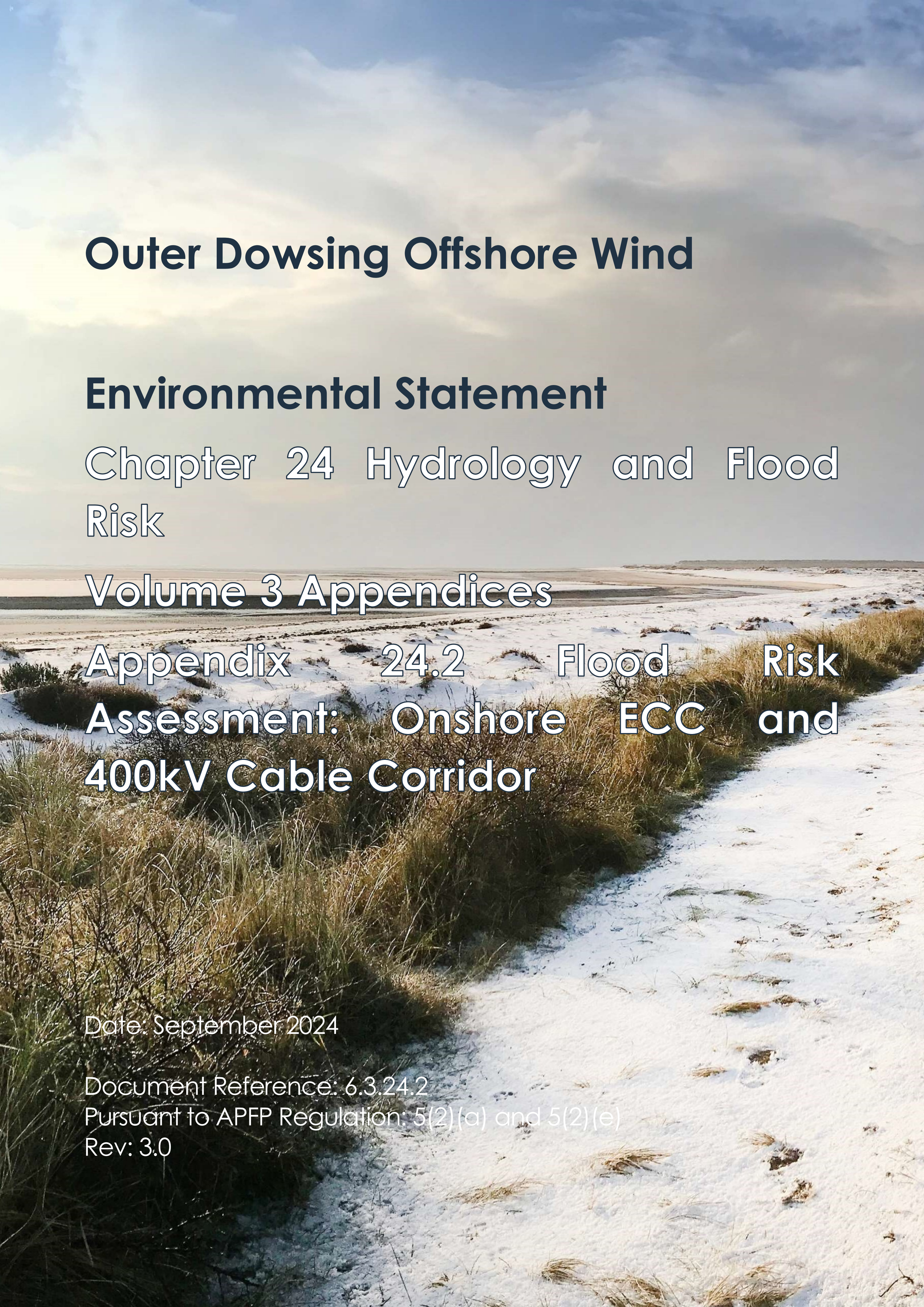

Outer Dowsing Offshore Wind

Environmental Statement

Chapter 24 Hydrology and Flood Risk

Volume 3 Appendices

Appendix 24.2 Flood Risk Assessment: Onshore ECC and 400kV Cable Corridor

Date: September 2024

Document Reference: 6.3.24.2
Pursuant to APFP Regulation: 5(2)(a) and 5(2)(e)
Rev: 3.0

Company:	**Outer Dowsing Offshore Wind**	Asset:	**Whole Asset**
Project:	**Whole Wind Farm**	Sub Project/Package:	Whole Asset
Document Title or Description:	Appendix 24.2 Flood Risk Assessment: Onshore EC and 400kV Cable Corridor		
Internal Document Number:	PP1-ODOW-DEV-CS-REP-0195_03	3rd Party Doc No (If applicable):	N/A

Rev No.	**Date**	**Status / Reason for Issue**	**Author**	**Checked by**	**Reviewed by**	**Approved by**
1.0	March 2024	DCO Application	SLR	GoBe	Shepherd and Wedderburn	Outer Dowsing
2.0	July 2024	Response to Section 51 Advice	SLR	Outer Dowsing	Shepherd and Wedderburn	Outer Dowsing
3.0	September 2024	Response to Rule 17 Request dated 31 July	SLR	Outer Dowsing	Shepherd and Wedderburn	Outer Dowsing

Appendix 24.2 Flood Risk Assessment Onshore Export Cable Corridor and 400kV Cables

Outer Dowsing Offshore Wind Environmental Statement

GoBe Consultants Ltd

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SLR Project No.: 410.V05356.00013

Client Reference No: 05356
19 September 2024
Revision: V3.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V1.0	1 March 2024	SLR Consulting Ltd	GoBe	Outer Dowsing Offshore Wind
V2.0	June 2024	SLR Consulting Ltd	Outer Dowsing Offshore Wind	Outer Dowsing Offshore Wind
V3.0	September 2024	SLR Consulting Ltd	Outer Dowsing Offshore Wind	Outer Dowsing Offshore Wind

Basis of Report

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Acronyms and Abbreviations

Acronym	Description
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
BSI	British Standards Institution
CC	Climate Change
CFB	Coastal Flood Boundary
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
DCO	Development Consent Order
DEFRA	Department for Environment, Food & Rural Affairs
DTM	Digital Terrain Model
EA	Environment Agency
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FRA	Flood Risk Assessment
GW	Gigawatt
HDD	Horizontal Directional Drilling
IDB	Internal Drainage Board
LB	Link Box
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LPA	Local Planning Authority
NGR	National Grid Reference
NGSS	National Grid Substation
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind, trading name of GT R4 Limited
OnSS	Onshore Substation
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment

Acronym	Description
SMP	Soil Management Plan
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
TJB	Transition Joint Bay
UK	United Kingdom
WFD	Water Framework Directive

Terminology

Term	Definition
400kV cables	High-voltage cables linking the OnSS to the NGSS.
Baseline	The status of the environment at the time of assessment without the development in place.
Cable Circuit	A number of electrical conductors necessary to transmit electricity between two points bundled as one cable or taking the form of separate cables, and may include one or more auxiliary cables (normally fibre optic cables).
Connection Area	An indicative search area for the NGSS.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the sensitivity of the receptor, in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the EIA.
Export Cables	High voltage cables which transmit power from the Offshore Substations (OSS) to the Onshore Substation (OnSS) via an Offshore Reactive Compensation Platform (ORCP) if required, which may include one or more auxiliary cables (normally fibre optic cables).
Haul Road	The track within the onshore ECC which the construction traffic would use to facilitate construction.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Intertidal	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Joint bays	An excavation formed with a buried concrete slab at sufficient depth to enable the jointing of high voltage power cables.

Term	Definition
Landfall	The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore.
Link boxes	Underground metal chamber placed within a plastic and/or concrete pit where the metal sheaths between adjacent export cable sections are connected and earthed.
Mitigation	Mitigation measures are commitments made by the Project to reduce and/or eliminate the potential for significant effects to arise as a result of the Project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects.
National Policy Statement (NPS)	A document setting out national policy against which proposals for Nationally Significant Infrastructure Projects (NSIPs) will be assessed and decided upon.
Offshore Reactive Compensation Platform (ORCP)	A structure attached to the seabed by means of a foundation, with one or more decks and a helicopter platform (including bird deterrents) housing electrical reactors and switchgear for the purpose of the efficient transfer of power in the course of HVAC transmission by providing reactive compensation.
Offshore Substation (OSS)	A structure attached to the seabed by means of a foundation, with one or more decks and a helicopter platform (including bird deterrents), containing— (a) electrical equipment required to switch, transform, convert electricity generated at the wind turbine generators to a higher voltage and provide reactive power compensation; and (b) housing accommodation, storage, workshop auxiliary equipment, radar and facilities for operating, maintaining and controlling the substation or wind turbine generators.
Onshore Export Cable Corridor (ECC)	The Onshore Export Cable Corridor (Onshore ECC) is the area within which the export cables running from the landfall to the onshore substation will be situated.
Onshore Substation (OnSS)	The Project's onshore High Voltage Alternating Current (HVAC) substation, containing electrical equipment, control buildings, lightning protection masts, communications masts, access, fencing and other associated equipment, structures or buildings; to enable connection to the National Grid.
Order Limits	The area subject to the application for development consent. The limits shown on the works plans within which the Project may be carried out.
Outer Dowsing Offshore Wind (ODOW)	The Project.
Pre-construction and post-construction	The phases of the Project before and after construction takes place.
Preliminary Environmental Information Report (PEIR)	The PEIR was written in the style of a draft Environmental Statement (ES) and provided information to support and inform the statutory consultation process during the pre-application phase.
The Project	Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as

Term	Definition
	'residential' or those using areas for amenity or recreation), watercourses etc.
Study Area	Area(s) within which environmental impact may occur – to be defined on a receptor-by-receptor basis by the relevant technical specialist.
Transition Joint Bays (TJBs)	The offshore and onshore cable circuits are jointed on the landward side of the sea defences/beach in a Transition Joint Bay (TJB). The TJB is an underground chamber constructed of reinforced concrete which provides a secure and stable environment for the cable.
Trenchless technique	Trenchless technology is an underground construction method of installing, repairing and renewing underground pipes, ducts and cables using techniques which minimize or eliminate the need for excavation. Trenchless technologies involve methods of new pipe installation with minimum surface and environmental disruptions. These techniques may include Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

Reference Documentation

Document Number	Title
6.1.3	Project Description
6.1.24	Hydrology, Hydrogeology and Flood Risk
6.3.24.3	Flood Risk Assessment: Onshore Substation
8.1	Outline Code of Construction Practice
8.1.3	Outline Soil Management Plan
8.1.5	Outline Surface Water and Drainage Strategy

24.0 Flood Risk Assessment Onshore Export Cable Corridor and 400kV Cables

24.1 Introduction

24.1.1 Overview

1. A Flood Risk Assessment (FRA) has been prepared for the proposed works to be undertaken during the construction and operation of the onshore Export Cable Corridor (ECC) and 400kV Cables for Outer Dowsing Offshore Wind (ODOW) ("the Project").

2. A full description of the works is provided in Volume 1, Chapter 3: Project Description (document reference 6.1.3) of the Environmental Impact Assessment (EIA).

3. The Project is a proposed offshore windfarm located approximately 54km off the Lincolnshire Coast, it is anticipated to generate renewable electricity equivalent to the annual electricity consumption of over 1.6 million households.

4. The offshore cables will be brought ashore at the cable landfall at Wolla Bank, south of Anderby Creek, north of the Wolla Bank Beach Car Park. The trenchless technique that will be adopted at the landfall is by Horizontal Directional Drilling (HDD) which is a proven technique. This method has been selected to avoid impacts on the coastal features and habitat in the area, as well as the existing infrastructure, sea defence and ornithological and ecological receptors. The HDD operations will be carried out from the landfall site to the west of Roman Bank where ducts would be installed under the intertidal and sea-defence zone by HDD; once complete, the offshore export cables will be brought ashore and jointed to the onshore export cables at the Transition Joint Bays (TJBs).

5. The TJB are covered once the joints are constructed and the land above is reinstated. The covers above each TJB chamber will either be buried or set flush with the surrounding ground level. Permanent access will be required at the TJB sites taken from Roman Bank Road.

6. The onshore ECC will comprise up to four cable circuits, each made up of three electrical cables, buried within trenches to a minimum depth of 1.2m. One or more fibre optic cables will also be installed alongside each circuit. The maximum width of each cable trench at the surface will be up to 5m, and a haul track will also be constructed along much of the length of the onshore ECC to facilitate construction traffic movements. The total width of the permanent corridor will be up to 60m, whilst the construction corridor will be up to 80m to allow for construction plant movements and sub and topsoil storage.

7. Once constructed, the access covers for the link boxes (LBs) will also be visible at the ground surface. These are used to house connections between the cable shielding, joints for fibre optic cables and other auxiliary equipment. These access covers are likely to be manhole type covers used for access during the operational phase.
8. The majority of trenches will be excavated using open cut techniques, however some sections, at sensitive crossings, main roads, and significant watercourses will be crossed using trenchless techniques, such as HDD.
9. Once the onshore ECC is constructed, there will be no development relating to the ECC above ground and the infrastructure will be sealed and is considered water compatible.

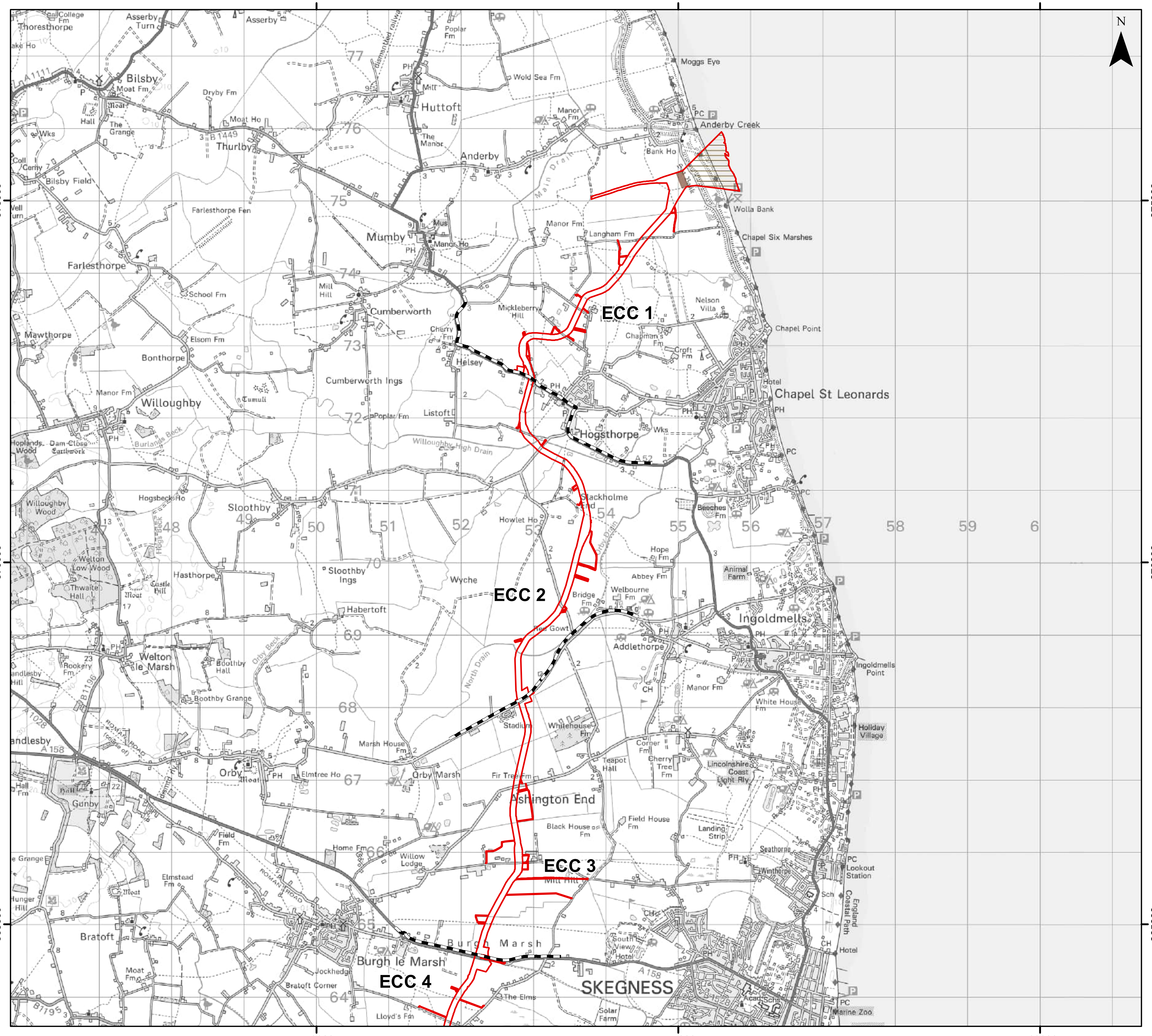
24.1.2 Context and Site Location

10. Cables will connect the turbines to the offshore substation platforms and then export the power generated to shore by export cables. The offshore ECC will make landfall at Wolla Bank, to the south of Anderby Creek where cables will be installed using trenchless techniques to pass under the sand dunes and coastal wildlife sites to connect into the TJB on agricultural land to the west of Roman Bank. From landfall, the ECC is proposed to run south to the onshore substation (OnSS) at Surfleet Marsh and 400kV cables running to the grid connection point at Weston Marsh. A site location plan is provided in Figure 24.2.1.
11. The onshore study area for Hydrology, Hydrogeology and Flood Risk is defined by the draft Order Limits, this has been split into a number of segments which describe the significant local features along the ECC.
12. The ECC segments from landfall to Weston Marsh are shown in Figure 24.2.1 and listed below:

- ECC 1: Landfall to A52 - Hogsthorpe;
- ECC 2: A52 - Hogsthorpe to Marsh Lane;
- ECC 3: Marsh Lane to A158 - Skegness Road;
- ECC 4: A158 - Skegness Road to Low Road;
- ECC 5: Low Road to Steeping River;
- ECC 6: Steeping River to Fodder Dike Bank/Fen Bank;
- ECC 7: Fodder Dike Bank/Fen Bank to Broadgate;
- ECC 8: Broadgate to Ings Drove;
- ECC 9: Ings Drove to Church End Lane;
- ECC 10: Church End Lane to The Haven;

- ECC 11: The Haven to Marsh Road;
- ECC 12: Marsh Road to Fosdyke Bridge;
- ECC 13: Fosdyke Bridge to Surfleet Marsh OnSS/Marsh Drove; and
- ECC 14: Surfleet Marsh OnSS/Marsh Drove to Weston Marsh NG Substation, within the Connection Area.

13. A separate FRA for the OnSS is provided as document reference 6.3.24.3).



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

Coordinate System: British National Grid

0 1 2 km

Scale: 1:50,000

A3 Page Size

Environmental Statement

Site Location Plan

Figure 24.2.1.1

OUTER DOWSING OFFSHORE WIND

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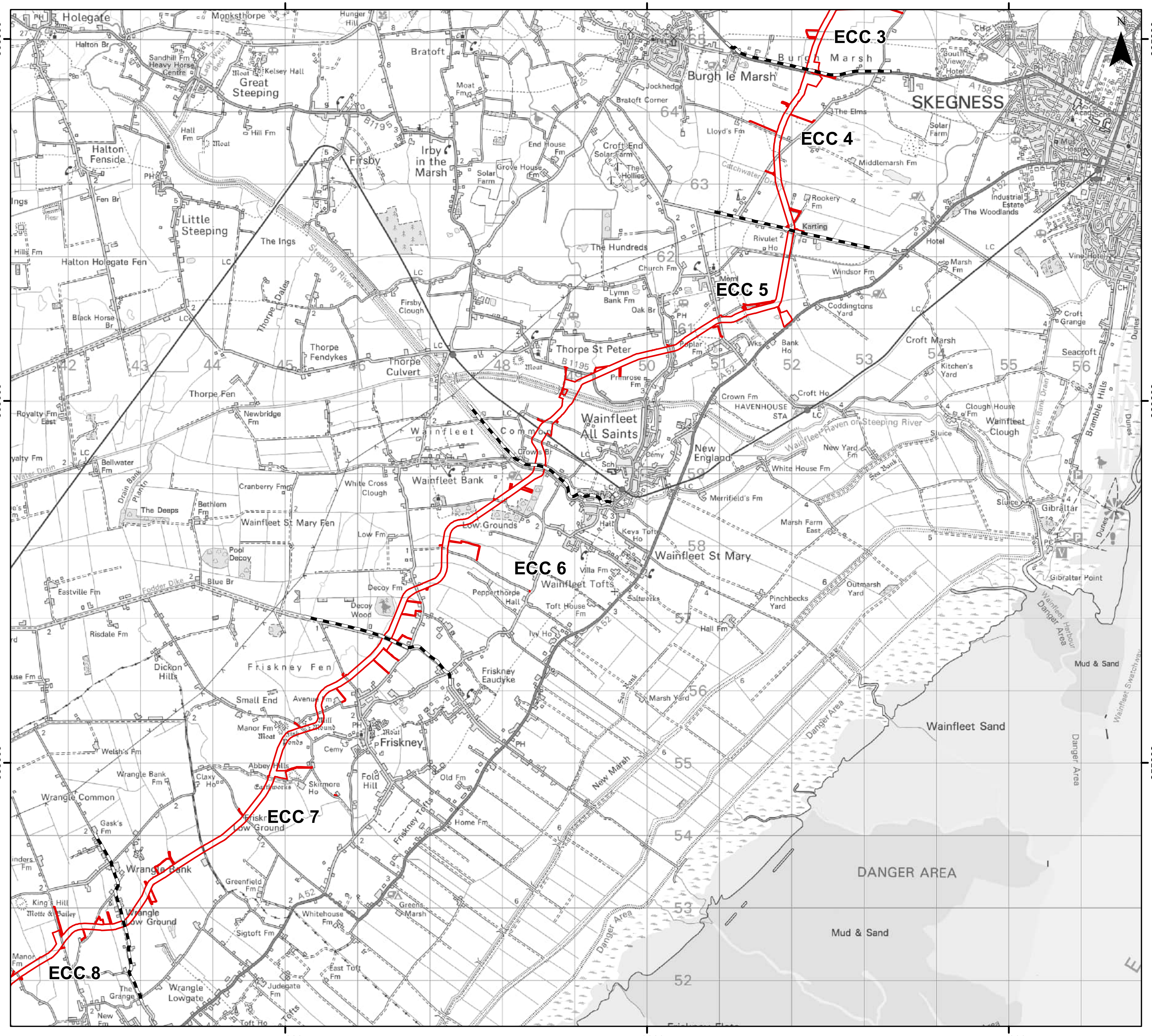

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Order Limits

Onshore Segment Break

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

Coordinate System: British National Grid

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Scale: 1:50,000

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Environmental Statement

Site Location Plan

Figure 24.2.1.2

OUTER DOWSING OFFSHORE WIND

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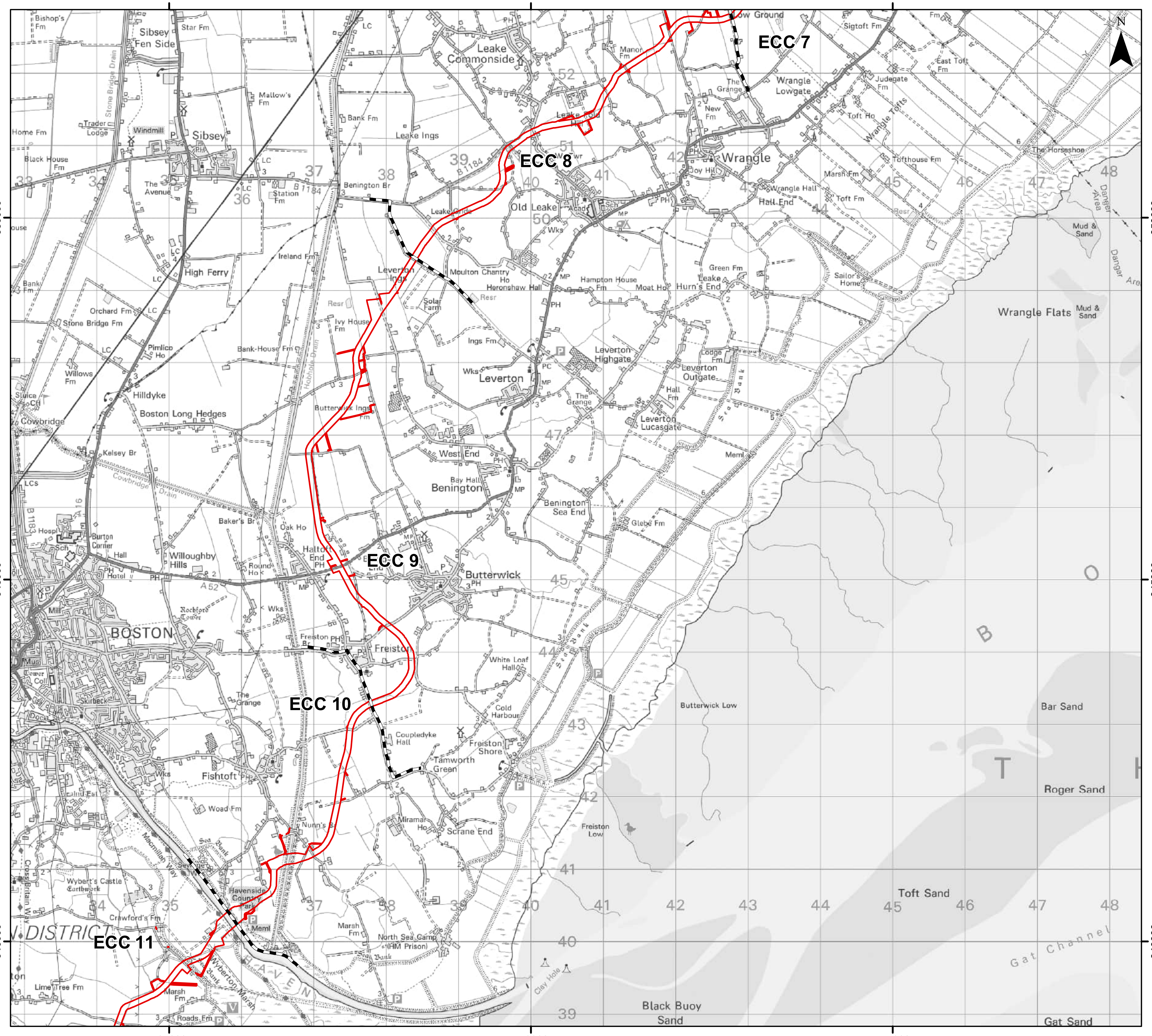

