cable ducts.
- Where trenchless techniques (i.e. HDD) are required (e.g. at water crossings), there will a temporary footprint of approximately $2500m^2$ and $5000m^2$ to support the HDD launch and receptor sites.
- Mobilisation areas will also be required for servicing the cable installation. These will be required to store equipment and provide welfare facilities. These will involve a temporary footprint of $10000m^2$. Hardstanding will be laid for the duration of construction.

2.2.1.4 Onshore Substation

41. A single onshore substation will be required regardless of whether HVAC or HVDC options are selected and the two options will have similar land take requirements:

- HVAC:
    - Construction area approximately 400m x 400m

    - Substation footprint (within construction area) approximately 250m x 300m

- HVDC:
    - Construction area approximately 400m x 400m
    - Substation footprint (within construction area) approximately 250m x 300m

42. A substation search zone (which has been refined from the substation search area shown in the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016)) is located to the south and east of the existing Necton 400kV National Grid substation. Initial survey and data collection for the EIA will enable the selection of the substation location for Norfolk Vanguard. Therefore the approach to baseline characterisation will initially consider the search zone and will then be refined once a final substation location is selected. The PEIR and ES will present a single substation location.

2.2.1.5 National Grid substation extension

43. An extension to the existing Necton 400kV National Grid substation will be required regardless of whether the HVAC or HVDC electrical solution is selected.

44. The busbar would be extended in an east west direction with seven additional Air Insulation Switchgear (AIS) bays for Norfolk Vanguard.

45. The extension to the existing Necton 400kV National Grid substation for Norfolk Vanguard and Norfolk Boreas combined require a further the busbar extension and five further AIS bays added for Norfolk Boreas. This extension to the Necton 400kV National Grid substation will be included in the Norfolk Vanguard DCO and EIA.

46. Re-configuration of overhead lines to change the arrangements of the 400kV circuits in close proximity to the substation, would also be required.

47. The National Grid substation extension will be included within the EIA for the Norfolk Vanguard DCO application.

2.2.1.6 Worst case scenario summary

48. For ground conditions receptors, the worst case scenario is related to the maximum area of ground to be disturbed. This means that the worst case scenario can be defined as follows:

- Landfall: Short HDD.
- Cable route: Norfolk Vanguard and Norfolk Boreas HVAC.
- Cable relay station: HVAC cable relay station required.
- Onshore substation:

   - Construction area approximately 400m x 400m
   - Substation footprint (within construction area) approximately 250m x 300m
- National Grid substation extension: Norfolk Vanguard and Norfolk Boreas.

2.2.2 Construction Programme

49. The HVAC option is based on a three phase development programme which would take a total of seven years (2020-2026), while the HVDC option is based on a two phase development programme which would take a total of six years (2020-2025). Both programmes include two years of enabling works during 2020 and 2021, consisting of road modifications, hedge and tree removal, preconstruction drainage, mobilisation area establishment and major crossing construction.

50. Duct installation for the landfall and onshore cable and primary works for the substation and cable relay station would take place during 2022 and 2023. The installation of the onshore cables would occur in phases in parallel with the commissioning of the phases of the offshore wind farm. In the HVAC programme, the cable and electrical plant installation and commissioning will take place over three years from 2024 to 2026. In the HVDC programme, installation and commissioning will take place over 2 years, from 2024 to 2025.

51. Construction works will not take place continuously in all locations during the proposed construction time. Construction activity along the onshore cable route will move along the route, between different sections and activity will be phased, with the trenching and laying of ducts taking place first, followed by the cable installation.

52. The construction period for the cable relay station and substation is expected to be approximately 18 months.

53. The construction programme within each phase of work is unlikely to have a significant impact on ground conditions, provided that measures are in place to control runoff from construction during wetter periods.

2.2.3 Operation and Maintenance (O&M) Strategy

54. The operations and maintenance strategies for each aspect of the development are unlikely to have a significant impact on ground conditions. In accordance with the Norfolk Vanguard EIA scoping report (Royal HaskoningDHV, 2016), impacts during O&M are scoped out of the EIA.

2.2.4 Decommissioning

55. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice,

rules and legislation change over time. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected that the onshore cables will be removed from ducts and recycled, with the joint pits and ducts left in situ. 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 plan will be provided.

2.2.5 Cumulative Impact Scenarios

2.2.5.1 Norfolk Boreas

56. If Norfolk Boreas uses the same landfall as Norfolk Vanguard, a total of 12 ducts would be required at the landfall (under the worst case HVAC electrical solution). The Happisburgh South landfall site is the only landfall option which can accommodate 12 ducts.

57. The following landfall scenarios for Norfolk Vanguard and Norfolk Boreas are currently being considered:

- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Bacton Green (4 ducts in total)
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Walcott Gap (4 ducts in total)
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (4 ducts in total)
- HVAC North - Landfall for Norfolk Vanguard at Bacton Green (6 ducts) with Norfolk Boreas at Walcott Gap (additional 6 ducts); or
- HVAC South - Landfall for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (12 ducts)

58. As discussed in Section 2.2.1, initial data collection for the Norfolk Vanguard EIA will enable selection of the landfall location for Norfolk Vanguard which will also inform the site selection for Norfolk Boreas. Final landfall locations for Norfolk Vanguard and Norfolk Boreas will be confirmed in the Norfolk Vanguard CIA. The options of HVAC and HVDC will be retained in the Norfolk Vanguard DCO application. Due to the greater number of ducts, an HVAC option will represent the worst case scenario.

59. The Norfolk Boreas cable relay station (only required under the HVAC scenario) will be located within one of the cable relay station search zones shown for Norfolk Vanguard. The Norfolk Vanguard and Norfolk Boreas cable relay stations may be co-located or at separate locations, subject to the landfall site selection. Final cable relay station site locations will be known for the Norfolk Vanguard CIA. The cable

relay stations for Norfolk Vanguard and Norfolk Boreas will be constructed separately, although construction periods could overlap. The footprint of the Norfolk Boreas cable relay station will be the same as described for Norfolk Vanguard in Section 2.2.1.

60. The CIA for Norfolk Boreas cable installation includes the following scenarios:

- Ducts for Norfolk Boreas are pre-installed during Norfolk Vanguard construction with cable pull through required during Norfolk Boreas construction;
  - Norfolk Boreas duct installation will be assessed in the project impact assessments for Norfolk Vanguard;
  - The cable pull through for Norfolk Boreas will be considered as part of the Norfolk Vanguard CIA); or
- Norfolk Boreas ducts and cables are installed at a separate time to Norfolk Vanguard.
  - This scenario will also be considered in the CIA, together with the parameters of Norfolk Vanguard alone.

61. The Norfolk Boreas substation will be located in the substation search zone shown for Norfolk Vanguard but will be constructed separately, although Norfolk Vanguard and Norfolk Boreas construction periods could overlap. The footprint of the Norfolk Boreas substation will be the same as those described for Norfolk Vanguard (Section 2.2.1).

62. As discussed in Section 2.2.1, the extension to the existing Necton 400kV National Grid substation for Norfolk Boreas would be done concurrently with Norfolk Vanguard construction under the Norfolk Vanguard DCO and therefore this is considered as part of the Norfolk Vanguard EIA.

2.2.5.2 Other Projects

63. Construction and commissioning of the substation for the Dudgeon Offshore Wind Farm is complete and operation is due to commence in 2017. Therefore cumulative impacts on ground conditions and contamination are unlikely and it is proposed to screen this out of the CIA.

64. The cable corridor for the Hornsea Project 3 Offshore Wind Farm makes landfall at Weybourne with grid connection at Norwich Main. Where the Hornsea Project 3 cable corridor crosses the Norfolk Vanguard cable corridor, there will be potential cumulative impacts on ground conditions and contamination and this will be assessed in the CIA.

65. Other developments (such as housing and roads) will be considered in the CIA. CIA screening will be undertaken in consultation with stakeholders.

3 BASELINE ENVIRONMENT

3.1 Desk Based Review

66. A desk based review of onshore water resources and flood risk receptors was undertaken as part of the scoping report (Royal HaskoningDHV, 2016). The Environmental Statement will build upon this information to thoroughly characterise the baseline environment and identify the receptors that could potentially be impacted by the proposed development.

67. An initial update to the desk based review presented in the scoping report (Royal HaskoningDHV, 2016) is provided in the subsequent sections. This takes into account the revised cable corridor.

3.1.1 Available Data

68. The information used to inform the ground conditions and contamination baseline shall be:

- Solid and Superficial Geology: British Geological Survey (BGS) online viewer: www.mapapps.bgs.ac.uk
- Hydrogeology: groundwater vulnerability, groundwater source protection zones and abstraction: Environment Agency "What's in your back yard" website: www.environment-agency.gov.uk
- Landfills and Mining: Environment Agency "What's in your back yard" website: www.environment-agency.gov.uk
- Water Framework Directive classification data: Environment Agency (2016) Catchment Data Explorer: www.environment.data.gov.uk /catchment-planning/
- Coastal Processes: Kelling to Lowestoft Ness Shoreline Management Plan

3.1.2 Solid and Superficial Geology

69. The solid geology beneath the proposed onshore works area compromises White Chalk and Crag Group deposits which dip gently to the south east. The Chalk contains numerous flint nodules (**Figure 1**). Eastwards, the Neogene and Quaternary marine sands and gravels (Crag) overlie the Chalk.

70. The solid deposits are predominantly overlain by glacial till dating from the Anglian glaciation, interspersed with sheets of glacial sands and gravels (**Figure 2**).

3.1.3 Mineral Safeguarding Areas

71. A Mineral Safeguarding Area is an area designated by a Minerals Planning Authority which covers known deposits of minerals which should be kept safeguarded from unnecessary sterilisation by non-mineral development.

72. There are several Mineral Safeguarding Areas within the proposed onshore works area. These are mostly sands and gravels associated with river valleys.

3.1.4 Hydrogeology

73. Regionally, the principal groundwater body covering the majority of the area of the proposed onshore works area is the Broadland Rivers Chalk & Crag. The Crag and the Chalk aquifers are classified as a Principal Aquifers and a number of groundwater Source Protection Zones (SPZs) are identified within the area. The Norfolk Vanguard Onshore works will cross several SPZs (**Figure 3**). The proposed onshore works will cross two inner (Zone 1) SPZs. These are in vicinity of North Walsham and Hoe.

74. The proposed onshore works area is underlain by four groundwater bodies, as defined under the Water Framework Directive:

- Broadland Rivers Chalk and Crag (GB40501G400300).
- Cam and Ely Ouse Chalk (GB40501G400500).
- North Norfolk Chalk (GB40501G400100).
- North West Norfolk Chalk (GB40501G400200).

75. The status of these water bodies is discussed in more detail in the separate Onshore Water Resources and Flood Risk method statement.

3.1.5 Land quality

76. The majority of the proposed onshore works area is largely agricultural in land use. There is therefore some potential for both diffuse and point sources of pollution from current agricultural activities to affect soil and groundwater.

77. Settlements within the onshore scoping area include the towns of North Walsham, Aylsham, Dereham and Reepham and both roads and railway lines cross though this area. There is potential for historical contamination to be present in the developed areas, including the Bacton Gas Terminal, historic and active landfill sites, railways and highways (**Figure 4**).

3.1.6 Designated sites

78. Happisburgh Cliffs Site of Special Scientific Interest (SSSI) is designated specifically for its geological interest (**Figure 4**). The cliffs are an important site for dating the Pleistocene succession in East Anglia, and display a range of marine, freshwater and glacial sediments which span five stages from the pre-Pastonian to the Anglian (Natural England, 1985). The SSSI is particularly important for several main features:

- Cliff exposures which uniquely show three glacial deposits.
- The Anglian-aged Cromer Tills, with intercalated water-deposited sediments.

- The underlying Cromer Forest-bed Formation, which is exposed at the foreshore and supports excellent development of pre-Pastonian and Pastonian deposits.

