7. Cultural Heritage

7.1 Introduction

This chapter examines the potential effects of the Scheme on cultural heritage assets. A heritage asset is defined by the NPPF as “a building, monument, site, place or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest”.

Heritage assets include designated assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens, Registered Battlefields and Registered Historic Wrecks) and non-designated assets identified by the Local Planning Authority (for example: locally listed buildings, archaeological sites and monuments and historic landscapes).

Both designated and non-designated cultural heritage assets have been examined as part of this assessment. Collectively, these assets are also identified as the historic environment.

7.2 Legislation and policy

7.2.1 Ancient Monuments and Archaeological Areas Act 1979

This Act (amended by the National Heritage Acts of 1983 and 2002) provides for the protection of Scheduled Monuments and Archaeological Areas but does not afford any protection to their settings.

7.2.2 Planning (Listed Buildings and Conservation Areas) Act 1990

The Town and Country Planning Act (1971) as amended by the Planning (Listed Buildings and Conservation Areas) Act 1990 details the statutory protection afforded Listed Buildings. The relevant legislation in this case extends from Section 66 (1) of the 1990 Act which states that in considering planning applications the Local Planning Authority (LPA) shall have special regard to the desirability of preserving the Listed Building or its setting, or any features of special architectural or historic interest that it possesses.

In addition, Section 72 of the 1990 Act states that in exercising all planning functions, LPAs must have special regard to the desirability of preserving or enhancing Conservation Areas.

7.2.3 National Planning Policy Framework

Section 16 of the NPPF contains paragraphs which relate to development proposals that have an effect upon cultural heritage assets. Such policies provide the framework that LPAs need to refer to when setting out a strategy for the conservation and enjoyment of the historic environment in their Local Plans.

When determining planning applications, the NPPF directs LPAs to apply the presumption in favour of sustainable development. Where a development plan is absent, silent or out-of-date, permission should be granted except where adverse impacts would significantly and demonstrably outweigh those benefits, when assessed against NPPF policies as a whole; or where specific policies contained within the NPPF (including those with regard to designated heritage assets) indicate that development should be restricted to some degree.

7.2.4 Local Policy

Current local policy is provided by the North Lincolnshire Local Development Framework Core Strategy (adopted June 2011). Policy CS6 addresses the historic environment. Policy CS6 states that the council will seek to protect, conserve and enhance the historic environment, and all new development must respect and enhance the local character and distinctiveness of the area in which it would be situated, particularly in areas with high heritage value.

In addition, policies HE5, HE8 and HE9 within the North Lincolnshire Local Plan (adopted May 2003) in respect of cultural heritage have been saved until the full implementation of the Local Development Framework. HE5 states that proposals which damage the setting of a listed building will be resisted. HE8 states that development proposals which would result in an adverse effect on Scheduled Monuments and other nationally important monuments, or their settings, will not be permitted. HE9 states that an archaeological assessment must be submitted which includes adequate assessment of the nature, extent and significance of the remains present and the degree to which the proposed development is likely to affect them. Sites of known archaeological importance will be protected. Where development impacting on sites is accepted, mitigation must be undertaken. Preservation in situ is the preferred mitigation. Where preservation in situ is not justified or possible, the developer will be required to make adequate provision for excavation and recording before and during development.

7.3 Methodology

7.3.1 General

Cultural heritage has been considered under the following three sub-topics:

- Archaeological Remains;
- Historic Buildings; and
- Historic Landscape

The assessment methodology follows the guidelines set out in Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 2, HA 208/07 including Annexes 5 (Archaeological Remains), 6 (Historic Buildings) and 7 (Historic Landscape) and professional judgement.

This chapter is informed by a Cultural Heritage Desk-Based Assessment (DBA) undertaken for the Scheme (Appendix 7.2). The report was compiled in accordance with the standard set out by the Chartered Institute for Archaeologists (CIfA) for Historic Environment Desk-Based Assessments (2017) and the Environment Agency's minimum technical requirements (2015). A geophysical survey was undertaken for the Scheme (Appendix 7.3).

This chapter is also informed by:

- Chapter 6: Landscape;
- Chapter 8: Water and Estuarine Processes; and
- Chapter 9: Land and Soils.

7.3.2 Study area

The study area has been defined as the footprint of the Scheme plus a 500m radius surrounding area. The study area for this assessment is considered appropriate in regard to

Archaeological Remains, Historic Buildings and the Historic Landscape due to the nature of the proposed works and anticipated sensitivity of the receiving environment.

The extent of the study area was agreed with the Archaeological Advisor to North Lincolnshire Council (Alison Williams) in June 2018.

Cultural heritage assets contained within the visual envelope outlined in Chapter 6: Landscape were assessed for impacts on their setting.