Legend

- Order Limits
- Onshore Segment Break

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

Coordinate System: British National Grid

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Scale: 1:50,000

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Site Location Plan

Figure 24.2.1.3

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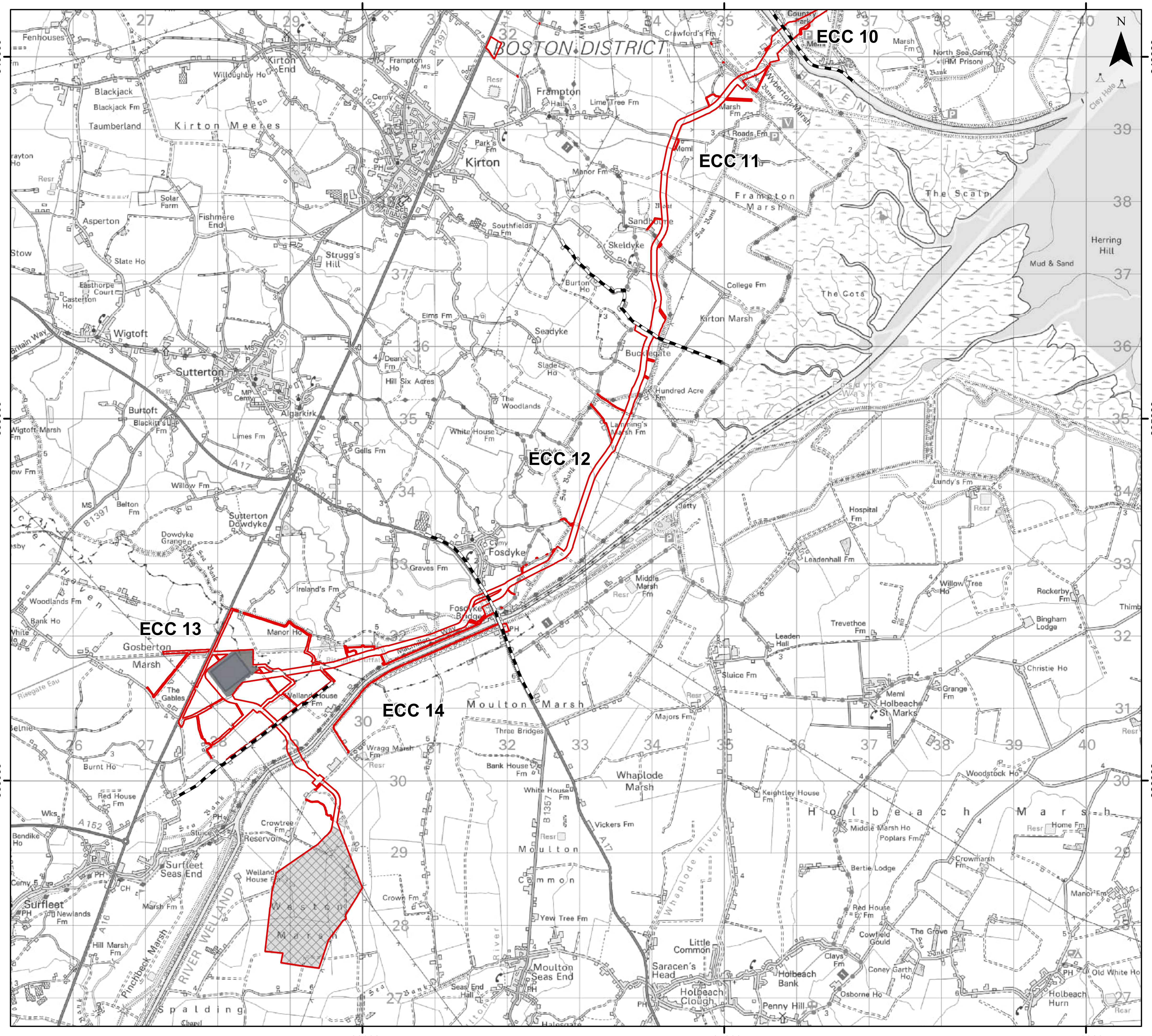

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

Coordinate System: British National Grid

0 1 2 km

Scale: 1:50,000

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Environmental Statement

Site Location Plan

Figure 24.2.1.4

OUTER DOWSING OFFSHORE WIND

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24.1.3 Background and Aims

14. The aim of the FRA is to outline the potential for the onshore ECC to be impacted by flooding, the impacts of the works associated with establishing the onshore ECC on flooding, and the proposed measures which could be incorporated to mitigate any identified risk. The report has been produced in accordance with the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government, 2023 and its associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (Ministry of Housing, Communities and Local Government, 2022), in addition to Paragraph 5.8.13 – 5.8.23 of the NPS EN-1 (DESNZ, 2023). Current best practice documents relating to assessment of flood risk published by the British Standards Institution BS8533 (BSI, 2017) has also been taken into account.

24.1.4 Data Sources Considered

15. In assessing the flood risk to the onshore ECC, the following data sources have been reviewed:

- ODOW Scoping Report;
- ODOW Preliminary Environmental Information Report (PEIR) and associated consultee responses;
- Mapping published on the Environment Agency (EA) website:
  - Risk of Flooding from Rivers and Sea:
    - Flood Map for Planning (EA, 2023a); and
    - Long Term Flood Risk Information (EA, 2023b).
  - Risk of Flooding from Reservoirs:
    - Environment Agency Long Term Flood Risk Information (EA, 2023b).
  - Risk of Flooding from Surface Water:
    - Environment Agency Long Term Flood Risk Information (EA, 2023b).
- British Geological Survey (BGS, accessed October 2023) mapping for details of superficial and bedrock geology, http://mapapps.bgs.ac.uk/geologyofbritain/home.html;
- Cranfield Soil and Agrifood Institute (Cranfield University, accessed October 2023) Soilscapes map viewer for soil information, http://www.landis.org.uk/soilscapes/;
- East Coast and Wash - 2018 Coastal Flood Boundary (CFB) Dataset (Environment Agency, 2021);
- East Lindsey Strategic Flood Risk Assessment, March 2017 (East Lindsey District Council, 2017);
- South East Lincolnshire Strategic Flood Risk Assessment, March 2017 (South East Lincolnshire Joint Strategic Planning Committee, 2017); and

- Department of Food and Rural Affairs (DEFRA)'s 'MAGIC' website (DEFRA, 2023).

24.1.5 Climate Change

16. The NPPF and NPS EN-1 requires that flood risk is considered over the lifetime of the onshore ECC and, therefore, consideration must be given to the potential impacts of climate change.

17. In February 2016 the Environment Agency published updated guidance on the impacts of climate change on flood risk in the UK to support NPPF. This was most recently updated in May 2022 (EA, 2022) and advice sets out that peak rainfall intensity, sea level, peak river flow, offshore wind speed, and extreme wave heights are all expected to increase in the future as a result of climate change. Consideration of the changes to these parameters should use the allowances outlined in Table 24.1, Table 24.2, and Table 24.3 based on the anticipated lifetime of the onshore ECC.

18. The guidance regarding climate change acknowledges that there is considerable uncertainty regarding the absolute level of change that is likely to occur. Therefore, the guidance provides estimates of the expected changes based upon different emissions scenarios over a number of different epochs.

19. Allowances in relation to offshore wind speed and extreme wave height are relevant to sites situated on the open coast. The Environment Agency coastal model data includes results from scenarios which include allowances for climate change. The modelling includes consideration of coastal flood defences (overtopping) and scenarios where coastal flood defences are breached.

24.1.5.1 Anticipated Lifetime of Development

20. The PPG to the NPPF classifies land uses into five categories. Utilities infrastructure such as these works is classified as 'Essential Infrastructure'. The onshore ECC is to be designed for a 35-year design life. It is anticipated that the Project will be operational by 2030, therefore it is anticipated the Project will be operational up to 2065. This falls within the 2050s epoch (2040 to 2069), when considering climate change allowances for river flow and sea level rise, and the 2070s epoch (2061 to 2125) for peak rainfall intensity.

24.1.5.2 Peak River Flow

21. The Environment Agency climate change guidance states that, for Essential Infrastructure within Flood Zones 2 or 3a and 3b, the ‘Higher Central’ allowance should be considered. The onshore ECC spans across two management catchments: Witham Management Catchment and Well and Management Catchment. As indicated by Table

24.1 below, the Higher Central allowance equates to 15% and 10% increases in peak river flow for respective catchments by the 2050s epoch based on the 35-year design life.

Table 24.1 Peak River Flow Climate Change Allowances

Management Catchment	Allowance Category	2020s (2015 to 2039)	2050s (2040 to 2069)	2080s (2070 to 2125)
Witham Management Catchment	Central	9%	8%	**21%**
	Higher Central	14%	15%	**32%**
	Upper End	27%	32%	**57%**
Welland Management Catchment	Central	5%	4%	**17%**
	Higher Central	10%	10%	**28%**
	Upper End	**22%**	**26%**	**53%**

24.1.5.3 Peak Rainfall Intensity

22. For peak rainfall intensity the PPG guidance states that flood risk assessments for 'Essential Infrastructure' Projects with a 35-year design life, the Central Allowance for the 2070's epoch (2061 to 2125) for both the 3.3% AEP storm event and 1% AEP storm event should be used. As shaded shown in Table 24.2, for both the Welland Management Catchment and Witham Management Catchment, this equates to a 25% uplift for both the 3.3% AEP and 1% AEP events.

Table 24.2 Peak Rainfall Intensity Climate Change Allowances

Management Catchment	Annual Exceedance Probability (%)	Allowance Category	2050s (2022 to 2060)	2070s (2061 to 2125)
Witham Management Catchment	3.3	Upper End	35%	**35%**
		Central	20%	**25%**
	1	Upper End	40%	**40%**
		Central	20%	**25%**
Welland Management Catchment	3.3	Upper End	35%	**35%**
		Central	20%	**25%**
	1	Upper End	40%	**40%**
		Central	**20%**	**25%**

24.1.5.4 Sea Level Rise

23. Climate change allowances guidance (EA, 2022) states that the predicted cumulative sea level rise for both the Higher Central and Upper End allowance should be assessed, calculated based upon the expected lifetime of the Project. Table 24.3 below details the

predicted sea level rise in mm per year for the Anglian region, with the cumulative amount for each respective epoch in brackets.

Table 24.3 Sea Level Allowances for the Anglian River Basin District per year (Epoch Total in Brackets)

River Basin District	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative Rise 2000 to 2125 (m)
Anglian	Higher Central	5.8	8.7	11.6	13	**1.20**
		(203)	(261)	(348)	(390)	
	Upper End	7	11.3	15.8	18.1	**1.60**
		(245)	**(339)**	**(474)**	**(543)**	

24. Using a baseline year of 2018, and based upon a Project lifetime of up to 2065, the predicted total cumulative sea level rise for the Upper End scenario using Table 24.3 is 458mm.

24.1.5.5 H++ Sea Level Allowances

25. Climate change allowances guidance (EA, 2022) states that for a Nationally Significant Infrastructure Project (NSIP), the H++ climate change allowances should also be used as the credible maximum climate change scenario. It is advised that the H++ climate change allowances should be applied as a sensitivity test to help assess how sensitive the Project is to changes in the climate for different future scenarios to ensure that the Project can be adapted to large-scale climate change over its lifetime.

24.2 Baseline Context

24.2.1 Local Hydrology

26. Six Environment Agency Main Rivers (EA, 2023c) are present across or around the onshore ECC, and are listed below:

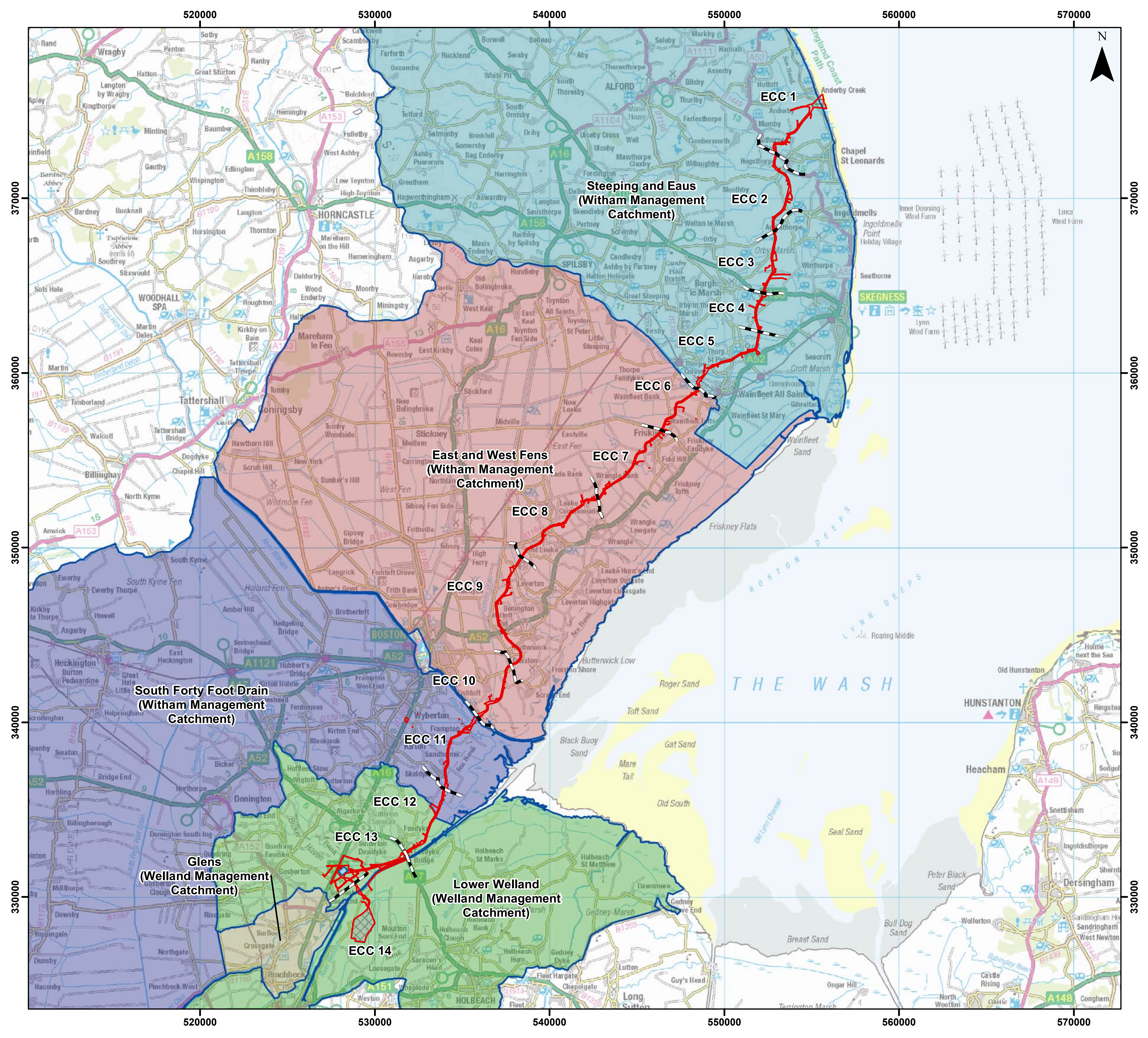
- Willoughby High Drain;
- The Lymn;
- Wainfleet Relief Channel;
- Steeping River;
- The Haven (Witham); and
- River Welland.

27. Several ordinary watercourses also flow across the onshore ECC serving as tributaries to the Main Rivers. There are also numerous Internal Drainage board (IDB) owned or maintained drains within the onshore ECC

28. The Environment Agency's Water Framework Directive (WFD) surface water Operational Catchments (EA, 2021) have been used to identify the surface water drainage catchments within this FRA.

29. The onshore ECC is located within the following four surface water Operational Catchments, which are also shown on Figure 24.2.2 below.

- Steeping and Eaus;
- Fens East and West;
- South Forty Foot Drain; and
- Welland Lower.



Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Landfall Trenchless Works
- Transition Joint Bay
- Connection

Surface Water Operational Catchments

- East and West Fens
- Glens
- Lower Welland
- South Forty Foot Drain
- Steeping and Eaus

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Coordinate System: British National Grid

0 5 10 km

Scale: 1:200,000

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Environmental Statement

Surface Water Operational Catchments

Figure 24.2.2

OUTER DOWSING OFFSHORE WIND

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24.2.1.1 Steeping and Eaus

30. The Steeping and Eaus Operational Catchment is a predominately rural catchment with small settlements. The catchment is predominately underlain by chalk bedrock geology, from which a number of chalk streams rise.

31. The Main Rivers within this Operational Catchment that cross the onshore ECC are:

- Willoughby High Drain;
- Wainfleet Haven;
- Steeping River; and
- The Lymn.

32. There are also numerous ordinary watercourses and IDB maintained drains within this Operational Catchment. The IDB drains within this Operational Catchment are operated and maintained by Lindsey Marsh IDB.

24.2.1.2 Fens East and West

33. The Fens East and West Operational Catchment includes the significant ordinary watercourses of West Fen Catchwater, Maud Foster Drain, and the Witham Drains. There are no Main Rivers located within this Operational Catchment. The north of the catchment uses the East and West Fen Catchment Drains, which intercept water from higher ground before discharging into the Haven at Boston. The Witham Drains discharge surface water runoff from the low-lying fenland areas and supply water for irrigation in summer months. These drains are operated and maintained by the Witham Fourth District IDB.

34. In addition to the above, there are numerous other ordinary watercourses and IDB maintained drains within this Operational Catchment.

24.2.1.3 South Forty Foot Drain

35. The South Forty Foot Drain Operational Catchment is predominately agricultural, with small settlements and drains the fenland areas of South Lincolnshire to the southwest of Boston. The South Forty Foot Drain is an ordinary watercourse which discharges into the Witham Haven in Boston via the Black Sluice pumping station. These drains and pumping station are operated and maintained by the Black Sluice IDB There are no Main Rivers within this Operational Catchment.

36. There are numerous other ordinary watercourses and IDB maintained drains within this Operational Catchment.

24.2.1.4 Lower Welland

37. The Lower Welland Operational Catchment starts to the south of Stamford, collecting urban run-off from Peterborough before ultimately draining to the River Welland, an Environment Agency Main River which runs across the Fens to Spalding, where the watercourse becomes tidal. The River Welland discharges into the North Sea via The Wash. It is an important source of water for agricultural use and is used to feed numerous IDB drains, which supply agricultural water to the arable and horticultural industries. The River Welland is the only Main River within this catchment. The IDB drains within this Operational Catchment are operated and maintained by the Welland and Deepings IDB and South Holland IDB (also the North Level IDB, but not in the area affected by the ECC).

24.2.2 Geology

38. A review of BGS mapping (BGS, 2023) for the area, as shown on Figure 24.2.3 and Figure 24.2.4 below shows the geology to be as follows across the onshore ECC:

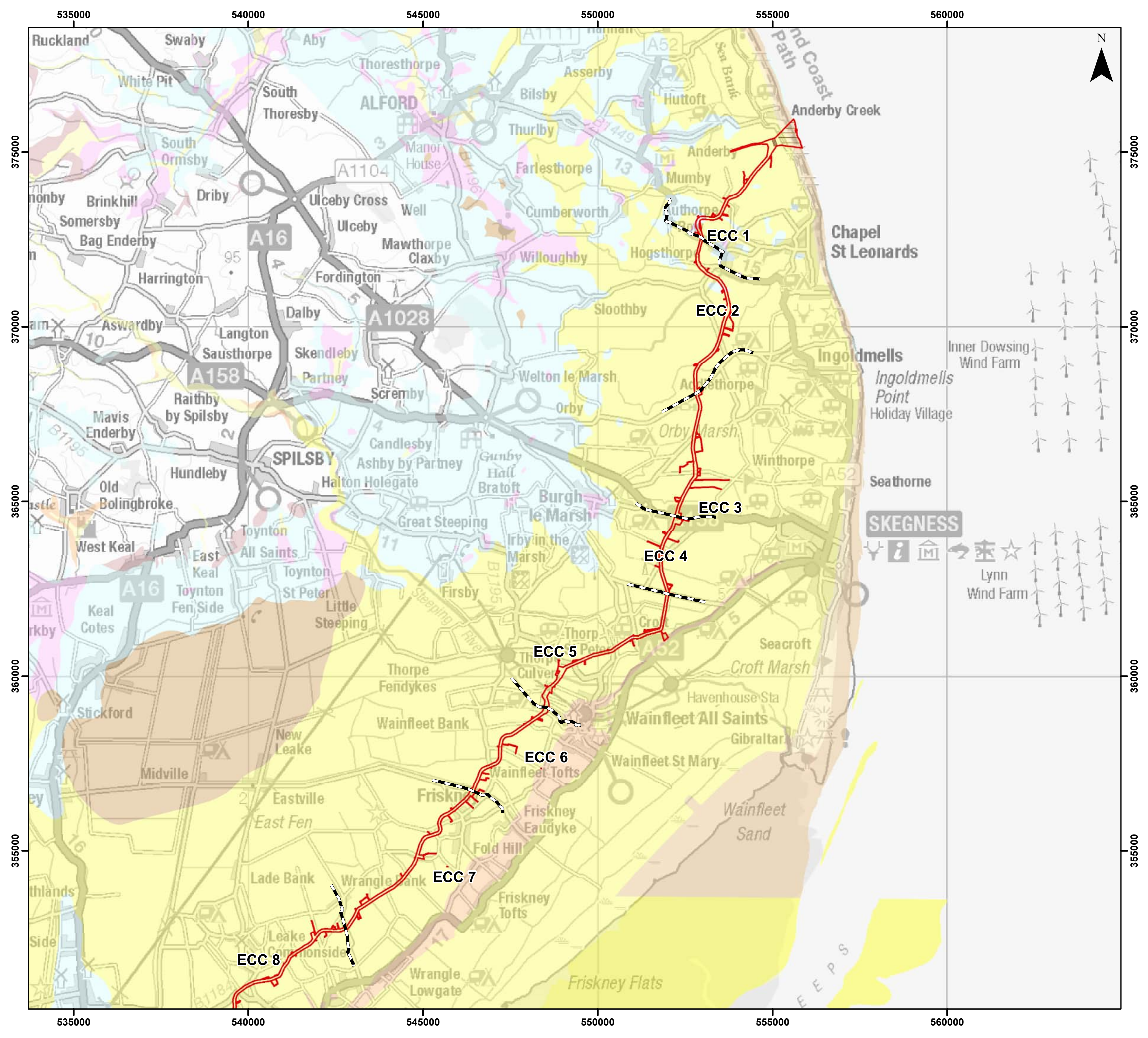
- Superficial Deposits:
  - Tidal Flat Deposits - clay and silt; and
  - Devensian Till - diamicton.
- Bedrock Geology:
  - Burnham Chalk Formation - chalk;
  - Welton Chalk Formation - chalk;
  - Ferriby Chalk Formation - chalk;
  - Carstone Formation - sandstone;
  - Claxby Ironstone Formation, Tealby Formation and Roach Formation (undifferentiated) - mudstone and limestone interbedded;
  - Spilsby Sandstone Formation - sandstone;
  - Kimmeridge Clay Formation - mudstone;
  - Ampthill Clay Formation - mudstone;
  - West Walton Formation - mudstone and siltstone; and
  - Oxford Clay Formation - mudstone.

39. Soilscapes (DEFRA, 2023) data indicates that the onshore ECC covers three categories which are as follows:

- Soilscape 21: 'Loamy and clayey soils of coastal flats with naturally high groundwater, with a loamy and clayey texture'. Drainage is classified as being 'naturally wet' and drains to local groundwater;

- Soilscape 18: ‘Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, with loamy and clayey texture’. Drainage is noted as being impeded, with grassland and arable and some woodland landcover; this drains to the stream network; and
- Soilscape 23: ‘Loamy and sandy soils with naturally high groundwater and a peaty surface’. Drainage is classified as being 'naturally wet' and drains to local shallow groundwater.

40. The loamy and clayey soils of the Soilscape 21 group covers the majority of the onshore ECC with some localised areas of the more slowly permeable and seasonally wet soils of the Soilscape 18 group present to the north of the onshore ECC at Mumby and Hogsthorpe. An area of loamy and sandy soils of the Soilscape 23 group is also present to the southwest of Wainfleet All Saints.