3.2 Planned Data Collection

3.2.1 Desk Based Data Collection

79. The results of the initial desk based review presented above will be used as a basis for a more detailed desk based assessment to characterise the baseline for ground conditions and contamination.

80. An Envirocheck Report (produced by Landmark Information Group) will be required to inform the EIA chapters focusing on the Ground Conditions and Contamination. This will include:

- Solid and superficial geology.
- Historical maps.
- Source Protection Zones and Groundwater Vulnerability.
- Site Sensitivity Map (including data from the Contaminated Land Register, discharge consents, abstractions, pollution incidents, BGS mineral sites, BGS recorded landfill sites, historical landfill sites)

81. The results presented in the Envirocheck report will be the primary information source used to inform the baseline characterisation and subsequent assessment of potential impacts on Ground Conditions and Contamination.

3.2.2 Field Data Collection

82. A site walkover survey will be undertaken in order to provide additional, up-to-date visual information on land use and land quality. The walkover will be undertaken along the cable route, concurrently with the Phase 1 Habitat Survey.

83. Given the predominantly rural land use in the Onshore Works area, it is assumed that that the regulators will not require pre-consent intrusive ground investigation.

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Defining Impact Significance

4.1.1 Sensitivity

84. The sensitivity of receptors is assessed according to the criteria set out in **Table 4-3** below and is based on the capacity of receptors to tolerate change and, whether or not increased risks would be acceptable, within the scope of the prevailing legislation and guidelines. The degree of change that is considered to be acceptable is therefore dependent on the value of a receptor, which is discussed in **Section 4.1.2**.

Table 4-1 Sensitivity criteria for ground conditions receptors

Sensitivity	Definition
High	Has very limited or no capacity to accommodate physical or chemical changes Increased risk of exposure / pollution would be unacceptable
Medium	Has limited capacity to accommodate physical or chemical changes or influences. Increased risk of exposure/ pollution may be acceptable
Low	Has moderate capacity to accommodate physical or chemical changes. Increased risk of exposure / pollution likely to be acceptable
Negligible	Is generally tolerant of physical or chemical changes Insensitive to increased risk of exposure / pollution

4.1.2 Value

85. The sensitivity assessment for water and mineral resources takes into account how ‘acceptable’ changes to the availability or quality of a particular resource would be. This is dependent on the value of that resource, which is assessed based on its strategic or geographic importance (**Table 4-1**).

Table 4-2 Value criteria for ground conditions receptors

Value	Definition
High	Is an international or nationally important resource.
Medium	Is a regionally important resource.
Low	Is a locally important resource.
Negligible	Is of no significant resource value

4.1.3 Overall Sensitivity

86. Generic receptor sensitivity examples based on the above criteria are given in **Table 4-3**. It should be noted that receptors may be assessed differently in the EIA due to site-specific considerations.

87. The sensitivity criteria and examples for controlled waters receptors are aligned with those used in the assessment of Water Resources impacts (see separate method statement).

Table 4-3 Generic receptor sensitivity assessment examples

Sensitivity / Value	Examples
High	**Human Heath** • Construction Workers • Site Operatives • General Public (Off-site)
	Controlled Waters • Groundwater SPZ 1 / 2 (inc. unpublished) • Surface Waters with WFD 'High' status objective • Surface water or groundwater supporting internationally designated or nationally important conservation site (eg. SAC, SPA, Ramsar site / SSSI) or fishery.
Medium	**Controlled Waters** • Principal Aquifer (resource potential) • Groundwater SPZ Total Catchment • Licenced groundwater / surface water abstractions • Surface waters with WFD Status / Potential objective 'Good' • Surface water or groundwater supporting regionally important wildlife sites (LNR, SNCI) or commercial aquaculture.
	Mineral Resources • Mineral Safeguard Area (regionally important resource)
Low	**Controlled Waters** • Secondary A / Undifferentiated Aquifer (resource potential) • Unlicenced water supplies • Surface waters with WFD Status / Potential objective 'Moderate' / 'Poor' • Surface water or groundwater supporting locally important wildlife or amenity site.
Very Low	**Controlled Waters** • Secondary B Aquifer / water-bearing Unproductive Strata (resource potential) • Surface waters with WFD Status / Potential objective 'Bad'

4.1.4 Magnitude

88. Potential effects may be adverse, beneficial or neutral. The magnitude of an effect is assessed qualitatively, according to the criteria set out in **Table 4-4**. The following definitions apply to time periods used in the magnitude assessment:

- Long-term: >5 years
- Medium-term: 1 to 5 years
- Short-term: <1 year

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

Table 4-4 Effect magnitude definitions and examples

Magnitude Definition	Examples
High Permanent or large scale change affecting usability, risk, value over a wide area, or certain to affect regulatory compliance	**Human Health Risk** • Permanent or major change to existing risk of exposure (Adverse / Beneficial). • Unacceptable risks to one or more receptors over the long-term or permanently (Adverse) • Prosecution under health and safety legislation (Adverse) • Remediation and complete source removal (Beneficial) • Construction workers at risk due to lack of appropriate personal protective equipment (Adverse)
	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 of a water supply source resulting in prosecution (Adverse) • Change in WFD water body status / potential or its ability to achieve WFD status objectives in the future (Adverse / Beneficial) • Permanent habitat creation or complete loss (Adverse / Beneficial) • Measureable habitat change that is sustainable / recoverable over the long-term (Adverse / Beneficial).
Medium Moderate permanent or long-term reversible	**Human Health Risk** • Medium-term or moderate change to existing risk of exposure (Adverse / Beneficial). • Unacceptable risks to one or more receptors over the medium-term (Adverse) • Serious concerns or opposition from statutory consultees (Adverse)

Magnitude Definition	Examples
	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). • Temporary change in status / potential of a WFD waterbody or its ability to meet objectives (Adverse / Beneficial).
Low Temporary change affecting usability, risk or value over the short-term or within the site boundary; measureable permanent change with minimal effect usability, risk or value; no effect on regulatory compliance	**Human Health Risk** • Short-term temporary or minor change to existing risk of exposure (Adverse / Beneficial). • Unacceptable risks to one or more receptors over the short-term (Adverse)
	Controlled Waters • Short-term or very localised effects on water quality or availability. (Adverse / Beneficial). • Short-term derogation of a water supply source (Adverse). • Measureable permanent effects on a water supply source that do not impact on its operation (Adverse). • Observable habitat change that is sustainable / recoverable over the short-term (Adverse / Beneficial). • No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).
Very Low Minor permanent or temporary change, undiscernible over the medium- to long-term short-term, with no effect on usability, risk or value	**Human Health Risk** • Negligible change to existing risk of exposure • Activity is unlikely to result in unacceptable risks to receptors (Neutral)
	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) • No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).

4.1.5 Significance

90. The impact significance assessment combines receptor sensitivity with effect magnitude, as shown in **Table 4-5**. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a

judgement has been reached, rather than as a prescriptive, formulaic tool. A description of each level of significance is provided in **Table 4-6**.

Table 4-5 Impact Significance Matrix

		Magnitude			
		High	Medium	Low	Very Low
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Very Low	*Minor*	*Negligible*	*Negligible*	*Negligible*

Table 4-6 Impact Significance Definitions

Impact 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 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.

91. Effects that result in Major or Moderate impacts are considered to be 'significant' in EIA terms. Significant impacts are those which are likely to influence the outcome of the planning application. Adverse significant impacts may require mitigation that is difficult or expensive to achieve whereas, beneficial significant impacts contribute to the case in favour of the Proposed Development.

92. Embedded mitigation will be referred to and included in the initial assessment of impact. If the impact does not require mitigation (or none is possible) the residual impact will remain the same. If however, mitigation is required there should be an assessment of the post-mitigation residual impact.

4.2 Assessment Methodology

4.2.1 Ground Contamination

93. The assessment of ground contamination impacts will consider human health and controlled waters (surface water and groundwater resources). The assessment will follow the Source-Pathway-Receptor approach, which identifies potential pollutant linkages that may result in unacceptable risks to receptors from ground contamination. For a risk to exist, all three elements (defined below) must be present.

- Source: A potentially polluting activity or existing ground contamination.
- Pathway: A route or means by which a receptor could be exposed to or affected by contamination.
- Receptor: Something that could be adversely affected by contamination.

94. The EIA baseline comprises a description of the current ground conditions and potential receptors. The impact assessment compares the baseline to a conceptual site model (CSM) describing feasible pollutant linkages associated with the construction phase of the proposed development (in accordance with the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) O&M phase impacts have been scoped out).

95. The impact assessment will be based on the findings of a land quality risk assessment, undertaken in general accordance with current UK guidance (and associated documents):

- Environment Agency Groundwater Protection: Principles and Practice, Version 1.1 (Environment Agency, 2013); and
- Environment Agency Model Procedures for the Management of Land Contamination (Contaminated Land Report (CLR) 11) (DFRA and Environment Agency, 2004).

96. The initial step will be to undertake a Preliminary Risk Assessment (PRA) to determine whether or not the onshore works pose potentially unacceptable risks to human health or the environment. The PRA is a desk-based study that proceeds, if required, to intrusive investigation, further risk assessment, options appraisal, remedial design, implementation planning and completion reporting.

97. The PRA will identify potential risks along the cable route. Should potentially unacceptable risks be identified, that cannot be mitigated through the use of appropriate personal protective equipment and adherence to a Construction Code of Practice, targeted soil or groundwater sampling may be undertaken prior to construction works commencing. The ground investigation data would inform a

generic quantitative risk assessment (GQRA) that would either confirm that risks to human health and controlled waters are low; or, inform the design of risk mitigation measures. These could include: further ground investigation to refine the risk assessment; remediation of contaminated ground; or, changes to the proposed construction methodology or scheme design.

4.2.2 Mineral Resources

98. The approach for assessing impact on mineral resources will be generally in accordance with mineral planning authority (MPA) guidance[1] for assessing the impacts of non-mineral development, and will be agreed in advance with Norfolk County Council.

99. The assessment will identify existing and proposed mineral and waste sites, and safeguard areas, from the published Minerals and Waste Development Plan Documents. The total safeguarded area affected by the proposed onshore cable route will be calculated using GIS, based on the worst-case scenario for the permanent cable easement. The depth of available resource will then be estimated based on available ground investigation data, to enable calculation of the total potential volume of sterilised resource.

100. This worst case estimate will be discussed with the MPA in the context of aggregate resources available in the local area and the cost effectiveness of pre-excavating and using the material for construction purposes within the project and reinstating the cable trench with imported backfill. Dependent on the outcome of consultation, further quantification of resource quality and value may be undertaken. The agreed construction approach will be set out in a materials management plan (MMP) to be followed during construction, which would also deal with excavated waste management.

4.3 Potential Impacts

4.3.1 Potential Impacts during Construction

4.3.1.1 Impact: Contaminant mobilisation from earthworks during construction

101. The excavation of the cable trench, earthworks for substation construction and the excavation and stockpiling of soils has the potential to mobilise existing ground contamination (if present), which could result in unacceptable human health risks to construction workers and pollution risks to controlled waters (surface water and groundwater).

[1] Guidance Note on the Mineral Safeguarding Process for aggregates – Sand & Gravel and Carstone. Norfolk County Council, November 2014.

Physical impacts on groundwater resources (i.e. on groundwater level will be discussed in the in the Water Resources chapter and cross referenced to this chapter as appropriate.

4.3.1.1.1 Approach to assessment

102. The potential impacts of the excavation of the cable trench and other earthworks will be assessed using expert judgement. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1** and field survey described in **Section 3.2.2**.

103. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place. For example, a Code of Construction Practice (CoCP) will be employed during site works to ensure that all appropriate Pollution Prevention Guidelines (PPG 17) and good practice guidelines are followed. Furthermore, sensitive locations identified along the route will be avoided by the use of HDD techniques where appropriate and practicable.

104. The potential for impacts on controlled waters will be considered in detail in the Onshore Water Resources and Flood Risk chapter of the Environmental Statement, and impacts on WFD water bodies (including groundwater) will be considered in the WFD Compliance Assessment. Any linkages to Ground Conditions and Contamination will be cross referenced to this chapter.

