

Hornsea 4



Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 6, Annex 1.1: Land Quality Preliminary Risk Assessment

Prepared Royal HaskoningDHV, 22 July 2019
Checked Royal HaskoningDHV, 23 July, 2019
Accepted Ant Sahota, Ørsted, 24 July 2019
Approved Julian Carolan, Ørsted, 26 July 2019

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (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 importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
EIA Regulations	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound.
Local Authority	The Local Authority is a body empowered by law to exercise various statutory functions for a particular area of the United Kingdom. This includes County Councils, District Councils and the Broads Authority, as set out in Section 43 of the Planning Act 2008. East Riding of Yorkshire Council (ERYC) is the Local Authority for the entirety of the onshore project footprint.
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Onshore substation / OnSS	Located as close as practical to the NGET substation at Creyke Beck and will include all necessary electrical plant to meet the requirements of the National Grid.
Ørsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four offshore wind farm project.
Transition Joint Bay (TJBs)	TJBs are pits dug and lined with concrete, in which the jointing of the offshore and onshore export cables takes place.
Trenchless Techniques	Also referred to as trenchless crossing techniques or trenchless methods. These techniques include 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.

Acronyms

Acronym	Definition
BGS	British Geological Survey
CSM	Conceptual Site Model
DEFRA	Department of Environment, Food and Rural Affairs
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ECC	Export Cable Corridor
OnSS	Onshore substation
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyls
PCOC	Potential contaminant of concern
PCSM	Preliminary Conceptual Site Model
PEIR	Preliminary Environmental Information Report
PPE	Personal Protective Equipment
PRA	Preliminary Risk Assessment
SPZ	Source Protection Zone
SVOC	Semi volatile organic compound
VOC	Volatile organic compound
WFD	Water Framework Directive

1 Introduction

1.1 Project Background

1.1.1.1 Ørsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Project Four offshore wind farm (hereafter Hornsea Four). Hornsea Four will be located approximately 65 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network. The location of Hornsea Four is illustrated on [Figure 1](#).

1.1.1.2 Royal HaskoningDHV was commissioned by the Applicant to undertake a Phase 1 Land Quality Preliminary Risk Assessment (PRA) within and around Hornsea Four.

1.2 Objectives

1.2.1.1 The key objective of this PRA is to develop a Preliminary Conceptual Site Model (PCSM) which provides the initial steps in the identification of any potential pollutant linkages and potentially unacceptable risks to sensitive receptors (e.g. human health and environmental receptors) associated with Hornsea Four. The PCSM draws conclusions from historical data available. These are then used to inform decisions with regards to whether further investigation or assessment (i.e. a Generic Quantitative Risk Assessment) is needed to understand and mitigate potential impacts.

1.2.1.2 The purpose of this report is to provide the findings of the PRA in support of [Volume 3, Chapter 1: Geology and Ground Conditions](#) which presents the assessments of any likely significant effects on geology and conditions, because of the development of the Hornsea Four project. This PRA is the first stage of an evolving risk assessment process that will be updated as the Environmental Impact Assessment (EIA) process, data gathering, and project design process develops through to the Development Consent Order (DCO) submission (Q1 2020).

1.3 Report Structure

1.3.1.1 This report comprises the following principal sections:

- [Section 1](#) – Introduction and Methodology;
- [Section 2](#) – Site Location and Description;
- [Section 3](#) – Environmental Setting;
- [Section 4](#) – Regulatory Information;
- [Section 5](#) – Preliminary Conceptual Site Model and Qualitative Assessment; and
- [Section 6](#) – Conclusions and Recommendations.

1.4 Methodology

- 1.4.1.1 This PRA has been completed in accordance with the recommended approach in Contaminated Land Report 11 (DEFRA and Environment Agency. 2004.).
- 1.4.1.2 This PRA is based solely on a desktop review of available information (e.g. historical maps and regulatory information). In the absence of site-specific ground investigation data, the assessments and conclusions drawn adopt a precautionary approach i.e. if a potential pollutant linkage (a source, pathway and receptor must be present for a potential pollutant linkage to exist, refer to [Section 5](#) for full details) has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists.
- 1.4.1.3 This PRA forms the initial step in the assessment of potentially contaminated land. It precedes, if required, intrusive investigations, risk assessments, options appraisals, remedial designs, implementation planning and completion reporting.
- 1.4.1.4 The following desk-based information sources have been reviewed and have informed this report:
- Envirocheck Report (Ref 201127462_1_1, 201127557_1_, 201127555_1_1, 201127465_1_1 and 201127560_1_1.) comprising historical maps, environmental sensitivity data and regulatory records ([Volume 6, Annex 1.2: Envirocheck Report](#), available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>);
 - British Geological Survey (BGS) online geology viewer;
 - The Coal Authority interactive online viewer;
 - UK Radon Website (Public Health England);
 - Environmental data available on the data.gov.uk website (DEFRA); and
 - Publicly available aerial imagery (Google Earth).

1.5 Study Area

- 1.5.1.1 Due to the size of the onshore elements, some sections within this PRA have been divided in to the following composite areas which together comprise the Hornsea Four PEIR boundary, as referred to within this PRA ([Figure 1](#)):
- Landfall – where the offshore export cables will connect to the onshore export cables. This area will include transition pit, cabling laydown, and temporary access tracks. These components are located near Fraisthorpe;
 - Onshore Export Cable Corridor (ECC) - is the proposed route the onshore export cables will take between landfall and the onshore substation (OnSS); and
 - OnSS – located to the west of the Creyke Beck National Grid Electricity Transmission (NGET) substation, Hornsea Four’s proposed grid connection point. A further section of the onshore export cables (within the 400 kV connection area) is then required to connect the OnSS to the Creyke Beck NGET substation.

1.5.1.2 The Hornsea Four land quality PRA study area includes a buffer zone of up to 1km that surrounds the Hornsea Four PEIR boundary. The buffer zones used within this study area are broken down further, as follows:

- A 250 m study area around the Hornsea Four PEIR boundary - for potential sources of contamination, including discharge consents, pollution incidents, landfills, and contemporary trade entries (see [Table 13](#)) that may indirectly impact areas within the Hornsea Four PEIR boundary. With regards to potential sources of contamination, sources at distances greater than 250 m have not been considered as it is anticipated that with increasing distance the risk from these potential sources to the Hornsea Four PEIR boundary diminishes due to an absence of viable pathways. For this reason, designated sites (e.g. Sites of Special Scientific Interest (SSSIs)) and surface water features, for example, have also been considered to a maximum distance of 250 m.
- A 1 km study area around the Hornsea Four PEIR boundary – within which historical maps have been reviewed provide a clear picture of the surrounding area. Both surface and groundwater water abstraction points, have been considered to a distance of 1 km as these are considered to be sensitive receptors that may be impacted by development. Within this distance there is a potential for contaminants to travel greater distances via surface and groundwater, where a pathway exists.

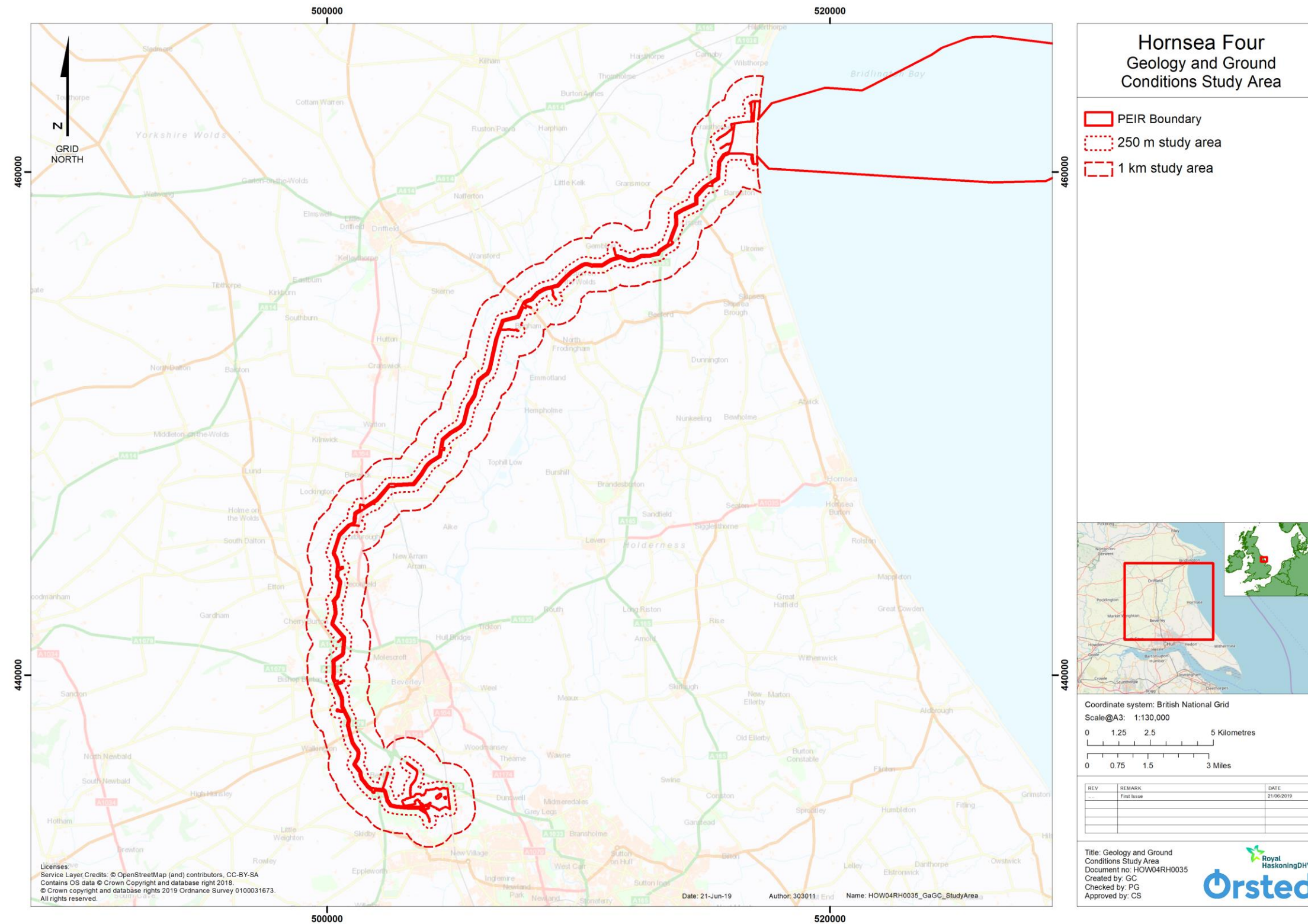


Figure 1: Study Areas Relevant to Geology and Ground Conditions (Not to Scale).

2 Site Location and Description

2.1 Current Land Use

2.1.1.1 Hornsea Four is located within the East Riding of Yorkshire, centred at National Grid Reference 501464, 4453528.

2.1.1.2 The landfall is located to the east of Fraisthorpe and comprises agricultural land and beach. From the landfall, the onshore ECC crosses predominantly open agricultural land avoiding the towns and villages of Lissett, Leconfield (and Leconfield airfield), Cherry Burton and Beverley, prior to reaching the OnSS before connecting to the Creyke Beck NGET substation, near Cottingham (**Figure 1**).

2.2 Historical Information

2.2.1.1 A review of historical maps contained within the 2019 Envirocheck Report obtained has been undertaken to identify key on-site and off-site features that may have contributed to land contamination. The key features identified are summarised below in **Table 1** and **Table 2** and the historical maps are included for reference in **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>).

Table 1: Historical Information (within the Hornsea Four PEIR boundary).

Map Dates	On-Site Features
Landfall	
1854 - 1855	<ul style="list-style-type: none"> Agricultural land with a small number of buildings and road. Dringhoe Drain is recorded. Hoe Pits recorded adjacent to Dringhoe Drain. Gravel pit recorded at Sweet Hill. Lissett and Barmston villages recorded within landfall area.
1892 - 1893	<ul style="list-style-type: none"> Multiple small unnamed pits recorded. Burial ground recorded adjacent to Sweet Hill gravel pit. Grave yard recorded within All Saints' Church in Barmston. Grave yard recorded within St. James' Church in Lissett. Marr Plantation recorded in central part of landfall area.
1910	<ul style="list-style-type: none"> Edge of East Redcarr Plantation recorded in south western corner of the landfall area. A pump is recorded in the south western part of the landfall area. Sweet Hill gravel pit no longer recorded.
1956	<ul style="list-style-type: none"> Airfield (RAF Lissett) recorded in western/south western part of landfall location.
1976 - 1977	<ul style="list-style-type: none"> Tithe Plantation has expanded into the landfall boundary (western boundary). A disused camp is recorded adjacent to Hill Farm. A filling station is recorded in Barmston. Barmston beach caravan park recorded.
1982 - 1984	<ul style="list-style-type: none"> A sand pit is recorded to the west of Dringhoe Drain. Airfield is recorded as disused.

Map Dates	On-Site Features
1911 – 1912	<ul style="list-style-type: none"> Sand pit no longer recorded.
1927	<ul style="list-style-type: none"> Mill Hill gravel pit recorded.
1976 - 1977	<ul style="list-style-type: none"> Pond recorded towards south western area of landfall. Small pits no longer recorded. Burial ground adjacent to Sweet Hill no longer recorded. Increase in number of buildings, thought to be residential, within Barmston. Several unspecified 'works' are recorded in the central area of the landfall area. Tanks are associated with the works.
1995	<ul style="list-style-type: none"> Two ponds are recorded within the footprint of Tithe Plantation.
OnSS	
1855	<ul style="list-style-type: none"> Agricultural land with a series of small buildings, woodland and gravel, chalk and sand pits.
1952 - 1953	<ul style="list-style-type: none"> Electricity pylons recorded traversing the southern part of the OnSS.
1968 – 1969	<ul style="list-style-type: none"> Shafts recorded adjacent to the Hull and Scarborough railway (also recorded within the 1 km Hornsea Four land quality PRA study area, see Table 2)
1970 -1977	<ul style="list-style-type: none"> Creyke Beck electricity substation and works recorded.
1982	<ul style="list-style-type: none"> Creyke Beck electricity substation has increased in size, works no longer recorded.
Onshore ECC	
1854 - 1855	<ul style="list-style-type: none"> Gravel and sand pits recorded throughout the onshore ECC. Agricultural land. Railway line recorded near Lockington. The River Hull bisects the onshore ECC.
1891 - 1892	<ul style="list-style-type: none"> Artesian wells. York, Markey Weighton and Beverley railway bisects onshore ECC.
1938 - 1951	<ul style="list-style-type: none"> Electricity pylons recorded.
1970 – 1975	<ul style="list-style-type: none"> York, Markey Weighton and Beverley railway recorded as dismantled railway.
1982	<ul style="list-style-type: none"> A1079 and A1035 bisects onshore ECC.
2019	<ul style="list-style-type: none"> No significant change.

Table 2 : Historical Information (within the 1 km Hornsea Four land quality PRA study area, exclusive of the Hornsea Four PEIR boundary).