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Superficial Geology

- Bank Deposits – Sand
- Beach And Tidal Flat Deposits - Clay, Silt And Sand
- Bedrock at or Near Surface
- Blown Sand – Sand
- Glaciofluvial Deposits, Devensian - Sand And Gravel
- Peat – Peat
- Storm Beach Deposits - Sand And Gravel
- Storm Beach Deposits - Sand And Silt
- Tidal Flat Deposits - Clay And Silt
- Till, Devensian – Diamicton

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

Sources:
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Environmental Statement

Superficial Geology

Figure 24.2.3.1

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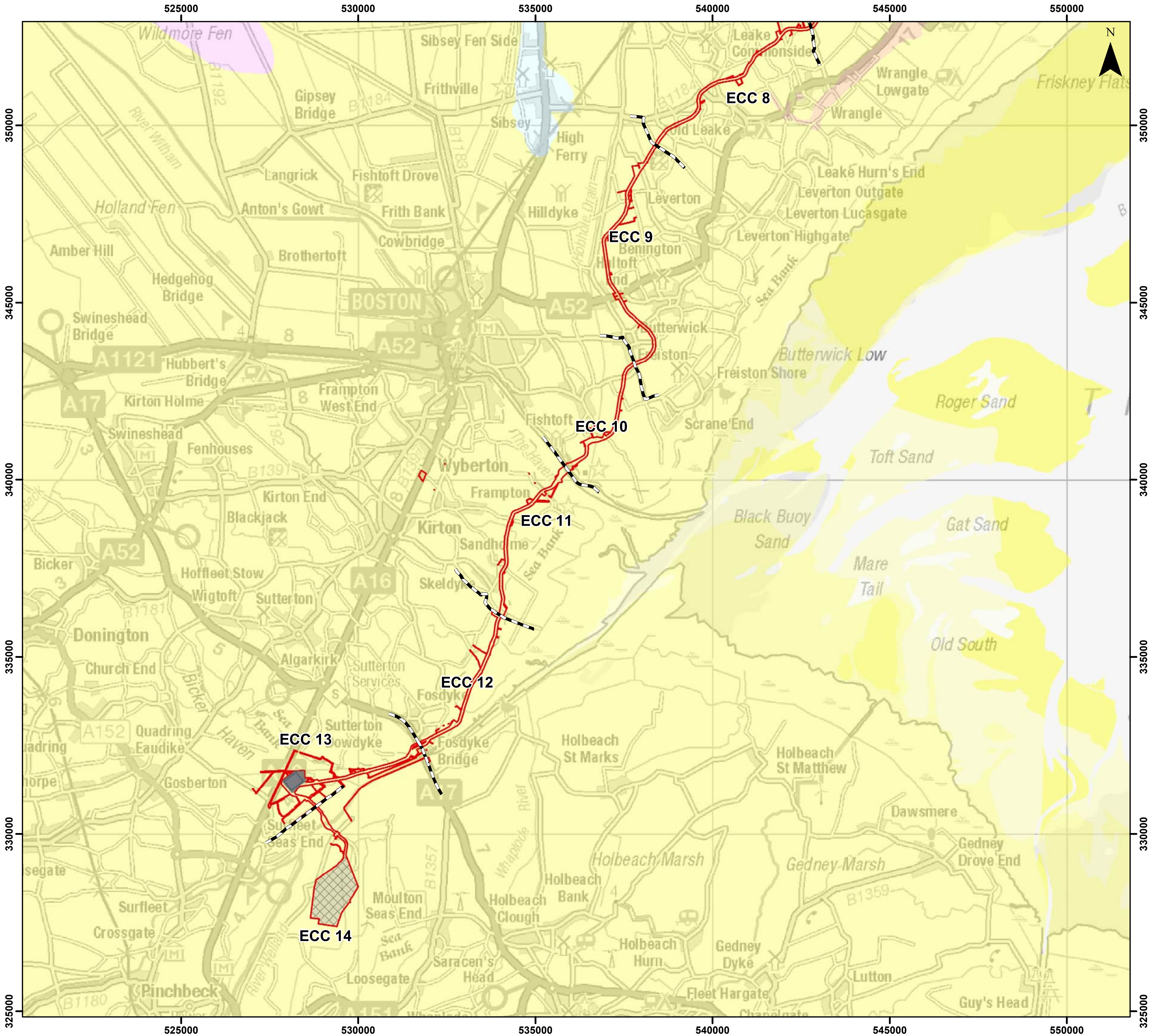

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Superficial Geology

- Bank Deposits – Sand
- Beach And Tidal Flat Deposits - Clay, Silt And Sand
- Bedrock at or Near Surface
- Blown Sand – Sand
- Glaciofluvial Deposits, Devensian - Sand And Gravel
- Peat – Peat
- Storm Beach Deposits - Sand And Gravel
- Storm Beach Deposits - Sand And Silt
- Tidal Flat Deposits - Clay And Silt
- Till, Devensian – Diamicton

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Superficial Geology

Figure 24.2.3.2

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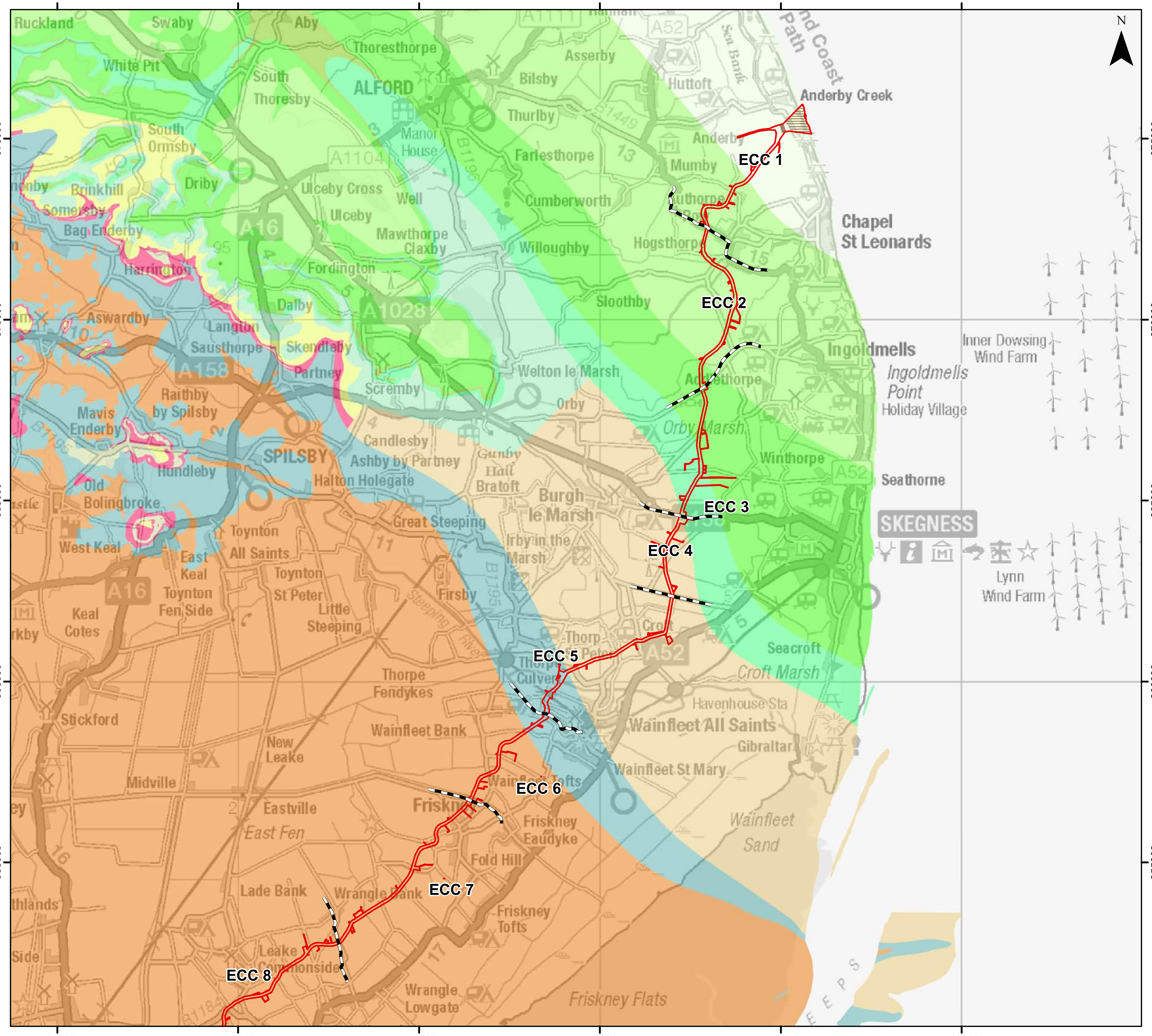

Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Sedimentary Bedrock

Cretaceous:
- Burnham Chalk Formation – Chalk
- Welton Chalk Formation – Chalk
- Ferriby Chalk Formation – Chalk
- Hunstanton Formation – Chalk
- Carstone Formation – Sandstone
- Roach Formation - Mudstone And Limestone, Interbedded
- Claxby Ironstone Formation, Tealby Formation And Roach Formation - Mudstone And Limestone, Interbedded
- Spilsby Sandstone Formation – Sandstone

Jurassic:
- Kimmeridge Clay Formation – Mudstone
- Ampthill Clay Formation – Mudstone
- West Walton Formation - Mudstone And Siltstone
- Oxford Clay Formation – Mudstone

Note:
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Environmental Statement

Bedrock Geology

Figure 24.2.4.1

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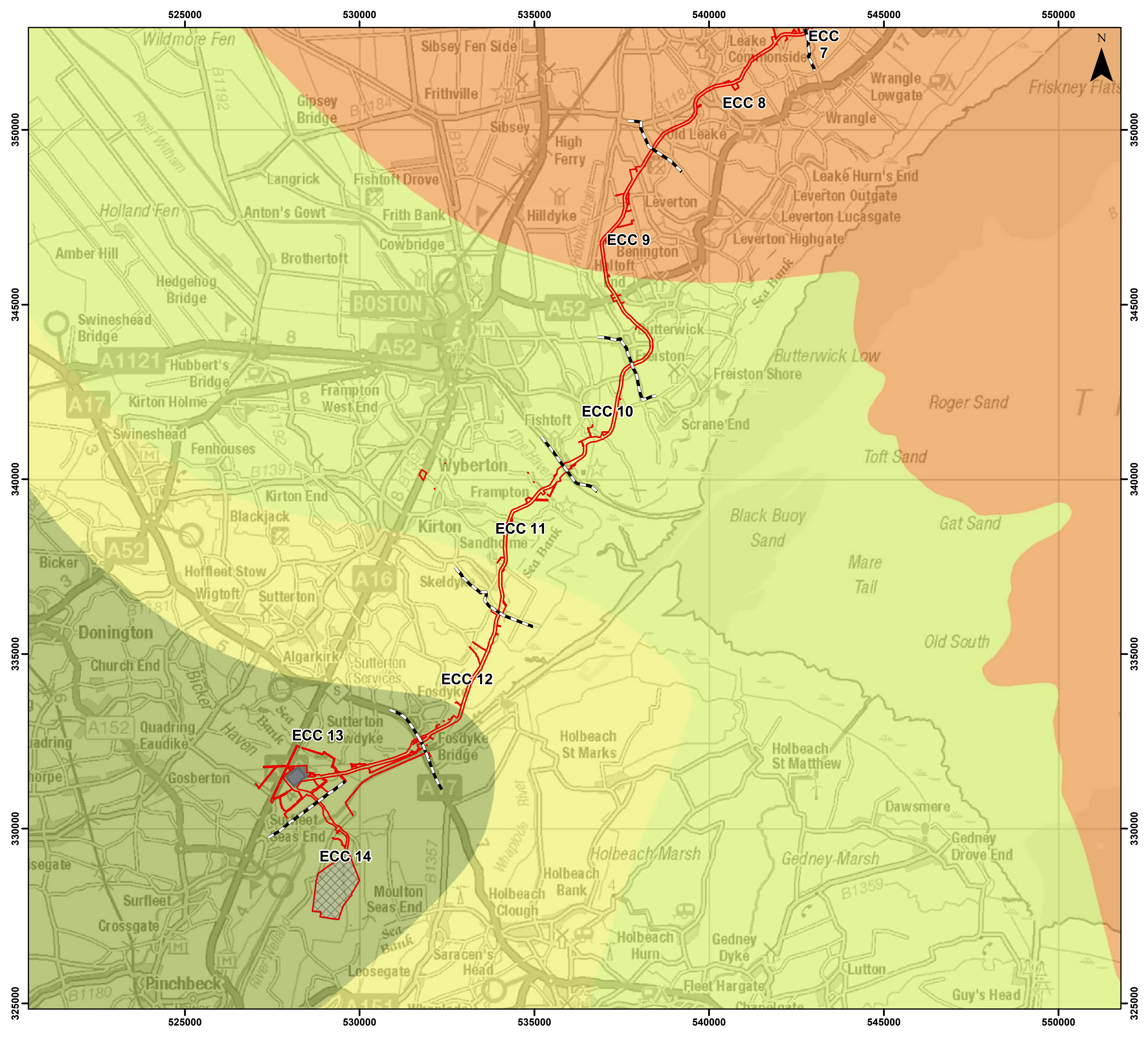

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Sedimentary Bedrock

Cretaceous:
- Burnham Chalk Formation – Chalk
- Welton Chalk Formation – Chalk
- Ferriby Chalk Formation – Chalk
- Hunstanton Formation – Chalk
- Carstone Formation – Sandstone
- Roach Formation - Mudstone And Limestone, Interbedded
- Claxby Ironstone Formation, Tealby Formation And Roach Formation - Mudstone And Limestone, Interbedded

Jurassic:
- Spilsby Sandstone Formation – Sandstone
- Kimmeridge Clay Formation – Mudstone
- Ampthill Clay Formation – Mudstone
- West Walton Formation - Mudstone And Siltstone
- Oxford Clay Formation – Mudstone

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Bedrock Geology

Figure 24.2.4.2

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24.2.3 Hydrogeology

24.2.3.1 Superficial Deposits

41. The superficial deposits across the majority of the onshore ECC are identified as Tidal Flat Deposits (clay and silt). This geology is designated as Unproductive aquifer, which is largely unable to provide useable water supplies and is unlikely to have surface water and wetland ecosystems dependent on them.

42. There are small, localised areas of Devensian Till (diamicton) along the onshore ECC route. These deposits are designated as Secondary (undifferentiated) aquifers. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.

24.2.3.2 Bedrock

43. The chalk bedrock geology (Burnham Chalk Formation, Welton Chalk Formation and Ferriby Chalk Formation) and Carstone Formation (sandstone) underlying the northern part of the onshore ECC are designated as Principal aquifers. Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and transmission. They may support water supply and/or river base flow on a strategic scale.

44. The Claxby Ironstone Formation, Tealby Formation and Roach Formation (mudstone and limestone interbedded) located south of the Principal aquifer and are designated as a Secondary B aquifer. Secondary B aquifers are mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks (called fissures) and openings or eroded layers. The Spilsby Sandstone Formation (sandstone) located south of the Secondary B aquifer is also designated as a Principal aquifer.

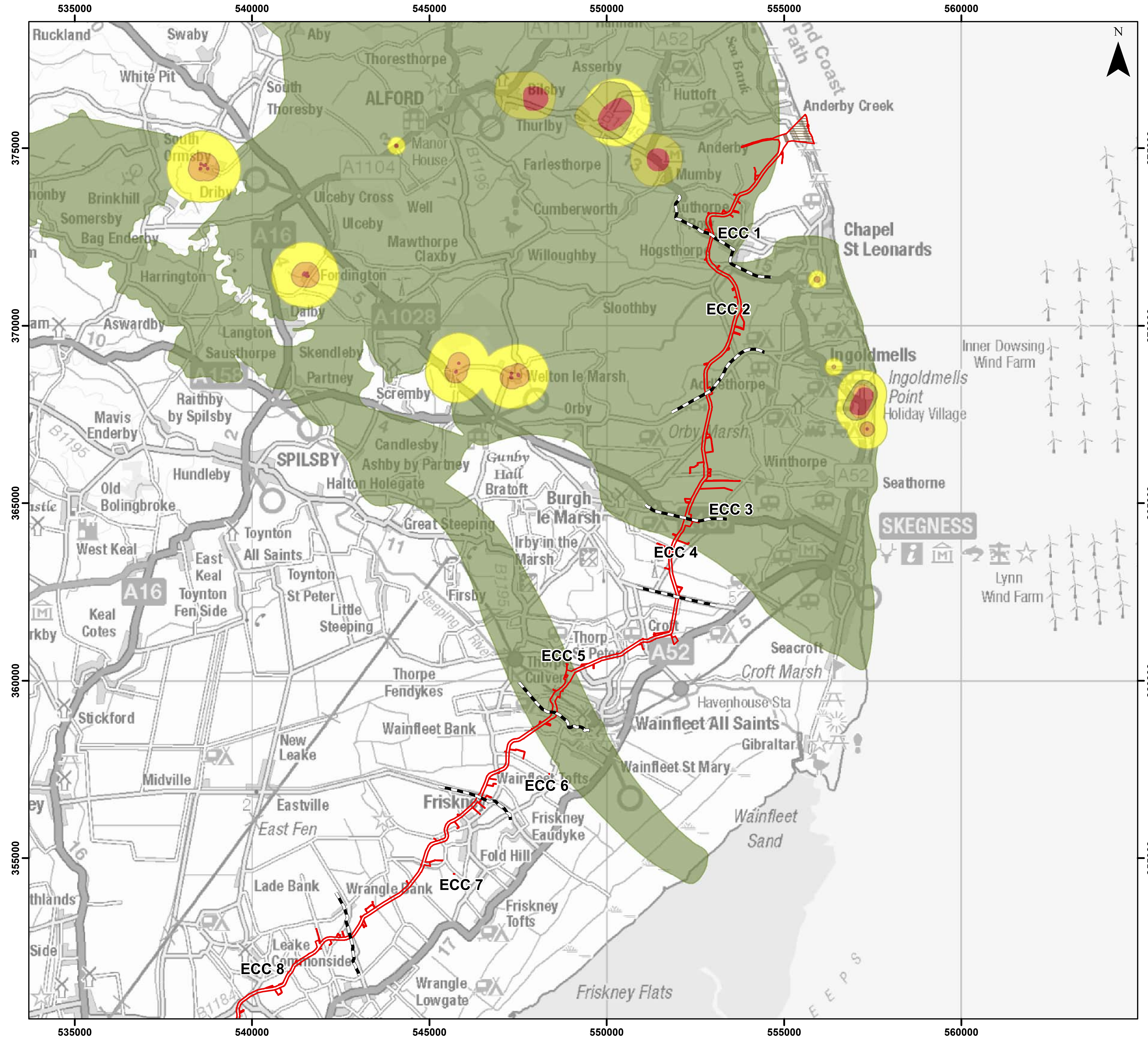
45. The remaining bedrock geology underlying the onshore ECC consists of mudstone and siltstone and are designated as Unproductive aquifers which are largely unable to provide useable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them.

24.2.3.3 Source Protection Zones

46. Segments ECC 1 - 3 of the onshore ECC route, along with the northernmost part of segment ECC 4 are located within Zone 3 of a Source Protection Zone (SPZ), as shown below in Figure 24.2.5. Zone 3 of a SPZ is the area around a supply source within which all the groundwater ends up at the abstraction point, however the time taken for groundwater to reach the

abstraction point could exceed 400-days. There is also a small area of Zone 3 SPZ, which cuts through Wainfleet All Saints, which falls within segment ECC 5.

47. The remainder of the ECC route, from the south of Wainfleet St Mary to the OnSS located at Surfleet Marsh and National Grid substation located at Weston Marsh, is not located within a SPZ.



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works
- Transition Joint Bay Area

Source Protection Zones

- 1
- 1c
- 2
- 2c
- 3

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Source Protection Zones

Figure 24.2.5.1

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Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection
- Area not Included in Export Cable Corridor Flood Risk Assessment

Note:
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Source Protection Zones

Figure 24.2.5.2

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24.3 Planning Policy & Guidance

48. The ECC, as part of the wider ODOW Project, will be subject to a Development Consent Order (DCO).

24.3.1 Flood Zone Classification

49. The definition of Environment Agency flood zones is provided in PPG Table 1: Flood Zones:

- Zone 1 - Low Probability (Flood Zone 1) is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% annual probability of occurrence (1 in 1,000-year) i.e., considered to be at 'low probability' of flooding.
- Zone 2 - Medium Probability (Flood Zone 2) is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% (1:100 year) and 0.1% (1:1,000 year) from fluvial sources and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources i.e., considered to be at 'medium probability' of flooding.
- Zone 3a - High Probability (Flood Zone 3a) is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200 year) from tidal sources i.e., considered to be at 'high probability' of flooding.
- Zone 3b - Functional Floodplain (Flood Zone 3b) This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:
    - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
    - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

50. In assessing the boundary between Flood Zones 1, 2 and 3, the protection afforded by any flood defence structures, and other local circumstances, is not considered by the Environment Agency.

51. The Environment Agency's Flood Map for Planning is included below as Figure 24.2.6. This mapping indicates that the majority of the ECC route is located within Flood Zone 3a, with some small, localised areas of Flood Zone 2. The onshore ECC is afforded the protection offered by formal Environment Agency flood defences along the Main Rivers and Lincolnshire coastline and it is therefore considered that no part of the onshore ECC or 400kV cable corridor lies within Flood Zone 3b. These flood defences are discussed further in Section 24.4.7.

24.3.2 National Planning Policy

52. The report has been produced in accordance with the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government, 2023 and its associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (Ministry of Housing,

Communities and Local Government, 2022). In addition, Paragraph 5.8.13 – 5.8.23 of the NPS EN-1 (DESNZ, 2023) has also been taken into account.

24.3.2.1 Sequential Test

53. In accordance with the NPPF, the Sequential Test is a requirement for all development proposed to be located within Flood Zones 2 and 3 or is at risk of other sources of flooding such as pluvial flooding. The aim of the Sequential Test, as set-out by the NPPF, is to:

"…steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available Sites appropriate for the proposed development in areas with a lower risk of flooding."

54. As the Project is located in Flood Zone 3a and is potentially at risk of flooding from other sources, the Sequential Test will be required.

55. The Sequential Test is considered further in Section 24.6.1.

24.3.2.2 Exception Test

56. The aim of the Exception Test is to require evidence for how flood risk will be managed on a development site, ensuring that the development remains safe throughout its lifetime while also ensuring that flood risk is not increased elsewhere.

57. The NPPF details which development types, based upon their vulnerability category, are appropriate within each respective flood zone and whether the Exception Test is required, as shown by Table 24.4.

58. As the majority of the onshore ECC is located within Flood Zone 2 and 3a, and the Project falls under the 'Essential Infrastructure' category in terms of vulnerability, the Exception Test is therefore required.

Table 24.4 Flood Risk Vulnerability and Flood Zone 'Incompatibility'

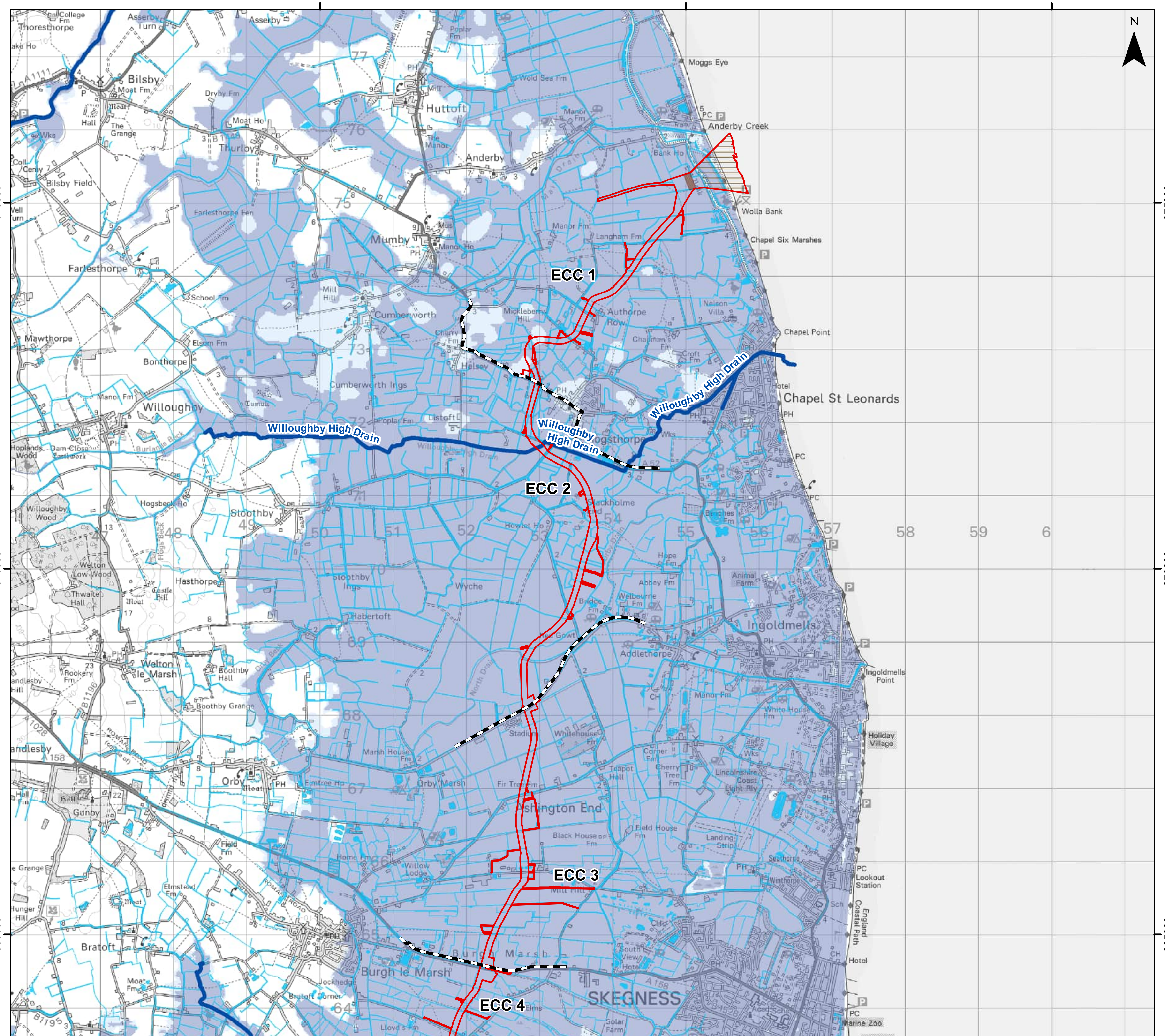
Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a†	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b Functional Floodplain*	Exception Test Required	✓	✗	✗	✗

†In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood

*In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

59. The Exception Test is considered further in Section 24.6.2.



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area
- Environment Agency Flood Zone 2
- Environment Agency Flood Zone 3
- Statutory Main River
- Minor Watercourse
- Waterbody

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Flood Map for Planning

Figure 24.2.6.1

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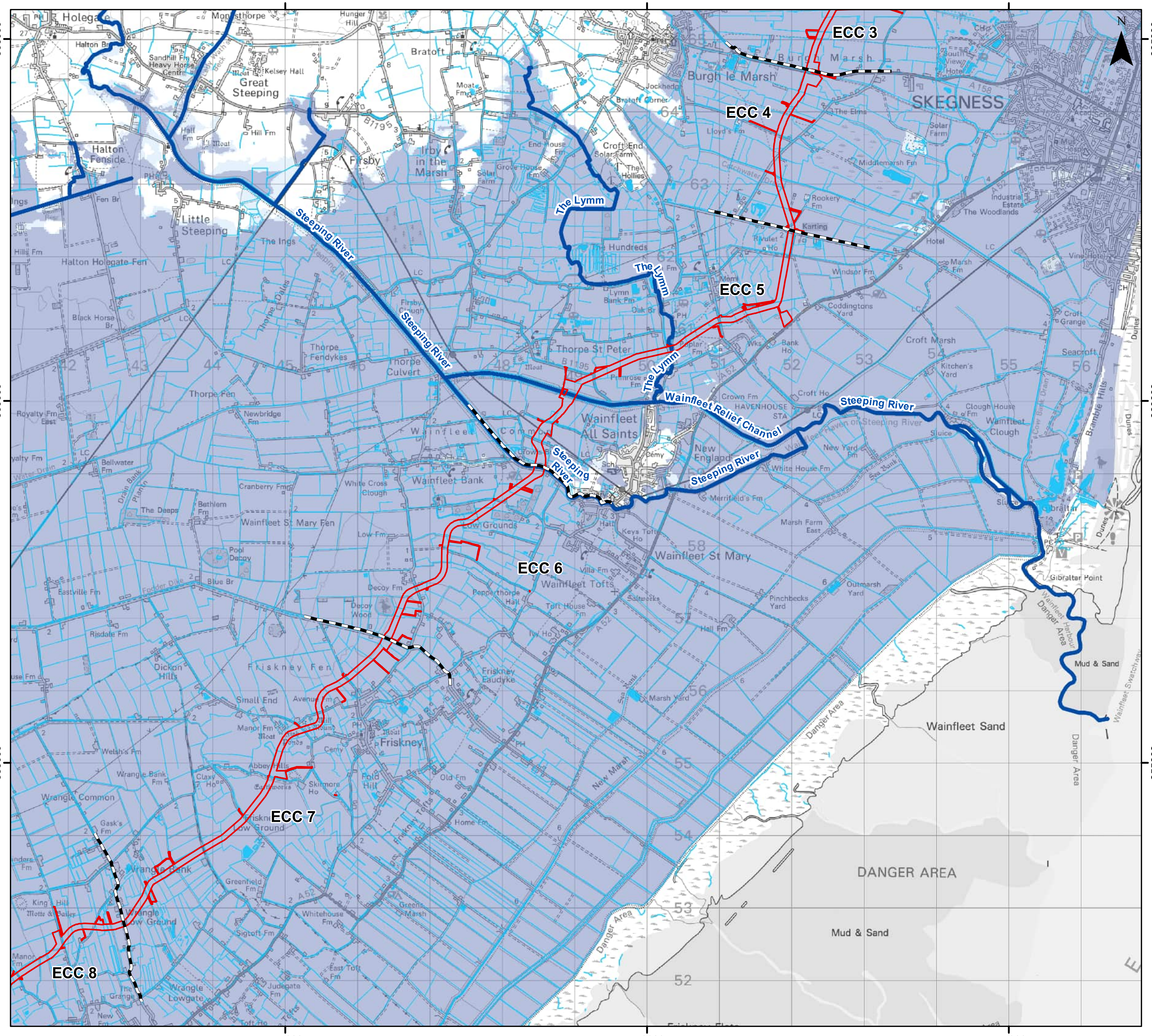