4.3.1.2 Impact: Alteration to coast line, including coastal geological designated sites

105. The proposed landfall works have the potential to impact upon coastal processes, and could therefore affect rates of erosion in a dynamic coastal area. These activities therefore have the potential to affect geological designated sites.

4.3.1.2.1 Approach to assessment

106. The potential impacts of increased surface water runoff will be assessed using expert judgement. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1**and field survey described in **Section 3.2.2**.

107. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

108. The potential for impacts on coastal processes will also be considered in the Offshore Marine Geology, Oceanography and Physical Processes and Onshore Water Resources and Flood Risk chapters. Impacts on WFD water bodies (including the hydromorphology of the coastal water body) will be considered in the WFD

Compliance Assessment. Any linkages to Ground Conditions and Contamination will be cross referenced to this chapter.

4.3.1.3 Impact: Sterilisation of mineral resources and waste generation

109. The proposed landfall works cross numerous mineral safeguard areas and would prevent future extraction of sand and gravel resources within the cable easement and the duct excavations would generate a significant volume of surplus waste material, not required for backfill. There is potential to reduce resource sterilisation by extracting sand and gravel resources prior to construction and, to reduce waste by re-using suitable material as aggregate during the construction phase.

4.3.1.3.1 Approach to assessment

110. A preliminary assessment of this impact will be undertaken in accordance with the method presented in Section 4.2.2. The findings will be discussed with the MPA prior to submission of the EIA to determine their significance and inform the development of mitigation measures, should these be required.

4.3.2 Potential Impacts during O&M

111. There are unlikely to be any significant impacts from the operation of the proposed project. O&M activities will follow standard procedures therefore minimising any potential impacts. Non-routine maintenance will be subject to robust and effective planning and risk assessment procedures. As discussed previously, impacts during O&M are scoped out of the EIA in accordance with the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016).

4.3.3 Potential Impacts during Decommissioning

112. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left in situ.

113. 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 plan would be provided.

114. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

4.3.4 Potential Cumulative Impacts

115. Any other project with the potential to result in impacts that may act cumulatively with Norfolk Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

116. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

117. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

5 REFERENCES

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Norfolk Vanguard Offshore Wind Farm

Environmental Impact Assessment

Onshore Water Resources and Flood Risk Method Statement

Document Reference: PB4476-003-032

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23/12/16	00	First draft for internal review	Natalie James	Ian Dennis/ GK	AD
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This method statement has been prepared by Royal HaskoningDHV on behalf of Vattenfall Wind Power Limited (VWPL) in order to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report. It has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate. All content and material within this document is draft for stakeholder consultation purposes, within the Evidence Plan Process.

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1 INTRODUCTION

1. The purpose of this method statement is to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report, in outlining the proposed approach to be taken and consideration to be made in the Onshore Water Resources and Flood Risk Assessment.

2. This Onshore Water Resources and Flood Risk method statement has been informed by the views expressed in the Scoping Opinion provided by the Planning Inspectorate.

1.1 Background

3. A Scoping Report (Royal HaskoningDHV, 2016) for the Norfolk Vanguard Environmental Impact Assessment (EIA) was submitted to the Planning Inspectorate on the 3rd October 2016. Further background information on the project can be found in the Scoping Report which is available at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000022-Scoping%20Report.pdf

4. The Scoping Opinion was received on the 11th November 2016 and can be found at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000018-Scoping%20Opinion.pdf.

1.2 Norfolk Vanguard Programme

5. This section provides an overview of key milestone dates for Norfolk Vanguard.

1.2.1 DCO Programme

- Scoping Request submission - 03/10/16 (complete)
- Preliminary Environmental Information submission - Q4 2017
- Environmental Statement and DCO submission - Q2 2018

1.2.2 Evidence Plan Process Programme

6. The Evidence Plan Terms of Reference (Royal HaskoningDHV, 2017) provides an overview of the Evidence Plan Process and expected logistics, below is a summary of anticipated meetings:

- Steering Group meeting -21/03/16 (complete)
- Steering Group meeting - 20/09/16

	(complete)
• Post-scoping Expert Topic Group meetings ○ Discuss method statements and Project Design Statement	- Q1 2017
• Expert Topic Group and Steering Group meetings as required ○ To be determined by the relevant groups based on issues raised	- 2017
• PEIR Expert Topic Group and Steering Group meetings ○ To discuss the findings of the PEI (before or after submission)	- Q4 2017/ - Q1 2018
• Pre-submission Expert Topic Group and Steering Group meetings ○ To discuss updates to the ES following PEI consultation	- Q1/Q2 2018

1.2.3 Survey Programme

7. As discussed in **Section 3.2**, a walkover survey is proposed to characterise the hydrological and geomorphological characteristics of the main surface watercourses that are crossed or connected to the proposed cable route and onshore grid connection.

8. These surveys will need to be undertaken during Q1 or Q2 2017 to provide sufficient time to inform the preparation of the PEIR.

2 PROJECT DESCRIPTION

2.1 Site Selection Update

9. Further to the site selection information provided within the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016), additional site selection work has been undertaken to refine the locations of the onshore infrastructure. The Norfolk Vanguard EIA Scoping Report identified search areas for the onshore infrastructure which were identified following constraints mapping to avoid or minimise potential impacts (e.g. noise, visual, landscape, traffic, human health and socio-economic impacts). Further data review has been undertaken to understand the engineering and environmental constraints within the search areas identified. The public drop-in-exhibitions in October 2016 and Scoping Opinion have also contributed to our broader understanding of local constraints and opportunities, feeding into the ongoing site selection and development of the EIA strategy. The project areas shown in Figure 3.1 are a draft for stakeholder consultation only and are provided in confidence. Equivalent information will be presented during open drop-in-exhibitions in March 2017, providing an opportunity for local people and the wider public to understand the way in which their feedback, as well as the Scoping Opinion and has influenced our design. Given the broad range and complexity of the factors influencing site selection and the scale of the area under discussion, it is our intention that local people and interested parties view the map for the first time, with Vattenfall and suitably qualified experts on hand. This enables a meaningful discussion of the proposed options and enables participants to refer directly to points of reference they may wish to discuss. During the March drop-in exhibitions, participants will also be invited to provide feedback on the latest design.

10. There are currently three landfall options with associated cable relay station search zones as well as an onshore substation search zone in proximity to the existing Necton 400kV National Grid substation (the grid connection point). A 200m wide cable corridor has been identified, within which the cable route will be located (see cable route parameters in Section 2.2.1). Ongoing public and stakeholder consultation as well as initial EIA data collection will be used to inform selection of final locations for the EIA and DCO application, with the aim to further avoid sensitive areas. Impacts that cannot be avoided through site selection will aim to be reduced through sensitive siting, alternative engineering solutions (mitigation by design) and additional mitigation measures where possible. Mitigation options will be developed in consultation with stakeholders.

2.1.1 Landfall Zones

11. The landfall search area was presented in the Scoping Report as Figure 1.3. This has been refined to three landfalls options (Zone 8), Bacton Green, Walcott Gap and Happisburgh South, following studies on the engineering feasibility of horizontal directional drilling (HDD). The two northern landfalls have the advantage that related onshore infrastructure (the cable relay station) could be placed close to the existing Bacton gas terminal in what is already an industrialised area thereby reducing landscape impacts, a preference stated by many at the public drop-in exhibitions. Discussions with the owners and operators of the gas terminal will inform the final landfall location.

12. Both northern options would require offshore cabling through the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) and concerns have been expressed by members of the public and a number of statutory authorities about impacts on the MCZ. Information from the offshore cable corridor geophysical and benthic survey from within the Cromer Shoal Chalk Beds MCZ will be reviewed to understand the extent of designated features and therefore the feasibility of installing offshore cables. Data on coastal erosion, including estimates of coastline movement over the life time of the wind farm, and the likelihood of archaeological finds, will be reviewed to understand the feasibility of a landfall south of Happisburgh. This site is outside the MCZ but siting the required onshore infrastructure within a rural location would require careful consideration.

2.1.2 Cable Relay Station Options

13. The cable relay station search area was presented in the Scoping Report as Figure 1.6. Refined search zones (Zone 7) have been defined based on the initial constraints mapping work, the updated landfall site selection and initial consultation. A number of receptors and impacts have been considered during the selection of the scoping search area and the refined search zones, particularly noise and visual impacts, ecology traffic, human health and socio-economic impacts. As with the landfall location, discussions with the owners of the gas terminal will inform the final landfall location.

2.1.3 Onshore Cable Route

14. The onshore cable corridor search area was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.5. The route shown on Figure 3.1 (Zone 4) is considered to be the shortest possible route (thereby minimising disturbance impacts) whilst also aiming to avoiding main residential areas and impacts to landscape and nature conservation designations where possible.

15. Routes in the north of the scoping search area were discounted owing to the presence of existing gas pipelines and the cables from the Dudgeon Offshore Wind Farm which significantly affected the number of complex crossings that would be required. The proposed route skirts around the main towns of North Walsham, Aylsham, Reepham and Dereham. The route corridor is currently 200m wide thereby allowing for further micro-siting following feedback from the public drop-in-exhibitions planned for March 2017 and information from planned survey work.

2.1.4 Substation Zone

16. The onshore substation search area, comprising five sectors, was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.4. Public consultation during the drop-in exhibitions indicated Sector 5 (to the south of the existing Necton 400kV National Grid substation) and Sector 1 (to the east) would be the best options in this location.

17. Sectors 2, 3 and 4 were discounted due to the proximity of the residential areas of Necton, Little Dunham, Great Fransham and Little Fransham.

18. Sector 1 was maintained as an option due to the existing woodland and topography of this area which could provide screening (in addition to project screening mitigation) which may limit visual impacts. Additional access would however be required for this sector.

19. Sector 5 was maintained as an option on the basis of keeping all existing and proposed development together, the lack of housing in this sector and good access from the A47. However concerns were raised regarding the ongoing industrialisation of the area.

20. The refined substation search zone (Zone 3) includes the parts of Sectors 1 and 5, south of the A47 and south of the existing overhead line.

21. A search area for underground cables has also been delineated (the western end of Zone 4) which is required to connect the substation located within Zone 3 to the existing Necton 400kV National Grid substation.

2.1.5 Extension to the Existing Necton 400kV National Grid Extension

22. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a decision has been made by the VWPL to include the required extension works to the existing Necton 400kV National Grid substation within the EIA and DCO application for Norfolk Vanguard. The aim of this approach is to enable a more transparent impact assessment and allow the development of more effective mitigation.

23. Appropriate search zones for the extension works have been developed in consultation with National Grid, including:

- Zone 1 - Land adjacent to the existing substation which could accommodate extension to the existing busbars (see Section 2.2.1.5).
- Zone 2 - Land where overhead line realignment works maybe required adjacent to the existing National Grid substation (see Section 2.2.1.5).

24. VWPL will work closely with National Grid to ensure the design of the extension works is appropriate.

2.1.6 Norfolk Boreas

25. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a grid connection agreement has been granted by National Grid for Norfolk Boreas at the existing Necton 400kV National Grid substation. Therefore the Norfolk Vanguard EIA will include the option for Norfolk Boreas cable ducts to be installed at the same time as Norfolk Vanguard.

2.2 Indicative Worst Case Scenarios

26. The following sections set out the indicative worst case scenarios for onshore water resources and flood risk. The PEIR/ES will provide a detailed Project Description describing the final Rochdale envelope for the Norfolk Vanguard DCO application. Each chapter of the PEIR/ES will define the worst case scenario arising from the construction, operation and decommissioning phases of the Norfolk Vanguard project for the relevant receptors and impacts. Additionally, each chapter will consider separately the anticipated cumulative impacts of Norfolk Vanguard with other relevant projects which could have a cumulative impact on the receptors under consideration.