Map Dates	Off-Site Features	Distance from Hornsea Four PEIR boundary (m)	Direction in relation to the Hornsea Four PEIR boundary
Landfall			
1854 - 1855	Cluster of buildings referred to as 'West End' recorded.	>500	South
1891 - 1894	East Redcarr Plantation.	0	South
	Tithe Plantation.	>80	North west
1910 - 1911	East Redcarr Plantation increased in size to the east.	0	South
1963 - 1979	Increase in size of Tithe Plantation.	0	North west
1982 - 1984	Lagoon recorded adjacent to Westfield Farm.	900	South west

Map Dates	Off-Site Features	Distance from Hornsea Four PEIR boundary (m)	Direction in relation to the Hornsea Four PEIR boundary
	Lagoon recorded to west of Dringhoe.	950	South

OnSS

1854 - 1855	Railway line (Hull and Scarborough).	0	North, east and south
1891 - 1894	Queensgate Whiting Works and Victoria Barracks recorded.	>500	North
	Hull Water Works.	>250	South
1954 - 1969	Sewage works (outskirts of Skidby).	600	South west
	Unspecified 'works' and builder's yard recorded adjacent to railway.	>250	South
1963 - 1979	Electricity pylons recorded adjacent to the southern boundary.	0	South
	Shafts recorded.	>10	South
	Whiting works now recorded as works.	>500	North
	Substation recorded adjacent to the Hull Water Works (now recorded as a pumping station).	>250	South
	Nursery recorded.	0	South
1986 - 1988	Footprint of 'works' has increased, builder's yard no longer recorded.	>250	South
1994 - 1995	A disused tip is recorded adjacent to a traveller's caravan site.	300	South
1999	Landfill site recorded adjacent to a golf course and traveller's caravan site.	>400	South

Onshore ECC

1854 - 1855	Lockington Railway Station.	500	South east
	Railway line (Hull and Scarborough).	0	North, east and south
1891 - 1894	East Riding Lunatic Asylum and hospital recorded.	600	East
	Artesian well.	500	East
	Old gravel pit	450	West
	Cherry Burton Station.	800	West
1910 - 1911	Gas works, and sewage works recorded adjacent to the lunatic asylum.	600	East
1928	Gas works, and sewage works no longer recorded adjacent to the lunatic asylum.	600	East
1951	Beeswick Brick and Tile Works.	500	North west

Map Dates	Off-Site Features	Distance from Hornsea Four PEIR boundary (m)	Direction in relation to the Hornsea Four PEIR boundary
1954 - 1969	Expansion of sand pits recorded.	>50	East
	Sewage works (Beverley Corporation).	0	East.
1963 - 1979	Cherry Burton Station no longer recorded.	800	West
	Increase in number of buildings, thought to be residential properties, recorded within Leconfield.	500	East
	Cherry Burton Nurseries and Raventhorpe Nursery recorded.	>250	West
	Shooting ground and gun club recorded in Bygot Wood.	>250	West
1982 - 1984	Poultry houses recorded adjacent to Killingwoldgraves Lane.	250	West
	Unspecified depot and 'works' recorded adjacent to the railway line.	100	East
	Sand Pits recorded as disused. Brigham Quarry recorded.	>50	East
	Trout farm recorded	1000	North west
1993	Sewage works (Beverley Corporation) recorded as disused.	0	East
	Former lunatic asylum no longer recorded.	600	East
1999	Fish Farm recorded.	>450	West
Features common across the 1 km Hornsea Four land quality PRA study area			
1854 - 1855	Agricultural land.	0	North, east, south and west
	Chalk, sand and gravel pits recorded along onshore ECC.	>100	North, east, south and west.
1893	York, Markey Weighton and Beverley railway branches off Hull and Scarborough railway.	0	East and west.
1963 - 1979	York, Markey Weighton and Beverley railway recorded as dismantled.	0	East and west.

3 Environmental Setting

3.1 Ground Conditions

3.1.1.1 Information on geological conditions within the Hornsea Four PEIR boundary has been collated from British Geological Survey (BGS) datasets including 1: 50,000 scale geological mapping. The anticipated geological sequence, as shown on the BGS online viewer, is outlined in [Table 3](#). [Figure 2](#) to [Figure 6](#) illustrate the BGS geological sequence within the 1 km Hornsea Four land quality PRA study area .

Table 3: Geology within the Hornsea Four PEIR boundary (see Figure 2 - 6).

Stratum	Unit	Description
Superficial Deposits	Till (Landfall, onshore ECC and OnSS).	No description given.
	Glaciofluvial Deposits (Landfall, onshore ECC and OnSS).	Sand and gravel.
	Alluvium (Landfall, onshore ECC and OnSS).	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger desiccated surface zone may be present.
Bedrock	Rowe Chalk Formation (Landfall and onshore ECC).	White, flint-bearing chalk with sporadic marl bands.
	Flamborough Chalk Formation (Landfall, onshore ECC and OnSS).	White, well-bedded, flint free chalk with common marl seams (typically about one per metre). Common stylolitic surfaces and pyrite nodules.
	Burnham Chalk Formation (onshore ECC and OnSS).	White, thinly-bedded chalk with common tabular and discontinuous flint bands; sporadic marl seams. Formal subdivision: none as defined here (BGS Lexicon), but there are many named marl and flint bands throughout the succession that are used to divide the formation. They are all of bed status.

3.1.1.2 Historical borehole records were also accessed via the BGS online viewer, a summary of the ground conditions encountered can be found in [Table 4](#).

Table 4: Summary of BGS borehole records within the Hornsea Four PEIR boundary (see Figure 2 - 6).

Borehole reference	Strata	Thickness (m)	Description
Landfall			
TA16SE28	Superficial beds	23.8	Drift.
	Bedrock	Thickness not provided	Chalk.
Onshore ECC			
TA04NW24	Superficial deposits	0.3	Soil.
		3.96	Gravel.
		4.27	Clay.
		3.66	Gravel.
	Bedrock	11.28 (base of borehole)	Chalk.
OnSS			
TA03NW150 / TA03NW3 / TA03NW177	Superficial deposits	0.61	Top soil.
		6.10	Yellow clay.
		3.96	Boulder clay.
	Bedrock	22.86 (base of borehole)	Chalk.
TA03NW34	Superficial deposits	9.75	Sand and gravel.
	Bedrock	14.63 (base of borehole)	Chalk and flint.
TA03SW20	Superficial deposits	0.30	Topsoil.
		1.22	Soft brown sand clay with pieces of gravel, flintstone and chalk.
		0.91	Very firm dark brown silty clay with pieces of flintstone and chalk.
		2.01	Sand, gravel with pieces of flintstone and chalk.
		1.07	Very firm dark brown silty clay with pieces of flint and chalk.
		0.76 (base of borehole)	Sand gravel flintstone and chalk.
TA03SW16	Superficial deposits	0.76	Topsoil.
		2.13	Sand and gravel with small pieces of flintstone and chalk.
		0.12	Firm brown sandy clay with very small gravel and pieces of chalk.
		2.44	Very firm dark brown silty clay with small pieces of chalk.
	Bedrock	0.61 (base of borehole)	Small pieces of chalk and flintstone.
TA03SW19	Superficial deposits	0.3	Topsoil.
		2.01	Sand and gravel with pieces of flintstone and chalk.
		2.28	Very firm dark brown silty clay with small pieces of chalk.
		1.53	Sand and gravel with pieces of flintstone and chalk.

Borehole reference	Strata	Thickness (m)	Description
	Bedrock	N/A (base of borehole)	Flintstone and chalk.
TA03SW18	Superficial deposits	0.3	Topsoil.
		1.53	Very firm mottled clay with pieces of chalk.
		1.22	Sand and gravel with pieces of flintstone and chalk.
		0.3	Fine sand with very small pieces of chalk.
		0.76	Medium grained sand small pieces of chalk.
		0.92	Very firm dark brown silty clay with small pieces of chalk.
	Bedrock	1.07 (base of borehole)	Pieces of flintstone and chalk.

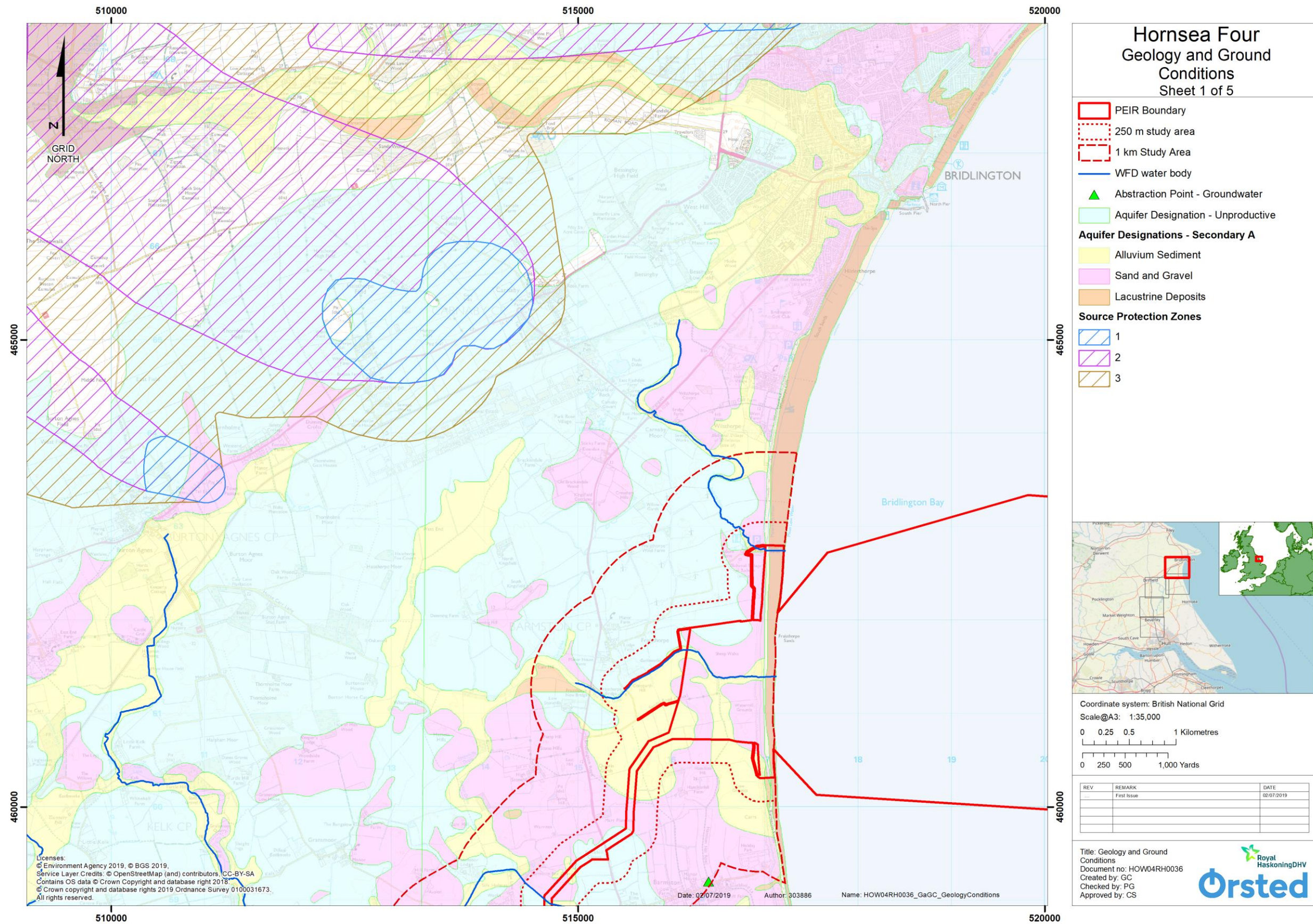


Figure 2: Geology and Ground Conditions within Landfall and Onshore ECC of the Hornsea Four PEIR boundary (Not to Scale).

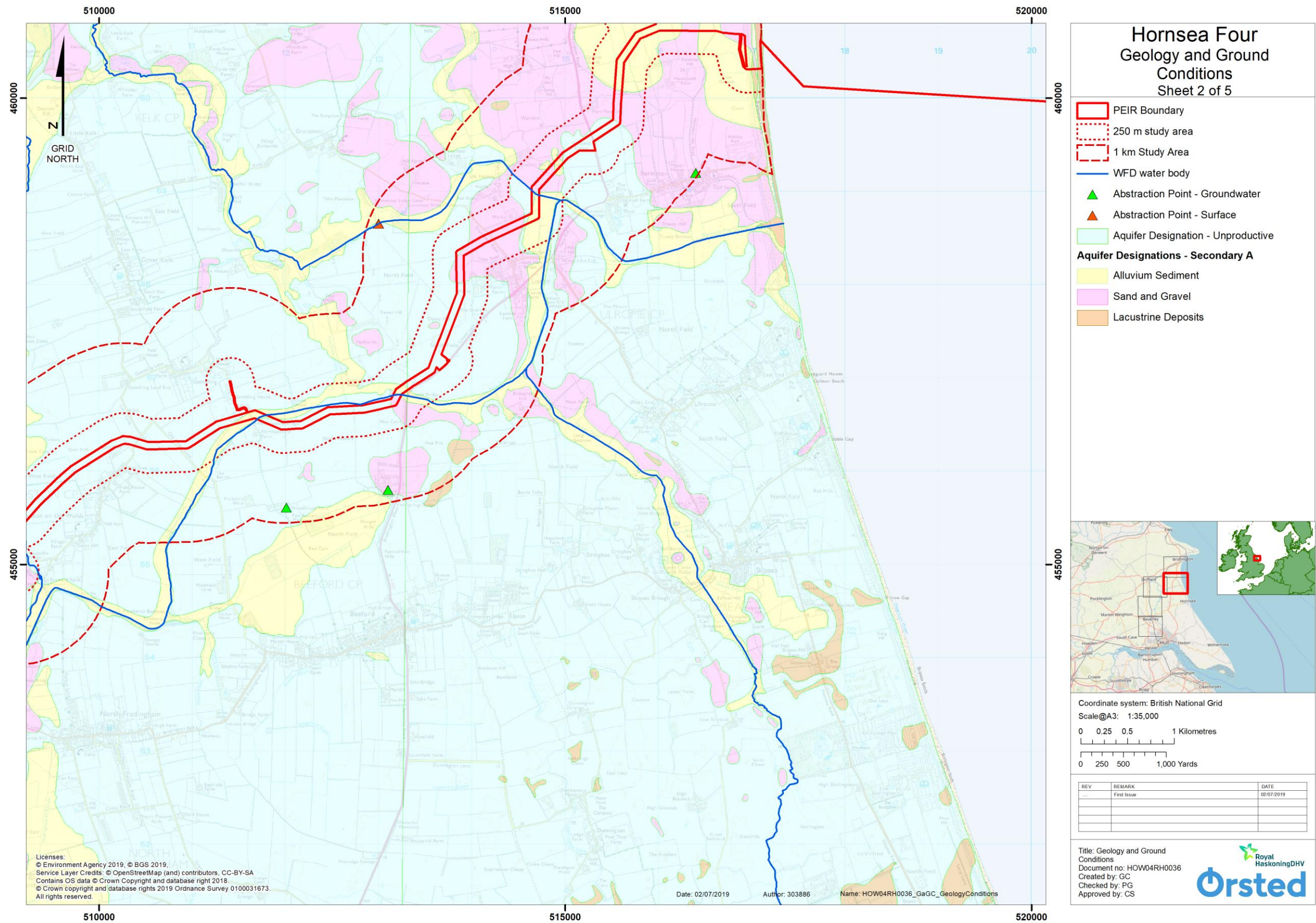


Figure 3: Geology and Ground Conditions within Landfall and Onshore ECC of the Hornsea Four PEIR boundary (Not to Scale).