Legend

- Order Limits
- Onshore Segment Break
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- Environment Agency Flood Zone 3
- Statutory Main River
- Minor Watercourse
- Waterbody

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Flood Map for Planning

Figure 24.2.6.2

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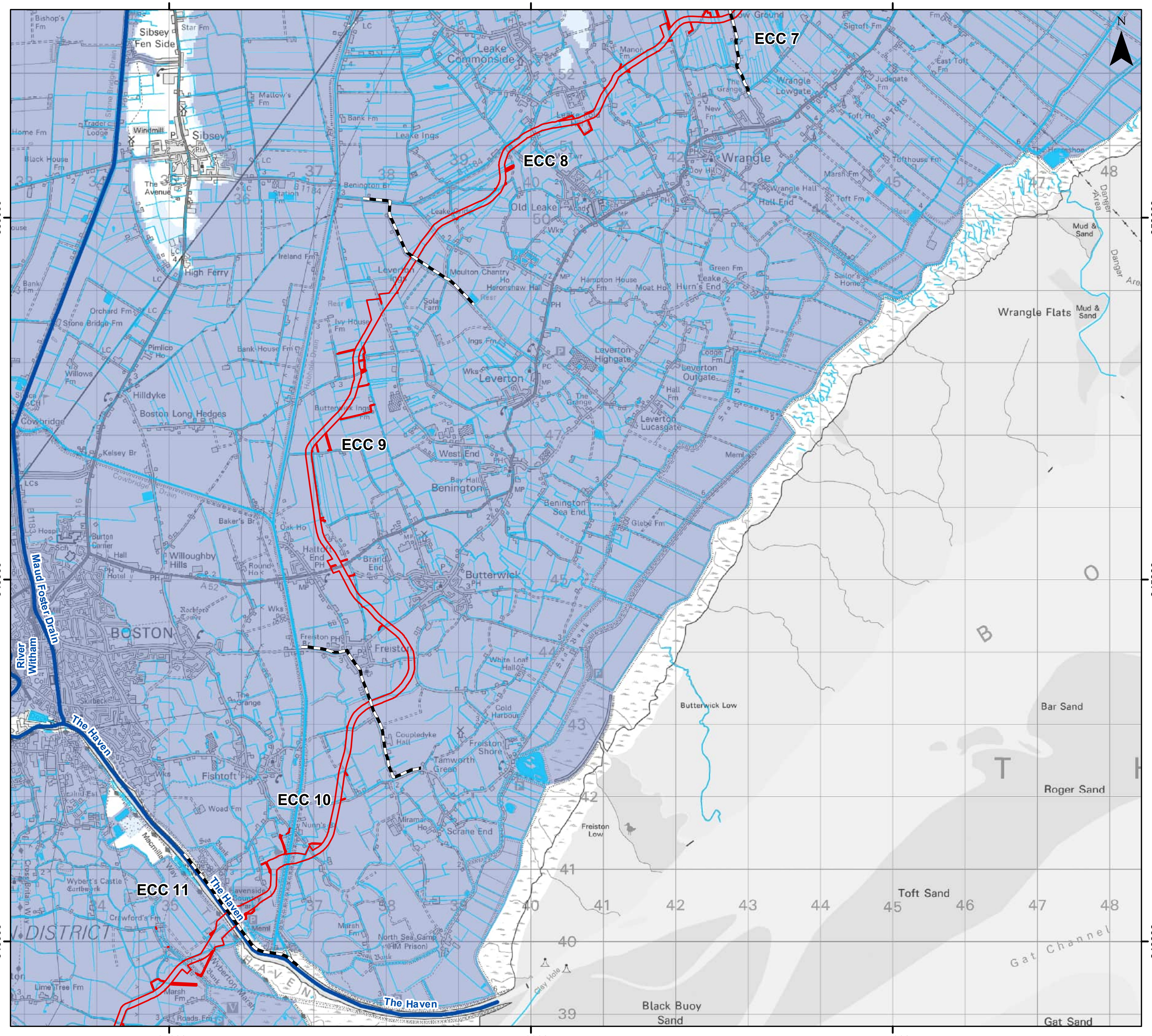

Legend

- Order Limits
- Onshore Segment Break
- Environment Agency Flood Zone 2
- Environment Agency Flood Zone 3
- Statutory Main River
- Minor Watercourse
- Waterbody

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Flood Map for Planning

Figure 24.2.6.3

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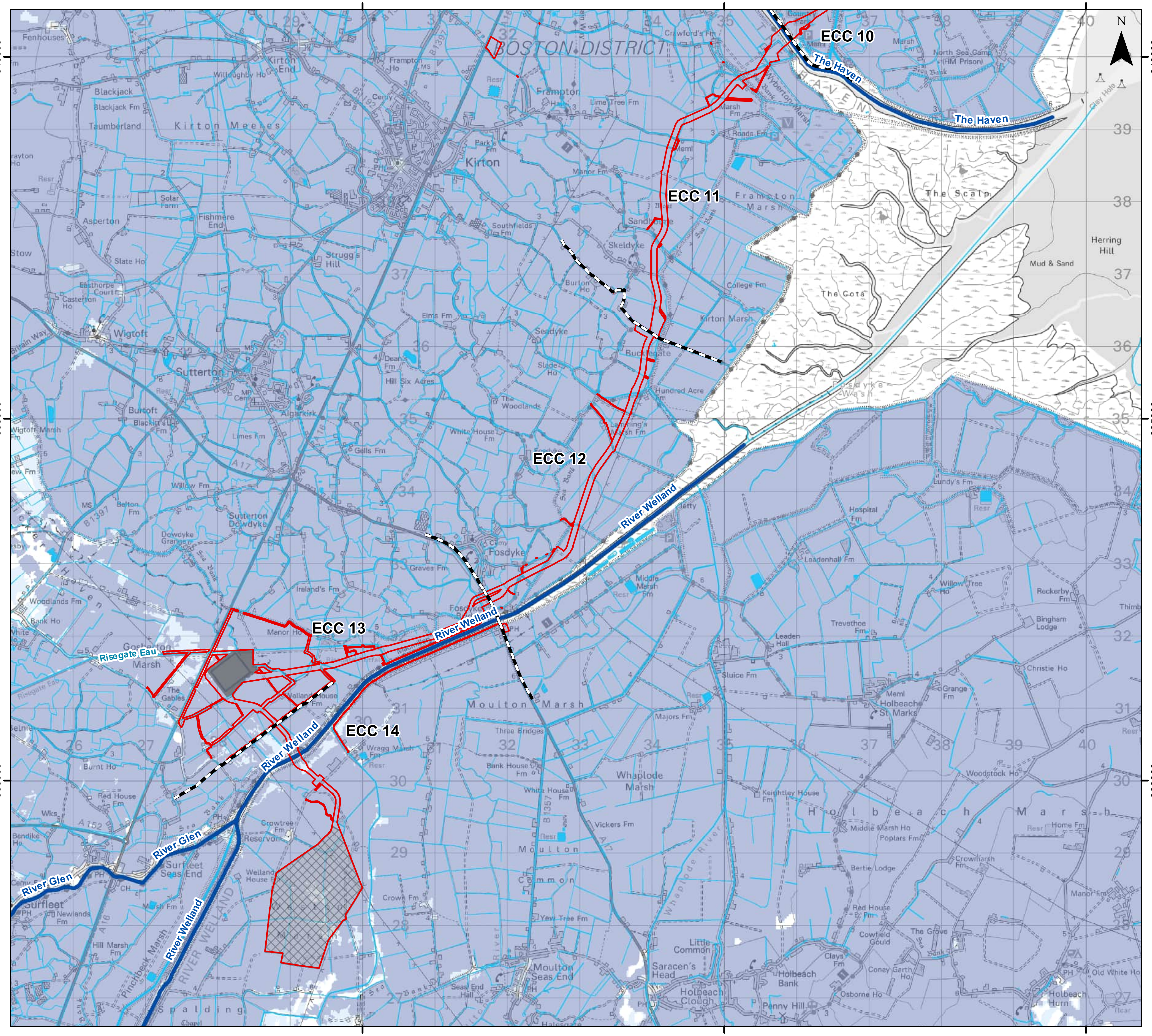

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment
- Environment Agency Flood Zone 2
- Environment Agency Flood Zone 3
- Statutory Main River
- Minor Watercourse
- Waterbody

Note:
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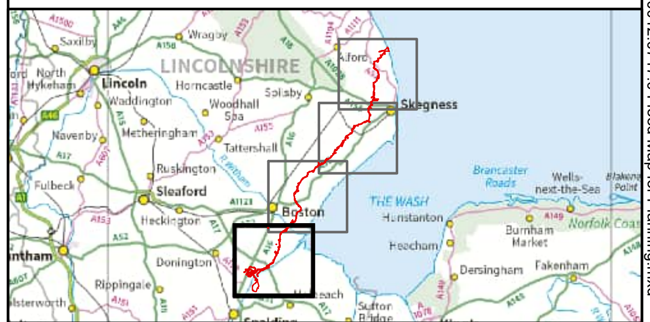

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Environmental Statement

Flood Map for Planning

Figure 24.2.6.4

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24.4 Potential Sources of Flooding

60. A screening study has been completed to identify whether there are any potential sources of flooding along the onshore ECC which may warrant further consideration. If required, any potential significant flooding issues identified in the screening study are then considered in subsequent sections of this assessment.

61. There are a number of potential sources of flooding and these include:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from surface water or overland flow;
- Flooding from groundwater;
- Flooding from sewers;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

24.4.1 Flooding from Rivers or Fluvial Flooding

62. An excerpt of the Environment Agency Flood Map for Planning (EA, 2023a) is displayed in Figure 24.2.6 above. This shows that the majority of the onshore ECC is located within Flood Zone 3, defined as land which has a 1 in 100 chance or greater of flooding each year from rivers (1% AEP). As discussed in Section 24.3.1, it is not considered that any part of the Site lies within Flood Zone 3b due to the Site being afforded protection by flood defences. The site is therefore considered to lie within Flood Zone1, Flood Zone 2 and Flood Zone 3a. There are numerous Main Rivers and ordinary watercourses that could pose a localised fluvial risk to the onshore ECC. However, due to the proximity of the onshore ECC to the coast, it is noted that the majority of these watercourses will be tidally influenced.

24.4.2 Flooding from the Sea or Tidal Flooding

63. An extract of the Environment Agency Flood Map for Planning (Environment Agency, 2023a) is provided in Figure 24.2.6 above. This shows that the onshore ECC is primarily located within Flood Zone 3, defined as land which has a 1 in 200 chance or greater chance of flooding each year from tidal sources (0.5% AEP). This is associated with the Lincolnshire coastline located to the east of the onshore ECC. As discussed in Section 24.3.1, it is not considered that any part of the Site lies within Flood Zone 3b due to the Site being afforded protection by flood defences.

64. Several flood defences are present in the vicinity of the onshore ECC offering protection. These include sea walls, groynes, embankments, dunes, engineered high ground, and natural high ground. The coastal defences offer protection against tidal flooding to most of the land behind these features, therefore the majority of the onshore ECC which lies west of the coastal defences is considered to be within the defended tidal floodplain. The standard of protection of tidal defences in this area vary between 1 in 100 chance (1% AEP) to 1 in 200 chance (0.5% AEP).

65. Cables within the onshore ECC will be buried, and thus it is expected that construction, operation, and maintenance, of the cables along the onshore ECC will not increase, nor be affected by incidences of tidal flooding should the defences be breached during the operational phase of the project. During the operational phase, the TJB will not be permanently raised and therefore will not increase or be affected by incidences of flooding during a breach of defences. The drill site at the TJB will be temporarily bunded during construction to protect against the residual risk of water ingress during drilling and duct installation activities. The installation methodology will also include measures to reduce the risk of frac-outs during construction and for the permanent sealing of the ducts. There will be no change to local surface water hydrology. This is detailed further in Volume 1, Chapter 3: Project Description (document reference 6.1.3).

66. A temporary noise bund (up to 4m high) will be located between the landfall works site and Roman Bank to provide noise attenuation to mitigate potential disturbance to ornithological receptors at Anderby Marsh Local Nature Reserve (LNR). It is recognised that large stockpiles of materials could block overland flow and result in changes to local surface water hydrology. The noise bund will be formed from soil that is stripped from the working area of the landfall site and as such will be covered under the Outline Soil Management Plan (SMP) (document reference 8.1.3), which forms part of the CoCP (document reference 8.1). In order to clarify the potential impact of the temporary noise bund at landfall on flooding hydraulic modelling has been undertaken and submitted as part of a Noise Bund Hydraulic Modelling Report (document reference 15.7, version 1)). The results of the noise bund hydraulic modelling are discussed further within Section 24.5.1.3.

67. Manhole access to Link Boxes along the onshore ECC route will also be provided. The inspection covers will be installed at ground level.

68. Breaching or failure of flood defences is considered to be a residual risk to the onshore ECC and should be considered for the construction phase (Section 24.7.1).

69. As stated above, the tidal defences are constructed to provide protection from the 0.5% AEP tidal event. It is reasonable to determine that flooding from tidal sources will not impact construction activity unless there is an extreme event or if defences were to fail. The existing residual risk due to the potential failure of these flood defences will be considered in Section 24.4.7.

70. There would be a potential risk of tidal flooding to activities carried out on the beach, on the seaward side of coastal defences at landfall during the construction phase. However, the installation of cables under the sea defences and intertidal area will be carried out by HDD from the TJB site landward of the defences and no work on the beach is planned. Therefore, there are no activities seaward of the defences that could be affected.

71. The residual risk of flooding from tidal sources is considered further in Section 24.4.7.

24.4.3 Flooding from Surface Water or Overland Flow

72. Surface water modelling has been undertaken by the Environment Agency to predict the likely extents, depths and velocities of surface water flooding at a given location across three rainfall events (3.33% AEP, 1% AEP and 0.1% AEP). An extract of the resulting surface water flood map is reproduced in Figure 24.2.7 below.

73. The Environment Agency defines surface water flood risk categories as follows:

- Very Low: less than 1 in 1,000 annual probability (0.1% AEP) of flooding in any given year;
- Low: less than 1 in 100 annual probability (1% AEP) but greater than or equal to 1 in 1,000 annual probability (0.1% AEP) of flooding in any given year;
- Medium: between 1 in 100 annual probability (1% AEP) and 1 in 30 annual probability (3.3% AEP) of flooding in any given year; and
- High: greater than 1 in 30 annual probability (3.3% AEP) of flooding in any given year.

74. It should be noted that this information does not take into consideration, or include in modelling, any land drainage or formal surface water drainage infrastructure installed beneath the ground surface.

75. Figure 24.2.7 indicates that the majority of the onshore ECC is at very low (less than 0.1% AEP) risk of flooding from surface water.

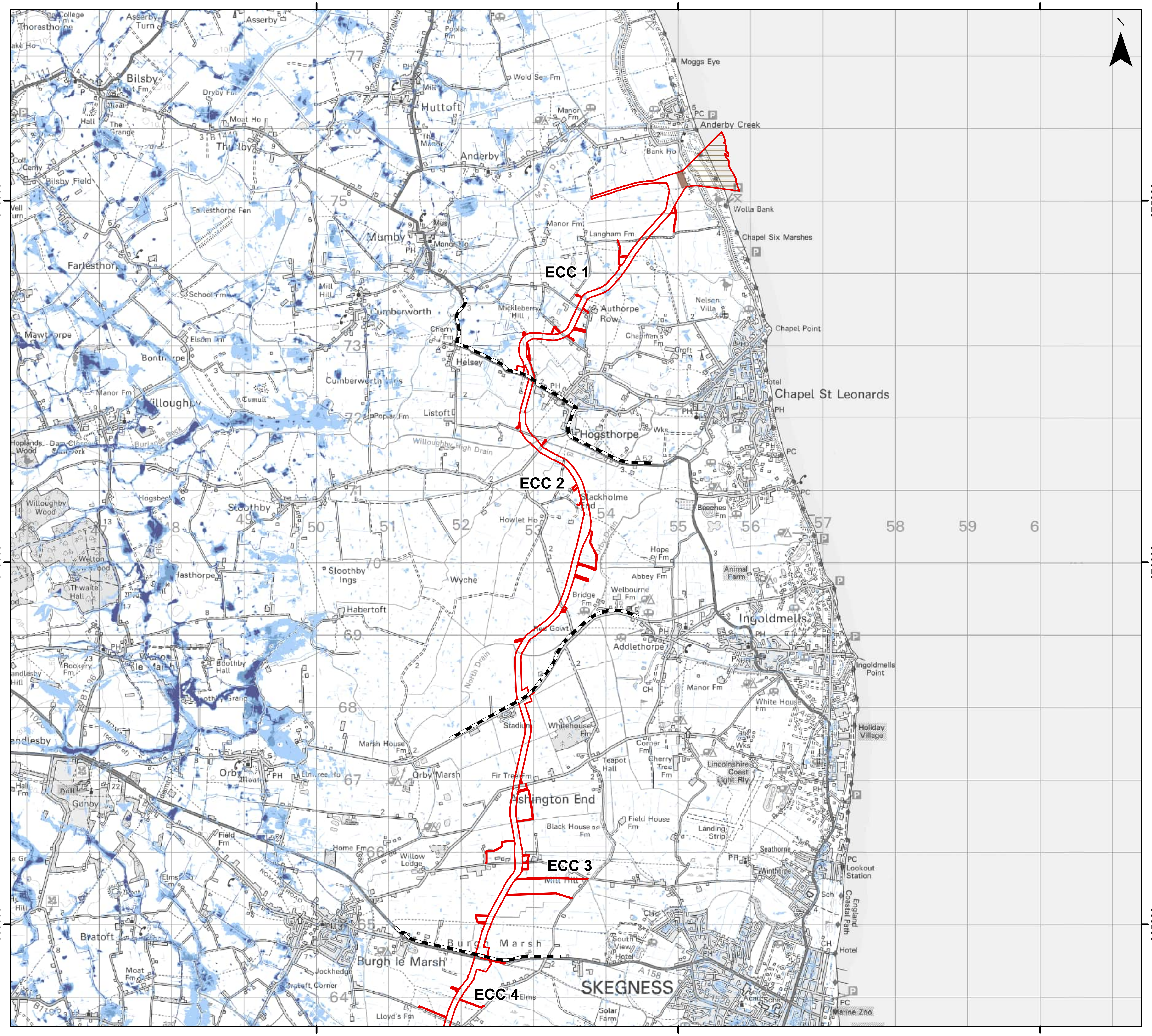
76. Figure 24.2.7 also indicates areas of the onshore ECC at potential risk of inundation from extreme rainfall are limited to small, isolated areas. The majority of risk ranging from Medium (1% AEP) to High (3.3% AEP) appear to either be related to corridors of existing ordinary watercourses, Main Rivers or IDB maintained drains, or is associated with small,

often isolated, areas of topographical low points that could theoretically hold water during extreme events. These areas do not affect large areas of the onshore ECC and no significant surface water flow pathways within the onshore ECC are identified, other than existing mapped water features.

77. During the construction phase of the onshore ECC, open trench construction methods will be used along the majority of the route, which will involve the temporary removal and stacking of topsoil from the corridor and subsoil from trenches. This change of land cover, potential need to temporarily divert smaller ditches and potential interception and diversion of water, has the potential to affect pre-existing surface water drainage patterns, with potentially more surface water being directed into the current drainage networks. Management of this additional risk will be provided in the form of a surface water drainage strategy for each section of construction, through liaison with the Lead Local Flood Authority (LLFA) of Lincolnshire County Council and IDBs. An Outline Surface Water Drainage Strategy document has been provided as part of the Code of Construction Practice (CoCP) as document 8.1.5. The final surface water drainage strategy will be prepared in the pre-construction phase and adhere to Sustainable Drainage Systems (SuDS) principles.

78. As the cables, joint bays and TJB will be buried, and LB covers located at ground level, it is not expected that the risk of surface water flooding will be heightened during the operational lifetime of the onshore ECC. The modification to land cover during the Project construction phase will be re-set after the cable installation, thus the risk of surface water flooding to the onshore ECC will remain as it is today, except for the influence of climate change, due to the absence of changes to hydrological and hydrogeological catchment characteristics.

79. Mitigation measures to prevent long term changes to surface water drainage are outlined in Section 24.7.1. Taking this into consideration, the risk of flooding via this source will not be a concern for the construction, operational and decommissioning phases of the Project and as such is not considered further.



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works
- Transition Joint Bay

Risk of Flooding from Surface Water Flooding Extent

- High Probability (3.3% aep)
- Medium Probability (1% aep)
- Low Probability (0.1% aep)

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Surface Water Flood Map

Figure 24.2.7.1

OUTER DOWSING OFFSHORE WIND

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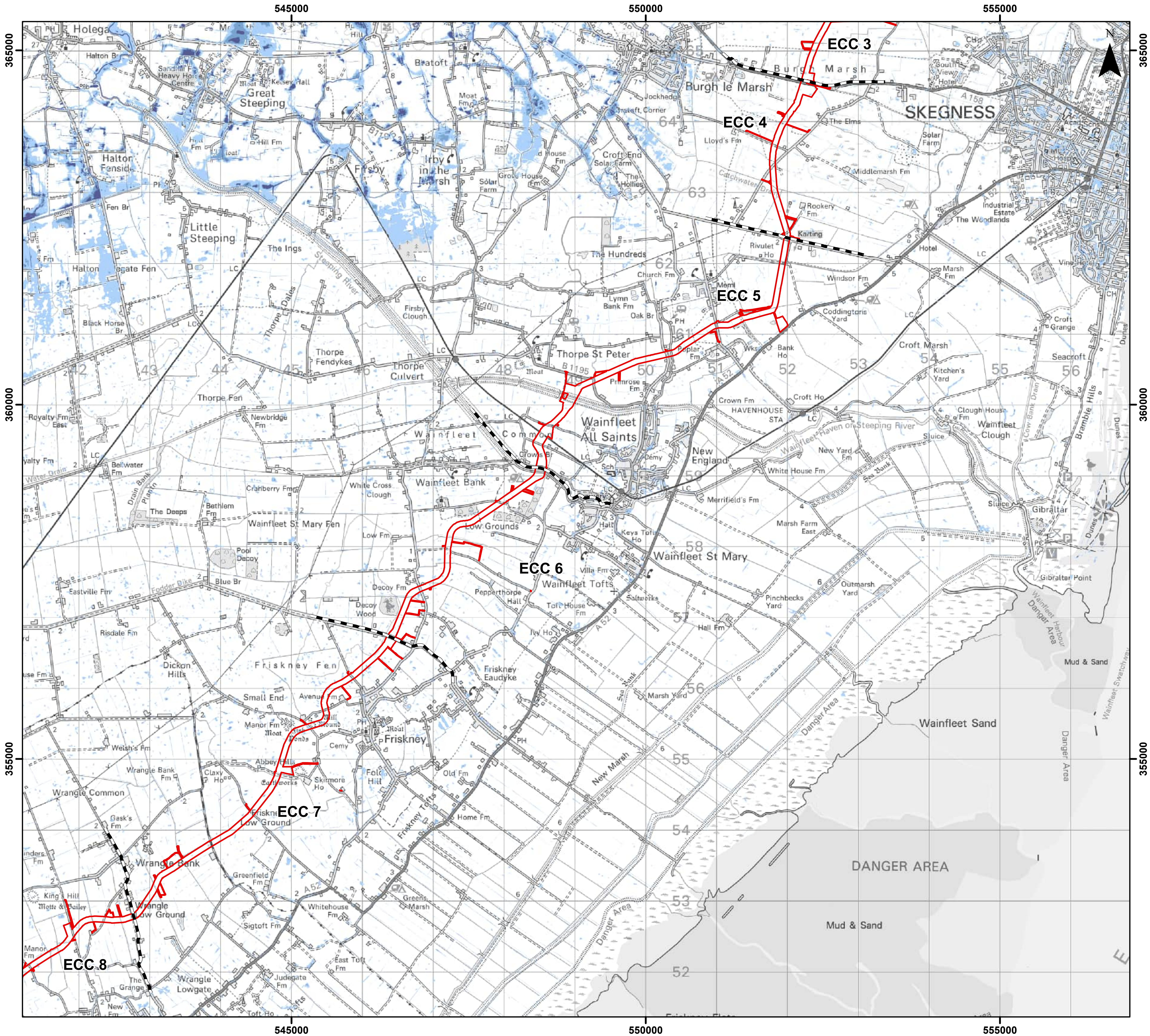

Legend

- Order Limits
- Onshore Segment Break

Risk of Flooding from Surface Water Flooding Extent

- High Probability (3.3% aep)
- Medium Probability (1% aep)
- Low Probability (0.1% aep)