2.2.1 Infrastructure Parameters

27. Two export schemes are being considered for Norfolk Vanguard, a High Voltage Alternating Current (HVAC) and a High Voltage Direct Current (HVDC) scheme. The decision as to which option will be used for the project will be agreed post consent and will depend on availability, technical considerations and cost. Both electrical solutions will have implications on the required onshore infrastructure. Typically the HVAC scenario involves a greater area of land take and additional infrastructure, and as such the HVAC scenario is assumed as the worst case in the remainder of this section. Where the worst case assumes the HVDC scenario, this is stated in the text.

28. The following key onshore project parameters are considered:

- Landfall (Horizontal Directional Drilling (HDD) and associated compounds);

- Cable relay station if required (HVAC only) within the cable relay station search zones;
- Cable corridor (with associated construction compounds and mobilisation areas);
- Onshore substation (within the substation search zone); and
- Extension to the existing Necton 400kV National Grid Substation, including overhead line modification.

29. There is an option for the cable ducts for Norfolk Boreas, (the sister project to Norfolk Vanguard) to be constructed and installed simultaneously with Norfolk Vanguard within a single cable corridor (see parameters in Section 2.2.1.3). Therefore this scenario will be considered within the Norfolk Vanguard EIA as associated development as part of the DCO application. There is also the scenario that the ducts for Norfolk Boreas cannot be installed at the same time as Norfolk Vanguard and therefore the scenario where Norfolk Boreas Ducts are installed as part of a separate project which will be considered within the Cumulative Impact Assessment (CIA), together with the parameters of Norfolk Vanguard alone.

30. All other components of Norfolk Boreas will be considered as part of the Norfolk Vanguard CIA.

2.2.1.1 Landfall

31. There are three potential landfall locations for Norfolk Vanguard:

- Bacton Green;
- Walcott Gap; and
- Happisburgh South.

32. Initial survey and data collection for the EIA will enable the selection of the landfall location for Norfolk Vanguard. Therefore the approach to baseline characterisation will initially consider all options and will then be refined once a final landfall location is selected. The PEIR and ES will present a single landfall option.

33. The Norfolk Vanguard offshore cables will be jointed to the onshore cables on the landward side of the landfall site. Cable ducts would be installed at the landfall so that the ends of the offshore cables can be pulled through to this joint location. These will be installed using Horizontal Directional Drilling (HDD) which is a trenchless installation technique. The HDD will exit at one of the following two locations:

- On the beach, above the level of mean low water spring (classified as “short HDD”).
- At an offshore location, away from the beach (up to 1000m in drill length) (classified as “long HDD”).

34. Key parameters:

- A total of 6 ducts for the HVAC option or 2 ducts for the HVDC option would be required at the landfall for Norfolk Vanguard. Therefore the HVAC option represents the worst case scenario.
- Temporary footprint of works will be up to 3000m^2, of which up to 900m^2 (6 transition pits, based on the HVAC option) will involve excavation for Norfolk Vanguard;
- If Norfolk Boreas cable ducts are installed concurrently with the Norfolk Vanguard ducts, the Norfolk Boreas ducts will be installed up to the joint pits on the landward site of the landfall works. No landfall works (e.g. transition pits, HDD works) will be undertaken for Norfolk Boreas and therefore the landfall works for Norfolk Boreas do not form part of the Norfolk Vanguard DCO and will be considered in the CIA (see Section 2.2.6).

2.2.1.2 Cable Relay Station

35. A cable relay station is required for an HVAC electrical solution only and would not be included in a HVDC connection solution. Therefore the HVAC option is the worst case scenario for this element of the onshore infrastructure.

36. The cable relay station accommodates the reactive compensation equipment required to compensate the capacitive losses generated by long HVAC power cables, and will be located near to the landfall.

37. There are currently seven cable relay station search zones being considered and a final location will be defined following landfall site selection for the EIA and DCO application. The PEIR and ES will present a single cable relay station location.

38. Key parameters:

- There will be a maximum temporary footprint of 15000m^2 during construction of the cable relay station.
- The operational area of the cable relay station will be approximately 10,500m^2.

2.2.1.3 Cable Route

39. There are several potential scenarios for the cable easement:

- Norfolk Vanguard HVDC: This would require a 35m temporary strip during construction, and a 13m permanent strip (including 8m access) during operation.
- Norfolk Vanguard HVAC: This would require a 50m temporary strip during construction, and a 25m permanent strip (including 8m access) during operation.
- Norfolk Vanguard and Norfolk Boreas HVDC: This would require a 45m temporary strip during construction, and a 20m permanent strip with (including 8m access) during operation.

- Norfolk Vanguard and Norfolk Boreas HVAC: This would require a 100m temporary strip during construction, and a 54m permanent strip (including two separate 8m access tracks and 6m separation between circuits) during operation.

40. The following will be the water crossing scenarios for Norfolk Vanguard and Norfolk Boreas being installed currently, with the HVAC option represents the WCS:

- HVAC option – up to 12 ducts installed at each waterbody crossing point
- HVDC option - up to 4 ducts installed at each waterbody crossing point

41. Key parameters:

- The length of the onshore cable route will be approximately 60km.
- The main cable installation method will be through the use of open cut trenching with High Density Polyethylene (HDPE) ducts installed, backfilled and cables pulled though the pre-laid ducts.
- Under the worst case scenario cable easement described above, an onshore temporary easement of 100m width corridor will be required. This will result in a temporary loss of a 100m area strip along the full length of the onshore cable corridor during the installation of the cable ducts. This will include a 38m wide strip for cable excavation (up to 12 cable trenches), two 6m wide access tracks either side of the 38m strip, and two 9m and two 13m strips for excavated material storage and topsoil storage respectively.
- The access tracks will be formed of protective matting, temporary metal road or permeable gravel aggregate dependant on the ground conditions.
- Joint pits with a footprint of 90m^2 will be required every 800m along the cable route (i.e. approximately 75 in no.) for installation of cables in the pre-installed cable ducts.
- Where trenchless techniques (i.e. HDD) are required (e.g. at water crossings), there will a temporary footprint of approximately 2500m^2 and 5000m^2 to support the HDD launch and receptor sites (Section 2.2.2 provides further information on construction methodologies for crossings).
- Mobilisation areas will also be required for servicing the cable installation. These will be required to store equipment and provide welfare facilities. These will involve a temporary footprint of 10000m^2 for the footprint of these areas. Hardstanding will be laid for the duration of construction.

2.2.1.4 Onshore Substation

42. A single onshore substation will be required regardless of whether HVAC or HVDC options are selected and the two options will have similar land take requirements:

- HVAC:
  - Construction area approximately 400m x 400m
  - Substation footprint (within construction area) approximately 250m x 300m
- HVDC:

- Construction area approximately 400m x 400m
- Substation footprint (within construction area) approximately 250m x 300m

43. Low level lighting will be required for the duration of the construction phase.

44. A substation search zone (which has been refined from the substation search area shown in the Norfolk Vanguard EIA Scoping Report, (Royal HaskoningDHV, 2016)) is located to the south and east of the existing Necton 400kV National Grid substation. Initial survey and data collection, and feedback from the local community and stakeholders, will enable the selection of the substation location for Norfolk Vanguard. Therefore the approach to baseline characterisation will initially consider the search zone and will then be refined once a final substation location is selected. The PEIR and ES will present a single substation location.

2.2.1.5 National Grid substation extension

45. An extension to the existing Necton 400kV National Grid substation will be required regardless of whether the HVAC or HVDC electrical solution is selected.

46. The busbar would be extended in an east west direction with seven additional Air Insulation Switchgear (AIS) bays for Norfolk Vanguard.

47. The extension to the existing Necton 400kV National Grid substation for Norfolk Vanguard and Norfolk Boreas combined would require a further busbar extension and five further AIS bays for Norfolk Boreas. This extension to the Necton 400kV National Grid substation will be included in the Norfolk Vanguard DCO and EIA.

48. Re-configuration of overhead lines to change the arrangements of the 400kV circuits in close proximity to the substation would also be required.

49. The National Grid substation extension will be included within the EIA for the Norfolk Vanguard DCO application.

2.2.2 Construction Programme

50. The HVAC option is based on a three phase development programme which would take a total of seven years (2020-2026), while the HVDC option is based on a two phase development programme which would take a total of six years (2020-2025). Both programmes include two years of enabling works during 2020 and 2021, consisting of road modifications, hedge and tree removal, preconstruction drainage, mobilisation area establishment and major crossing construction.

51. Duct installation for the landfall and onshore cable and primary works for the substation and cable relay station would take place during 2022 and 2023. The installation of the onshore cables would occur in phases in parallel with the

commissioning of the phases of the offshore wind farm. In the HVAC programme, the cable and electrical plant installation and commissioning will take place over three years from 2024 to 2026. In the HVDC programme, installation and commissioning will take place over 2 years, from 2024 to 2025.

52. Construction works will not take place continuously in all locations during the proposed construction period. Construction activity along the onshore cable route will move along the route, between different sections and activity will be phased, with the trenching and laying of ducts taking place first, followed by the cable installation.

53. The construction period for the cable relay station and substation is expected to be approximately 18 months.

54. The overall approach would be to minimise the length of time that any temporary watercourse crossings are in place, by sequentially excavating trenches, installing the ducts and reinstating the natural watercourse at each location. The cables would be pulled through the ducts at a later date. However, the running track would need to be retained in place for extended periods to enable access during construction.

55. Assuming that river crossing works and activities in the functional river floodplain are avoided during the autumn and winter, the construction programme within each phase of work is unlikely to have a significant impact on water resources and flood risk receptors.

56. The longer the temporary works (including temporary watercourse crossings and works along the cable route) required to construct the proposed development remain in place, the greater the potential for impact on water resources and flood risk receptors. In this context, the worst case scenario for water resources and flood risk receptors is therefore the construction of the onshore infrastructure for the Norfolk Vanguard and Norfolk Boreas developments in two separate phases which will be considered in the CIA.

2.2.3 Construction Methodology

57. The construction methodologies proposed for the cable relay station, onshore substation and extension to the existing Necton 400kV National Grid substation are unlikely to differ between the available options.

58. However, several alternative watercourse crossing methods are proposed along the cable route:

- Open cut trenching with temporary dams and diversions (piped or pumped) on watercourses shallower than 1.5m from bank top to stream bed.

- Open cut trenching with culverting for watercourses deeper than 1.5m from bank top to steam bed.
- Trenchless techniques (e.g. horizontal directional drilling, auger boring or micro-tunnelling) where open cut trenching is deemed unsuitable or inappropriate.

59. Approximately 48 watercourse crossings will be required, including one each on the River Wensum and the River Bure. Several other larger watercourses that are designated as water bodies in their own right under the WFD would also be crossed, including Wendling Beck (twice), King's Beck and the North Walsham & Dilham Canal.

60. Both open cut trenching options are likely to have some impact upon water resources and flood risk receptors, for example by impounding flows and restricting the downstream movement of sediment. In contrast, trenchless techniques would not directly interact with surface waters.

61. Cable burial has the potential to affect the dynamics of the watercourse in the long term if the ducting is not sufficiently deeply buried beneath the active bed of the channel (i.e. the surface layers that are frequently mobilised during higher energy flows, and the subsurface layers that underlie them). A burial depth of 1.5m is currently proposed. Further investigations are required to confirm that this depth is sufficient to avoid the cabling becoming exposed during high energy events which mobilise the bed and create scour (and the degree of change is likely to vary depending upon the scale and energy of the watercourse). This applies to both trenching and trenchless techniques, although the nature of the trenchless techniques means that the cable is likely to be buried at considerable depth below the channel bed.

62. In this context, the realistic worst case scenario is therefore the restriction of trenchless techniques to the River Wensum and the River Bure. There is unlikely to be any significant difference in level of impact between the different trenchless techniques that have been suggested.

2.2.4 Operation and Maintenance (O&M) Strategy

63. The operations and maintenance strategies for each aspect of the development are unlikely to have a significant impact on water resources and flood risk receptors. In accordance with the Norfolk Vanguard EIA scoping report (Royal HaskoningDHV, 2016), impacts during O&M are scoped out of the EIA.