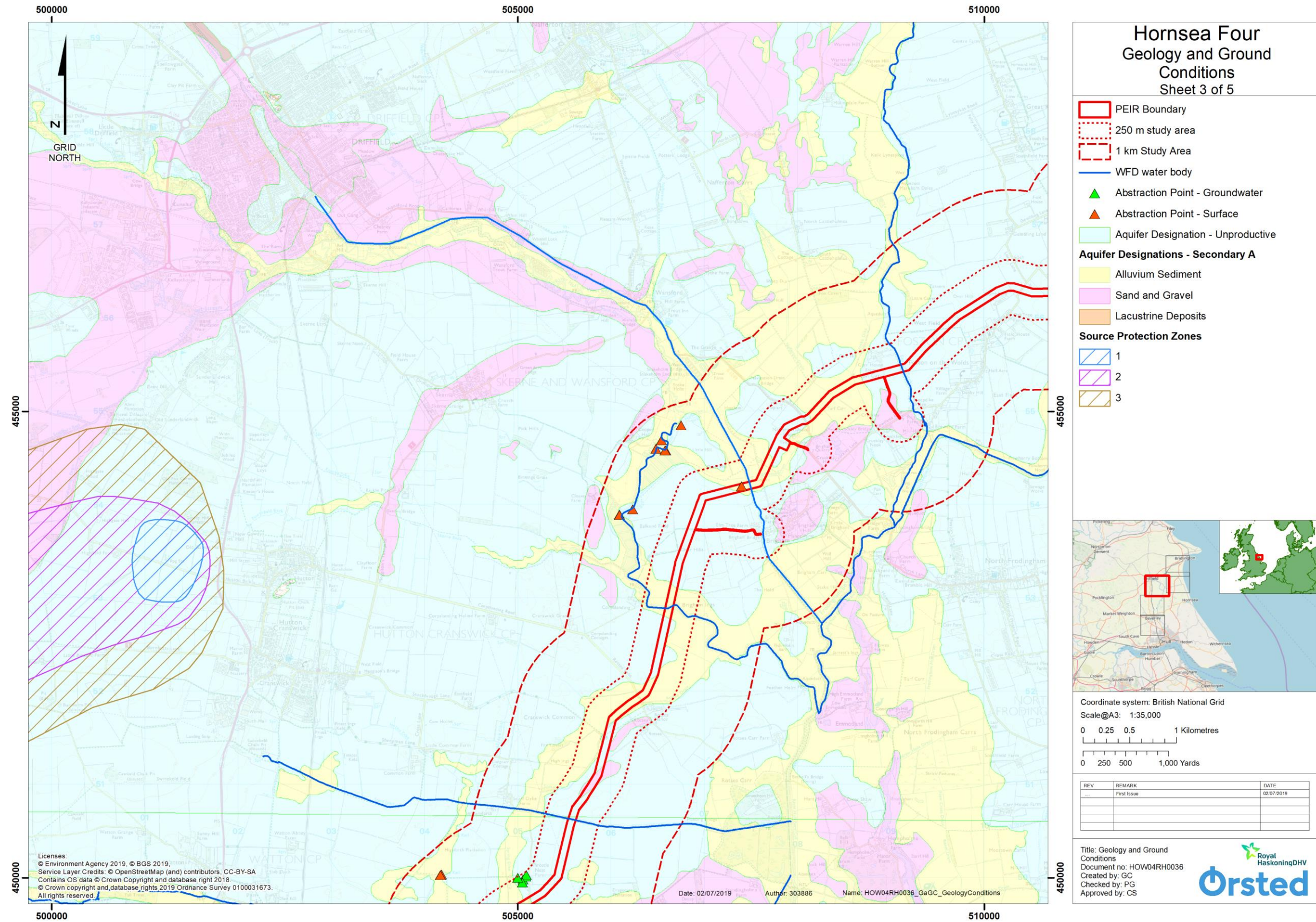


Figure 4: Geology and Ground Conditions within the Onshore ECC of the Hornsea Four PEIR boundary (Not to Scale).

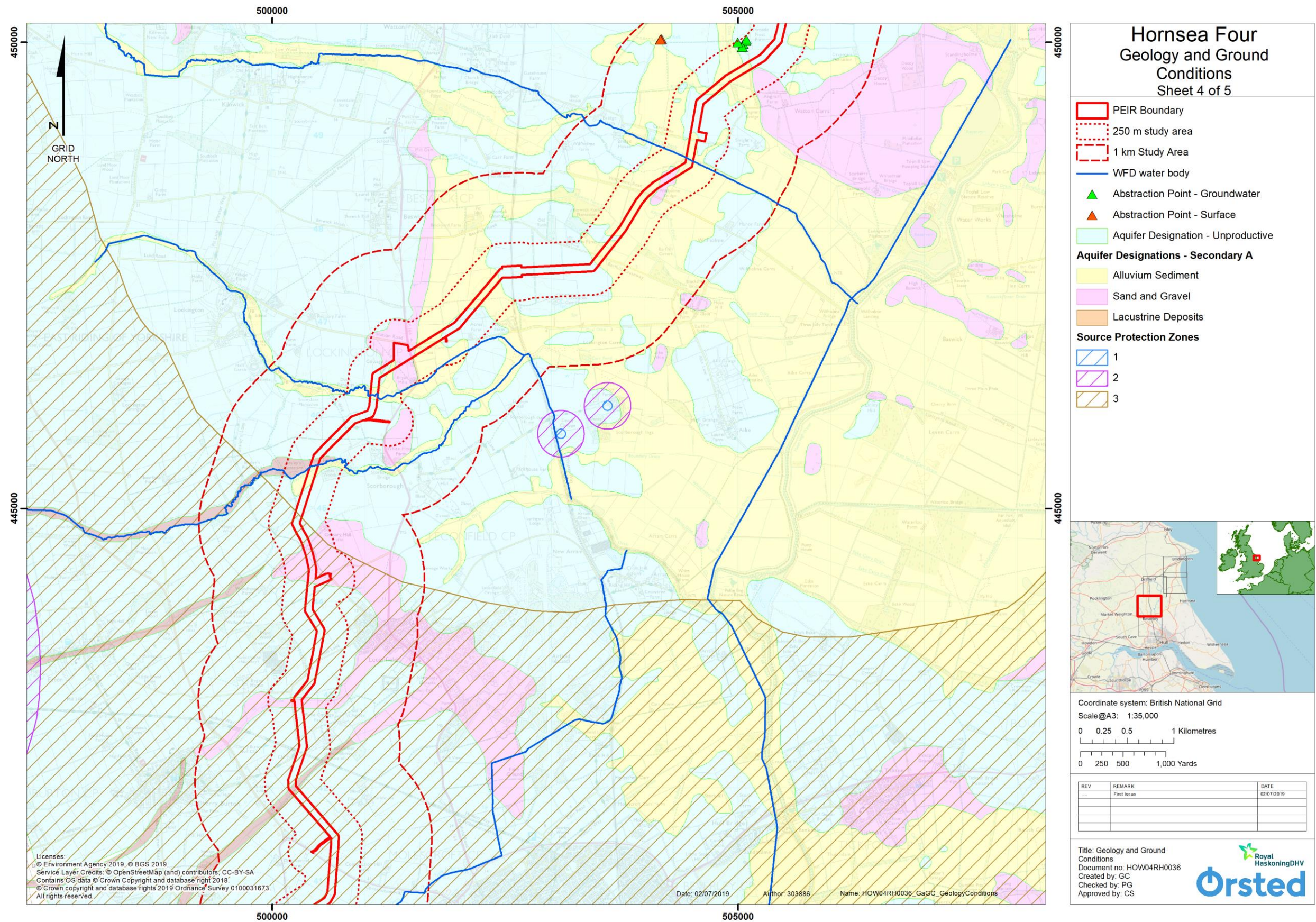


Figure 5: Geology and Ground Conditions within the Onshore ECC of the Hornsea Four PEIR boundary (Not to Scale).

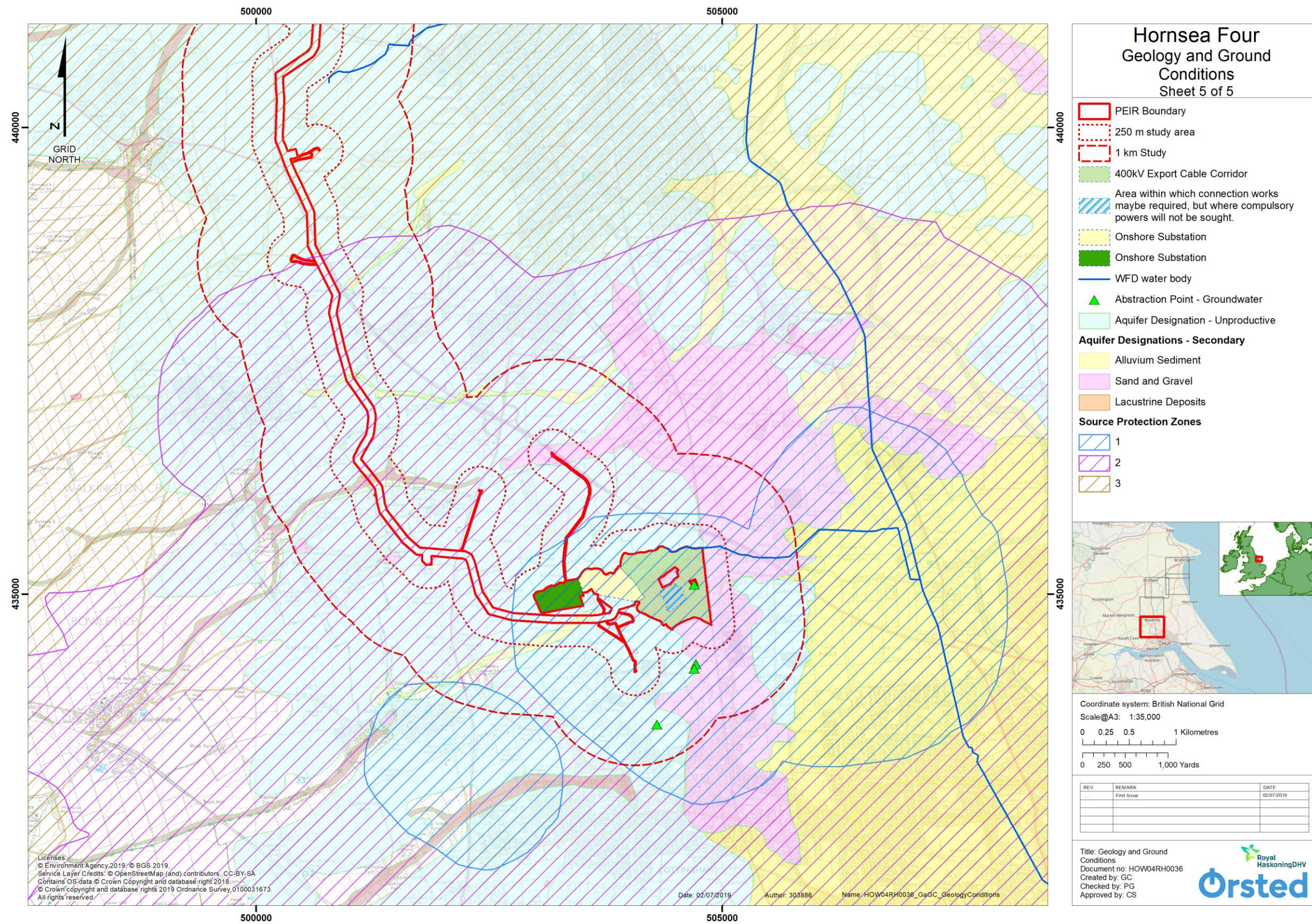


Figure 6: Geology and Ground Conditions within the Onshore ECC and OnSS of the Hornsea Four PEIR boundary (Not to Scale).

3.1.2 Mining and Mineral Extraction

3.1.2.1 Information presented on the Coal Authority Interactive Map indicates that Hornsea Four is not located within a coal mining reporting area or in a high risk development area. Information contained within **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that there are several BGS Recorded Mineral Sites recorded both within the Hornsea Four PEIR boundary (**Table 5**) and within the 250 m Hornsea Four land quality PRA study area (**Table 6**).

Table 5: BGS Recorded Mineral Sites within the Hornsea Four PEIR boundary.

Site Name	Coordinates	Element of Hornsea Four	Commodity	Status
Cottage Pasture Gravel and Sand Pits	501392, 446614	Onshore ECC	Sand and gravel	Ceased
Cottage Pasture Gravel and Sand Pits	501454, 446660	Onshore ECC	Sand and gravel	Ceased
Wilfholme Bridge Gravel Pit	504297, 448606	Onshore ECC	Sand and gravel	Ceased
Burn Park Chalk Pit	503625, 434794	Onshore ECC	Chalk	Ceased
Gill's Charity	500248, 442822	Onshore ECC	Chalk	Ceased

Table 6: BGS Recorded Mineral Sites within the 250 m Hornsea Four land quality PRA study area , exclusive of the Hornsea Four PEIR boundary.

Site Name	Coordinates	Distance from Hornsea Four PEIR boundary (m)	Commodity	Status
Bently	501265, 436121	2 m (west of onshore ECC)	Chalk	Ceased
Bently	501208, 436106	5 m (west of onshore ECC)	Chalk	Ceased
Gill's Charity	500388, 442836	21 m (east of onshore ECC)	Sand and gravel	Ceased
Cottage Pasture Gravel and Sand Pits	501435, 446574	30 m (south-east of onshore ECC)	Sand and gravel	Ceased
Cottage Pasture Gravel and Sand Pits	501484, 446570	30 m (south-east of onshore ECC)	Sand and gravel	Ceased
Broadgate Farm	500996, 437894	46 m (east of OnSS)	Chalk	Ceased
Burn Park Gravel Pit	503654, 434849	77 m (north of OnSS)	Sand and gravel	Ceased
Pillwoods Farm Gravel Pit	504703, 434626	78 m (west of OnSS)	Sand and gravel	Ceased
Lockington Gravel Pit	501324, 446861	82 m (north of onshore ECC)	Sand and gravel	Ceased
Gill's Charity	500111, 442857	97 m (west of onshore ECC)	Sand and gravel	Ceased
High Ings Gravel Pit	506462, 451846	110 m (south-east of onshore ECC)	Sand and gravel	Ceased

Site Name	Coordinates	Distance from Hornsea Four PEIR boundary (m)	Commodity	Status
Gill's Charity	500451, 442839	121 m (east of onshore ECC)	Sand and gravel	Ceased
Broadgate Farm	500698, 438167	155 m (west of onshore ECC)	Chalk	Ceased
Broadgate Farm	501081, 437950	168 m (east of onshore ECC)	Chalk	Ceased
Dunswell Road Gravel Pit	505090, 434890	188 m (east of OnSS)	Sand and gravel	Ceased
Gill's Charity	500521, 442871	219 m (east of onshore ECC)	Sand and gravel	Ceased
Fishpond Wood Sand Pit	501463, 435358	242 m (west of onshore ECC)	Sand	Ceased
Tinker's Nook Sand Pit	508331, 454788	244 m (south-east of onshore ECC)	Sand	Ceased

3.1.3 Radon Gas

3.1.3.1 Information presented within [Volume 6, Annex 1.2: Envirocheck Report](#) (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that Hornsea Four is located within an area where less than 1% of properties are above the action level. As such no radon protection measures are considered necessary within structures constructed within the Hornsea Four PEIR boundary, including at the OnSS.