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Surface Water Flood Map

Figure 24.2.7.2

OUTER DOWSING OFFSHORE WIND

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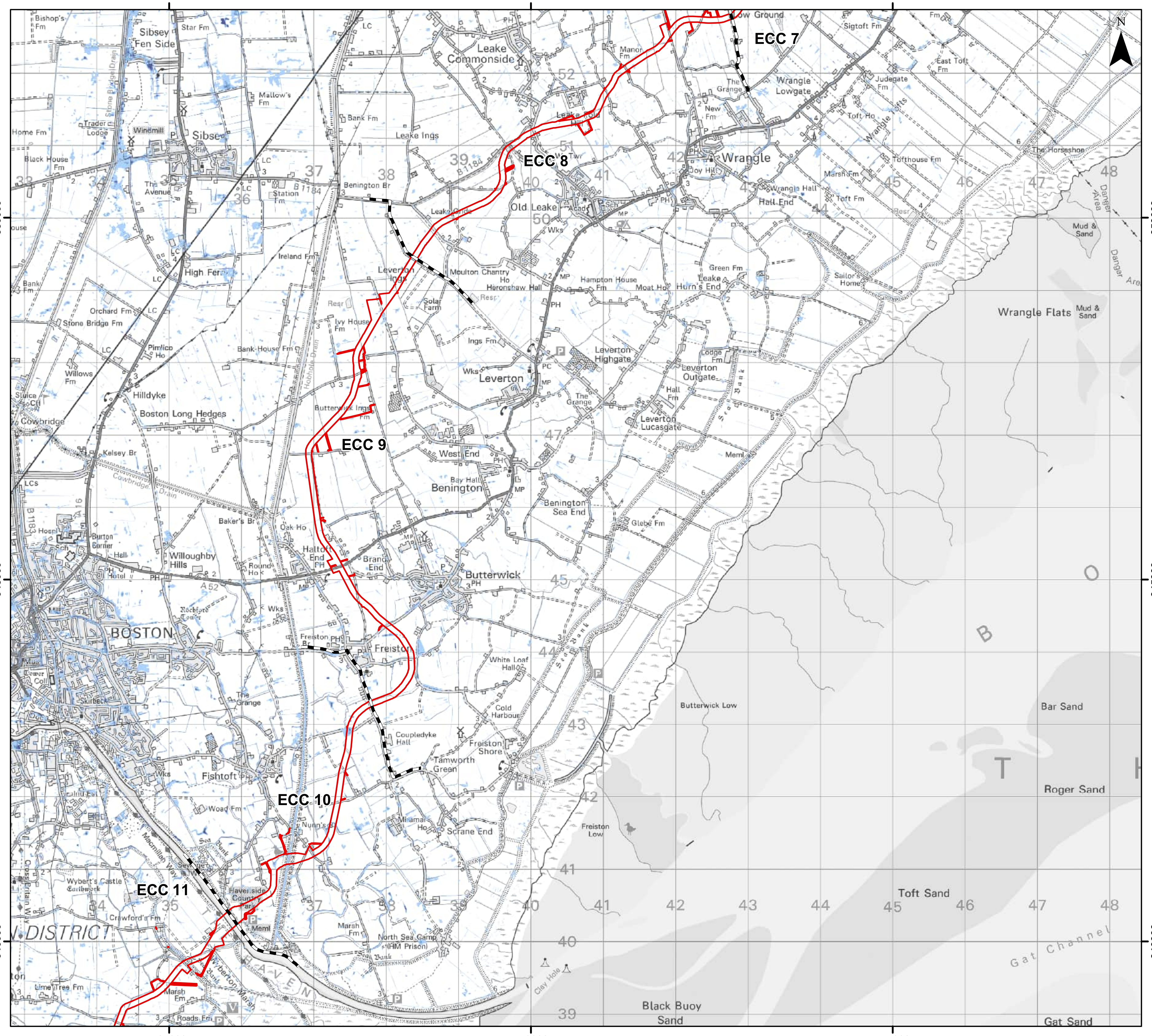

Legend

- Order Limits
- Onshore Segment Break

Risk of Flooding from Surface Water Flooding Extent

- High Probability (3.3% aep)
- Medium Probability (1% aep)
- Low Probability (0.1% aep

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Surface Water Flood Map

Figure 24.2.7.3

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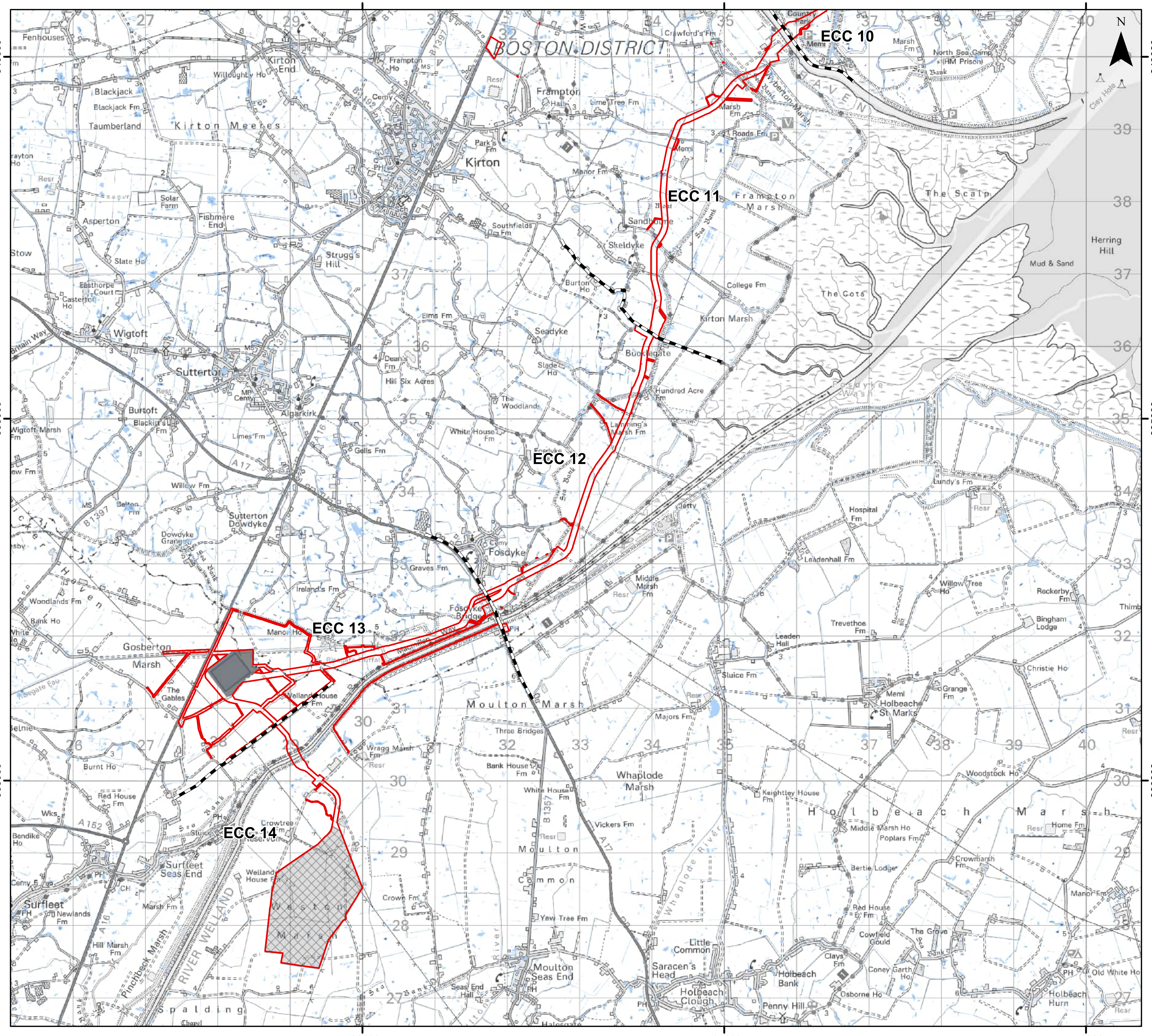

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection
- Area not Included in Export Cable Corridor Flood Risk Assessment

Risk of Flooding from Surface Water Flooding Extent

- High Probability (3.3% aep)
- Medium Probability (1% aep)
- Low Probability (0.1% aep

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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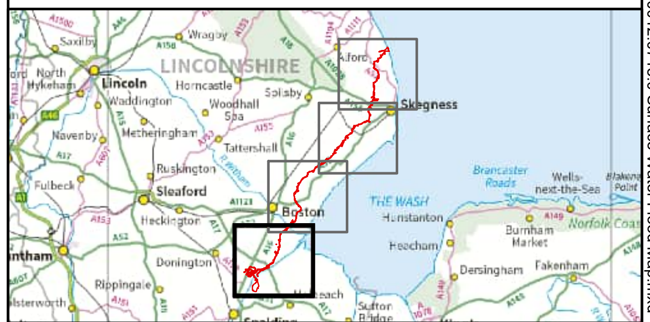

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Environmental Statement

Surface Water Flood Map

Figure 24.2.7.4

OUTER DOWSING OFFSHORE WIND

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24.4.4 Flooding from Groundwater

80. As detailed in Section 24.2.3, the British Geological Survey (BGS, 2023) mapping indicates that segments ECC 1 -3 and the north of ECC 4 of the onshore ECC is underlain by chalk and sandstone bedrock deposits which are considered to have high permeability and a high level of storage and water transmission.

81. The majority of the superficial deposits along the onshore ECC consist of Tidal Flat Deposits which are considered to have low permeability. The Devensian Till Deposits are considered to have variable permeability depending on their specific properties and composition. The onshore ECC crosses areas of low-lying land particularly along segments ECC 5 – 9, which are closer to the coastline and may have shallow groundwater linked to the coast.

82. The BGS Groundwater Flooding Susceptibility mapping, accessed via data from Envirocheck (November 2022 and March 2023), shows that the majority of the ECC lies within an area not susceptible to groundwater flooding.

83. The effect that the onshore ECC will have on groundwater flooding once operational is not considered to be significant due to all ground conditions being reinstated following construction. However, it should be noted that perched groundwater may be present within the superficial geology along the onshore ECC and this water may be encountered during construction works. Cable construction mitigation measures outlined in Section 24.7.1 will be implemented as part of a CoCP to manage activities and mitigate against this risk for the construction phase.

84. The risk of flooding via this source will not be a concern for the operation and decommissioning phase of the Project and as such is not considered further.

24.4.5 Flooding from Sewers and Water Mains

85. As outlined in Section 24.2, the majority of land crossed by the onshore ECC is agricultural land and is unlikely to have significant formal sewerage infrastructure. Utilities data acquired from Anglian Water indicates that there are various areas of the route in which sewer and mains water utilities are present. Where sewer and mains networks are present it is considered that failure or surcharge (blocked or collapsed sewer or burst main) of the utility networks would result in the limited emergence of flood water at the surface along the onshore ECC route, which would progress in accordance with the topographic gradient and be infiltrated to ground or pass to local surface water drainage features.

86. The potential risk of flooding from this source is unlikely and any flooding would result in localised flood extents that would be similar in nature to the surface water flood risk discussed in Section 24.4.3. Due to the nature of the Project proposals and the unlikely nature of this type of flooding, flooding from sewers in the vicinity of the onshore ECC is not anticipated to have any impact during the life of the Project.

87. The risk of flooding from sewers is therefore concluded to be low and is not considered further.

24.4.6 Flooding from Reservoirs, Canals, or other Artificial Sources

88. Environment Agency Flood mapping (EA, 2023) indicates that the majority of the onshore ECC does not lie within an area at risk of flooding from reservoirs.

89. A small area along the onshore ECC within segment ECC 11, adjacent to Wyberton Marsh Pumping Drain, is shown to lie within an area at risk of reservoir flooding during both 'wet day' and 'dry day' scenarios. The ‘dry-day’ scenario predicts the flooding that would occur if the failure occurred when rivers are at normal levels. The ‘wet day’ scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood. This risk is thought to be associated with Wyberton Marsh Pumping Station. Flooding from the risk of failure of pumping stations is considered within Section 24.4.7 below.

90. There is also another small area of the onshore ECC, within segment ECC 9, which is shown to lie within an area at risk of reservoir flooding during a 'wet day' scenario This risk is associated with Birkwood Hall reservoirs located approximately 15km northwest of the onshore ECC.

91. Reservoirs are regularly inspected by registered panel engineers and as such the risk of failure or breach is considered to be extremely unlikely. The risk of flooding from reservoirs will therefore not be considered further.

92. There are no canals or other artificial sources within or in the immediate vicinity of the onshore ECC and therefore the risk of flooding from this source will not be considered further.

24.4.7 Flooding from Infrastructure Failure

24.4.7.1 Flood Defences

93. Coastal flood defences are located along the Lincolnshire coastline. These defences run parallel to the coastline and protect the land in which the proposed onshore ECC lies. At

landfall, the beach forms part of the defences and forms part of the Environment Agency Saltfleet to Gibraltar Point Strategy, which currently involves annual nourishment of the beach. ODOW's landfall overlaps with the Environment Agency's beach maintenance area. ODOW has engaged with the Environment Agency and a works management agreement is proposed to avoid ODOW's construction activities having any impact upon the Environment Agency's coastal defence maintenance works.

94. Environment Agency maintained defences are also present along Main Rivers within the onshore ECC:

- Willoughby High Drain - natural high ground;
- Steeping River – embankments and walls;
- The Lymn - natural high ground;
- Wainfleet Relief Channel - embankments; and
- The Haven – embankments.
- River Welland - engineered high ground, embankments.

95. These defences are regularly inspected and maintained by the Environment Agency, however, there is a residual risk of failure which will be considered in Section 24.5.

There are also numerous non-Environment Agency maintained defences located within the onshore ECC (i.e. IDB or private defences).

24.4.7.2 Pumping Stations

96. The IDBs maintain a number of pumping stations that serve the land which is crossed by the onshore ECC. Failure of a pumping station would have the potential to increase flood risk locally, effectively creating an increase in fluvial flood risk. The IDBs undertake regular inspections and carry our regular maintenance and servicing of all assets under their care, including pumping stations. The likelihood of failure is considered to be low, and any failure would be immediately notified to the relevant IDB via telemetry or alarm for inspection and repair. This is the case for the northern end of the ECC, which is close to but does not cross the Main Drain, which discharges into the North Sea via the Anderby Sluice.

24.4.7.3 Culverts

97. Several culverts were observed during site visits, primarily along ordinary watercourses and field drainage channels. In the event of blockage through vegetation growth, littering or failure there is potential for the water flow to be affected or reduced. The pre-existing risk of culvert blockage can be mitigated through regular maintenance regimes to ensure that these structures are cleaned regularly. The site construction techniques will aim to

preserve the current state of the ordinary watercourses within the onshore ECC and thus will not increase the current flood risk for the Project.

98. While the local fluvial and tidal flood defences provide a high standard of protection there is inherently a residual risk of failure from these structures, including culverts, around the onshore ECC. This is therefore considered further within Section 24.5.

24.4.7.4 Cable Installation

99. Whilst most of the cable route will be constructed using open-cut methods, trenchless techniques such as HDD will be used to pass beneath obstructions such as the coastal sand dunes at the landfall, and significant watercourses and flood defences along the length of the ECC. Through ongoing consultation, the Environment Agency has raised concerns that such trenchless techniques could cause an unnatural risk of flooding by creating a flowpath along which water could flow in the event of an installation or equipment failure.

100. Volume 1, Chapter 24: Onshore Hydrology, Hydrogeology and Flood Risk (document reference 6.1.24) outlines embedded mitigation to manage this construction method and includes specific measures to avoid increasing flood risk when drilling under defences and when stockpiling materials (Document Reference 8.1: Outline Code of Construction Practice). This includes the construction of a temporary bund around the HDD rig at the landfall to prevent flooding in the event that a failure results in the ingress of water into the cable conduit.

24.4.8 Flood Risk Summary

101. A summary of the potential sources of flooding and the flood risk arising from them is presented in Table 24.5.

Table 24.5 Potential Sources of Flooding

Potential Source of Flooding	Significant Flood Risk at the Site (Y/N)
Rivers or Fluvial Flooding	Y
Sea or Tidal Flooding	Y
Surface Water or Pluvial Flooding	N
Groundwater	N
Sewers	N
Reservoirs, Canals, and other Artificial Sources	N
Infrastructure Failure	Y- residual risk of Tidal/Fluvial Flooding

102. A detailed assessment of the existing baseline flood risks detailed in Table 24.5 is undertaken further in Section 24.5.

24.5 Detailed Assessment of Flood Risk

103. The flood risk screening provided in Section 24.4 has demonstrated that the onshore ECC is potentially at risk of flooding from tidal and fluvial sources, and infrastructure failure is also identified as a residual risk.

104. Flood risk analysis contained within this section is for the onshore ECC. An FRA for the OnSS is provided as a separate document (Document reference 6.3.24.3).

24.5.1 Flooding from the Sea or Tidal Flooding

105. As discussed in Section 24.4.2, the onshore ECC is at risk of flooding from tidal sources due to the residual risk of failure of flood defences along the Lincolnshire coastline. The extent of flooding in the event of a flood defence failure can be different than that which is indicated on Environment Agency flood risk mapping, therefore additional assessments and modelling has been conducted by the Environment Agency to determine the potential outcome of these events.

106. As part of a data request, the Environment Agency has provided breach and overtopping modelling for the coastline adjacent to the onshore ECC. This modelling was published by Mott MacDonald in December 2010 (Mott MacDonald, 2010) as part of the Northern Area Tidal Modelling project. The Northern Area Tidal Modelling project covers the coastline from Whitton, west of the Humber Bridge, to Terrington on the Wash between the River Nene and the River Great Ouse.

24.5.1.1 Defence Failure by Overtopping

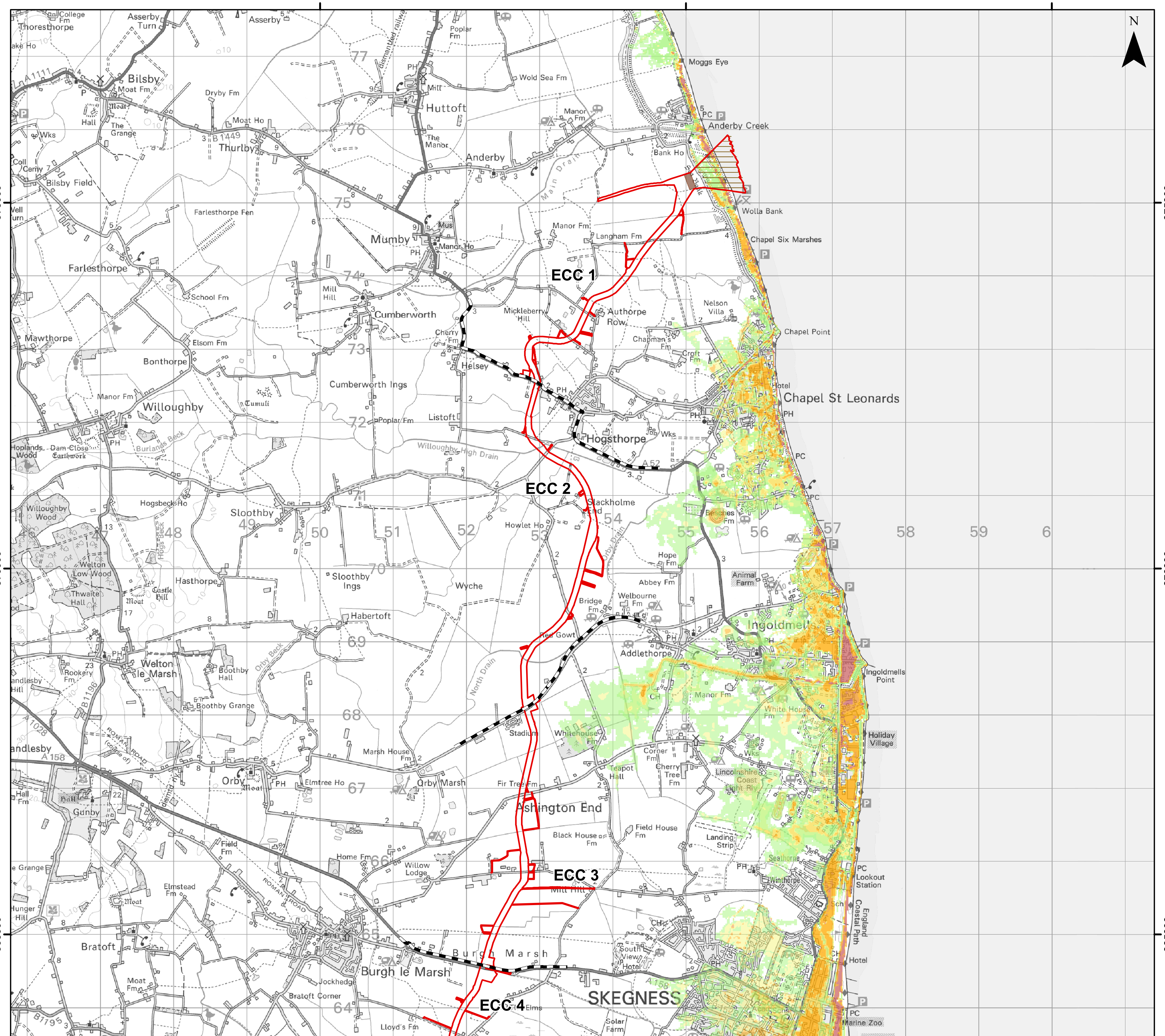
107. The Northern Area Tidal Modelling study focuses on flood risk from seawater overtopping of the sea defences from a combination of tides, tide surges and waves along the coastline between Humber Estuary to the Wash.

108. The overtopping depth mapping shows for a 1 in 200 chance scenario (0.5% AEP event), the majority of the onshore ECC does not lie within an area at risk of flooding from failure of defences by overtopping. There is a small section slightly north and south of The Haven that is at potential risk, with flood depths of less than 0.5 m predicted. A small area at landfall, on the landward side of coastal defences, is also noted to be at risk of flooding during this scenario.

109. The overtopping depth mapping for a 1 in 1,000 chance scenario (0.1% AEP event), shows a similar pattern in terms of the potential risk of flooding, with slightly increased depths and extents in the vicinity of The Haven.

110. The overtopping mapping depth for a 1 in 200 chance scenario plus climate change (CC) (2115) (0.5% AEP event + CC) shows the majority of the onshore ECC lies within an area at risk of flooding from failure of defences by overtopping, with the exception being an area to the north of the A52 reach near Wainfleet All Saints. The flood depths do not exceed 1 m, apart from in areas around The Haven and the Wash, which reach depths of up to 3 m.

111. The overtopping hazard mapping shows certain areas the ECC crosses areas that have higher hazard ratings. These areas relate to the northeastern and southwestern areas where the ECC crosses the Haven, and to the east of Hobhole Drain. The northern and southern areas of the River Welland at Fosdyke Bridge also have higher hazard ratings than surrounding areas. The Environment Agency's overtopping flood hazard mapping is shown in Figure 24.2.8



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.5% AEP

Figure 24.2.8.1 (A)

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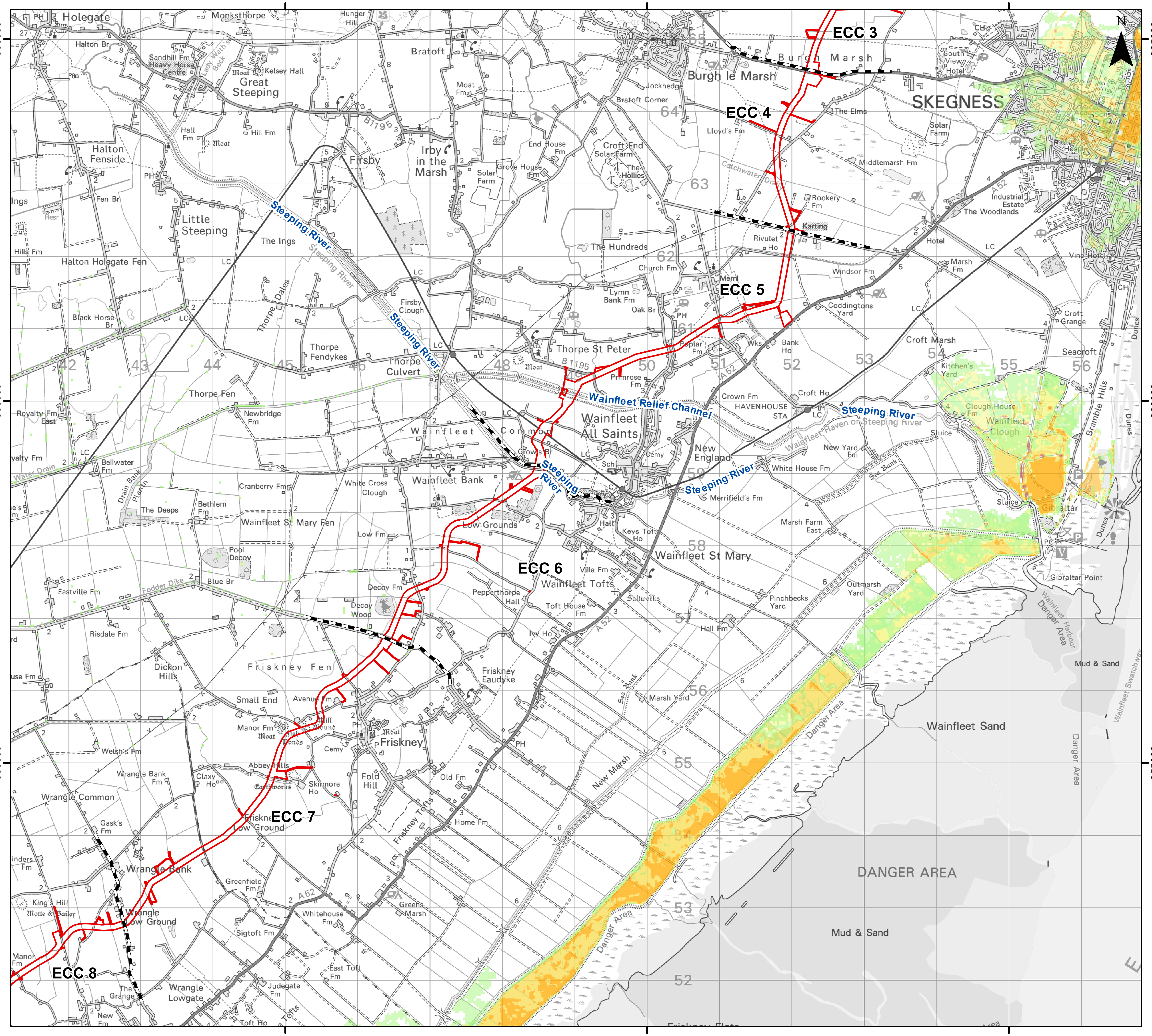

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
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Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.5% AEP

Figure 24.2.8.2 (A)