2.2.5 Decommissioning

64. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice,

rules and legislation change over time. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected that the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left in situ. 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 plan will be provided.

2.2.6 Cumulative Impact Scenarios

2.2.6.1 Norfolk Boreas

65. If Norfolk Boreas uses the same landfall as Norfolk Vanguard, a total of 12 ducts would be required at the landfall (under the worst case HVAC electrical solution). The Happisburgh South landfall site is the only landfall option which can accommodate 12 ducts.

66. The following landfall scenarios for Norfolk Vanguard and Norfolk Boreas are currently being considered:

- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Bacton Green (4 ducts in total)
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Walcott Gap (4 ducts in total)
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (4 ducts in total)
- HVAC North - Landfall for Norfolk Vanguard at Bacton Green (6 ducts) with Norfolk Boreas at Walcott Gap (additional 6 ducts); or
- HVAC South - Landfall for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (12 ducts)

67. As discussed in Section 2.2.1, initial data collection for the Norfolk Vanguard EIA will enable selection of the landfall location for Norfolk Vanguard which will also inform the site selection for Norfolk Boreas. Final landfall locations for Norfolk Vanguard and Norfolk Boreas will be confirmed in the Norfolk Vanguard CIA. The options of HVAC and HVDC will be retained in the Norfolk Vanguard DCO application. Due to the greater number of ducts, an HVAC option will represent the worst case scenario.

68. The Norfolk Boreas cable relay station (only required under the HVAC scenario) will be located within one of the cable relay station search zones shown for Norfolk Vanguard. The Norfolk Vanguard and Norfolk Boreas cable relay stations may be co-located or at separate locations, subject to the landfall site selection. Final cable relay station site locations will be known for the Norfolk Vanguard CIA. The cable relay stations for Norfolk Vanguard and Norfolk Boreas will be constructed separately, although construction periods could overlap. The footprint of the Norfolk Boreas cable relay station will be the same as described for Norfolk Vanguard in Section 2.2.1.

69. The CIA for Norfolk Boreas cable installation includes the following scenarios:

- Ducts for Norfolk Boreas are pre-installed during Norfolk Vanguard construction with cable pull through required during Norfolk Boreas construction;

  - Norfolk Boreas duct installation will be assessed in the project impact assessments for Norfolk Vanguard;
  - The cable pull through for Norfolk Boreas will be considered as part of the Norfolk Vanguard CIA); or

- Norfolk Boreas ducts and cables are installed at a separate time to Norfolk Vanguard.

  - This scenario will also be considered in the CIA, together with the parameters of Norfolk Vanguard alone.

70. The Norfolk Boreas substation will be located in the substation search zone shown for Norfolk Vanguard but will be constructed separately, although Norfolk Vanguard and Norfolk Boreas construction periods could overlap. The footprint of the Norfolk Boreas substation will be the same as those described for Norfolk Vanguard (Section 2.2.1).

71. As discussed in Section 2.2.1, the extension to the existing Necton 400kV National Grid substation for Norfolk Boreas would be done concurrently with Norfolk Vanguard under the Norfolk Vanguard DCO and therefore this is considered as part of the Norfolk Vanguard EIA.

2.2.6.2 Other Projects

72. Construction and commissioning of the substation for the Dudgeon Offshore Wind Farm is complete and operation is due to commence in 2017. Therefore cumulative impacts on water quality and flood risk are unlikely and it is proposed to screen this out of the CIA.

73. The cable corridor for the Hornsea Project 3 Offshore Wind Farm makes landfall at Weybourne with grid connection at Norwich Main. Where the Hornsea Project 3 cable corridor crosses the Norfolk Vanguard cable corridor, there will be potential cumulative impacts on water resources and flood risk and this will be assessed in the CIA.

74. Other developments (such as housing and roads) will be considered in the CIA. CIA screening will be undertaken in consultation with stakeholders.

75. Specific developments will be identified on the following basis:

- Their geographical location within the same hydrological catchments as the proposed Norfolk Vanguard onshore development (using the WFD river water body catchment boundaries as a proxy).
- Additional hydrological catchments with upstream or downstream connectivity to those in which the developments are located.

3 BASELINE ENVIRONMENT

3.1 Desk Based Review

76. A desk based review of onshore water resources and flood risk receptors was undertaken as part of the scoping report (Royal HaskoningDHV, 2016). The Environmental Statement will build upon this information to thoroughly characterise the baseline environment and identify the receptors that could potentially be impacted by the proposed development.

77. An initial update to the desk based review presented in the scoping report is provided in the subsequent sections. This takes into account the revised cable corridor.

3.1.1 Available Data

78. The data sources to be used to inform the water resources and flood risk baseline review will include:

- Information on the current classification and status objectives of surface and groundwater bodies under the WFD, which is included in the Environment Agency's Catchment Data Explorer. This is available online: http://environment.data.gov.uk/catchment-planning/
- Additional information on water body status, included in the Anglian River Basin Management Plan. This is available online: https://www.gov.uk/government/collections/river-basin-management-plans-2015#anglian-river-basin-district-rbmp:-2015
- Information on designated sites, available on Natural England's MAGIC website: http://www.magic.gov.uk/
- More detailed information on the condition of designated sites, available on Natural England's Designated Sites View. This is available online: https://designatedsites.naturalengland.org.uk/SiteSearch.aspx
- The Environment Agency's Risk of Flooding from Surface Water tool, which is available online: https://flood-warning-information.service.gov.uk/long-term-flood-risk
- Environment Agency's Risk of Flooding from Rivers and Sea (Flood Map for Planning) tool, which is available online: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=_e&ep=map&scale=7&x=531500&y=181500

3.1.2 Surface water catchments

79. The proposed development is located in three main surface water catchments:

- The River Bure and several of its tributaries would be crossed by the proposed cable route. The river rises near Briston, from where it flows in an easterly direction until it reaches Ailsham. From here, it continues to flow to the south east until it enters the sea at Great Yarmouth. The downstream reaches of the river include a wide range of wetland features, including Hoveton Great broad and Marshes, Woodbastwick Fens and Marshes, Bure Marshes and the Norfolk Broads.
- The River Wensum and several of its tributaries would be crossed by the proposed cable route. The river rises near Whissonsett, from where it flows north towards Fakenham before continuing in a broadly south easterly direction towards Norwich. The River Wensum is designated as a SSSI and SAC (see **Section 3.1.6**).
- The River Wissey, the headwaters of which would include the proposed grid connection at the existing Necton 400kV National Grid substation. The Wissey rises to the south of Dereham, from where it drains in a westerly direction towards Necton before eventually joining the River Great Ouse at Denver Sluice, near Downham Market.

80. Each of these catchments is divided into a number of separate water bodies for Water Framework Directive (WFD) classification purposes. Water bodies that could potentially be affected by the proposed development have initially been identified using the Environment Agency's Catchment Data Explorer. The initial screening exercise has demonstrated that the proposed development is located within nine surface water body catchments, five of which are directly crossed by the cable route (**Figure 3.1**). The proposed activities are also located within four groundwater bodies (**Figure 3.2**). Further details of each water body are provided in **Table 3.1**.

81. The main characteristics of the surface water bodies can be summarised as follows:

- The North Walsham and Dilham Canal (GB105034055710) is designated as Heavily Modified due to ongoing land drainage, flood protection and recreational uses. The water body is currently at Bad Ecological Potential as a result of pressures on fish and macrophyte populations.
- The East Ruston Stream (GB105034055670) is a Heavily Modified Water Body due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of low dissolved oxygen concentrations and pressures on fish populations.
- The King's Beck (GB105034055730) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophyte populations.
- The River Bure (Scarrow Beck to Horstead Mill) (GB105034050932) is designated as a Heavily Modified Water Body due to its ongoing recreational usage. The

water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophyte populations.

- The Mermaid Stream (GB105034050900) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and a lack of measures to improve geomorphological diversity
- The Blackwater Drain (Wensum) (GB105034051120) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophytes.
- The River Wensum (upstream of Norwich) (GB105034055881) is designated as a Heavily Modified Water Body on account of its ongoing flood protection function. The water body is currently at Moderate Ecological Potential as a result of hydromorphological modifications and pressures on phytobenthos.
- The Wendling Beck (GB105034051020) is designated as a Heavily Modified Water Body as a result of ongoing land drainage and flood protection functions. The water body is currently at Good Ecological Potential, although pressures on fish and macrophytes are identified in the RBMP.
- The River Wissey (upper) (GB105033047890) is not designated as a Heavily Modified Water Body. The water body is currently at Moderate Ecological Status as a result of modifications to the hydrological regime, high phosphate concentrations, and pressures on macrophytes and phytobenthos.

3.1.3 Other Surface Watercourses

82. The WFD river water body lines presented on **Figure 3.1** represent the main stem channel of each watercourse, and were originally based on the Environment Agency's main river network. However, there are a large number of smaller watercourses that drain into these water bodies. These include small streams as well as a large number of agricultural drainage channels. The majority of these features are unnamed and due to the number within the onshore development area cannot be individually listed here.

83. Any further watercourses which have the potential to be impacted by the proposed onshore development will be identified as part of the more detailed desk based review, prior to commencement of the assessment process.

Table 3.1 WFD water bodies potentially affected by the proposed development

Water body name	Water body ID	Type	Hydromorphological designation	Current WFD water body status	Project activities required within catchment?	Project crossing main channel?
North Walsham and Dilham Canal	GB105034055710	River	Heavily Modified	Bad	✓	✓
East Ruston Stream	GB105034055670	River	Heavily Modified	Moderate	✓	-
King's Beck	GB105034055730	River	Heavily Modified	Moderate	✓	✓
Bure (Scarrow Beck to Horstead Mill)	GB105034050932	River	Heavily Modified	Moderate	✓	✓
Mermaid Stream	GB105034050900	River	Heavily Modified	Moderate	✓	-
Blackwater Drain (Wensum)	GB105034051120	River	Heavily Modified	Moderate	✓	-
Wensum u/s Norwich	GB105034055881	River	Heavily Modified	Moderate	✓	✓
Wendling Beck	GB105034051020	River	Heavily Modified	Good	✓	✓ (x2)
Wissey - Upper	GB105033047890	River	-	Moderate	✓	-
Broadland Rivers Chalk and Crag	GB40501G400300	Groundwater	-	Poor	✓	-
Cam and Ely Ouse Chalk	GB40501G400500	Groundwater	-	Poor	✓	-
North Norfolk Chalk	GB40501G400100	Groundwater	-	Poor	✓	-
North West Norfolk Chalk	GB40501G400200	Groundwater	-	Poor	✓	-

3.1.4 Flood Risk

84. Environment Agency flood zone maps (Environment Agency, 2012) indicate that the majority of the onshore scoping area is located within an area of low flood risk (Flood Zone 1). Flood Zone 1 is defined as land as having a less than 1 in 1,000 annual probability of river flooding (<0.1%).

85. At landfall, the infrastructure is located within close proximity to an area of Flood Zone 3 deemed to be at high flood risk. This area of high flood risk is likely to be tidally controlled and as such would be deemed to have a 0.5% or greater annual chance of flooding. The area is also shown to not benefit formal any formal flood defences.

86. As identified in **Figure 3.3**, the development shall intercept a number of watercourses and at these locations the Environment Agency flood zone maps show areas of Flood Zone 2, deemed to be at medium fluvial flood risk (between 0.1% - 1% annual risk of flooding) and areas of Flood Zone 3, deemed to be at high fluvial flood risk (1% or greater).

87. It is important to note that **Figure 3.3** does not show all watercourses the development shall come in contact with and as such further areas at medium or high risk of fluvial flooding may occur along the development route. Areas designated for substation locations will require further detailed flood risk assessment to ensure all plant is located above any potential flood risk, from fluvial, surface water and other sources.