3.2 Hydrogeology and Groundwater Vulnerability

3.2.1.1 The superficial Alluvium and Glaciofluvial Deposits within the Hornsea Four PEIR boundary are classified as Secondary A aquifers and Secondary B aquifers (illustrated on [Figure 2 to Figure 6](#)). Secondary A aquifers are composed of permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers. A Secondary B aquifer comprises predominantly lower permeability strata which may, in part, have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

3.2.1.2 The Superficial Till Deposits within the Hornsea Four PEIR boundary are classified as a Secondary Undifferentiated aquifer. Aquifers are given this classification when it has not been possible to attribute either category A or B to a rock type.

3.2.1.3 The Rowe Chalk Formation, Flamborough Chalk Formation and Burnham Chalk Formation within the Hornsea Four PEIR boundary are classified as Principal aquifers. Aquifers within this classification are composed of geology that exhibits high permeability and/or provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

3.2.1.4 **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that the area within the Hornsea Four PEIR boundary has been assigned a medium to high groundwater vulnerability risk for the Superficial aquifers and low to high for Principal aquifers. A high groundwater vulnerability designation indicates that the soil is easily able to transmit pollution to groundwater, which is characterised by high leaching potential in soils and the absence of low permeability superficial deposits.

3.2.2 Groundwater Source Protection Zones

3.2.2.1 Groundwater Source Protection Zones (SPZs) are defined around abstraction boreholes used for potable water supply. They delineate the area where the release of a contaminant into the aquifer could impact on the abstraction. There are three types of SPZ:

- The Inner Zone (Zone 1) is the most sensitive and certain activities with potential to pollute groundwater are restricted in this area;
- The Outer Zone (Zone 2) is less sensitive, and there are fewer restrictions; and
- Total Catchment (Zone 3) is outside of Zone 2 and indicates the recharge area that contributes to that water supply.

3.2.2.2 Information presented in **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that areas of the onshore ECC and OnSS are within Zone 1, Zone 2 and Zone 3 SPZs, as illustrated on **Figure 2 to Figure 6**).

3.2.3 Groundwater Abstractions

3.2.3.1 There are two records of groundwater abstractions identified within the Hornsea Four PEIR boundary (as illustrated on **Figure 2 to Figure 6**), details of which are presented in **Table 7**.

Table 7: Groundwater Abstractions within the Hornsea Four PEIR boundary (see Figure 2 – 6).

Permit Holder	Coordinates	Location within Hornsea Four PEIR boundary	Abstraction Details
W Hagues	504700, 435100	OnSS	Borehole (chalk), 63m ³ per day extraction volume; permit issued 25/8/93 no end date in information available. Groundwater abstracted for general agriculture (spray irrigation).
W Hagues	504700, 435100	OnSS	As above, permit issued 25/8/93, no end date.

3.2.3.2 An additional 128 groundwater abstractions were identified in the information reviewed within the 1 km Hornsea Four land quality PRA study area (exclusive of the Hornsea Four PEIR boundary). The majority of the abstractions are associated with general agriculture and domestic uses. **Table 8** summarises both potable groundwater records and other sensitive abstractions within this area (as illustrated on **Figure 2 to Figure 6**).

Table 8: Groundwater Abstractions within the 1 km Hornsea Four land quality PRA study area , exclusive of the Hornsea Four PEIR boundary (see Figure 2 – 6).

Permit Holder	Coordinates	Distance from Hornsea Four PEIR boundary (m)	Abstraction Details
Mr P E Sewell	504300, 433600	609 m south east of onshore ECC	Borehole (chalk), daily abstraction rate not supplied in information received, permit issued 1/4/2008, no end date in information available. Groundwater abstracted for private non-industrial amenity: Make up or top up water.
Yorkshire Water Services Ltd.	504720, 434250; and 504700, 434200	340 m; and 393 m south west of onshore ECC	Pumping shaft (chalk), daily abstraction rate 68182 m ³ per day, permit issued 27/6/1973 and 2/2/2005, no end date in information available. Groundwater abstracted for public water supply: potable water supply.
J Marr Ltd	505050, 449950; 505057, 449982; 505084, 450015; and 505090, 450030	170 m; 194 m; 208 m; and 218 m south west of onshore ECC	Borehole (chalk), daily abstraction rate not supplied in information received, permit issued 7/8/2003, 1/4/2008, 1/4/2013 and 1/4/2016, no end date in information available. Groundwater abstracted for food and drink: water bottling.
Blue Keld Springs Ltd.	505050, 449950 and 505000, 450000	170 m and 239 m south west of onshore ECC	Borehole (chalk), daily abstraction rate not supplied in information received, permit issued 27/11/2002 and 12/5/2003, no end date in information available. Groundwater abstracted for food and drink: water bottling.

3.3 Hydrology

3.3.1.1 Information provided in [Volume 6, Annex 1.2: Envirocheck Report](#) (available online <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that there are 388 records of water bodies within the Hornsea Four PEIR boundary. Of these, 357 are recorded as rivers present at the surface and 27 are rivers recorded as underground. The water bodies identified are comprised of both small streams and drainage ditches as well as larger water bodies over 1 km in length.

3.3.1.2 A total of 430 water bodies are recorded within the 250 m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four PEIR boundary). This include seven lakes and 423 inland rivers, of which 32 are recorded as underground rivers.

3.3.1.1 The Environment Agency’s Water Framework Directive (WFD) water quality data for all surface waters in the Hornsea Four PEIR boundary, as presented on the Catchment Data Explorer (last updated January 2019) demonstrates that the water quality does not generally meet the required standards under the WFD and is under pressure from point source pollution from sewage and industrial discharges, and diffuse pollution from agriculture. As a result, concentrations of nutrients such as phosphate, ammonia, and contaminants such as metals are elevated within a large portion of the watercourses within the 250 m Hornsea Four land quality PRA study area (see [Figure 2 to Figure 6](#) for WFD waterbodies).

3.3.2 Surface Water Abstractions

3.3.2.1 There is one record of a surface water abstraction identified within the Hornsea Four PEIR boundary (illustrated in [Figure 4](#), the details of which are presented in [Table 9](#).

Table 9: Surface Water Abstractions within the Hornsea Four PEIR boundary (see Figure 4).

Permit Holder	Coordinates	Location within Hornsea Boundary	Abstraction Details
W E Foreman and Son Ltd	507400, 454200	onshore ECC	Surface water abstracted for general agriculture – spray irrigation at a rate of 682 m ³ per day. Permit issued 27/3/97, no end date is provided in the information received.

3.3.2.2 There are an additional 85 records of surface water abstraction points recorded within the 1 km Hornsea Four land quality PRA study area (exclusive of the Hornsea Four PEIR boundary). The majority of the abstractions are associated with general agriculture and domestic uses. [Table 10](#) summarises surface water abstraction points that are deemed to be the most sensitive within this area (see [Figure 2 to Figure 6](#)).

Table 10: Surface Water Abstractions within the 1km Hornsea Four land quality PRA study area , exclusive of the Hornsea Four PEIR boundary.

Permit Holder	Coordinates	Distance from Hornsea Four PEIR Boundary (m)	Abstraction Details
Yorkshire Wildlife Trust	506588, 454580; 506091, 453895; and 506233, 453951	600 m; 622 m; and 736 m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 5/9/2012 and 20/1/2014, no end date is provided in the information received.
Yorkshire Wildlife Trust	506750, 454850	767 m south west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 5/9/2012 and 14/3/2016 no end date is provided in the information received.
Mr K Ryder	506580, 454580 and 506090, 453890	605 m north and 735 m north west of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is not provided within the information received. Permit issued 13/3/1975, 1/4/2008 and 14/3/2016, no end date is provided in the information received.
Rainbow Springs Fish Farm	506480, 454600 and 506540, 454690	686 m north of onshore ECC	Surface water abstracted (West Beck) for aquaculture. The daily abstraction rate is 60000 m ³ per day. Permit issued 13/10/2006, no end date is provided in the information received.
J Marr Ltd	504182, 450035 and 504170, 450030	743 m and 747 m south west of onshore ECC	Surface water abstracted (spring – Blue Kell) for food and drink: water bottling. The daily abstraction rate is not provided in the information received. Permit issued 1/4/2013, no end date available in information received.
Blue Keld Springs Ltd	504170, 450030	747 m south west of onshore ECC	Surface water abstracted (spring – Blue Kell) for food and drink: water bottling. The daily abstraction rate is not provided in the information received. Permit issued 30/7/2003, no end date available in information received.

3.4 Sensitive Land Use

3.4.1.1 Information provided in **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>) indicates that there are sensitive land uses recorded within the Hornsea Four PEIR boundary, details of which are provided below in **Table 11** and **Figure 7 to Figure 11**. Details of sensitive land uses within the 250 m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four PEIR boundary) are provided in **Table 12**. These sites are considered, by statutory agencies, to be of special importance due to their intrinsic qualities which are unique to those areas. Thus they are regarded to be sensitive land uses due to the importance attached to them.

Table 11: Sensitive Land Uses Within the Hornsea Four PEIR boundary.

Designation	Name of Site	Coordinates	Element of Hornsea Boundary
SSSI	River Hull Headwaters	507043, 452467 and 509147, 455457	onshore ECC

Table 12: Sensitive Land Uses Within the 250m Hornsea Four land quality PRA study area, exclusive of the Hornsea Four PEIR boundary.

Designation	Name of Site	Distance (m)	Coordinates
SSSI	Bryan Mills Field	143 (east of onshore ECC)	501295, 446149
		143 (north west of onshore ECC)	501404, 446148
		166 (west of onshore ECC)	501475, 446245

3.4.1.2 The River Hull Headwaters is designated as a SSSI as the headwaters are nationally important as the most northerly chalk stream system in Britain. The SSSI is currently undergoing river restoration works as 65% of this SSSI were assessed as being in an unfavourable condition by Natural England in 2003.

3.4.1.3 Bryan Mills Field is a SSSI that comprises a tall fen community which occupies the centre of a small ungrazed field, the surrounding drier areas of which have been planted with trees.

3.4.1.4 Parts of the Hornsea Four PEIR boundary are located within the following Nitrate Vulnerable Zones (NVZ):

- River Hull from Arram Bank to Humber NVZ (surface water);
- Yorkshire Chalk NVZ (groundwater);
- Barmston Sea Drain from Skipsea Drain to North Sea NVZ (surface water); and
- Earls Dyke from source to North Sea NVZ (surface water).

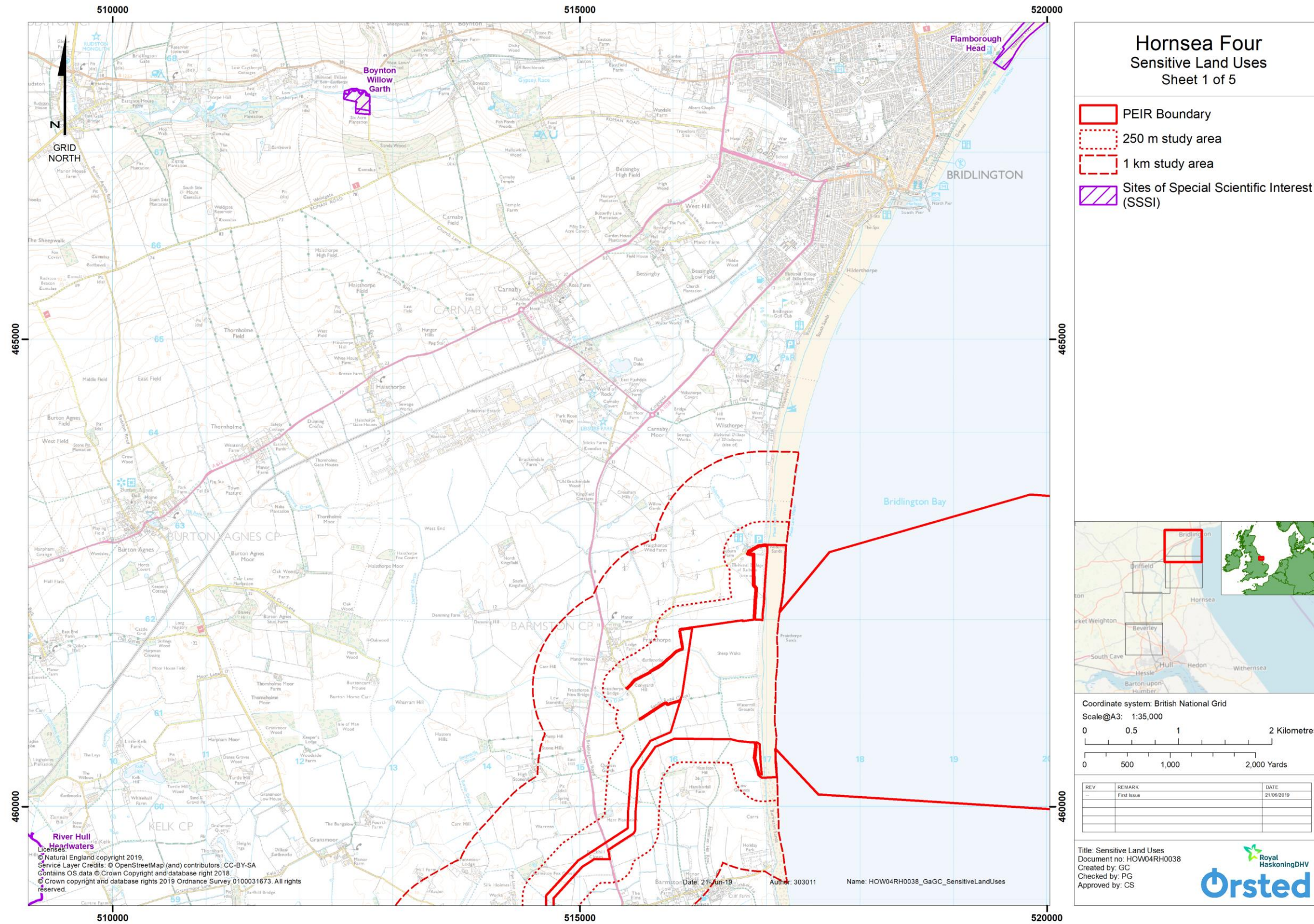


Figure 7: Designated Sites in relation to the Hornsea Four geology and ground conditions study area (Not to Scale).