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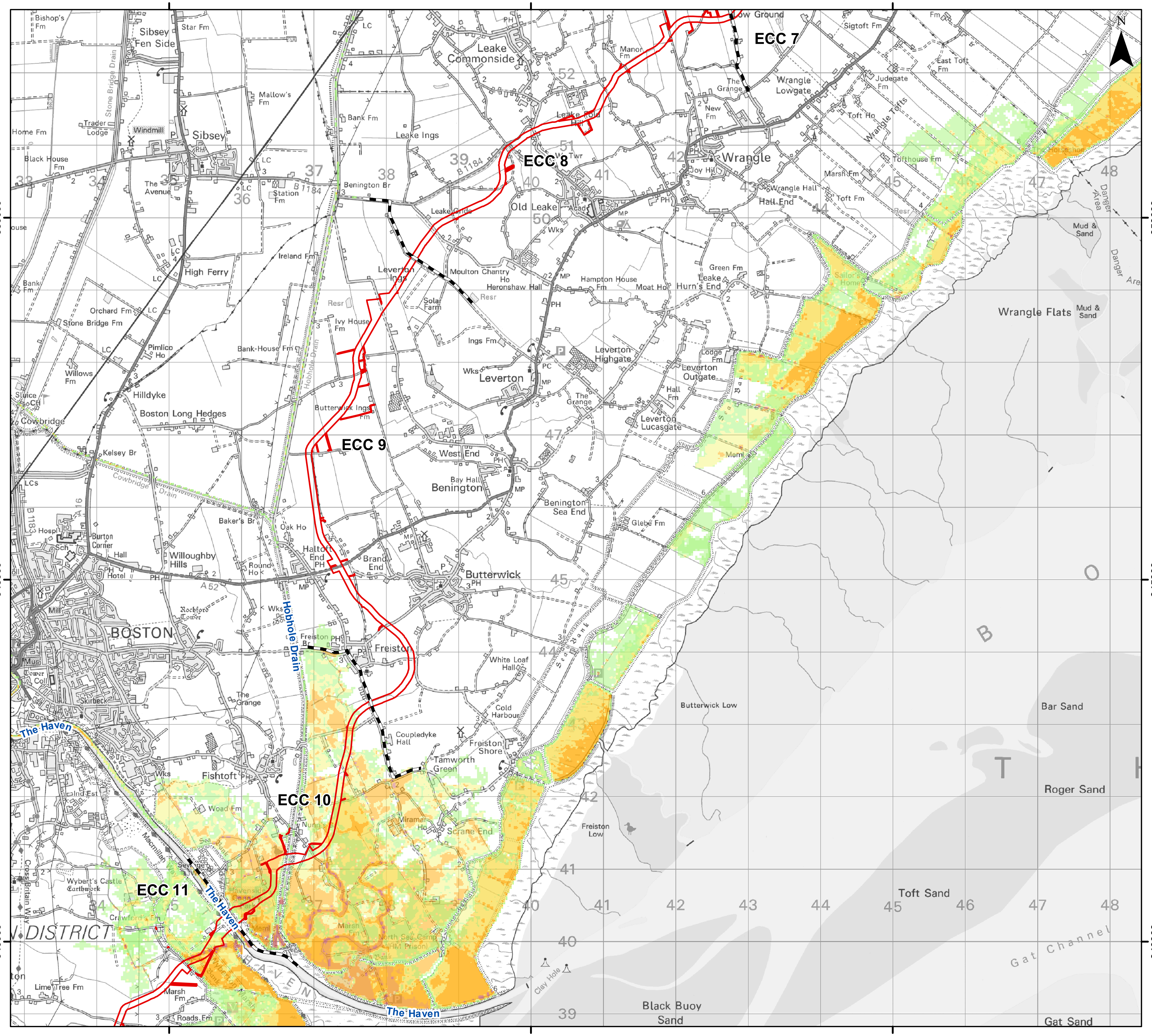

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.5% AEP

Figure 24.2.8.3 (A)

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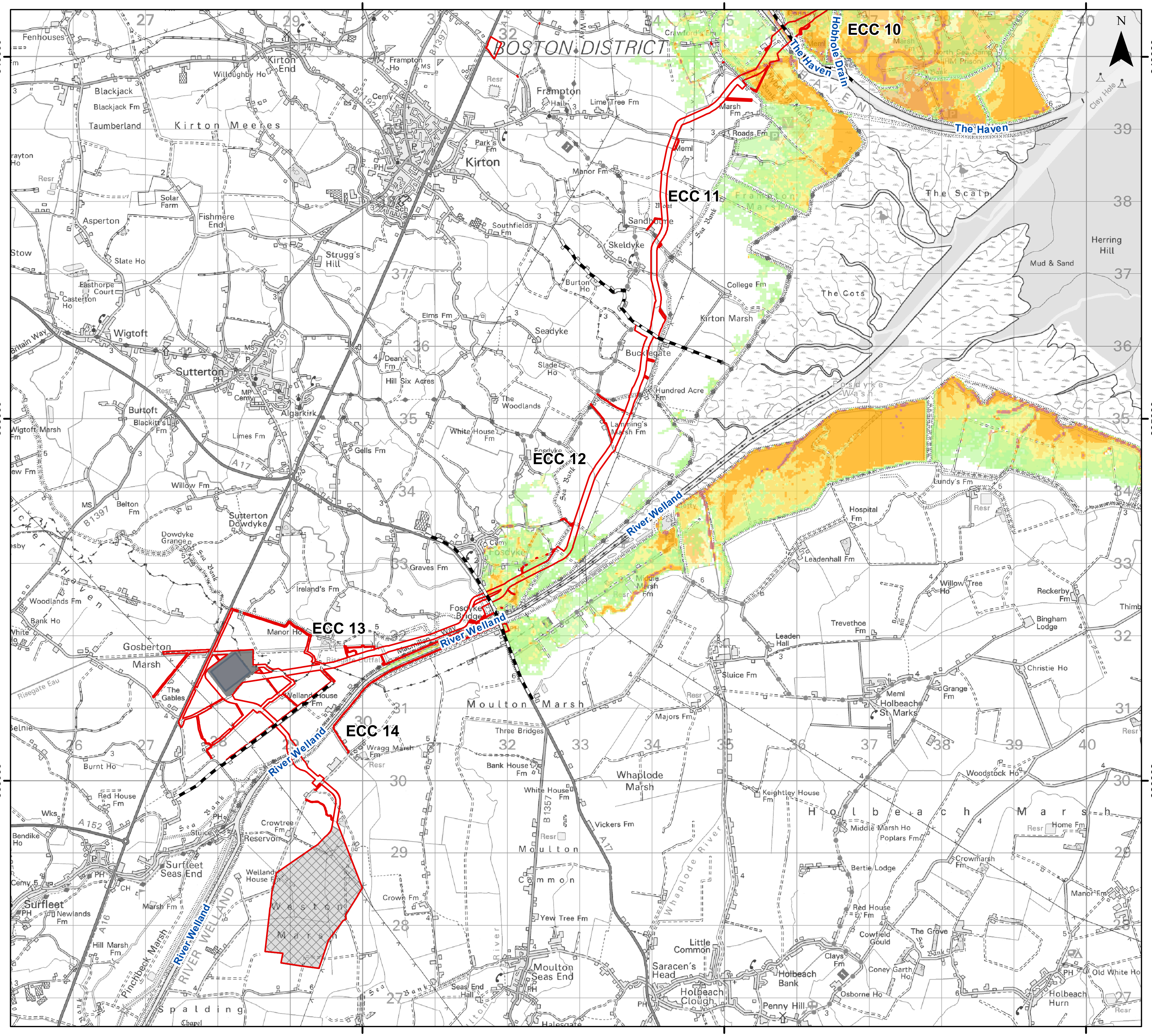

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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0 1 2 km

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Environmental Statement

Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.5% AEP

Figure 24.2.8.4 (A)

OUTER DOWSING OFFSHORE WIND

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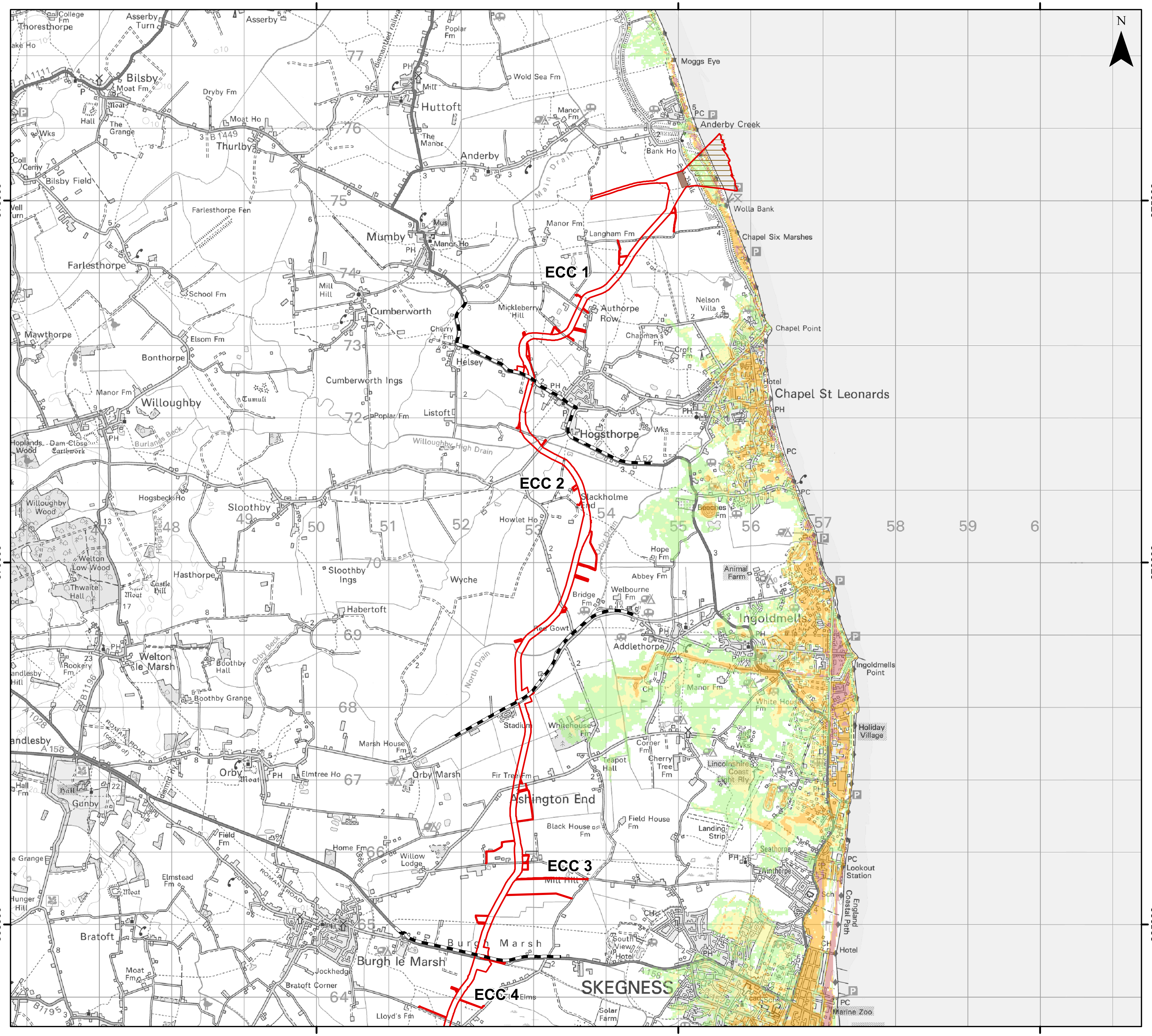

Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.1% AEP

Figure 24.2.8.1 (B)

OUTER DOWSING OFFSHORE WIND

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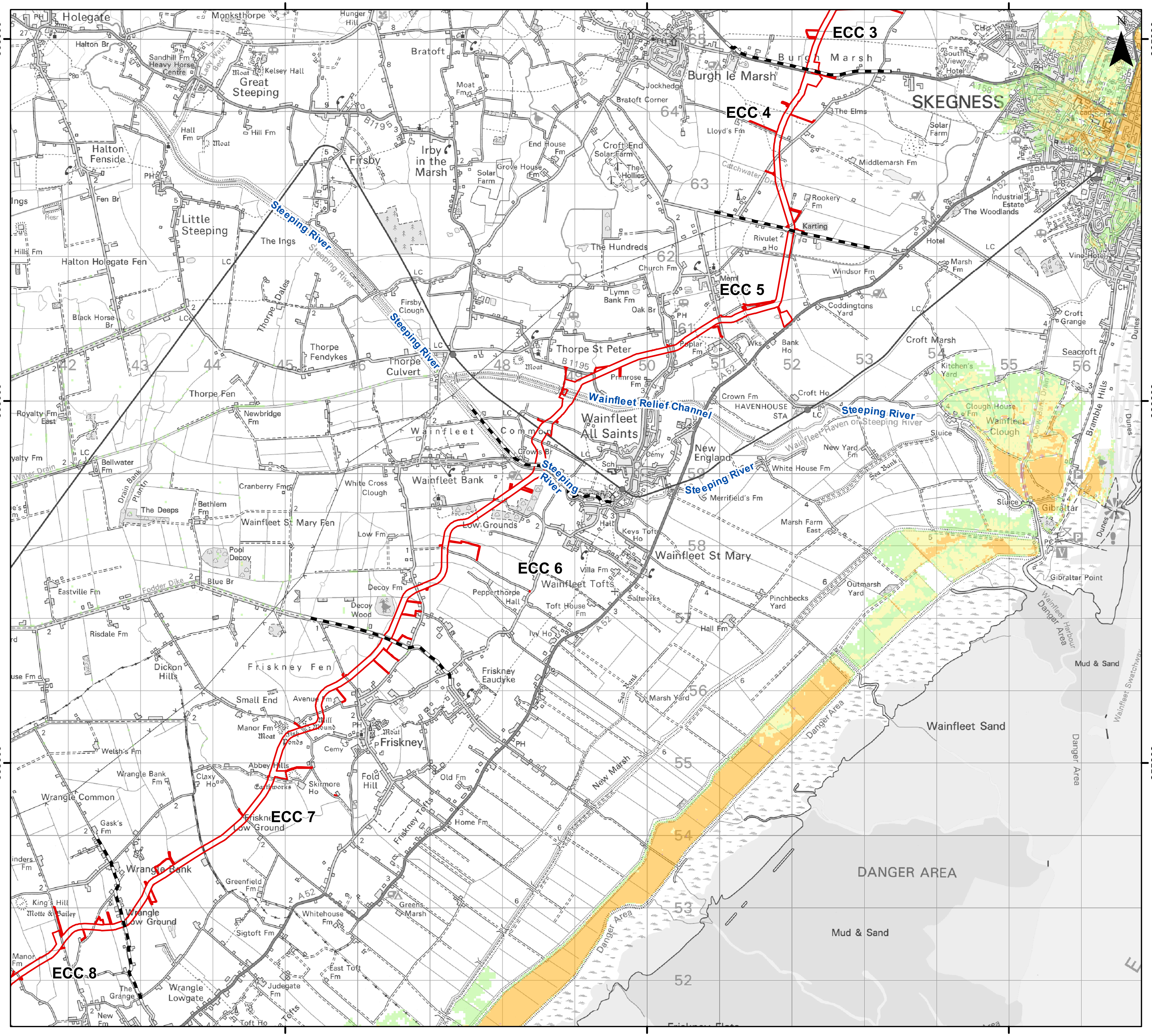

Legend

Order Limits

Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.1% AEP

<= 0.75

0.75 - 1.25

1.25 - 2

> 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.1% AEP

Figure 24.2.8.2 (B)

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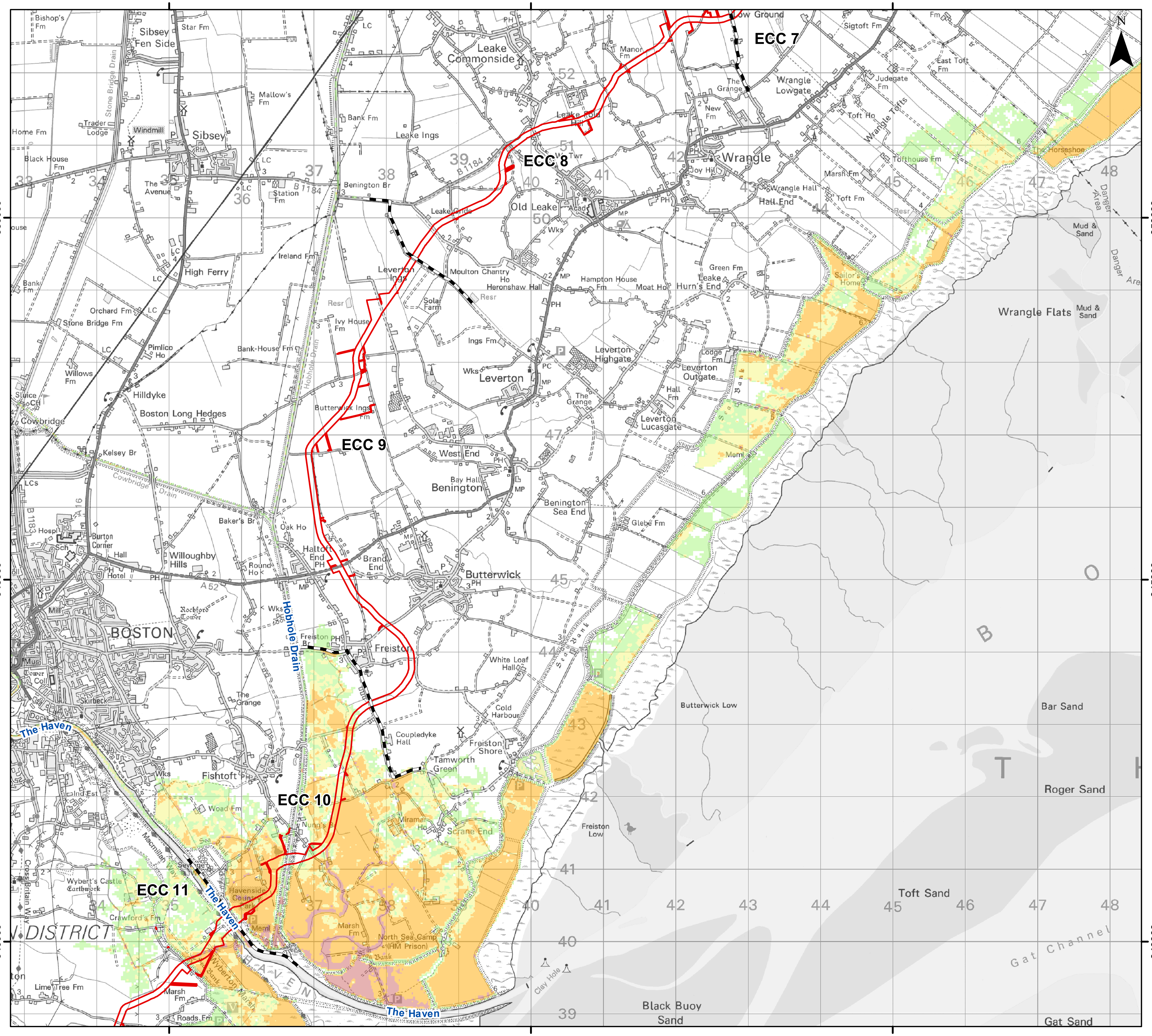

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.1% AEP

Figure 24.2.8.3 (B)

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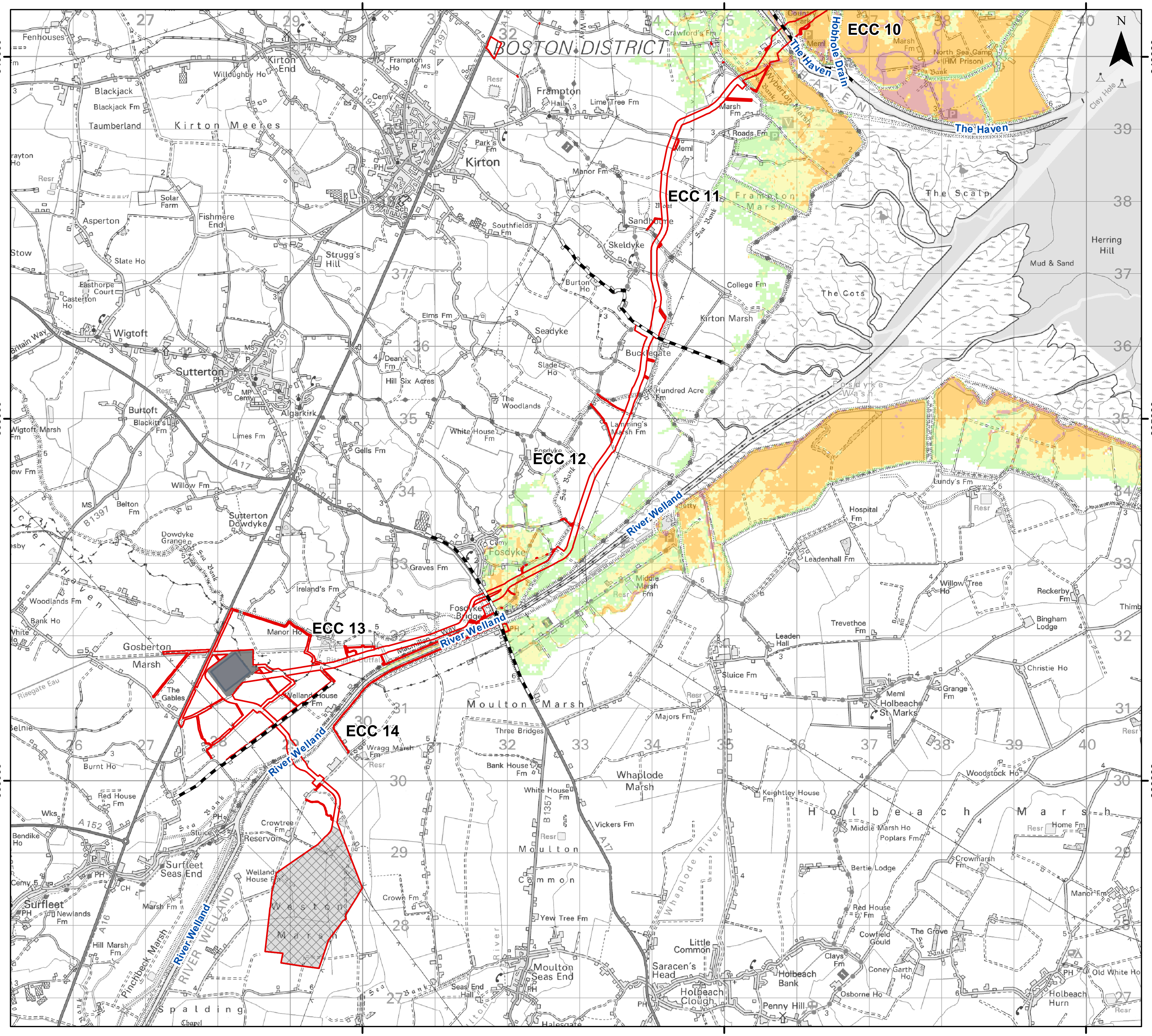

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Coordinate System: British National Grid

0 1 2 km

Scale: 1:50,000

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Environmental Statement

Environment Agency Coastal Flood Defence Overtopping Flood Hazard Mapping 0.1% AEP

Figure 24.2.8.4 (B)

OUTER DOWSING OFFSHORE WIND

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24.5.1.2 Defence Failure by Breach

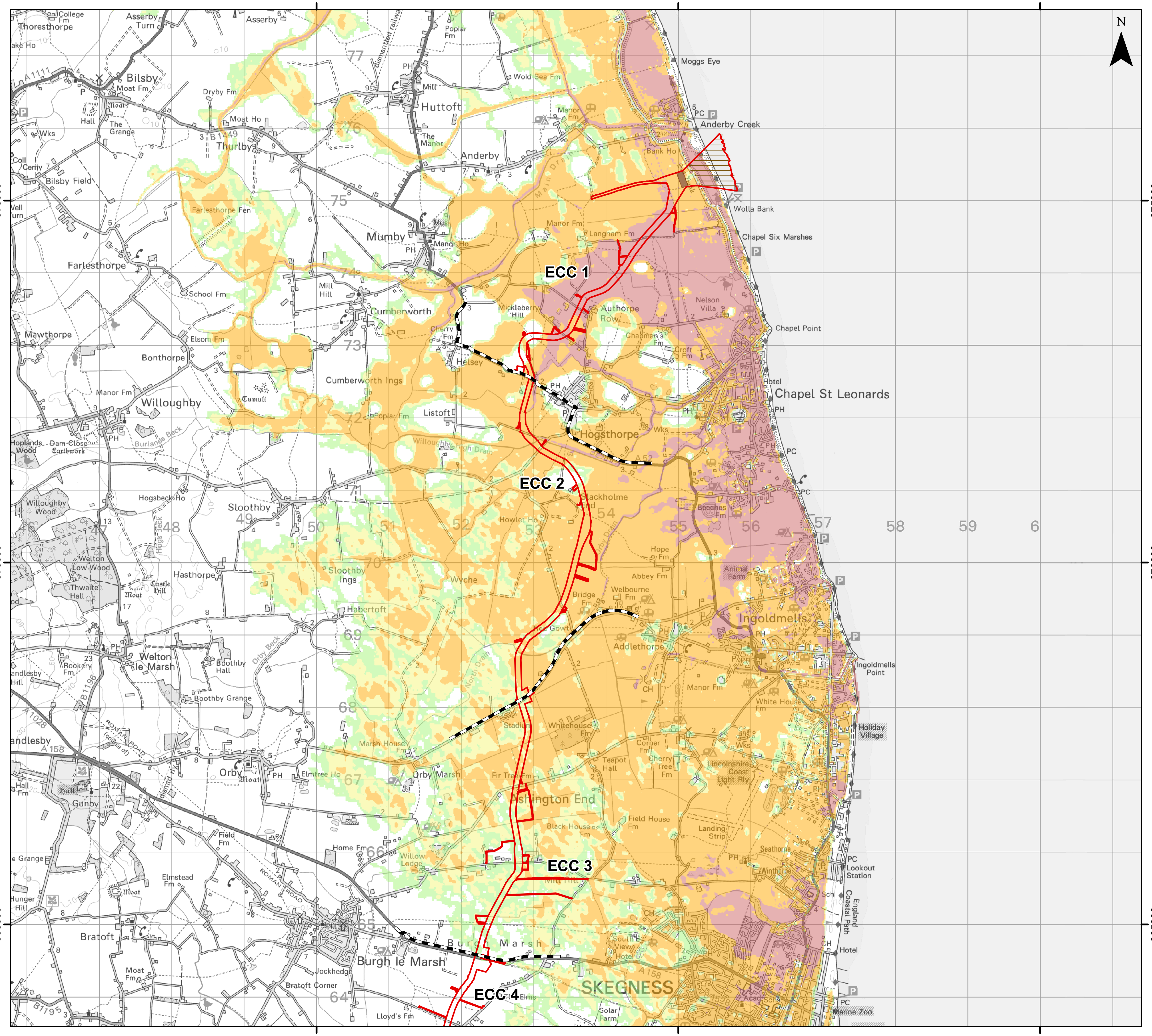
112. In total, 102 breach locations were specified by the Environment Agency along the coastline as part of the Northern Area Tidal Modelling project. The density of the breach locations is higher along the coastline in the urban areas. This study includes breach locations along the tidal Witham Haven.

113. The breach depth mapping indicates the risk of flooding for a 1 in 200 chance scenario (0.5% AEP event), the majority of the onshore ECC lies within an area at risk of flooding from failure of defences by breach, with the exception being an area to the north of the A52, from Low Road to Broadgate, which is not at risk of flooding. The flood depths along the majority of the onshore ECC do not exceed 1 m depth apart from in some localised places of lower ground, where depths reach up to 2 m: landfall and an area around Hogsthorpe, the area around Friskney Tofts, The Haven and surrounding areas (Fishtoft and Frampton), and the Fosdyke area to the north of the River Welland. The breach mapping also indicates the extent of flooding for a 1 in 1,000 chance scenario (0.1% AEP event), which shows a similar pattern of flood risk with slightly increased depths.