3.1.5 Groundwater

88. Regionally, the principal groundwater body covering the majority of area of the proposed onshore scoping area is the Broadland Rivers Chalk & Crag. The chalk bedrock is designated as a Principal Aquifer and a number of groundwater Source Protection Zones (SPZs) are identified within the area, with both inner and outer zones of the SPZs extending across the eastern section of the cable route.

89. There are small sections of the onshore scoping area close to the coast, north of North Walsham, which are underlain by the North Norfolk Chalk groundwater body. The far west of the onshore scoping area, particularly around the proposed grid connection, are underlain by the North Norfolk Chalk and North West Norfolk Chalk groundwater bodies.

3.1.6 Designated Sites

90. The River Wensum is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) on account of the water-dependent features and habitats that it supports.

91. The river was designated as a SSSI because it provides an exceptional example of an enriched, calcareous lowland river, supporting a diverse assemblage of plants and invertebrates. The SSSI is currently in unfavourable condition due to hydrological pressures, high phosphate concentrations, high turbidity and siltation-related issues.

92. The Wensum was also designated as a SAC because it supports Annex 1 watercourses with *Runuculion fluitantis* and *Callitricho-Batrachion* vegetation communities. It also supports Annex II species such as white clawed crayfish, Desmoulin's whorl snail, brook lamprey and bullhead.

3.2 Planned Data Collection

3.2.1 Desk Based Data Collection

93. The results of the initial desk based review presented above will be used as a basis for a more detailed desk based assessment to characterise the baseline for water resources and flood risk receptors.

94. GIS analysis will be used to identify potential receptors, based on the potential for hydrological connectivity with the proposed development activities. This will be informed by comparing the site red line boundary (including details of the location of cable route, relay stations, substations and all access routes) to three primary data sets:

- WFD river water body outlines, which represent discrete catchments (or sub-catchments) for surface hydrology. Any activities undertaken within these catchments have the theoretical potential to impact upon water receptors within the catchment area.
- A detailed representation of the surface drainage network, which will be used to identify individual surface water receptors within each catchment that could potentially be affected by the proposed development.
- WFD groundwater body outlines, which will be used to identify sub-surface water receptors.

95. The results of this GIS analysis will be used to:

- Produce a definitive list of surface water receptors that could be indirectly impacted by the proposed development (e.g. as a result in changes to hydrology and runoff characteristics).

- Produce a definitive list of surface water receptors that will be directly impacted (i.e. crossed) by the proposed transmission route.

96. For each receptor, the potential mechanisms for impact based on the nature of the proposed construction and O&M activities and the degree of hydrological connectivity between them and the receptor will be identified. This will include the potential for changes to surface and groundwater hydrology, geomorphology, water quality and flood risk. This definitive list of receptors will be used as the basis for all subsequent stages of the assessment, including the Environmental Impact Assessment (**Section 4**), Flood Risk Assessment (**Section 5**) and WFD compliance assessment (**Section 6**).

3.2.2 Consultation

97. Consultation will be undertaken with the Environment Agency to obtain the most recent WFD status classification and objective data for each water body, including (where available) detailed reports which support the information published on the Catchment Data Explorer.

98. Consultation will also be undertaken with Natural England to confirm the condition and status objectives of the River Wensum SSSI and SAC and agree the approaches to design and configuration of river crossing and site compound locations.

3.2.3 Field Data Collection

99. The proposed onshore cable route will cross a variety of surface waters, ranging from major watercourses to small agricultural drainage ditches. The proposed scheme includes six crossings of watercourses that are designated as main rivers by the Environment Agency and are also river water bodies under the Water Framework Directive (see **Section 0** for further information). The cable route and onshore grid connection are also close to several other watercourses.

100. It is proposed that a targeted walkover survey is undertaken to characterise the surface water conditions at each proposed crossing point, and any other watercourses where there is a high potential for impact (e.g. the grid connection point, substations and construction compounds). These surveys will consider a variety of factors that are necessary to characterise the baseline geomorphology, including:

- Flow conditions, including dominant flow types and the degree of variability within each reach.
- Channel form, including planform, width and depth variation, bank form and condition, substrate types and the type and presence of bed forms such as pools, riffles and bars.

- Floodplain characteristics, including connectivity to the river channel, and the structure of the riparian zone.
- Evidence of channel modification, including enlargement and resectioning, artificial bank protection, embankments and in-channel structures.

101. At the proposed crossing points, the walkover survey will encompass the cable corridor width and at least 200m upstream and downstream. In areas where the spatial extent of the works is greater (e.g. the grid connection, substations and construction compounds), the walkover survey will encompass the entire length of any watercourses within the proposed development footprint, and, where appropriate, a representative distance upstream and downstream.

102. Based on the initial information presented in this report, the following primary locations for the walkover survey have been identified:

- The North Walsham and Dilham Canal at Little London.
- King's Beck at Banningham.
- The River Bure at Abbot's Hall Farm, Drabblegate.
- An unnamed tributary of the Blackwater Drain near Sparham.
- The River Wensum at Old Hall Farm, Mill Street.
- Wendling Beck at Old Brigg, Gressenhall, and Podmore.
- Watercourses situated within the proposed grid connection site, including an unnamed tributary draining into the River Wissey to the south of Ivy Todd, and a headwater stream of Wendling Brook adjacent to Great Wood.

103. Additional surveys may be required if major watercourses are identified in substation or compound areas or along the cable route. This will be confirmed by comparing the proposed development footprint to the detailed drainage network in GIS prior to the commencement of any field surveys.

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Overall approach

104. This section sets out the overall approach to the assessment and highlights the main potential impacts on water resources and flood risk receptors. Note that separate, more detailed methodologies are provided for the Floor Risk Assessment and WFD compliance assessment in **Sections 5** and **6**, respectively. Impacts are common between the different assessments, and have not therefore been repeated.

4.2 Defining Impact Significance

105. Two key groups of impacts have been identified for the purpose of defining impact significance:

- Water resources: These are potential effects on the physical (including hydrology and geomorphology), biological or chemical character of surface waters or groundwater, potentially impacting on secondary receptors such as wetlands or abstractions, and WFD water body status.
- Flood risk: These are the potential impacts of the Proposed Development on site drainage, conveyance and surface water flooding.

106. Whilst there are clear links between the two impact groups, the assessment of receptor sensitivity and the magnitude of effect may differ. Further details are provided in the subsequent sections.

4.2.1 Sensitivity

107. Receptor sensitivity has been defined with reference to the adaptability, tolerance, recoverability and value of individual receptors. Table 4.1 sets out definitions for the value and sensitivity for surface water receptors.

4.2.2 Value

108. It should be noted that high value and high sensitivity are not necessarily linked with respect to a particular impact. A receptor could be of high value but have a low sensitivity to an effect. It is therefore important not to inflate the significance of an impact due to the value of the receptor. Instead, the value can be used as a modifier for the sensitivity assigned to the receptor. Definitions for the value of surface waters are provided in **Table 4.2**.

Table 4.1 Criteria for appraisal of sensitivity for surface water receptors

Sensitivity	Definition	Examples
High	Receptor has no or very limited capacity to accommodate changes to hydrology, geomorphology or water quality. Increased risk of flooding would be unacceptable.	**Water Resources** Controlled waters with an unmodified, naturally diverse hydrological regime, a naturally diverse geomorphology with no barriers to the operation of natural processes, and good water quality. Supports habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality. Supports Principal Aquifer with public water supply abstractions by provision of recharge. Site is within Inner or Outer Source Protection Zones.
		Flood Risk Highly Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with more than 100 residential properties (after DMRB, 2009).
Medium	Receptor has limited capacity to accommodate changes to hydrology, geomorphology or water quality. Increased risk of flooding may be acceptable.	**Water Resources** Controlled waters with hydrology that sustains natural variations, geomorphology that sustains natural processes, and water quality that is not contaminated to the extent that habitat quality is constrained. Supports or contributes to habitats or species that are sensitive to changes in surface hydrology, geomorphology and/or water quality. Supports Principal Aquifer with public water supply abstractions by provision of recharge. Site is within a Catchment Source Protection Zone. Supports Secondary A Aquifer with water supply abstractions. Site is within Inner or Outer Source Protection Zones.
		Flood Risk More Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with between 1 and 100 residential properties or industrial premises (after DMRB, 2009).
Low	Receptor has moderate capacity to accommodate changes to hydrology, geomorphology or water quality. Increased risk of flooding / pollution likely to be acceptable	**Water Resources** Controlled waters with hydrology that supports limited natural variations, geomorphology that supports limited natural processes, and water quality that may constrain some ecological communities. Supports or contributes to habitats that are not sensitive to changes in surface hydrology, geomorphology or water quality. Supports Secondary A Aquifer with water supply abstractions by provision of recharge. Site is within a Catchment Source Protection Zone.
		Flood Risk Less Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with 10 or fewer industrial properties (after DMRB, 2009).
Negligible	Receptor is generally tolerant of changes to hydrology, geomorphology or water quality. Insensitive to increased risk of flooding.	**Water Resources** Controlled waters with hydrology that does not support natural variations, geomorphology that does not support natural processes, and water quality that constrains ecological communities. Aquatic or water-dependent habitats and/or species are tolerant to changes in hydrology, geomorphology or water quality. Supports Secondary A Aquifer without abstractions, or Secondary B Aquifer. Does not provide recharge to groundwater.

Sensitivity	Definition	Examples
		Flood Risk Water Compatible Land Use, as defined by NPPF PPG (DCLG, 2015). Land with limited constraints and a low probability of flooding of residential and industrial properties (after DMRB, 2009).

Table 4.2 Criteria for appraisal of value for surface water receptors

Value	Definition	Examples
High	Receptor is an internationally or nationally important resource with limited potential for offsetting / compensation.	**Water resources** WFD water body at Good or High status. Supports or contributes to designated habitats or species of national or international importance (e.g. SAC, SPA, Ramsar site / SSSI). Licensed potable abstractions (surface water and groundwater).
		Flood Risk Nationally significant infrastructure. Internationally or nationally designated planning policy areas.
Medium	Receptor is a regionally important resource with limited potential for offsetting / compensation.	**Water resources** WFD water body at Moderate status. Supports or contributes to habitats with high biodiversity or species of UK regional or local value (LNR, SNCI, RIGS). Licensed non-potable abstractions (surface water and groundwater).
		Flood Risk Locally significant infrastructure. Local planning policy designated sites.
Low	Receptor is a locally important resource.	**Water resources** WFD water body at Poor status. Supports or contributes to habitats of UK regional or local value. Unlicensed potable abstractions (surface water and groundwater).
		Flood Risk Drainage that does not discharge to Critical Drainage Areas.
Negligible	Receptor is not considered to be an important resource.	**Water resources** WFD water body at Bad status. Aquatic or water-dependent habitats and/or species are not sensitive to changes in hydrology, geomorphology or water quality. The waters are tolerant to the proposed changes. No abstractions (surface water and groundwater).
		Flood Risk No significant infrastructure.

Table 4.3 Criteria for appraisal of magnitude of effect for surface water receptors

Sensitivity	Definition	Examples
High	Permanent or large scale change affecting usability, risk, value over a wide area, or certain to affect regulatory compliance	**Water Resources** 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 of a water supply source resulting in prosecution (Adverse). Change in WFD water body status / potential or its ability to achieve WFD status objectives in the future (Adverse / Beneficial). Permanent habitat creation or complete loss (Adverse / Beneficial). Measureable habitat change that is sustainable / recoverable over the long-term (Adverse / Beneficial).
		Flood Risk Permanent or major change to existing flood risk e.g. creation of flood plain resulting in decrease in flood risk on- and off-site (Beneficial). Reduction in on-site flood risk by raising ground level in conjunction with provision of compensation storage (Beneficial). Increase in off-site flood risk due to raising ground levels without provision of compensation storage (Adverse). Re-location of development outside floodplain or flood zone (Beneficial). Failure to meet either Sequential or Exception Test (if applicable) (Adverse).
Medium	Moderate permanent or long-term reversible change affecting usability, value, risk, over the medium- term or local area; possibly affecting regulatory compliance	**Water Resources** 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). Temporary change in status / potential of a WFD waterbody or its ability to meet objectives (Adverse / Beneficial).
		Flood Risk Medium-term or moderate change to existing flood risk e.g. Increase in off-site flood risk within the local area due to increased impermeable area (Adverse) Possible failure of Sequential or Exception Test (if applicable) Reduction in off-site flood risk within the local area due to the provision managed drainage system (Beneficial)
Low	Temporary change affecting usability, risk or value over the short-term or within the site boundary; measureable permanent change with minimal effect usability, risk or value; no effect on regulatory compliance	**Water Resources** Short-term or very localised effects on water quality or availability. (Adverse / Beneficial). Short-term derogation of a water supply source (Adverse). Measureable permanent effects on a water supply source that do not impact on its operation (Adverse). Observable habitat change that is sustainable / recoverable over the short-term (Adverse / Beneficial). No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).
		Flood Risk Short-term temporary or minor change to existing flood risk e.g. Increase in on-site or off-site flood risk due to reduced attenuation storage during construction (Adverse). Localised increase in on-site or off-site flood risk due to increase in impermeable area (Adverse).