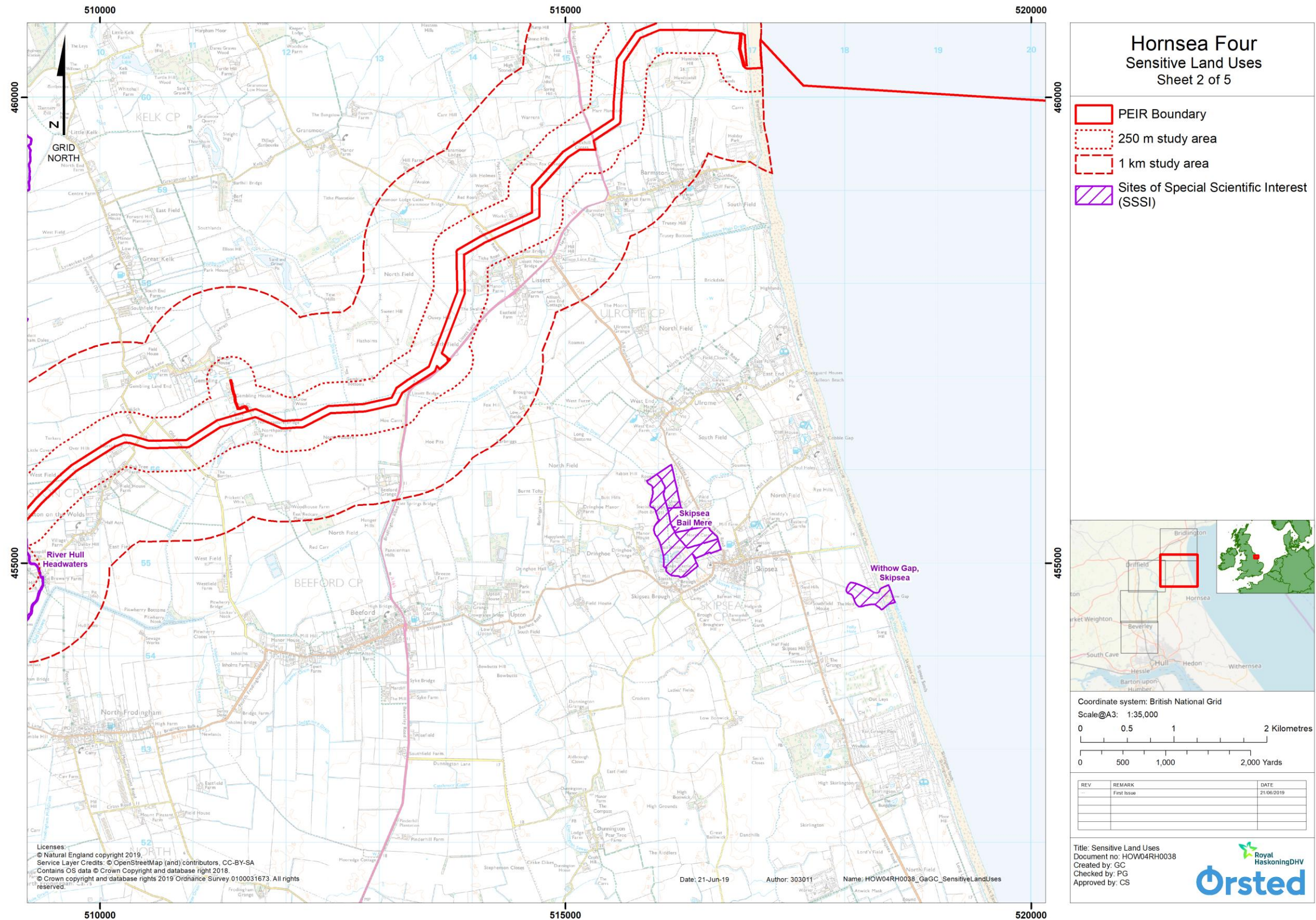


Figure 8: Designated Sites in relation to the Hornsea Four geology and ground conditions study area (Not to Scale).

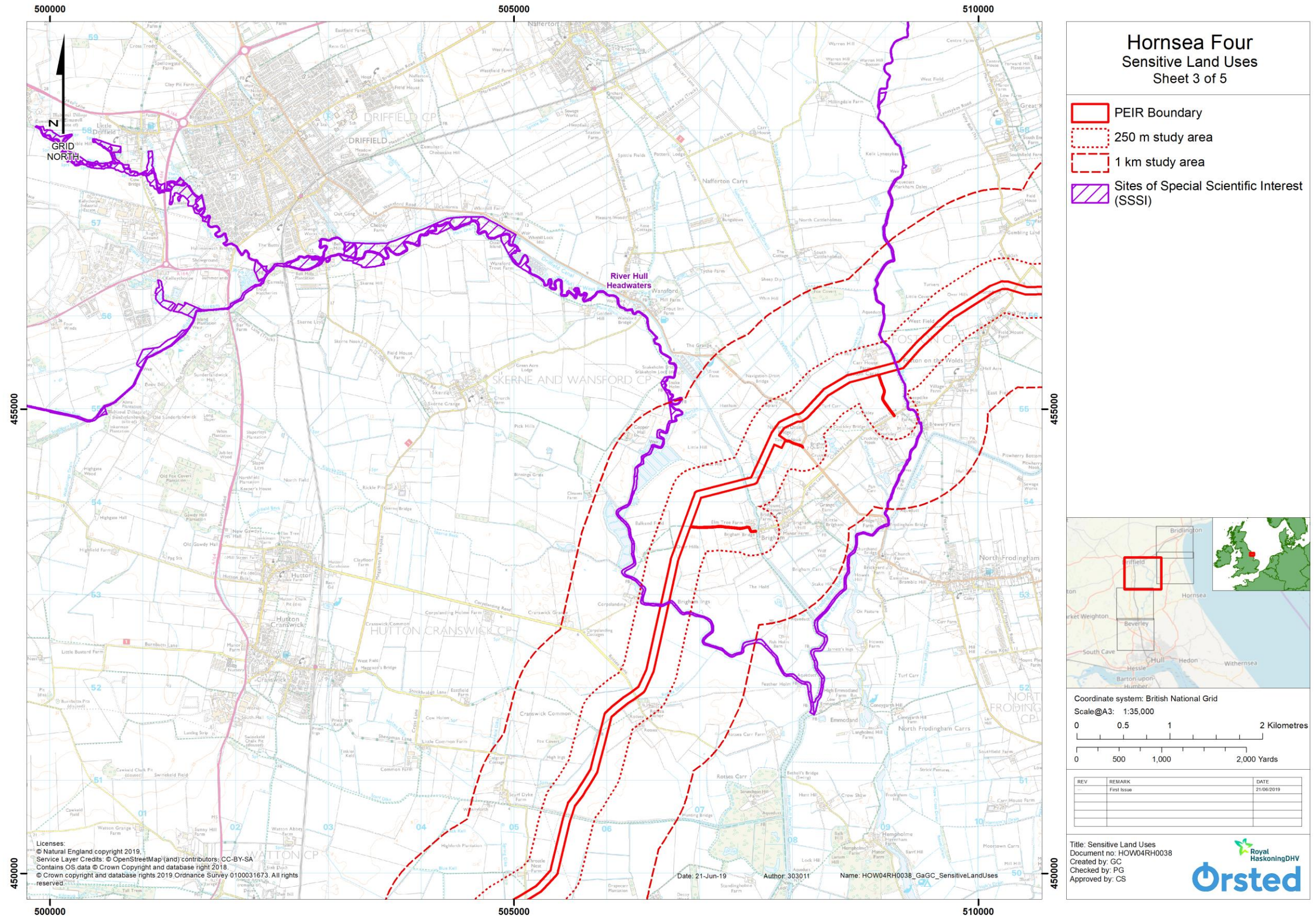


Figure 9: Designated Sites in relation to the Hornsea Four geology and ground conditions study area (Not to Scale).

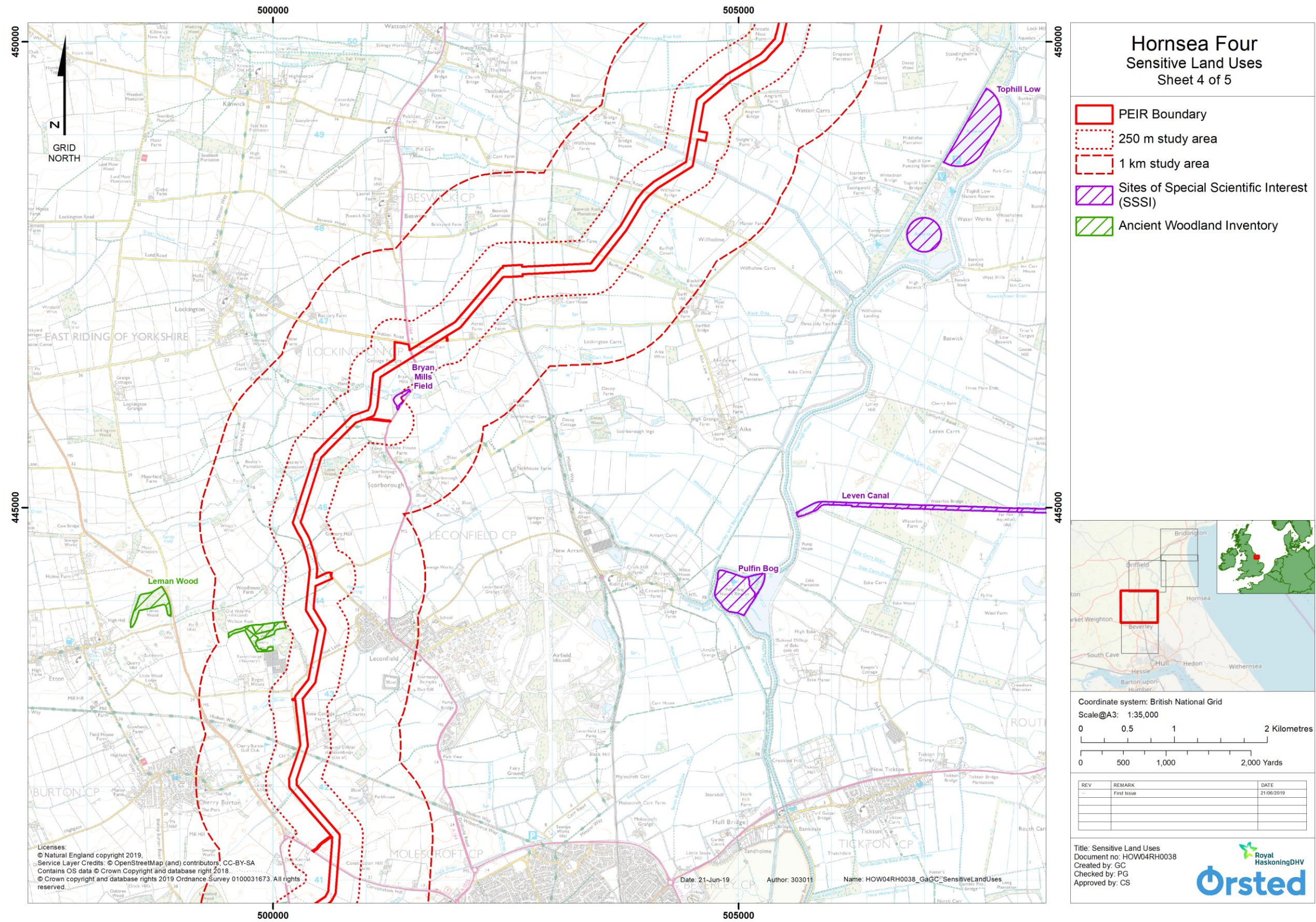


Figure 10: Designated Sites in relation to Hornsea Four geology and ground conditions study area (Not to Scale).

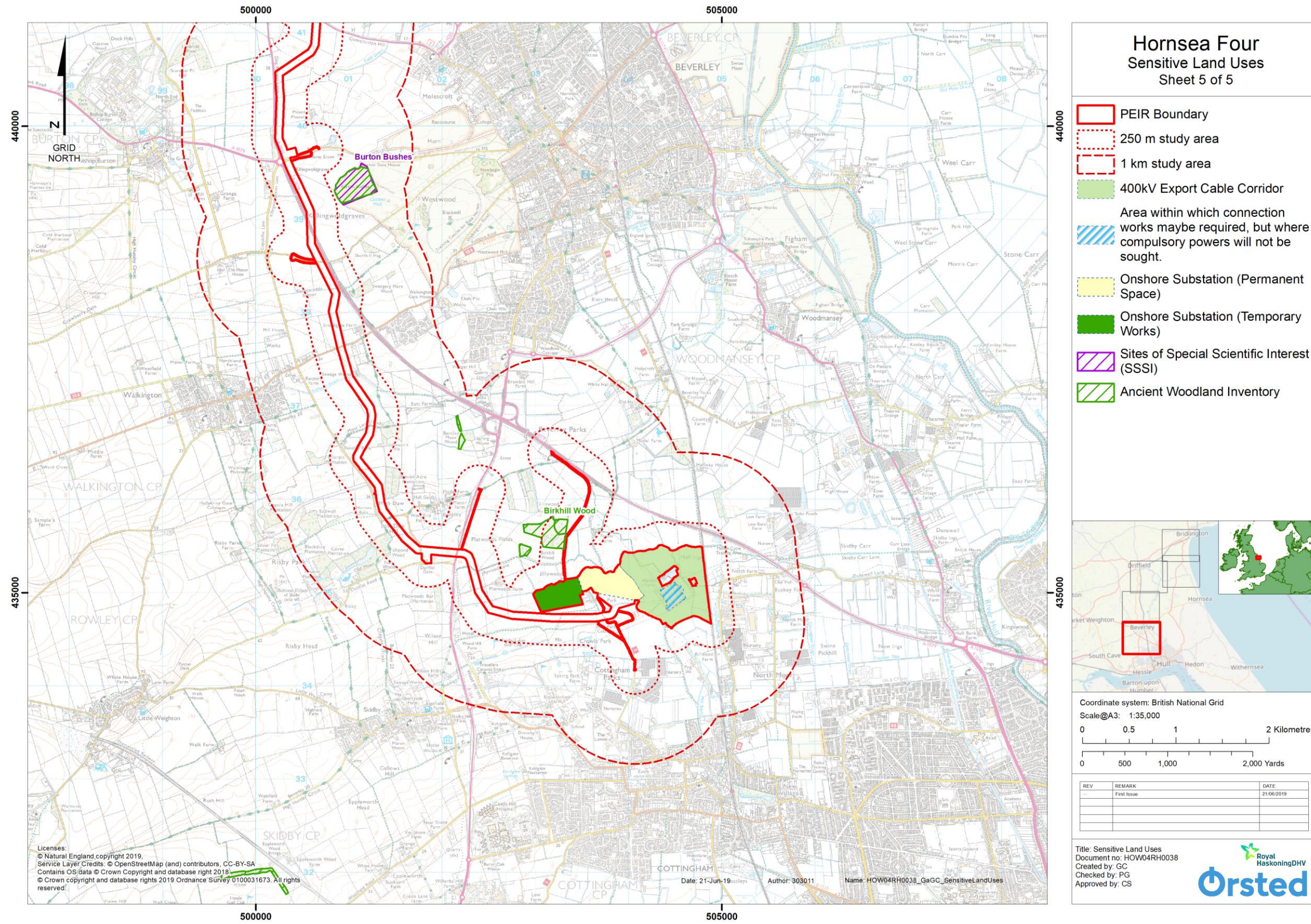


Figure 11: Designated Sites in relation to the Hornsea Four geology and ground conditions study area (Not to Scale).

4 Regulatory Information

- 4.1.1.1 Regulatory information relating to potentially contaminative activities in the vicinity of the Hornsea Four PEIR boundary has been summarised in **Table 13**. Further details are provided in **Volume 6, Annex 1.2: Envirocheck Report** (available online at <https://hornseaprojects.co.uk/Hornsea-Project-Four/Documents-Library/Formal-Consultation>).

Table 13: Regulatory Information (as reported on in Volume 6, Annex 1.2: Envirocheck report).