114. The breach depth mapping for a 1 in 200 chance plus CC scenario (2115) (0.5% + CC AEP event), indicates that a larger proportion of the onshore ECC lies within an area at risk of flooding from failure of defences by breach, with only a small, isolated area near Wainfleet All Saints not being within an area at risk. There is also an increase of potential flood depths along the ECC, with the majority of flood depths being between 1.5 m to 2 m apart from some areas to the north of the A52 which reach less than 1 m.

115. The breach hazard mapping shows certain areas the ECC crosses that have higher hazard ratings. These areas relate to the northeastern and southwestern areas where the ECC crosses the Haven. The northern and southern areas of the River Welland where the ECC runs parallel to the watercourse also have higher hazard ratings than surrounding areas. The southern bank of the River Welland, where the 400KV cable crosses the River Welland also has a higher hazard rating than surrounding areas.

116. There is also an area near the landfall, to the east of the ECC at Chapel St Leonards that is within a higher hazard rating than other areas. The Environment Agency breach flood hazard mapping is shown in Figure 24.2.9.



Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.5% AEP

Figure 24.2.9.1 (A)

OUTER DOWSING OFFSHORE WIND

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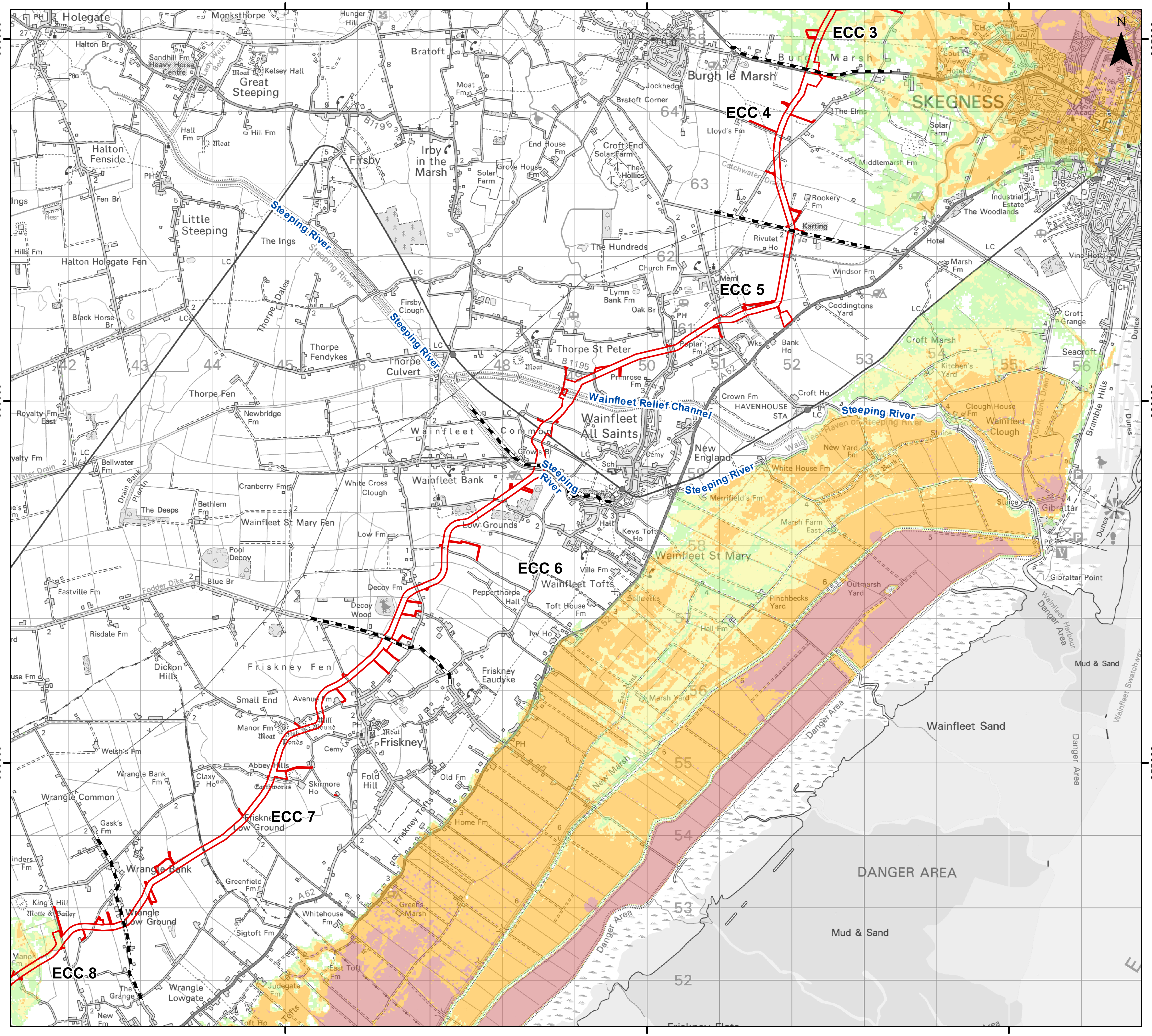

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.5% AEP

Figure 24.2.9.2 (A)

OUTER DOWSING OFFSHORE WIND

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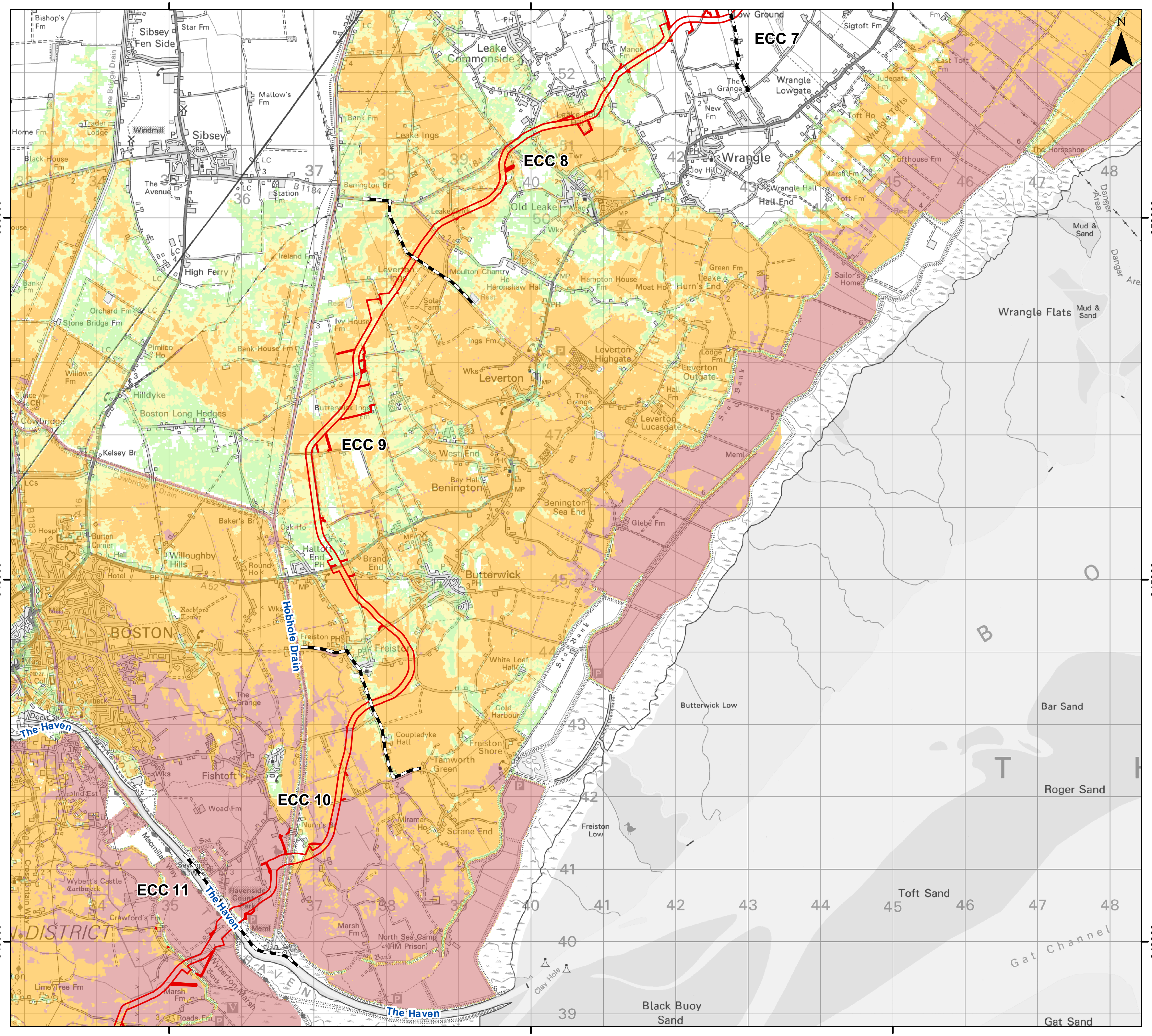

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.5% AEP

Figure 24.2.9.3 (A)

OUTER DOWSING OFFSHORE WIND

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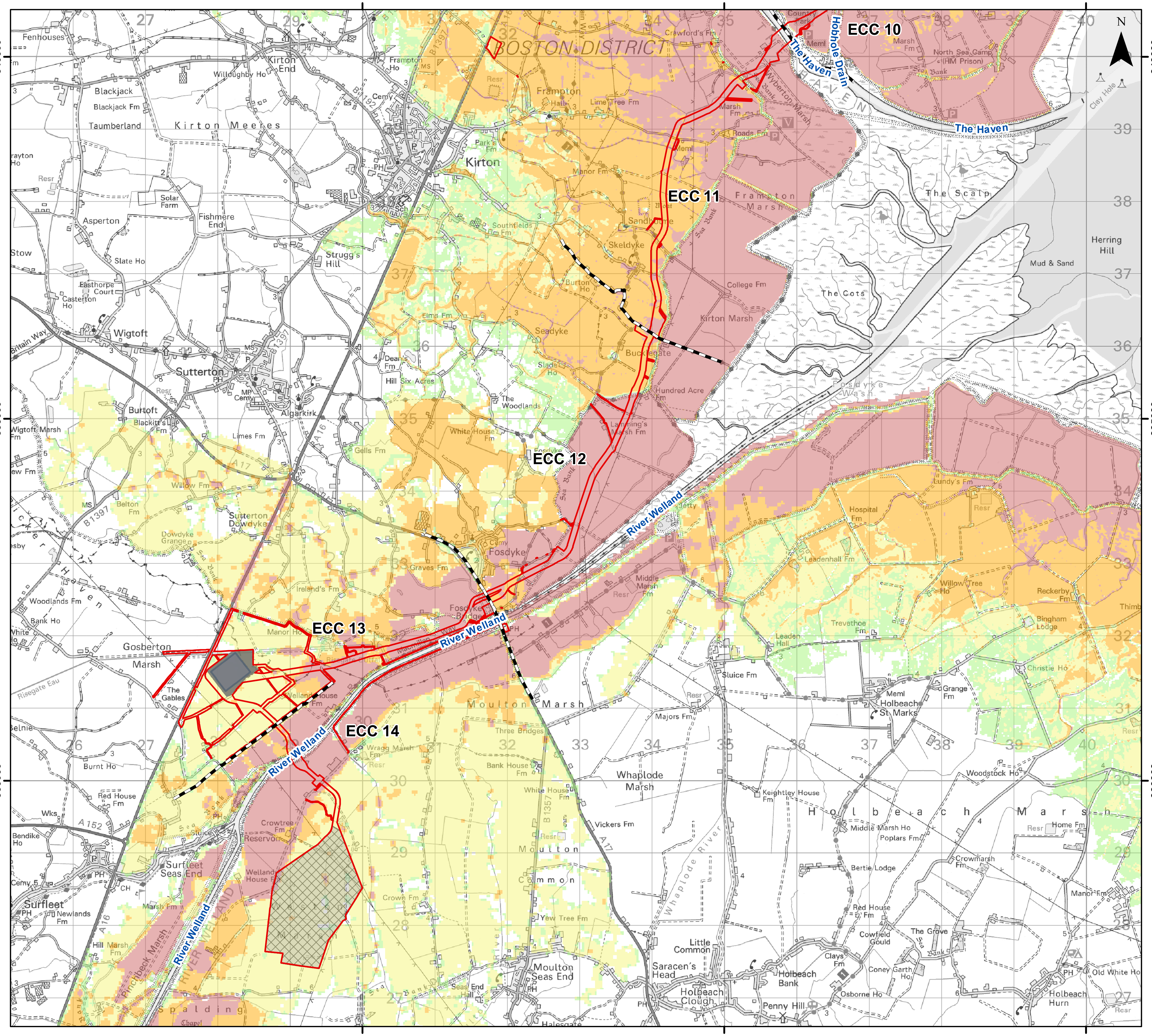

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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0 1 2 km

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.5% AEP

Figure 24.2.9.4 (A)

OUTER DOWSING OFFSHORE WIND

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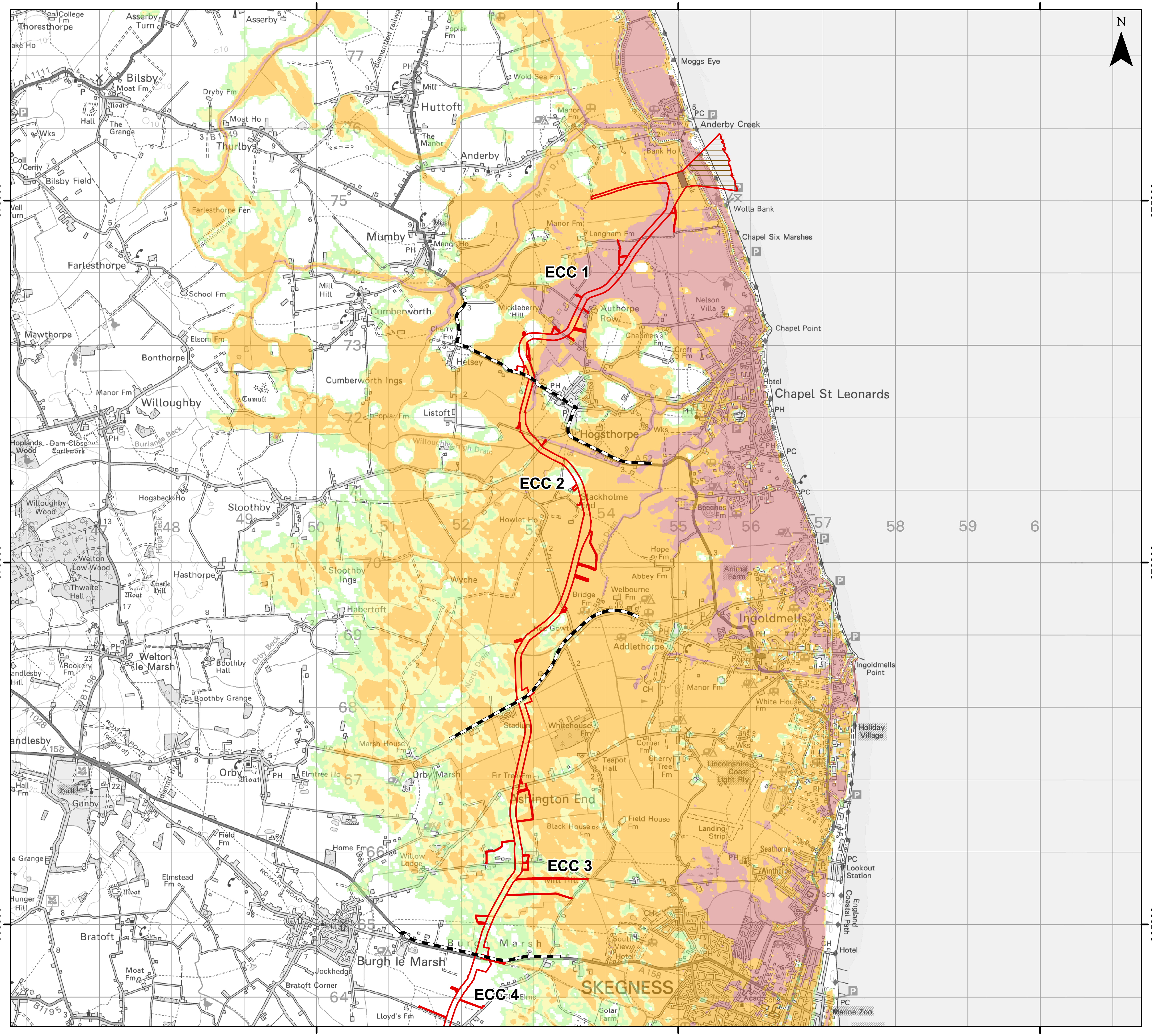

Legend

- Order Limits
- Onshore Segment Break
- Landfall Trenchless Works Area
- Transition Joint Bay Area

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.1% AEP

Figure 24.2.9.1 (B)

OUTER DOWSING OFFSHORE WIND

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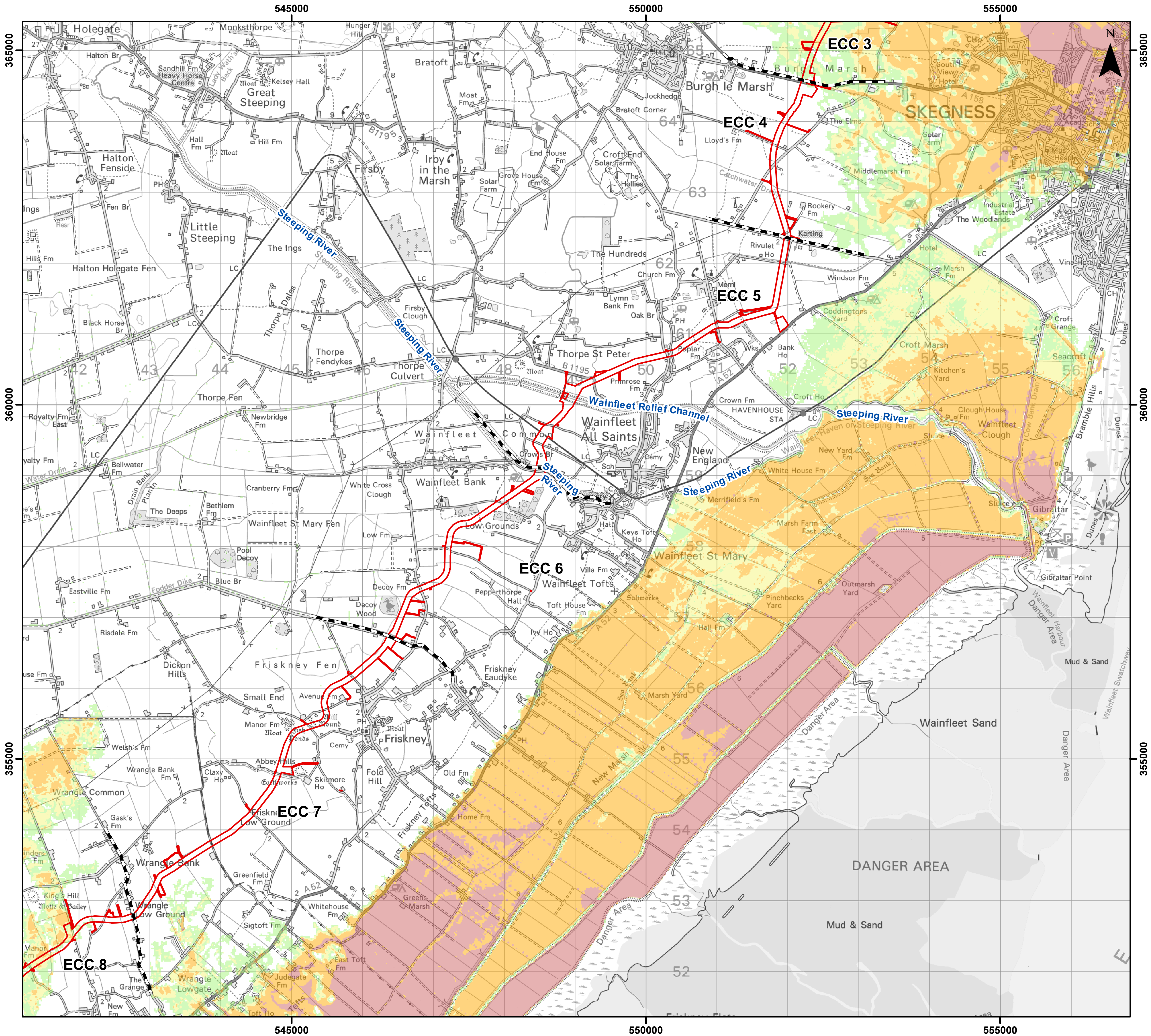

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.1% AEP

Figure 24.2.9.2 (B)

OUTER DOWSING OFFSHORE WIND

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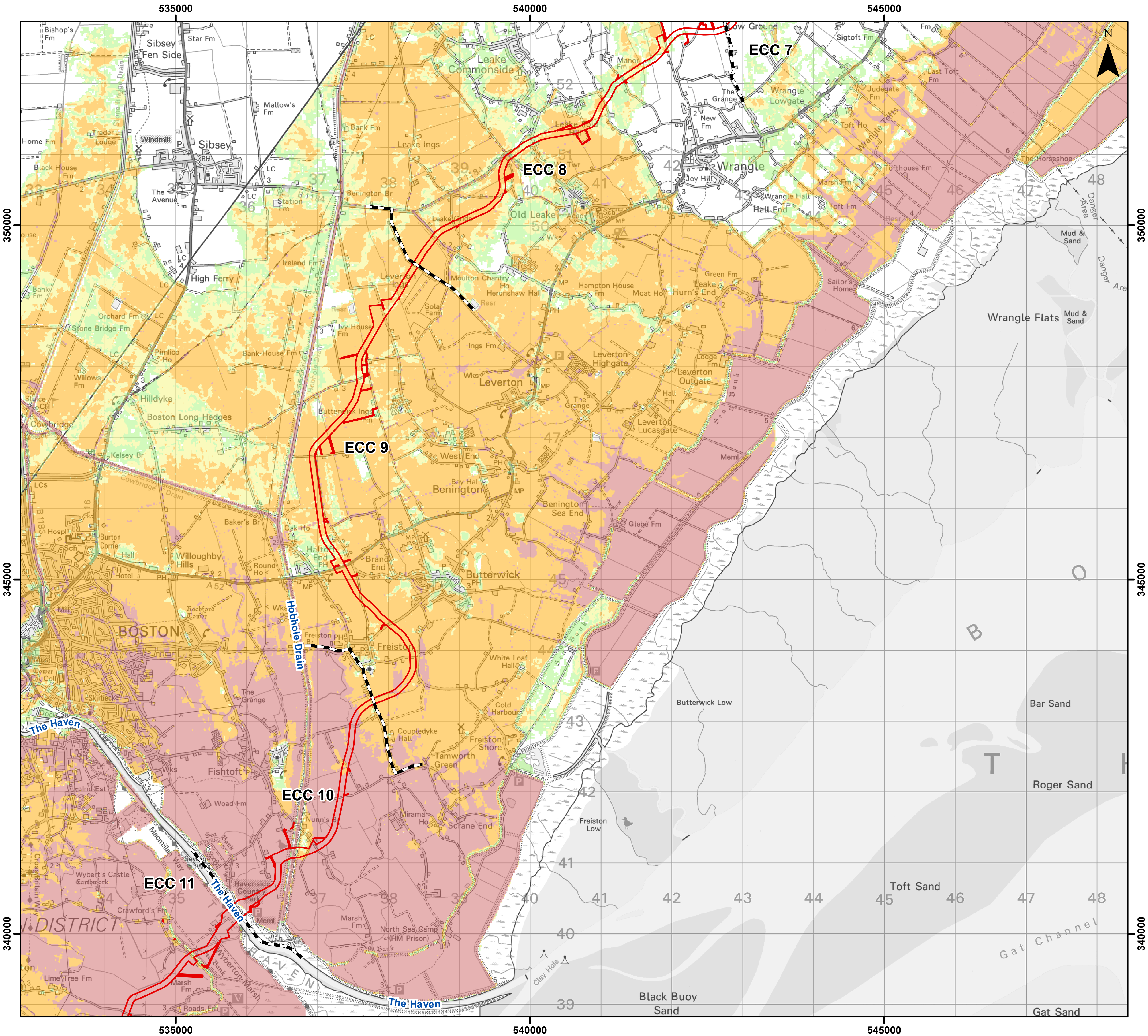

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.1% AEP

Figure 24.2.9.3 (B)

OUTER DOWSING OFFSHORE WIND

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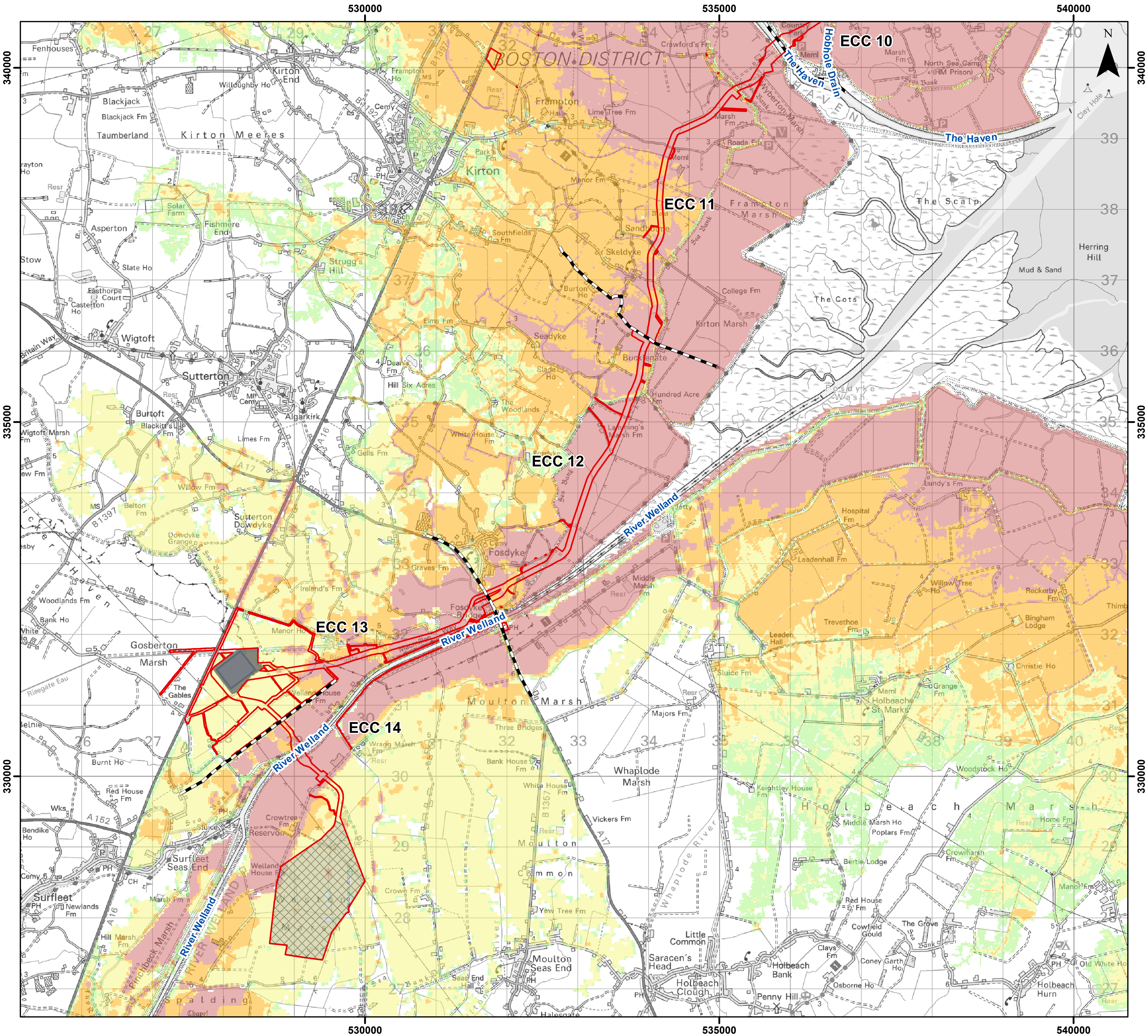