Sensitivity	Definition	Examples
		Passing of Sequential and Exception Test (Neutral).
Negligible	Minor permanent or temporary change, undiscernible over the medium- to long-term short-term, with no effect on usability, risk or value	**Water Resources** 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). No change in status / potential of a WFD waterbody or its ability to meet objectives (Neutral).
		Water Resources 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). Temporary change in status / potential of a WFD waterbody or its ability to meet objectives (Adverse / Beneficial).

4.2.3 Magnitude

109. Receptor magnitude has been defined with consideration to the spatial extent, duration, frequency and severity of the effect. Impact magnitude is defined in **Table 4.3**.

4.2.4 Significance

110. The potential significance of an impact is a function of the sensitivity of the receptor and the magnitude of the effect. This is derived using an impact significance matrix, as shown in **Table 4.4**. Definitions of each level of significance are provided in Table 4.5.

111. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool.

112. Effects that result in Major or Moderate impacts are usually considered to be 'significant' in EIA terms. Significant impacts are those which are likely to influence the outcome of the planning application. Adverse significant impacts may require mitigation that is difficult or expensive to achieve whereas, beneficial significant impacts contribute to the case in favour of the proposed development.

Table 4.4 Impact Significance Matrix

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

Table 4.5 Impact Significance Definitions

Impact 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 result in exceedance of statutory objectives and / or breaches of legislation.

Impact Significance	Definition
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.

4.3 Potential Impacts

4.3.1 Potential Impacts during Construction

4.3.1.1 Impact: Direct disturbance of surface water bodies

113. The installation of the cable infrastructure has the potential to directly disturb the bed and banks of the watercourses it crosses. Although HDD has been proposed for the larger watercourse crossings (specifically the Rivers Wensum and Bure), it is likely that open trench techniques will be used for the majority of crossings. Open trench cutting techniques have the potential to alter the geomorphology of the watercourse by disrupting flow conveyance and sediment transport (particularly of coarse bed sediments), and cause localised disruption to the bed and banks. The likelihood of this occurring is dependent on the method of installation, size of the crossing in relation to the watercourse, and whether any parts of the cable ducting are proud of the natural bed. All cable ducting will need to be installed at sufficient depth beneath the bed of the watercourse to prevent geomorphological impacts (e.g. bed scour and channel instability) and avoid exposure during periods of higher energy flow where the bed could be mobilised. This depth is dependent upon the characteristics of each individual watercourse, but it will be necessary to install cabling below the active bed to prevent impacts.

114. Temporary dams installed while trenching takes place will reduce flow and sediment conveyance, create upstream impoundment, and could potentially encourage fine sedimentation. They could also act as a barrier to the movement of fish and other aquatic organisms, which is important from a WFD compliance perspective. Furthermore, other temporary structures such as bridges, which may require additional temporary works, also have the potential to affect the geomorphology of the channel.

4.3.1.2 Approach to assessment

115. The potential impacts of channel disturbance will be assessed based on the expert judgement of an experienced fluvial geomorphologist. This assessment will be

informed by the results of the desk based assessment outlined in **Section 3.2.1** and the geomorphological walkover survey outlined in **Section 3.2.3**. The latter is likely to be particularly important in assessing the likely geomorphological responses of each channel to physical disturbance.

116. In addition, reference will be made to guidance on the potential impacts of infrastructure such as culverts and bridges contained within the WFD Expert Assessment guidance (Defra/EA, 2009) and, in particular, Environment Agency (2016) WFD compliance assessment guidance for works in rivers.

117. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

4.3.1.3 Impact: Increased surface water runoff and altered groundwater flows

118. The proposed onshore development (the landfall, cable relay station, cable route and National Grid Connection substation construction sites) has the potential to alter surface drainage patterns, increase surface water runoff and increase flood risk as a result of:

- The installation of surface and buried infrastructure, which has the potential to change surface and subsurface flow routes and change the distribution of groundwater.
- The installation of watercourse crossings, which has the potential to alter surface flows (e.g. by impounding watercourses).
- Soil compaction by construction vehicles, which could potentially reduce infiltration and increase surface runoff.
- Any dewatering of trenches could increase surface flows.

4.3.1.4 Approach to assessment

119. The potential impacts of increased surface water runoff will be based on the expert judgement of an experienced fluvial geomorphologist. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1** and the geomorphological walkover survey outlined in **Section 3.2.3**.

120. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

121. Further details on the proposed approach to assessing changes to flood risk are provided in **Section 5**.

4.3.1.5 Impact: Increased sediment supply

122. The proposed construction activities (at the landfall, relay station, cable route and National Grid Connection substation construction sites) will involve extensive

earthworks and create areas of bear ground by removing surface vegetation cover. This is likely to increase the potential for the erosion of soil particulates, resulting in an increase in the supply of fine sediment to surface watercourses through surface runoff.

123. Increased sediment supply could also result in increased deposition on the bed of the channel. This could smother existing substrates and encourage geomorphological instability, and could potentially cause deterioration in the status of the morphology of the affected channel.

124. In addition, an increase in fine sediment supply could result in localised increases in turbidity and may temporarily increase sediment deposition in the channel downstream. This could potentially smother existing bed habitats and reduce light penetration, adversely affecting biological quality elements (e.g. macrophytes, aquatic invertebrates and fish) and causing deterioration in water body status. Chalk streams such as the River Wensum are likely to be particularly sensitive to such increases in fine sediment supply.

4.3.1.6 Approach to assessment

125. The potential impacts of increased sediment supply will be assessed based on the expert judgement of an experienced fluvial geomorphologist. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1** and the geomorphological walkover survey outlined in **Section 3.2.3**.

126. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

4.3.1.7 Impact: Accidental release of fuels, oils, lubricants and construction materials

127. There is the potential for the accidental release of lubricants, fuel oils and drilling fluid from construction machinery working in and adjacent to surface watercourses, through spillage, leakage and in-wash from vehicle storage areas after rainfall. There is also the potential for accidental release of construction materials (including concrete) into the aquatic system during construction.

128. If significant leakage or spillage is left unmitigated, there is the potential for adverse impacts upon water quality if these substances enter the river water bodies or percolate into the groundwater body.

4.3.1.8 Approach to assessment

129. The potential impacts of the release of contaminants will be assessed based on the expert judgement of an experienced water quality specialist. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1**.

130. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

4.3.2 Potential Impacts during O&M

4.3.2.1 Impact: Increased surface water runoff

131. The permanent above-ground infrastructure, including the landfall, cable relay station, onshore substation, extension to the existing Necton 400kV National Grid substation and any new, permanent access tracks are likely to result in enduring changes to land use. The change in use from existing greenfield agricultural land use could create an increase in impermeable area. Whilst permeable surface treatments will be used where possible, the substation and cable relay station are expected to include areas of roads and other areas of development with impermeable surfaces.

132. There is therefore likely to be an increase in surface water runoff from impermeable areas. This could impact upon the hydrology of the surface water system and increase downstream flood risk.

133. Furthermore, increases in runoff could also result in permanent changes to geomorphology and physical habitat condition as a result of changes to surface water flows (e.g. increased runoff and flow velocities). These could impact upon the geomorphology of surface watercourses by increasing erosion rates and encouraging geomorphological adjustment.

4.3.2.2 Approach to assessment

134. The potential impacts of permanent changes to impermeable areas will be assessed based on the expert judgement of an experienced flood risk practitioner. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1** and drainage calculations produced as part of the design process.

135. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

4.3.2.3 Supply of fine sediment and other contaminants

136. The permanent operation of the proposed development could result in the supply of fine sediment, fuels, oils and lubricants from the road network and other impermeable surfaces. This could potentially affect the geomorphology and water

quality in the surface drainage network (see **Sections 4.3.1.5** and **4.3.1.7** for further details of potential responses).

4.3.2.4 Approach to assessment

137. The potential impacts of the increased supply of sediment and other contaminants will be assessed based on the expert judgement of an experienced water quality specialist and geomorphologist. This assessment will be informed by the results of the desk based assessment outlined in **Section 3.2.1** and the geomorphological walkover survey outlined in **Section 3.2.3**.

138. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design will be in place.

4.3.3 Potential Impacts during Decommissioning

139. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left in situ.

140. 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 plan would be provided.

141. At this stage, it is anticipated that the decommissioning impacts will be similar in nature to those of construction (**Section 4.3.1**).

4.3.4 Potential Cumulative Impacts

142. Onshore cumulative impacts will be considered as part of the EIA process. Any other project with the potential to result in impacts that may act cumulatively with Norfolk Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

143. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

144. Other developments with potential to impact upon water resources and flood risk receptors will be considered. These are likely to include schemes that involve watercourse crossings, other forms of direct disturbance to the river channel, and ground disturbance that could potentially increase the supply of sediment and other contaminants into the surface drainage system.

5 FLOOD RISK ASSESSMENT METHODOLOGY

5.1 Introduction into Flood Risk Assessments for Planning

145. In England, the requirements of a flood risk assessment for planning purposes are set out by national government, supported by the Environment Agency. Flood risk assessments for planning must adhere to the National Planning Policy Framework (NPPF); however, some Local Planning Authorities will have additional requirements, based on local policy and often associated with particular styles of development.

146. Flood risk assessments for planning are required for all development, regardless of scale for development within Flood Zone 2 or 3, or within a Critical Drainage Area. Developments of 1ha or greater will also require a flood risk assessment regardless of location.

147. Some Local Planning Authorities have additional requirements for when developers require a flood risk assessment; often when surface water flooding has been identified as a concern a flood risk assessment will be required.

148. The information and data required within a flood risk assessment is dependent on location and type of development; for example, a new development of over 1ha in Flood Zone 1 will have different needs to a new development over 1ha in Flood Zone 3.

149. Environment Agency data are required for all flood risk assessments for planning purposed; however the level of detail required again varies depending on the type of development and its location. Further details into this can be found on the government webpage; flood risk assessment for planning applications (https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications).

5.2 Requirements

150. Flood risk assessments for the Norfolk Vanguard project shall incorporate data from a number of sources, including;

- The relevant level of Environment Agency flood data.
- Relevant Internal Drainage Board flood data.
- Topographic survey data, or remotely sensed LiDAR data.
- Local Council Policy and Local Plan.
- Strategic Flood Risk Assessments.
- Surface Water Management Plans.

151. Given the development is for essential infrastructure the type of flood risk assessment shall be tailored to meet the needs of each individual site. For development located in close proximity to potentially sensitive receptors a joined

up approach will be required to ensure development can be undertaken without increasing flood risk, or negatively affected the ecology of an area. Permanent structures and temporary structures will also need to be managed differently.