Environmental Records	Number of records within Hornsea Four PEIR boundary	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary	Description
Discharge Consents	5	6	<p>The five discharge consents located within the Hornsea Four PEIR boundary are outlined below:</p> <ul style="list-style-type: none"> • National Grid Transco Plc - trade discharge (site drainage) to a tributary of Creyke Beck. The permit was issued 27 March 2004 and is recorded as revoked in March 2011. (504170, 434970 - OnSS). • National Grid Electricity Transmission Plc - trade discharge (contaminated surface water) to a tributary of Creyke Beck. The permit was issued 1 August 2006, no end date is provided in the information received. (504680, 434850 - OnSS). • National Grid Company Plc - sewage discharge (final/treated effluent) to a tributary of Creyke Beck. The permit was issued 24 September 1997, no end date is provided in the information received. (504700, 435000 - OnSS). • David Michaels – discharge of sewage effluent to an unnamed inland water body. The dates of permit issue and end date are not provided within the information received. (501150, 436650 – onshore ECC). • Stephen Andrew Burley (sewage discharge -final/treated effluent) (501490, 446550 – onshore ECC). <p>The six discharge consents present within the 250 m Hornsea Four land quality PRA study are registered to:</p> <ul style="list-style-type: none"> • Ashfield Farm (sewage discharge -final/treated effluent), 184 m south west (500200, 440800 – of onshore ECC). • East Riding of Yorkshire Council (sewage discharge -final/treated effluent) 241 m west (510400, 456600 – of onshore ECC). • Halsham Salads Ltd (sewage discharge -final/treated effluent) 60 m east (504000, 434200 – of OnSS), (trade discharge – site drainage) 233 m south (504500, 434400 of landfall).

Environmental Records	Number of records within Hornsea Four PEIR boundary	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary	Description
			<ul style="list-style-type: none"> Mr Stephen Holtby (sewage discharge -final/treated effluent) 189 m east (501089, 437861 – of onshore ECC). The Occupier (sewage discharge -final/treated effluent) 130 m west (500150, 439650 – of onshore ECC). W H Woods - sewage discharge (treated effluent) to an unnamed water body. The permit was issued 10 January 1986, no end date is provided in the information received. 226m north west (514500, 459200 – of onshore ECC).
Pollution Incidents to Controlled Waters	3	7	<p>Three pollution incidents to controlled waters recorded within the Hornsea Four PEIR boundary, details of which are provided below:</p> <ul style="list-style-type: none"> Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504001, 435001 - OnSS). Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504001, 434996 - OnSS). Farm: the incident occurred in December 1992 with the pollutant recorded as heating oil. The incident is recorded as a Category 3 – minor incident, the receiving water is reported as Cottingham Drain. (504006, 434996 - OnSS). <p>Seven pollution incidents to controlled waters have been recorded within the 250 m Hornsea Four land quality PRA study area, details of which are provided below:</p> <ul style="list-style-type: none"> Horticultural: the incident occurred in December 1996 with the pollutant recorded as chemicals – detergents/surfactant. The incident is recorded as Category 3 – minor incident, the receiving water was a tributary of Mill Beck. The incident occurred 54 m west of Hornsea Four PEIR boundary (504000, 434200 – of OnSS). Farm: the incident occurred in February 1990 with the pollutant involved recorded as miscellaneous (vegetation cuttings). The incident is recorded as a Category 3 – minor incident, the receiving water is recorded as Scurf Dike. The incident occurred 96 m east of Hornsea Four PEIR boundary (507600, 453800 of Onshore ECC).

Environmental Records	Number of records within Hornsea Four PEIR boundary	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary	Description
			<ul style="list-style-type: none"> • Farm: the incident occurred in February 1991 with the pollutant recorded as heating oil. The incident is recorded as a Category 2 – significant incident, the receiving water was Wanlass Beck and Creyke Beck (confluence of the two). The incident occurred 122 m south of Hornsea Four PEIR boundary (504500, 434500 of OnSS). • Water Company Sewage (foul sewer): the incident occurred in February 1990 with the pollutant involved recorded as crude sewage. The incident is recorded as a Category 3 – minor incident, the receiving water was not reported in the information provided. The incident occurred 142 m south of Hornsea Four PEIR boundary (509200, 454900 – of Onshore ECC). • Other General Premises: the incident occurred in April 1994 with the pollutant recorded as miscellaneous (no visible pollutant). The incident is recorded as a Category 3 – minor incident, the receiving water is recorded as Creyke Beck. The incident occurred 174 m east of Hornsea Four PEIR boundary (505001, 435001 - OnSS). • Water Company Sewage (sewage treatment works): the incident occurred in October 1994 with the pollutant recorded as sewage (treated effluent). The incident is recorded as a Category 3 – minor incident, the receiving water was Driffield Canal. The incident occurred 187 m north west of Hornsea Four PEIR boundary (505101, 450001 of Onshore ECC). • Other General Premises: the incident occurred in May 1992 with pollutant involved recorded as miscellaneous – inert suspended solids. The incident is recorded as a Category 3 – minor incident, the receiving water was Kelk Beck. The incident occurred 228m south of Hornsea Four PEIR boundary (509300, 454800 of Onshore ECC).
Substantiated Pollution Incidents	2	0	<p>There are two recorded substantiated pollution incidents within the Hornsea Four PEIR boundary, details of which are provided below:</p> <ul style="list-style-type: none"> • A Category 2 significant incident (water) occurred in July 2006, the type of pollutant is recorded as general biodegradable materials and wastes (food & drink). (516773, 461397 - landfall). • A Category 2 significant incident (water) occurred in January 2015, the type of pollutant was not identified. (515827, 461474 - landfall).

Environmental Records	Number of records within Hornsea Four PEIR boundary	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary	Description
Registered Landfill, Historic Landfill or other Waste Disposal Sites	N/A – no records of landfills in information available	N/A – no records of landfills in information available	N/A
Local Authority Pollution Prevention and Control Authorisations	N/A – no records of local authority pollution prevention control authorisations in information available	N/A – no records of local authority pollution prevention control authorisations in information available	N/A
Fuel Sites	N/A – no records of fuel sites in information available	N/A – no records of fuel sites in information available	N/A
Contemporary Trade Directory Records (active and former)	0	13	<p>Active entries within the 250 m Hornsea Four land quality PRA study area include the following:</p> <ul style="list-style-type: none"> • Caravan dealers and manufacturers – 193 m east (505071, 434673 - of OnSS). • Food products (manufacturers) – 124 m north (508843, 455569 of Onshore ECC). • Horticultural equipment maintenance and repair – 194 m east (505043, 434409 - OnSS). <p>Inactive entries within the 250 m Hornsea Four land quality PRA study area include the following:</p> <ul style="list-style-type: none"> • Shredding equipment and services – 175 m north (511399, 456767 – of Onshore ECC). • Car body repairs – 134 m east (505009, 434747 of OnSS). • Joinery manufacturers – 142 m east (505012, 434787 – of OnSS). • Engineers – 248 m south (505029, 434468 – of OnSS). • Road haulage services – 245 m north west (507836, 455080 – Onshore ECC). • Road haulage services – 211 m south (504056, 433948 – OnSS).

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Environmental Records	Number of records within Hornsea Four PEIR boundary	Number of records within the 250 m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary	Description
			<ul style="list-style-type: none">• Oil fuel distributors – 217 m south (504056, 433948 – of OnSS).• Agricultural engineers – 233 m north west (500202, 440846 of Onshore ECC).• Agricultural machinery sales and service – 233 m north west (500202, 440846 – of Onshore ECC).• Pet food and animal feed – 219 m west (500106, 439495 of Onshore ECC).

5 Preliminary Conceptual Site Model and Qualitative Assessment

Current guidance recommends that a Conceptual Site Model (CSM) is formulated based on the information available (CLR11, DEFRA and Environment Agency, 2004.). As more information becomes available the CSM may be updated. The CSM is based on the identification and assessment of potential sources, potential receptors, and the anticipated pathways to those receptors, identified as a result of desk-based research. For contamination within soil and water to pose a risk, a feasible pollutant linkage must be established. A pollutant linkage consists of three parts:

- A source of contamination in or on the land;
- A viable pathway by which the contaminant is able to cause harm (or which presents a significant possibility of such harm being caused); and
- A receptor which is sensitive to impact from the contamination.

5.1.1.1 Where all three of these are present, a feasible pollutant linkage exists.

5.1 Potential Sources

5.1.1.1 Potential sources of contamination within the Hornsea Four PEIR boundary are presented in [Table 14](#) and illustrated in [Figure 12](#) to [Figure 18](#).

Table 14: Potential Sources of Contamination within the Hornsea Four PEIR Boundary (see Figure 12- 18).

Potential Source	Potential Contaminants of Concern (PCOC)
Gravel, sand and chalk pits (backfilled)	The contaminants of concern (including asbestos) associated with the backfilling of the pits are dependent on the age of emplacement and materials used. With increasing age of emplacement, the risks posed by PCOC may have decreased. It is not known from the information received how many of the pits have been backfilled and whether any of the pits were officially utilised as landfills. There is the potential for ground gases to be present within backfilled pits, again this is dependent on the materials used.
Agricultural land use	In addition to herbicides and pesticides it is not uncommon for discarded material to be buried on farm land such as demolition rubble associated with remodelling works and can include asbestos sheeting and old farm machinery.
Railway and sidings	Active and historical railway activity is a potential source of contamination. These activities are historically associated with herbicides, metals, hydrocarbons and sulphates (Department of Environment – Industry Profiles). A range of PCOC, including asbestos, can also be associated with the materials used within the track bedding material and fill used in the formation of embankments.
Electricity substations and pylons	Potential sources of PCBs and oils associated with possible electrical equipment, plant, interceptors and oil storage tanks.
Unspecified works	A number of unspecified works have been recorded within the Hornsea Four PEIR boundary, therefore a range of PCOC may be associated with these areas.
Burial grounds	Potential contaminants of concern associated with cemeteries include metals (including mercury), solvents (associated with coffins), biological, formaldehyde and herbicides.

Potential Source	Potential Contaminants of Concern (PCOC)
Airfield	The DoE Industry Profile for airports indicates that the PCOC associated with the historic aviation activity within the Hornsea Four PEIR boundary includes polycyclic aromatic hydrocarbons (PAH), volatile and semi-volatile organic compounds (VOCs and SVOCs), glycols, metals and metal compounds, petroleum hydrocarbons, phenols, polychlorinated biphenyls (PCBs), inorganic compounds, asbestos and herbicides.
Unspecified tanks	A number of unspecified tanks have been recorded within the Hornsea Four PEIR boundary, therefore a range of PCOC may be associated with these areas.
Landfill	It is not known from the information received whether former gravel/sand/chalk pits were utilised as either official or unofficial landfill sites, therefore a range of PCOC may be associated with these areas.

5.1.1.2 Several current and historical activities undertaken within 250m Hornsea Four land quality PRA study area (exclusive of the Hornsea Four PEIR boundary) also have the potential to release contaminants into the ground, which may have subsequently migrated to the site in groundwater. These are identified in [Table 15](#) and illustrated in [Figure 12](#) to [Figure 18](#).

Table 15: Potential Sources of Contamination within the 250m Hornsea Four Land Quality PRA Study Area, exclusive of the Hornsea Four PEIR boundary.

Potential Source	Potential Contaminations of Concern (PCOC)
Railway line and stations	Active and historical railway activity is a potential source of contamination. These activities are historically associated with herbicides, metals, hydrocarbons and sulphates (Department of Environment – Industry Profiles).
Gravel, sand and chalk pits (backfilled)	The contaminants of concern (including asbestos) associated with the backfilling of the pits are dependent on the age of emplacement and materials used. With increasing age of emplacement, the risks posed by PCOC may have decreased. It is not known from the information received how many of the pits have been backfilled and whether any of the pits were officially utilised as landfills. There is the potential for ground gases to be present within backfilled pits, again this is dependent on the materials used.
Sewage works	A sewage works, to the immediate east of the onshore ECC, has been recorded within the Hornsea Four land quality PRA study area (250 m buffer) The processing of sewage could have led to a wide range of contaminants being present at these locations, depending on the site’s full operational histories and usage. The DoE Industry Profile for sewage works and sewage farms indicated that the PCOCs likely to be present include metals, metalloids and their compounds, organic and inorganic PCOC, acids and asbestos.
Unspecified works	A number of unspecified works have been recorded within 250 m of Hornsea Four land quality PRA study area, therefore a range of PCOC may be associated with these areas.
Electricity substations and pylons	Potential sources of PCBs and oils associated with possible electrical equipment, plant, interceptors and oil storage tanks.
Tip and landfill	It is not known from the information received whether former gravel/sand/chalk pits were utilised as either official or unofficial landfill sites, therefore a range of PCOC may be associated with these areas.