Legend

- Order Limits
- Onshore Segment Break
- Onshore Substation (OnSS) Footprint
- Connection Area
- Area not Included in Export Cable Corridor Flood Risk Assessment

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency Coastal Flood Defence Breach Flood Hazard Mapping 0.1% AEP

Figure 24.2.9.4 (B)

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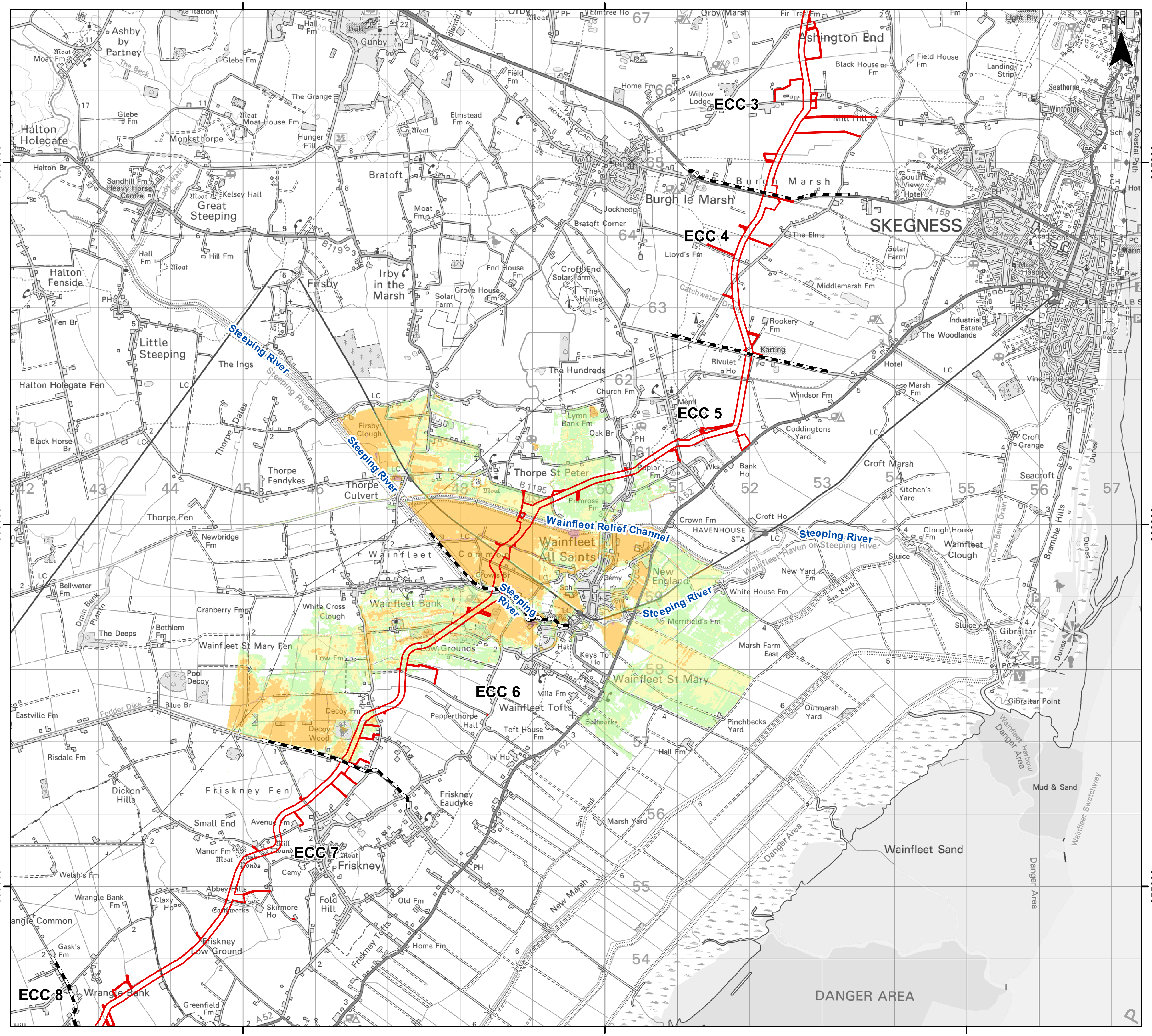

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.5% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
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Environmental Statement

Environment Agency River Steeping Flood Defence Breach Flood Hazard Mapping 0.5% AEP
Figure 24.2.9 (C)

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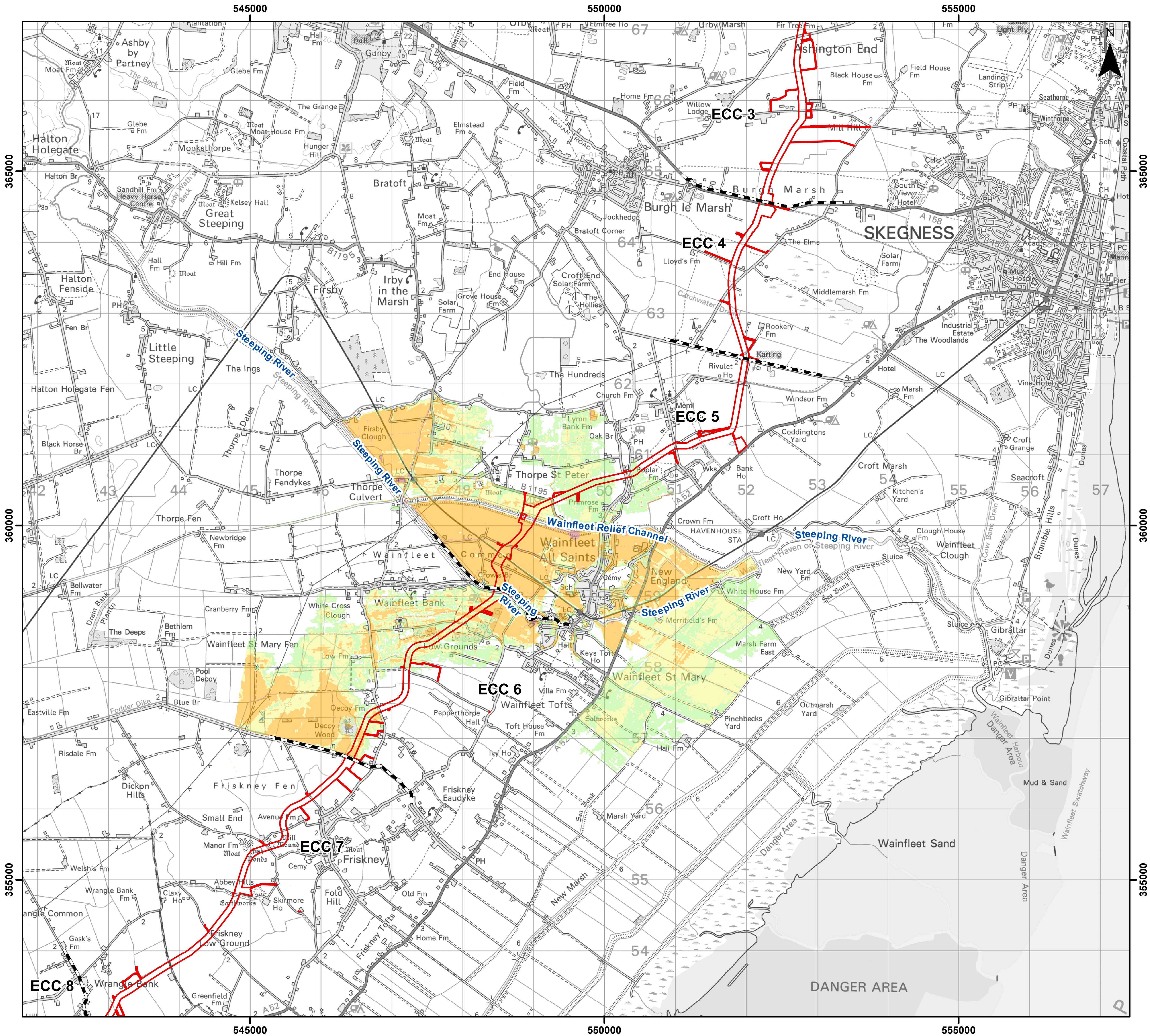

Legend

- Order Limits
- Onshore Segment Break

Environment Agency Flood Hazard Mapping 0.1% AEP

- <= 0.75
- 0.75 - 1.25
- 1.25 - 2
- > 2

Note:
ECC FRA does not include an assessment of the National Grid Substation within the Connection Area

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Environmental Statement

Environment Agency River Steeping Flood Defence Breach Flood Hazard Mapping 0.1% AEP
Figure 24.2.9 (D)

OUTER DOWSING OFFSHORE WIND

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24.5.1.3 Noise Bund Hydraulic Modelling

117. As discussed in Section 24.4.2, a detailed hydraulic modelling report (Noise Bund Hydraulic Modelling Report (document reference: 15.7, version 1)) has been undertaken to clarify the flood risk impacts from the installation of a temporary noise bund at landfall during the construction phase of the Project.

118. The hydraulic modelling was undertaken for both baseline and proposed development scenarios for overtopping and breach of defences. Two breach scenarios were considered; Breach 1 (breach of coastal dunes) and Breach 2 (breach of both coastal dunes and Roman Bank). For planning purposes, the hydraulic modelling for the temporary noise bund has considered the 1in 200 year (0.5% AEP) event, plus an allowance for climate change. In order to check sensitivity to more extreme events, the hydraulic modelling has also considered the 1 in 1000 year (0.1% AEP) event, plus an allowance for climate change.

119. During the overtopping and Breach 1 scenario (breach of dunes), the peak flood extents do not reach the noise bund location during the 0.5% AEP event or the 0.1% AEP plus climate change event. This is shown in Figure 6 and 7 of Noise Bund Hydraulic Modelling Report (document reference: 15.7).

120. For the Breach 2 scenario, in the event of a breach of both the coastal dunes and Roman Bank, flood water does not reach the location of the noise bund for the 0.5% scenario.

121. When assessing sensitivity to more extreme events it is noted that flood water is expected to reach the proposed noise bund during the 0.1% AEP plus climate change event. This is shown in Figure 8 of the Noise Bund Hydraulic Modelling Report (document reference: 15.7).

122. As shown in Figure 10 of the Noise Bund Hydraulic Modelling Report (document reference 17.7), during the proposed development scenario, increases in flood extent and flood depth are noted to the east and south of the noise bund location, with increases in depths of approximately 0.03 m – 0.15 m. A slight reduction in depths is noted to the north and west of the site. There are no sensitive receptors in the areas of increased flood depths, with the majority of the areas being agricultural fields.

123. The only small increase in flood depth to sensitive receptors is located at Chapel Point Holiday Park, with an approximate increase in flood depths of 0.03 m. However, this is considered to be an in-channel increase that would not lead to out of channel

flows, and therefore still leaves a freeboard to any potential properties or sensitive receptors of approximately 2 m.

124. It should be emphasised that the increase in flood depths is only observed for the 0.1% AEP + climate change event, where both flood defences are breached, and therefore is an extreme residual risk scenario.

125. It is therefore not proposed that any additional mitigation measures, other than those outlined in Section 24.7.1, are necessary in regard to the noise bund and flood risk.

24.5.2 Flooding from Fluvial Sources

126. As discussed in Section 24.4.1, parts of the onshore ECC could be at risk of fluvial flooding. As part of a data request, the Environment Agency has provided fluvial modelling for River Steeping and Willoughby High Drain, as discussed below.

24.5.2.1 River Steeping

127. The Environment Agency has provided fluvial modelling for the River Lymn-Steeping catchment. This modelling was published by JBA in October 2009 (JBA, 2009) as part of the River Lymn-Steeping Flood Map Improvements Study. The study covers the fluvial River Lymn-Steeping and six of its tributaries (Rain Beck, Double Dike, Partney Beck/Langton Beck, Lady Wath's Beck, Firsby Sewer and Cowcroft Drain) and Wainfleet Relief Channel.

128. The fluvial extent mapping indicates that for the 1 in 100 chance defended scenario (1% AEP event), the onshore ECC is not at risk of flooding from the River Lymn-Steeping. For the 1 in 1,000 chance defended scenario (0.1% AEP event), a small area of the onshore ECC between Collision Lane and Wainfleet Road is at risk of flooding from this source.

129. For the 1 in 100 chance defended scenario plus 20% CC (1% AEP + 20% CC event), there is a small area of the onshore ECC, between Collision Lane and Wainfleet Road which is at risk of fluvial flooding.

130. The fluvial hazard mapping shows higher hazard ratings in the area between Steeping River and Wainfleet Relief Channel, which the ECC crosses.

24.5.2.2 Willoughby High Drain at Wolla Bank

131. The Environment Agency has provided fluvial modelling for Willoughby High Drain at Wolla Bank, where the cable reaches landfall. The fluvial mapping shows that the

onshore ECC is not at risk of flooding in this location up to and including the 0.1% AEP + 65% CC event.

24.5.2.3 Willoughby High Drain at Hogsthorpe

132. The Environment Agency has also provided fluvial modelling for Willoughby High Drain at Hogsthorpe. The fluvial mapping shows that the onshore ECC at this location is not at risk of fluvial flooding for the majority of events, except the 1 in 1,000 chance scenario (0.1% AEP event) and the 1 in 1,000 chance scenario plus 25% CC (0.1% AEP + 25% CC event).

24.5.3 Summary of Detailed Assessment of Flood Risk

133. In summary, the onshore ECC is at risk of flooding from breach and overtopping of defences during tidal scenarios, and also limited areas of fluvial risk.

134. The potential changes in flood severity associated with climate change will gradually increase the residual risk along the onshore ECC associated with a breach and overtopping of defences, however, once constructed there will be no surface features in areas at risk and very limited need for personnel to visit the onshore ECC. Arrangements for safe access to the onshore ECC during the construction and operational phases are outlined in Section 24.7.

135. The regular maintenance and management of flood defences by the Environment Agency further assists to reduce the likelihood of flooding. Trenchless construction techniques will be used at the landfall area and to cross other flood defence infrastructure along the onshore ECC, so that the existing flood defences are not compromised, to assist with protecting sensitive features, and to minimise the extent of direct interaction with coastal or estuarine features. The nature of construction techniques to be adopted are outlined in Chapter 3 (document reference 6.1.3). Considering this, the flood risk to the onshore ECC in the event of a breach, overtopping, or fluvial event caused by this Project is likely to be very limited and would only occur during or following a severe weather scenario.

24.6 Sequential and Exception Test

136. As discussed in Section 24.3.1 the majority of the onshore ECC lies within Flood Zone 3a. As detailed in Section 24.1.5 the Project proposals are considered to be 'Essential Infrastructure'.

24.6.1 Sequential Test

137. With reference to the NPPF, the Sequential Test gives preference to locating new development in areas at lowest risk of flooding (i.e. Flood Zone 1). The Environment Agency Flood Map for Planning and Strategic Flood Risk Assessments (SFRAs) are geared to providing the basis for applying this test.

138. The Sequential Test requires developers to:

"…demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed."

139. Details of the sequential test and site selection are addressed in Volume 1, Chapter 6.1.4: Site Selection and Consideration of Alternatives (document reference: 6.1.4).

24.6.2 Exception Test

24.6.2.1 Part One

140. The first part of the Exception Test requires that the Project must demonstrate wider sustainability benefits to the community that outweigh flood risk.

141. The Project is a Nationally Significant Infrastructure Project (NSIP), which is a 1.5 Gigawatt (GW) offshore windfarm off the Lincolnshire Coast. Once completed it will be one of the UK's largest offshore windfarms. It is anticipated to generate renewable electricity equivalent to the annual electricity consumption of over 1.6 million households and will play a critical role in achieving the UK Government's ambition to deliver 50 GW of offshore wind by 2030 and to achieve net zero by 2050. The Project will displace the equivalent of nearly 2 million tonnes CO_2 emissions per year of operation through the generation of renewable electricity.

142. Based on the above, it is therefore considered that the first part of the Exception Test is passed.

24.6.2.2 Part Two

143. To satisfy the second part of the Exception Test, it must be demonstrated that the Project will be safe for its lifetime taking into account the vulnerability of its users and that it will not increase flood risk elsewhere, and, where possible, will reduce flood risk overall.

144. During the operational phase of the onshore ECC, the Project will not be at risk of flooding, and will not increase flood risk elsewhere. The onshore ECC will only be at potential risk of flooding during the construction phase, which could lead to a temporary increase in flood risk elsewhere during this phase. It is proposed that this is managed through appropriate mitigation measures outlined in Section 24.7.1.

145. It is therefore considered that the second part of the Exception Test is passed.

24.7 Flood Risk Mitigation

146. From the analysis of flood risk discussed in Section 24.4 and Section 24.5, flooding of the onshore ECC from any source is considered to be low or negligible due to the nature of the Project, where infrastructure will be buried underground. There is a residual risk of flooding to the onshore ECC from overtopping or a tidal breach of flood defences, however as the cables will be buried underground and not vulnerable to flooding, this risk would only affect the construction and decommissioning phases.

147. Mitigation measures contained within this section are for the onshore ECC. The FRA for the OnSS is provided as a separate document (Document reference 6.3.24.3) which outlines mitigation measures for the OnSS location.

24.7.1 Construction Phase

24.7.1.1 Flood Response

148. The main risk of flooding to the onshore ECC is derived from the residual risk existing from tidal flood defence overtopping or failure and the risk of tidal flooding to any landfall activities on the seaward side of coastal defences during the construction phase. Flood response planning is required for improving the awareness of personnel working on the site for an incoming tidal event and will be beneficial for the areas of the onshore ECC at residual risk from tidal flood defence failure which encompasses the proposed landfall area and the onshore ECC.

149. The full extent of the onshore ECC lies within 'Flood Alert' and 'Flood Warning' areas for coastal flooding and potential flooding from tidally influenced watercourses inland from the coast. It is recommended that the Principal Contractor signs up to the Environment Agency's 'Floodline' flood warning service for general awareness of an oncoming tidal event in relation to the onshore ECC. The flood response should form part of a wider Emergency Flood Response Plan for the onshore ECC showing which 'Flood Alert' and 'Flood Warning' areas relate to the different segments of the onshore ECC and should include details of actions to be carried out should a warning or alert be received. These actions may include the removal or securing of sensitive plant or equipment and evacuation of personnel from the work area.

150. An Emergency Flood Response Plan for the construction phase will be submitted as part of the final CoCP.

24.7.1.2 Third Party Assets

151. The Environment Agency has a responsibility for inspecting and maintaining the surrounding flood defence infrastructure on a regular basis and the IDBs have responsibility for a number of pumping stations and watercourse crossings along the onshore ECC. Any signs of damage or degradation to third party assets, particularly after an extreme tidal flood event should be reported to the Environment Agency or relevant IDB immediately.

152. In addition to this, the Principal Contractor is expected to liaise with the Environment Agency and relevant IDBs, particularly during the construction phase, where it is expected that the onshore ECC will involve trenchless techniques under flood defences or managed watercourses. This is to ensure the viability of the defences and water channels during the construction works. All works that cross flood defences or Main Rivers will require pre-construction approval of details from the Environment Agency and any works crossing IDB managed watercourses will require approval from the respective IDB.

153. Regular maintenance and clearing of debris from culverts along ordinary watercourses are essential and may require consultation with IDBs during the construction phase to ensure that no blockages are present. All flood defences, watercourses and drainage culverts will be inspected for damage or debris following a flood event. Remedial clearing of gullies and clean-up of debris from working areas may also be required. These maintenance and management measures should be formally incorporated into the site maintenance and management programme with records demonstrating compliance being kept.

24.7.1.3 Surface Water Drainage

154. Prior to commencement of the construction works, a number of surveys and studies will be undertaken to inform the Project of the final design including ecological surveys, geotechnical investigations and drainage assessments.

155. Surface water drainage requirements during construction will be dictated by the final Surface Water Drainage Strategy and will be designed to meet the requirements of the NPPF, NPS EN-1 and NPS EN-5, with runoff limited, through the use of SuDS and infiltration techniques where feasible, which can be accommodated within the onshore ECC area. An outline of the measures to be included in this plan is included in the

application as the Outline Surface Water Drainage Strategy (Document Reference 8.1.5), appended to the Outline CoCP (Document Reference 8.1).

156. The final Surface Water Drainage Strategy will be developed according to the principles of the SuDS discharge hierarchy. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (infiltration);
- To a surface water body;
- To a surface water sewer, highway drain or another drainage system; or
- To a combined sewer.

157. During construction works there are a number of smaller agricultural land drains and watercourses, along the onshore ECC route, that may be only seasonally wet. Trenched crossings will potentially be used for these watercourse crossings. It will be necessary to ensure that flow along the watercourse is maintained and there is no increase in flood risk as a result of the temporary works.

158. There is a risk of surface water flooding from these smaller agricultural land drains and watercourses and/or the flow routes into them being affected by construction of the onshore ECC. Embedded mitigation measures to intercept and collect flow will be implemented along the onshore cable route to ensure there is no increase in flood risk to off-site receptors. This will typically include pre-construction land drainage and the temporary installation of interceptor drainage ditches parallel to the cable trenches and soil storage areas to provide interception of surface water runoff.

159. The final Surface Water Drainage Strategy will be developed, agreed with regulators, submitted to discharge a requirement of the DCO and implemented to minimise water within the working areas, ensure ongoing drainage of surrounding land and that there is no increase in surface water flood risk. This will assess the current and proposed runoff rates, volume of storage required and the proposed approach for discharge of water from each location.

24.7.1.4 Construction Activities

160. Construction activities along the onshore ECC will include earthwork excavations, the trenching of cables, trenchless cable installation and the introduction of temporary watercourse crossings for the construction haul road.

161. The stockpiling of soils that are excavated to facilitate the trenching works will be managed through a plan within the CoCP. An Outline Soil Management Plan (Document Reference 8.1.3), appended to the Outline CoCP (Document Reference 8.1), has been submitted as part of the DCO. The placement of stockpiles will be such that the stockpiles are set back from existing watercourses as required by the Environment Agency or IDB. Stockpiling will be managed to not present any alterations to local hydrological regimes or present a continuous barrier to overland flow, with regular breaks being created within the stockpiles.

162. Section 24.5.1 and 24.5.2 outline areas along the ECC and 400kV cable that are shown to have higher hazard class ratings for residual tidal and fluvial flood risk. Stockpiling and other works in these areas will be minimised or avoided where possible in order to mitigate against any increased risk and allow flood flow through and within flood cells. Detail with regard to stockpiling and phasing of work will be finalised post-consent. The exact positioning and size of stockpiles will not be known until post-consent detailed design. Stockpiling will be for earth removed from cable trenches locally, and therefore there will be no net loss of volumetric floodplain storage.

163. The temporary noise bund at landfall has been hydraulically modelled, as detailed in the Noise Bund Hydraulic Modelling Report (15.7) and assessed in Section 24.5.1.3 and no mitigation is considered necessary. The noise bund will be formed from soil that is stripped from the working area of the landfall site and as such will be covered under the Outline Soil Management Plan (SMP) (document reference 8.1.3), which forms part of the CoCP (document reference 8.1).

164. Temporary culverts will be the primary method to allow the haul road to cross watercourses and will be installed subject to agreement of the design by the relevant regulatory authority with responsibility for the watercourse being crossed. At some locations, it may be necessary to install temporary bridges where the watercourse is unsuitable for culverting or if this is specifically required by the relevant authority. Where it is necessary for the haul road to cross a main river, a temporary bridge will be installed. Temporary bridges will also be used where the haul road crosses over secondary flood defences and associated drains. Design of each crossing will include consideration of the flow capacity of the channel to be crossed and the routing of exceedance flows should the crossing point become blocked. Temporary culverts and bridge structures will be removed once the cable installation works is completed. The

introduction of temporary culverts and bridge crossings will be designed to not alter hydrological regimes and will not increase flood risk locally. The size and design of culverts will be a matter or pre-construction approval by the relevant IDB.

24.7.2 Operational Phase

24.7.2.1 Cable Resilience

165. The onshore ECC will comprise of buried cables. Link boxes will be present along the cable route in addition to the TJBs at landfall and cable termination at the substation. All elements of the proposed onshore ECC are resilient to water and would not be affected by flooding of land along the onshore ECC corridor. The buried cables (including the link boxes) will be resilient to and not affected by any groundwater and therefore will remain operational.

24.8 Conclusions

166. Based on the information available, the assessment of flood risk at the onshore ECC for the Project finds that it is at risk of tidal flooding (residual risk) through failure of tidal flood defence infrastructure and fluvial flooding. With reference to Environment Agency mapping, the majority of the onshore ECC is indicated to be located within Flood Zone 3a. As the coastal extent of the onshore ECC benefits from the protection of several flood defences, the risk of tidal flooding is reduced, however there is still a residual risk, albeit at a very low probability of flooding via a tidal flood defence failure scenario.

167. Flood risk from all other potential sources is not considered to be significant. The construction methods promote the protection of the current states of the watercourses within the onshore ECC. This includes trenchless construction and trenching methods for smaller watercourses. Trenchless construction will be used at the landfall, so that the existing sea defences are not compromised.

168. No flood risk to the ECC infrastructure is considered likely as the electricity cables will be buried, and are therefore considered resilient to flooding.

169. It is recommended that the Principal Contractor subscribes to the Environment Agency's 'Floodline' flood warning service to raise awareness of impending tidal event. All flood defences, watercourses and drainage culverts will be inspected for damage or debris following a flood event. Remedial clearing of gullies and clean-up of debris from working areas may also be required.

170. On the basis of well-maintained flood defences, it can be concluded that the onshore ECC is protected from flooding up to and including the 0.5% AEP event. This means that provided flood defences remain effective, the risk of flooding at the onshore ECC site will be equivalent to areas designated as Flood Zone 1, with some limited fluvial risk around watercourses.

171. In conclusion, based on the information outlined within this FRA, the perceived level of flood risk to, and caused by the construction, maintenance, and operation of the onshore ECC is low, and the Project would be safe, without increasing flood risk elsewhere.

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