5.3 Initial assessment of flood risk assessment requirements

5.3.1 Types of development

152. The types of development associated with the Norfolk Vanguard project have been categorised into eight development zones:

- Development zone 1 - Extension to the existing Necton 400kV National Grid substation.
- Development zone 2 - Re-configuration of overhead lines in close proximity to the existing Necton 400kV National Grid substation
- Development zone 3 - Substation search zone.
- Development zone 4 - Cable corridor.
- Development zone 5 - HDD areas, including compounds and HDD sites on both sides of the feature to be drilled under.
- Development zone 6 - Mobilisation areas, in which construction compounds may be sited.
- Development zone 7 - Search zones for Cable Relay Station locations.
- Development zone 8 - Drill corridors from offshore to onshore at landfall.

5.3.2 Flood risk assessment requirements

153. An initial appraisal of the level of flood risk assessment required for each part of the proposed development is presented in **Table 5.1** and **Figure 5.1**. Note that these assessments will focus on above-ground development, and as such Zone 4 has not been considered.

154. Specific working sites within the development zones identified above have been categorised into three groups, based on the location of the proposals:

- Assessment may not be required: These sites are in Flood Zone 1 and are unlikely to need an FRA.
- Assessment potentially required: These sites are in close proximity to Flood Zones 1 or 2 and an FRA may be required.
- Assessment will be required: These sites are in Flood Zones 2 or 3 and an FRA will be required.

155. However, it should be noted that the area of these sites has not been considered at this stage; any developments greater than 1ha will require assessment. Furthermore, the Local Planning Authority may require assessment for multiple sites that form part of the same development.

Table 5.1 Initial appraisal of flood risk assessment requirements (see Figure 5.1)

Figure Label Number	Development Zone	Flood Zone	Surface Water Flood Risk	Source of Flooding	Initial appraisal of FRA requirements
0	1	1 with 3 on boundary	Low	Unnamed watercourse	May not be required
1	2	1 with 3 on boundary	Low – High	Unnamed watercourse	May not be required
2	3	1 and 3	Low – High	Unnamed watercourse	May not be required
7	5	1	Low	-	May not be required
9		3	Low	Tidal	Will be required
39		1, 2, 3	Low – High	Tidal	Will be required
69		1	Low	-	May not be required
68		1	Low	-	May not be required
67		1	Low – High	-	May not be required
63		1	Low	-	May not be required
64		1 in close proximity to 3	Low	River Bure	Potentially required
65		1 in close proximity to 3	Low	River Bure	Potentially required
55		1 in close proximity to 3	Low – High	River Wensum	Potentially required
56		3	High	River Wensum & Penny Spot Beck	Will be required
57		3	High	River Wensum & Penny Spot Beck	Will be required
53		1	Low	-	May not be required
52		1	Low	-	May not be required
48		1 & 3	High	Wendling Beck	Will be required
49		1 & 3	High	Wendling Beck & Wendling Carr	Will be required
70	6	1	Low	-	May not be required
66		1 & 3	Low	-	Will be required
62		1	Low – High	-	May not be required
61		1	Low	-	May not be required
60		1 & 3	Low – High	Unnamed watercourse	Will be required
59		1 with 3 in proximity	Low	Unnamed watercourse	Potentially required
58		1	Low – High	-	May not be required
47		1	Low	-	May not be required
51		1	Low	-	May not be required
50		1	Low – High	-	May not be required
40	7	1	Low – Medium	-	May not be required
41		1	Low	-	May not be required
42		1	Low	-	May not be required
43		1	Low – High	-	May not be required

Figure Label Number	Development Zone	Flood Zone	Surface Water Flood Risk	Source of Flooding	Initial appraisal of FRA requirements
44		1	Low	-	May not be required
45		1 with 3 in proximity	Low – High	Ordinary watercourse	Potentially required
8	8	1	Low	-	May not be required
10		3	Low	Tidal	Will be required
75		1, 2, 3	Low – High	Tidal	Will be required

6 WFD COMPLIANCE ASSESSMENT METHODOLOGY

6.1 Overall approach to the WFD compliance assessment

156. The way in which WFD impacts are assessed is quite different to the approach conventionally used within the Environmental Impact Assessment (EIA) process. The standard EIA approach assesses whether an impact is minor, moderate or major, and whether it is beneficial or adverse. This is not compatible with the requirements of the WFD, which requires an assessment of whether a scheme (or element of a scheme) is compliant or non-compliant with the environmental objectives outlined in **Table 6.1.**

Table 6.1 Environmental objectives of the WFD

Objectives (taken from Article 4 of the WFD)	Reference Article
Surface waters	
Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water.	4.1(a)(i)
Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015.	4.1(a)(ii)
Heavily Modified and Artificial Water Bodies	
Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015.	4.1(a)(iii)
Progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.	4.1(a)(iv)
Groundwater	
Prevent Deterioration in status and prevent or limit input of pollutants to groundwater (Daughter Directive).	4.1(b)(i)

157. Following the recommendations made by the Environment Agency in their internal guidance (Environment Agency, 2016), the approach adopted in this assessment is to determine whether the scheme has:

- Potential to cause deterioration in surface water body status by adversely affecting biological, hydromorphological and/or physico-chemical quality elements.
- Potential to cause deterioration in groundwater body status by adversely affecting quantitative and chemical quality elements.
- Potential to prevent achieving WFD status objectives by impacting upon proposed mitigation measures already identified for water bodies in the area.
- Potential to incorporate mitigation measures included in the appropriate River Basin Management Plan(s).

158. Where the assessment suggests that deterioration in water body status is likely to occur as a result of the scheme, measures to mitigate the likely impacts and therefore avoid deterioration in status are recommended.

159. A four stage process will be used to undertake the WFD compliance assessment. These stages are described in more detail in the subsequent sections:

- Stage 1: Screening assessment.
- Stage 2: Scoping assessment.
- Stage 3: Detailed compliance assessment (if required).
- Stage 4: Summary of mitigation, improvements and monitoring (if required).

6.2 Stage 1: Screening assessment

6.2.1 Identification of WFD water bodies

160. Water bodies that could potentially be affected by the scheme will be identified using the Environment Agency's online WFD mapping system (the Catchment Data Explorer tool), which supports the Anglian River Basin Management Plan (RBMP) (Environment Agency, 2015). Water bodies will be selected for consideration in the compliance assessment based on the following criteria:

- All surface water bodies that could potentially be directly impacted by the scheme (i.e. those within the scheme footprint).
- Any surface water bodies further upstream that have direct connectivity and could potentially be affected by the proposed works.
- Any surface water bodies downstream that have direct connectivity and could potentially be affected by the proposed works.
- Any groundwater bodies that underlie the proposed scheme.

161. To facilitate this identification process and in particular to inform the decision on whether connectivity might lead to impacts, a hydromorphological assessment of the potential impacts of the scheme and potential extent of upstream and downstream propagation will be made, using the Joint Defra/Environment Agency Flood and Coastal Erosion Risk Management R&D Programme (2009) Expert Assessment Framework as a basis.

6.2.2 Collation of baseline information

162. The following tasks will be undertaken to collate the information required to inform the WFD compliance assessment:

- Collection of water body baseline data, including on the type and status of each quality element and, if appropriate, reasons for failure and mitigation measures identified by the Environment Agency. These data will be collated from the

River Basin Management Plan 2 Class Objective Data and any supporting information for each water body available from the Environment Agency.
- Collection of design information for the proposed development, broken down into individual activities so that the compliance of each activity can be considered in the assessment. This will include the identification of the control measures that have been included within the design to minimise the potential impacts of the proposed development.

6.3 Stage 2: Scoping assessment

163. A scoping assessment will be undertaken to determine whether there is the potential for construction impacts from installing the WCS and any associated activities during the operational phase to cause deterioration in the status or potential of any of the water bodies identified during Stage 1, and whether there is potential to cause a failure to meet GES or GEP targets for these water bodies. The scoping assessment will consider:

164. The potential of each activity to adversely impact on any of the quality elements sufficient to cause deterioration in water body status. This assessment will be based on expert judgement, informed by available data and, in the case of hydromorphological impacts, using the guidance included in the Flood and Coastal Erosion Risk Management R&D Programme Expert Assessment Framework (DEFRA/EA, 2009). It will be broken down into the potential impact of the various scheme components on each quality element so that any areas of potential impact could be clearly identified, including:

- The potential for the scheme to impact upon proposed WFD mitigation measures and improvements, and therefore prevent GES or GEP being achieved.
- The potential for cumulative impacts as a result of existing pressures, new or recent schemes in the area, and any planned schemes.
- The potential for impacts on critical and sensitive habitats, including designated sites and habitats with particular ecological importance.

165. Water bodies and activities can be screened out of further assessment if it can be satisfactorily demonstrated that there will be no impacts. If impacts are predicted, it will be necessary to undertake a Stage 3 detailed compliance assessment. If no impacts are predicted, the assessment will be complete at the end of Stage 2.

6.4 Stage 3: Detailed compliance assessment

166. The Stage 3 assessment would determine whether the activities and/or scheme components that have been put forward from the Stage 2 scoping assessment will cause deterioration and whether this deterioration will have a significant non-temporary effect on the status of one or more WFD quality elements at water body level. For priority substances, the process requires the assessment to consider

whether the activity is likely to cause the quality element to achieve good chemical status.

167. If it is established that an activity and/or scheme component is likely to affect the status at water body level (that is, by causing deterioration in status or by preventing achievement of WFD objectives (including those for Protected Areas) and the implementation of mitigation measures for HMWBs), or that an opportunity may exist to contribute to improving status at a water body level, potential measures to avoid the effect or achieve improvement must be investigated. This stage will consider such measures and, where necessary, evaluate them in terms of cost and proportionality.

168. As outlined above, the end result of Stage 2 would be an agreed list of water bodies, scheme activities and quality elements to be carried forward for further assessment. Stage 3 would then consider the potential for status deterioration associated with each scheme activity (i.e. not the scheme as a whole) on the biological, hydromorphological and physico-chemical and chemical quality elements of each relevant surface water body, and the quantitative and chemical quality elements of each relevant groundwater body.

169. The assessment would establish whether the scheme activities would:

- Cause deterioration within a water body.
- Prevent WFD status objectives (i.e. GES or GEP) being achieved, including prevention of the delivery of mitigation measures identified in the RBMP.
- Prevent status objectives being achieved in any other water bodies, including prevention of the delivery of mitigation measures identified in the RBMP.

170. Following the broad principles of the WFD, the scheme would be considered to be non-compliant if any of the scheme components are likely to cause a non-temporary deterioration in any of the quality elements individually or cumulatively at a water body level.

171. Impacts of the scheme on other European legislation, including the Habitats Directive, Birds Directive, Bathing Waters Directive (2006/7/EC) and Freshwater Fish Directive (2006/44/EC) for example would also be considered in line with Articles 4.8 and 4.9 of the WFD. Where necessary, reference would be made to supporting information contained in the relevant EIA chapters, and in the case of Natura 2000 protected areas, the Shadow HRA (both of which would accompany the project application documents).

172. If, at the end of the Stage 3 assessment process, negative impacts have been identified, measures to mitigate the impacts and, if possible, to improve the state of the water environment would be considered. Where possible, multiple benefits will

be sought from each measure (e.g. across different water bodies or improving more than one quality element). Appropriate guidance will be consulted, such as the online "Healthy Catchments" guidance (ERRC, undated). The scope of all measures would be agreed in consultation with the appropriate regulatory authorities.

6.5 Stage 4: Summary of mitigation, improvements and monitoring

173. This stage of the process would provide a summary of the preceding stages and any mitigation and monitoring proposals for each of the activities assessed. This stage would summarise the results of the assessment that is described in the previous sections. This summary would include:

- An overview of the results of the assessment, including whether proposed scheme activities have been screened out, assessed in detail, or mitigated against.
- A description of potential impacts on water body status, including a summary of the activities that cause the impact, and a breakdown of the water bodies and quality elements that they affect.
- A description of the mitigation measures that are required to address any impacts, and prevent deterioration in status or failure to meet WFD objectives set for the relevant water bodies.
- A description of any monitoring that is required, in order to demonstrate that the scheme will not result in impacts on water body status.
- A description of any improvements that can be implemented as part of the proposed development.

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