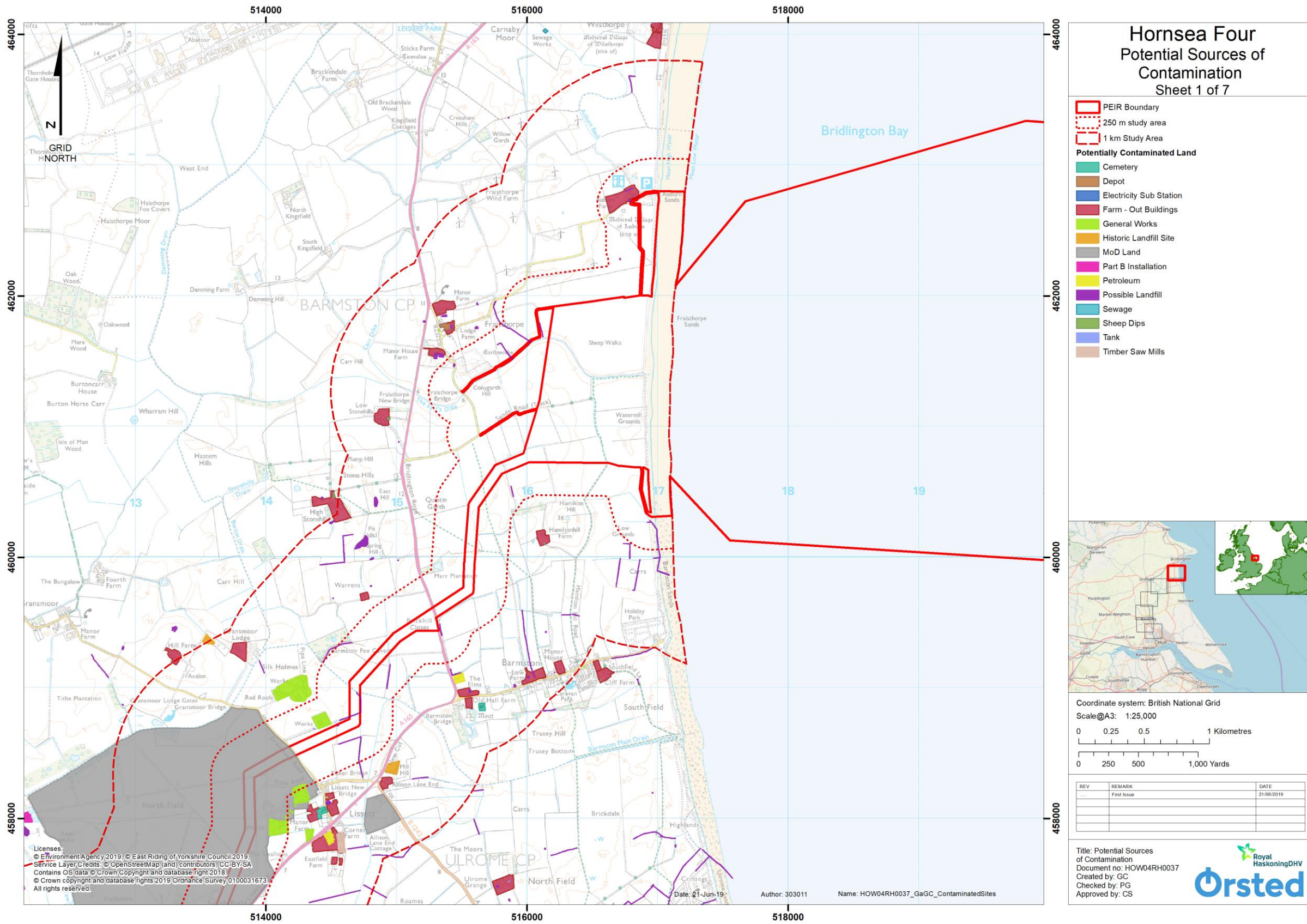


Figure 12: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

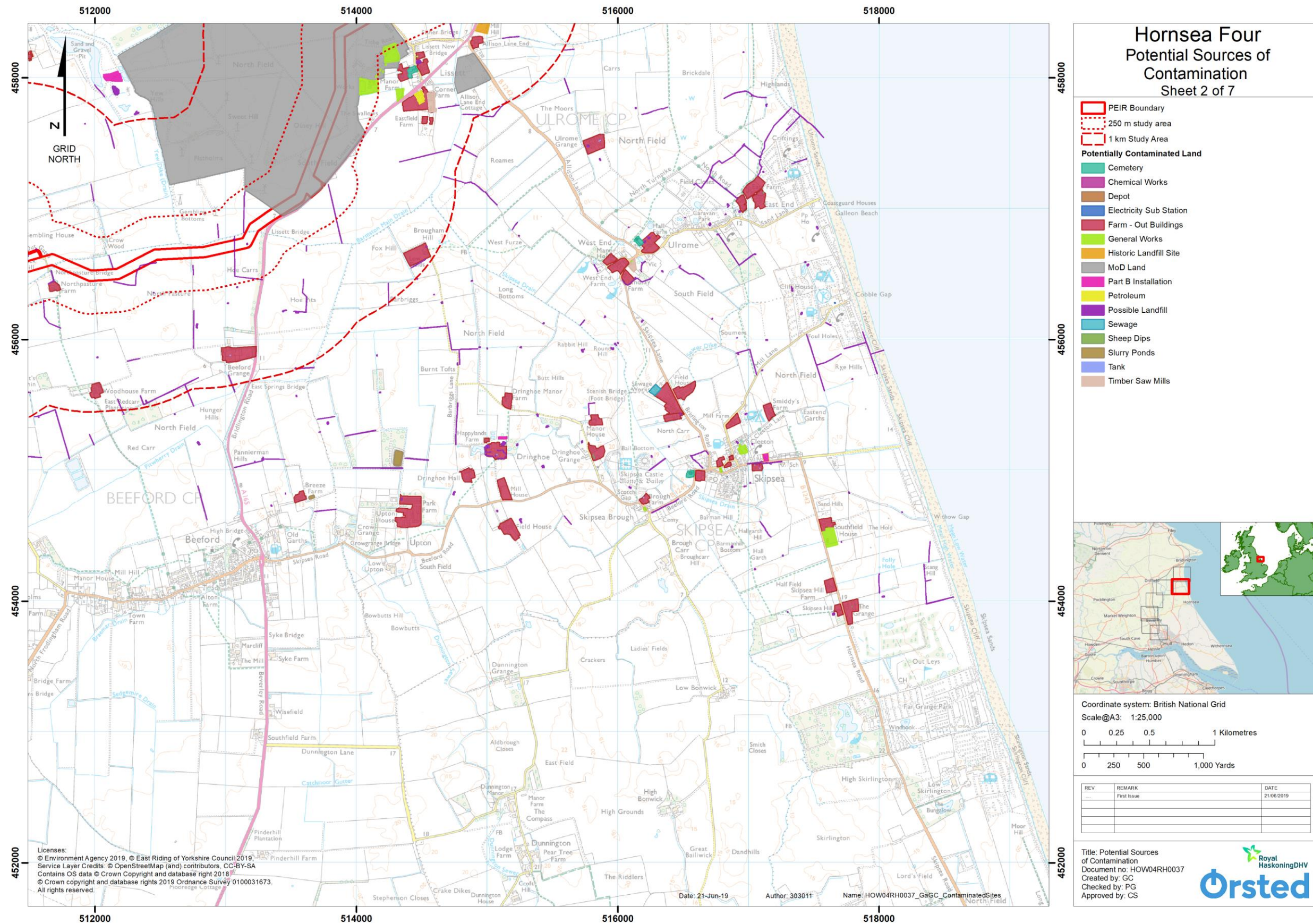


Figure 13: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

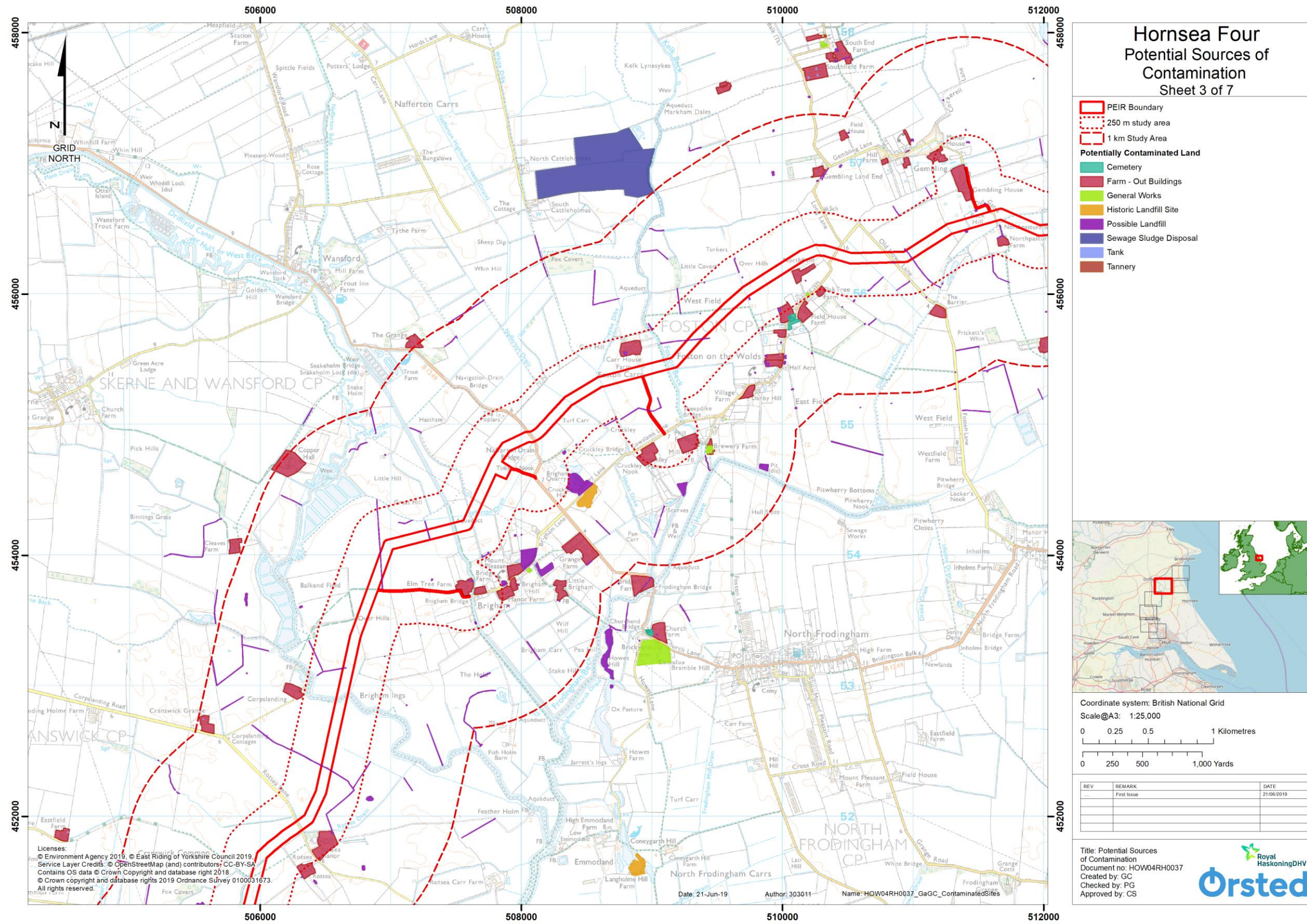


Figure 14: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

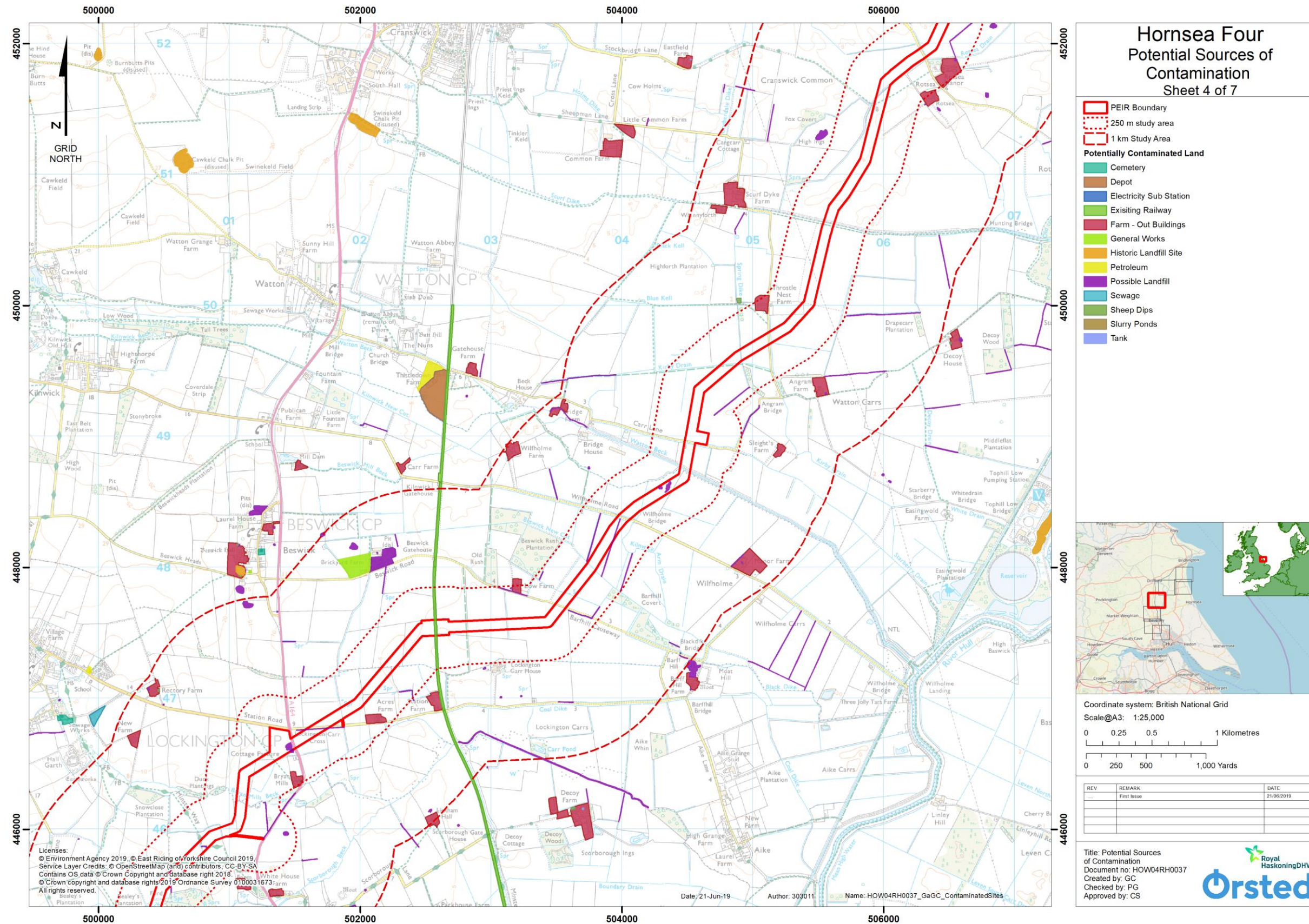


Figure 15: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

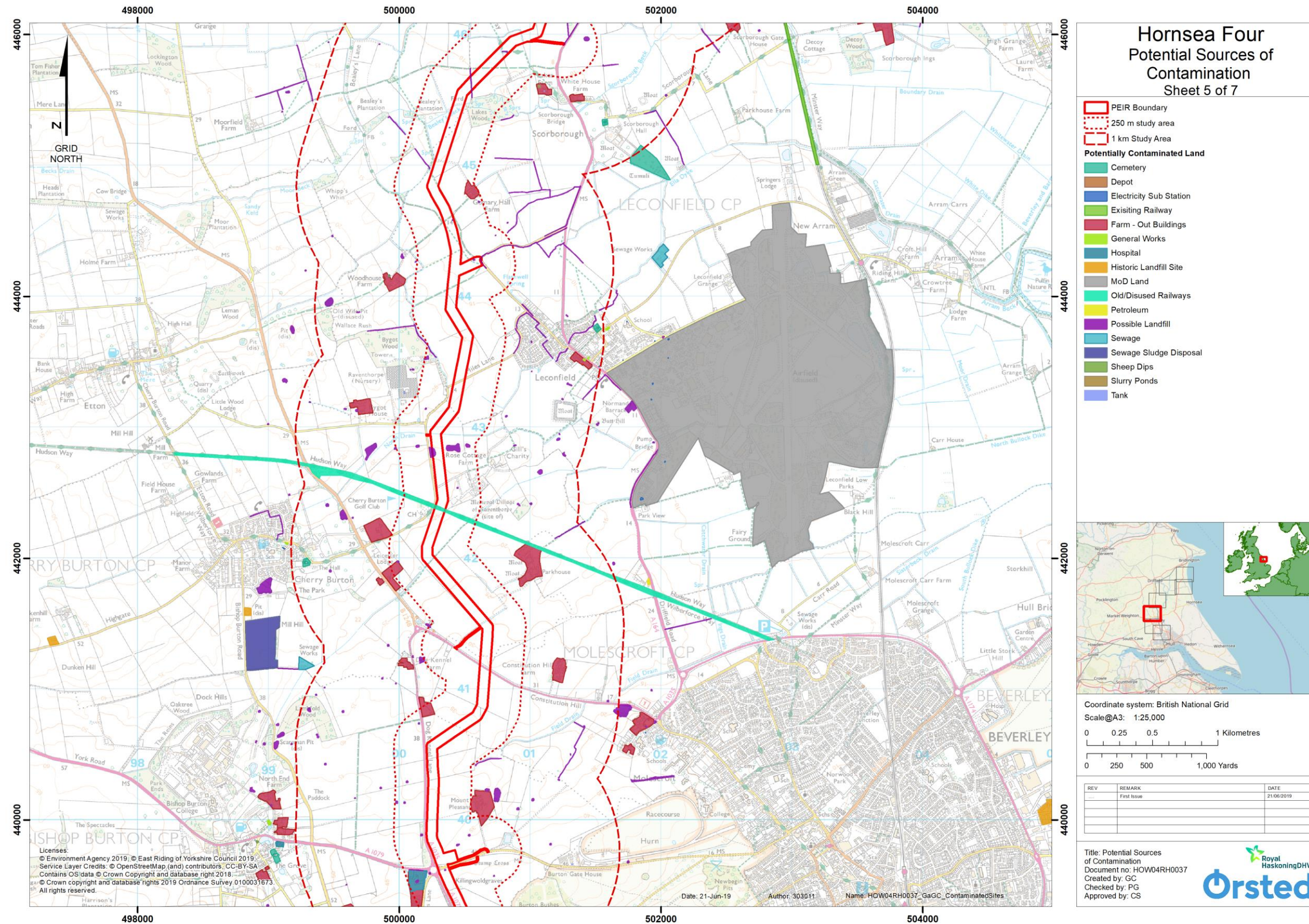


Figure 16: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

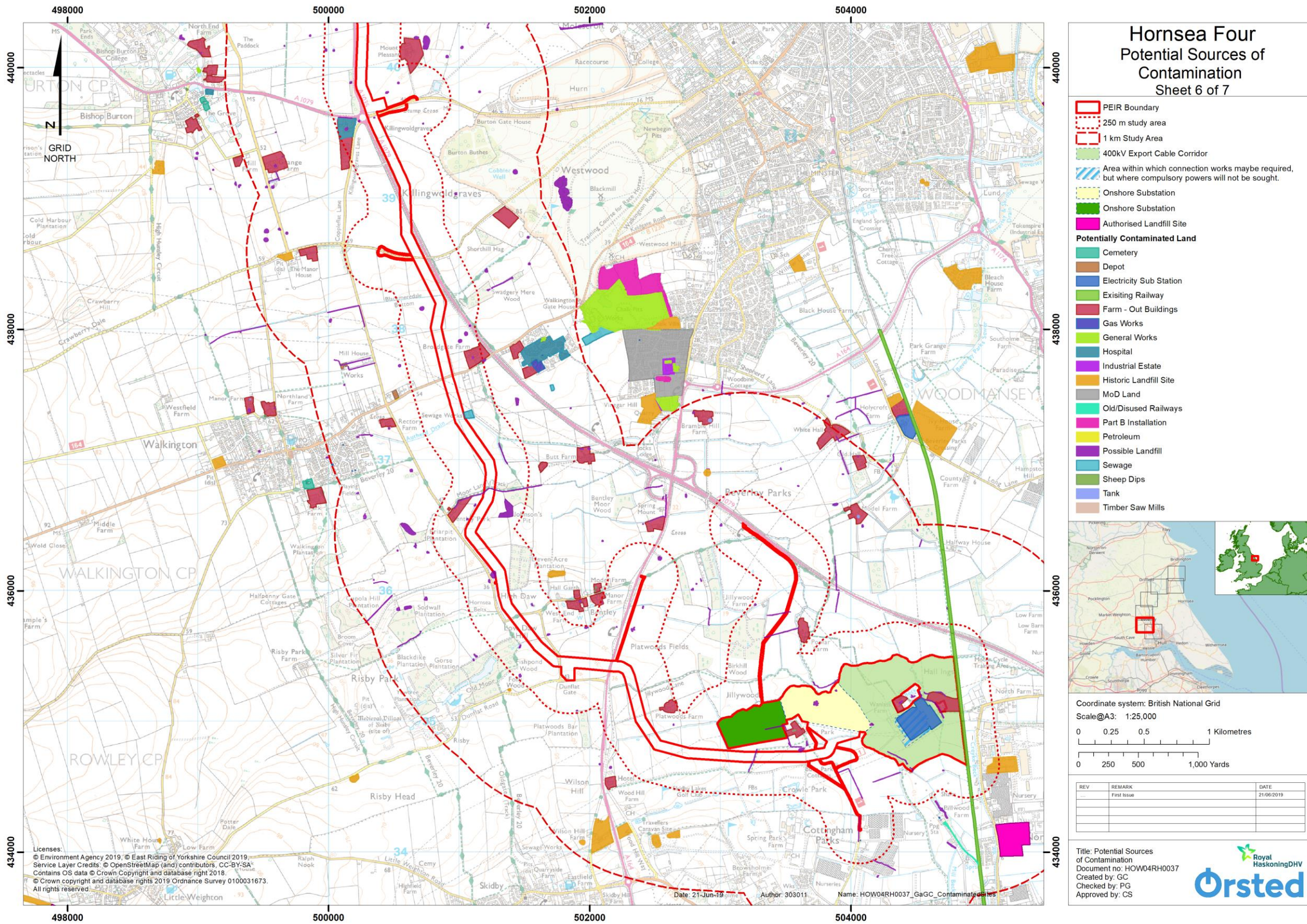


Figure 17: Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

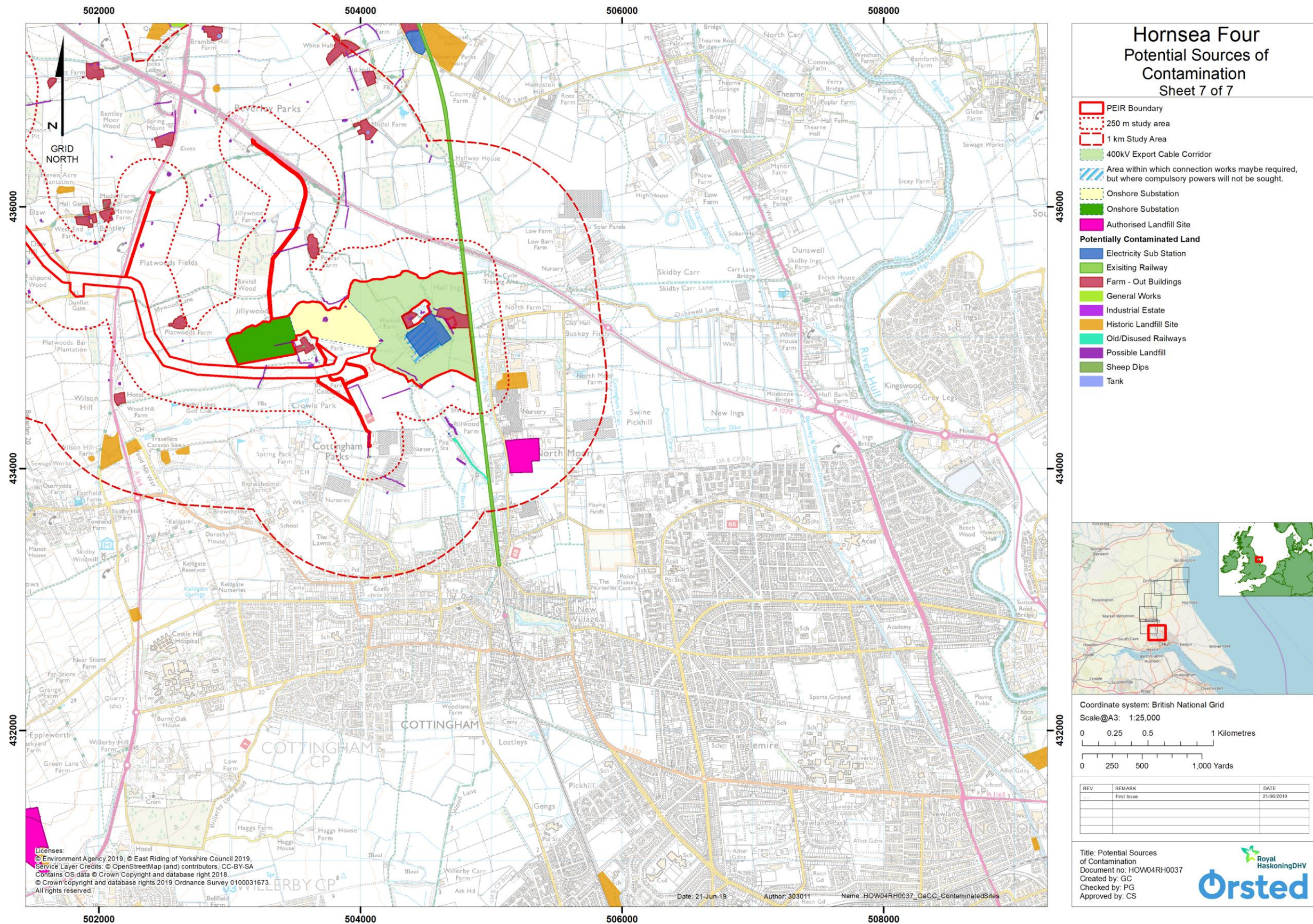


Figure 18 : Potential Sources of Contamination within the Hornsea Four PEIR boundary and Hornsea Four Land Quality PRA Study Area (Not to Scale).

5.2 Qualitative Risk Assessment

5.2.1.1 This Qualitative Risk Assessment (QRA) follows the relevant guidance (DEFRA and Environment Agency 2004 and Environment Agency, 2004). The QRA considers the PCOC, site setting and proposed site use to establish whether a feasible pollutant linkage is likely to exist. If a feasible pollutant linkage is identified this is then assessed to determine whether it could represent an unacceptable risk to human health or controlled waters. It should be noted that the assessment is based on historical information only and has not yet been informed by ground investigation, therefore the assessment has taken a precautionary approach. As such if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists, for the purpose of the QRA. The Preliminary CSM (PCSM) and QRA are presented in [Table 16](#).

Table 16: Preliminary Conceptual Site Model and Qualitative Risk Assessment.

Source	Pathway	Receptor	Qualitative Assessment
Potential on-site and off-site sources of soil and groundwater contamination.	Dermal contact, ingestion and inhalation.	Construction workers.	<p>Construction workers have the potential to be exposed to contaminants if any are present. The PCSM is based on historical information and has not been informed by ground investigation, therefore a precautionary approach (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists) has been adopted.</p> <p>It should be noted that the proposed development is located in an undeveloped area, predominantly utilised for agricultural purposes. Furthermore, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume 3, Chapter 1: Geology and Ground Conditions.</p>
	Dermal contact, ingestion and inhalation.	Site operatives.	<p>During the operational phase of the project, site operatives have the potential to be exposed to contaminants, if present, during maintenance works. This is a precautionary conclusion (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage is present) in the absence of ground investigation information.</p> <p>Furthermore, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is</p>

Source	Pathway	Receptor	Qualitative Assessment
			provided in Volume 3, Chapter 1: Geology and Ground Conditions .
Contaminant migration via leaching and groundwater transport.	Superficial Secondary A Aquifer, Secondary B Aquifer and Secondary Undifferentiated Aquifer. Principal Aquifer (bedrock). Surface water bodies. Groundwater and surface water abstractions.		<p>Sensitive water resources have been identified as part of the PRA and the ground conditions are such that they could permit the migration of contaminants if present. Potential isolated sources have been identified although as indicated in Section 3. This is based on a precautionary approach in the absence of ground investigation information (i.e. if a potential pollutant linkage has been identified it is assumed to be present until further site-specific information is available to clarify whether the linkage actually exists).</p> <p>Construction activities associated with the proposed development include trenching, horizontal directional drilling and piling (if required) have the potential to disturb existing contamination and/or create preferential pathways which could result in contaminant migration to sensitive water resources. However, Hornsea Four is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume 3, Chapter 1: Geology and Ground Conditions.</p>
Contaminant migration via leaching and groundwater transport and physical transport by surface runoff due to erosion.	Designated sites.		<p>Designated sites are present within the Hornsea Four preliminary land quality risk assessment study area and the ground conditions are such that they could permit the migration of contaminants if present.</p> <p>Construction activities could disturb contamination if present which could result in the migration of contamination via leaching, groundwater transport and physical transport by surface runoff, particularly in the areas surrounding the SSSI which is designated due to its ecological sensitivities. However, Hornsea Four is committed to ensuring that potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume 3, Chapter 1: Geology and Ground Conditions.</p>
Physical transport by surface runoff due to erosion.	Surface water bodies.		In areas in close proximity to surface waters there is the risk that during construction works runoff from exposed contaminated soils may occur which could transport contaminated sediments or dissolved contaminants to nearby surface waters. Hornsea Four is committed to ensuring that potential pollutant linkages are appropriately investigated, assessed and mitigated. Further information in

Source	Pathway	Receptor	Qualitative Assessment
			relation to these is provided in Volume 3, Chapter 1: Geology and Ground Conditions .
Ground gases and vapours.	Gas generation and transport.	Construction workers, future site operatives and future infrastructure.	Landfills and areas of Made Ground may exist within isolated areas of the Hornsea Four PEIR boundary. Unrecorded landfill sites may be present and if these are encountered during construction works Hornsea Four is committed to conducting an appropriate risk assessment and if necessary, removing the contaminated material / treating it and / or installing appropriate mitigation measures. Further information in relation to these is provided in Volume 3, Chapter 1: Geology and Ground Conditions .

5.3 Uncertainties in the Conceptual Site Model

5.3.1.1 The PCSM and QRA has been developed based on a desk-based review of available information, and in the absence of site-specific ground investigation data. For this reason they adopt a precautionary approach, assuming that if a potential pollutant linkage has been identified, it is present, until further site-specific information is available to clarify whether the linkage actually exists. Without further site-specific data potential pollutant linkages cannot be ruled out. However, it should be noted that Hornsea Four will be largely located in an undeveloped area, and the potential pollutant linkages identified in the PCSM are only associated with a comparatively small number of isolated areas.

5.4 Summary of Proposed Mitigation

5.4.1.1 The proposed mitigation measures and commitments to be adopted by Hornsea Four are described and evaluated in [Volume 3, Chapter 1: Geology and Ground Conditions](#) (see [Section 1.11](#)) to which this document forms an annex. A list of all commitments for Hornsea Four can be found in [Volume 4, Annex 5.2: Commitments Register](#).

5.4.1.2 In summary, Hornsea Four is committed to ensuring potential linkages are investigated and mitigated, as summarised below:

- Development of a pre-construction intrusive investigation strategy targeting areas where further information is required to corroborate or discount the identified potential pollutant linkages. The strategy will be developed in liaison with ERYC and Environment Agency.
- If further investigation (e.g. pre-construction ground investigation) corroborates the PCSM, mitigation measures will be adopted to manage the potential risks prior to construction.
- Adoption of an unforeseen contamination protocol to be adopted during the construction phase.

6 Conclusions and Recommendations

- 6.1.1.1 The key objective of the PRA was to develop a PCSM to aid in the identification of any potential pollutant linkages and potentially unacceptable risks to sensitive receptors associated with development of Hornsea Four, so that appropriate mitigation measures can be adopted to ensure the proposed scheme is delivered without risk to sensitive receptors. These are then used to inform decisions with regards to whether further investigation or assessment is needed (i.e. a Generic Quantitative Risk Assessment) to understand and mitigate potential impacts.
- 6.1.1.2 The PRA has identified a limited number of plausible pollutant sources and linkages in isolated areas within the Hornsea Four PEIR boundary. However, it should be noted that the PRA has been developed based on a desk-based review of available information, and in the absence of ground investigation data, and the PCSM adopts a precautionary approach.
- 6.1.1.3 It should be noted that whilst potential pollutant linkages have been identified as a result of the precautionary approach taken, this should be considered in the context that the proposed scheme will largely be located in an undeveloped area. Furthermore, the potential pollutant linkages identified in the PCSM are only associated with isolated locations (see [Figure 12 to Figure 18](#))
- 6.1.1.4 Hornsea Four is committed to a range of actions to ensure potential linkages are investigated and mitigated, recommendations and commitments can be found in [Volume 3, Chapter 1: Geology and Ground Conditions](#) and [Volume 4, Annex 5.2: Commitments Register](#).

7 References

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