7.3.3 Data sources

The data used to determine the baseline conditions for this assessment were accessed from the following sources:

- National Heritage List for England (NHLE) for information of designated cultural heritage assets;
- North Lincolnshire Historic Environment Record (HER) for information on non-designated assets including archaeological sites and monuments, previous archaeological events, and historic landscape characterisation data;
- North Lincolnshire Council (NLC) for information on locally listed buildings and Conservation Areas;
- Ground Investigation (GI) reports for the Scheme and geological information held by the British Geological Survey (BGS);
- Historic maps and pertinent historical material held at the Lincolnshire Archives and Lincoln Central Library (visited June 2018);
- The results of previous archaeological investigations within, and in close proximity to, the Scheme;
- Historic aerial photographs held at the Historic England Archive, Swindon (visited December 2016);
- A site inspection was undertaken on the 24th August 2018;
- The Portable Antiquities Scheme (PAS); and
- Open source EA Light Detection And Ranging (LiDAR) data.

Plots of designated and non-designated assets on Figures 7.1-7.3.

Each asset discussed below is identified by a unique asset number that can be cross-referenced to the gazetteer provided at Appendix 7.1.

7.3.4 Assessment of value (sensitivity)

DMRB HA208/07 provides a methodology for the assessment of the value of cultural heritage assets and use of this methodology in this assessment aligns with the guidance provided by the NPPF. Conservation Principles (English Heritage 2008) was taken into consideration within the assessment of the value of cultural heritage assets.

The assessment was undertaken on a five-point scale of Very High, High, Medium, Low and Negligible. DMRB provides a robust methodology for the assessment of value of heritage assets and is widely accepted by the main heritage bodies. Table 7.1 is consulted throughout to provide the appropriate value for each heritage asset identified below.

Table 7.1: Assessing the value of cultural heritage assets

Value	Criteria
Very High	• World Heritage Sites (including buildings and those inscribed for their historic landscape qualities) • Assets of acknowledged international importance • Assets that can contribute significantly to acknowledged international research objectives • Extremely well-preserved historic landscapes with exceptional coherence, time-depth or other critical factors
High	• Scheduled Monuments (including standing remains) • Designated historic landscapes of outstanding interest • Undesignated assets of schedulable quality and importance • Assets that can contribute significantly to national research objectives • Grade I and II* Listed Buildings • Other Listed Buildings that can be shown to have exceptional qualities in their fabric or historical associations • Conservation Areas containing very important buildings • Undesignated structures of clear national importance • Undesignated landscapes of outstanding interest, high quality or importance and of demonstrable national value • Well-preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factors
Medium	• Designated or undesignated assets that contribute to regional research objectives • Undesignated historic landscapes that would justify special historic landscape designations, or landscapes of regional value • Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor • Grade II Listed Buildings • Conservation Areas containing buildings that contribute significantly to its historic character • Historic Townscape or built-up areas with important historic integrity in their buildings, settings or built settings
Low	• Designated and undesignated assets of local importance • Robust undesignated historic landscapes and historic landscapes with importance to local interest groups • Historic landscapes whose value is limited by poor preservation and / or poor survival of contextual associations • Assets compromised by poor preservation and/or poor survival of contextual associations • Assets of limited value, but with potential to contribute to local research objectives • 'Locally Listed' buildings • Historic (unlisted) buildings of modest quality in their fabric or historical association • Historic Townscape or built-up areas of limited historic integrity in their buildings, or built settings
Negligible	• Assets with very little or no surviving archaeological interest

Value	Criteria
	• Buildings of no archaeological or historical note, or buildings of an intrusive character • Landscapes with little or no significant historical interest
Unknown	• The importance of the resource has not been ascertained, or buildings with some (hidden) potential for historical significance

7.3.5 Magnitude of impact

Magnitude of impact is the degree of change that would be experienced by an asset as a result of the Scheme, as compared with a 'do nothing' situation. Magnitude of impact is assessed without reference to the value of the receptor, and may include physical impacts upon the asset, or impacts upon its setting or amenity value. Assessment of magnitude with and without mitigation is based on professional judgement informed by DMRB methodology and criteria for Archaeological Remains, Historic Buildings and the Historic Landscape, set out in Table 7.2.

Table 7.2: Assessing the Magnitude of Impact

Magnitude	Factors in the Assessment of Magnitude of Impact
Major	• Change to most or all key archaeological materials, such that the resource is totally altered. • Change to key historic building elements, such that the resource is totally altered. • Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise or change to sound quality; fundamental changes to use or access; resulting in total change to historic landscape character unit. • Comprehensive changes to setting
Moderate	• Changes to many key archaeological materials, such that the resource is clearly modified. • Change to many key historic building elements, such that the resource is significantly modified. • Changes to the setting of a cultural heritage asset, such that it is significantly modified. • Changes to many key historic landscape elements, parcels or components, visual change to many key aspects of the historic landscape, noticeable differences in noise or sound quality, considerable changes to use or access; resulting in moderate changes to historic landscape character.
Minor	• Changes to key archaeological materials, such that the asset is slightly altered. • Change to key historic building elements, such that the asset is slightly different. • Change to setting of a cultural heritage asset, such that it is noticeably changed. • Changes to few key historic landscape elements, parcels or components, slight visual changes to few key aspects of historic landscape, limited changes to noise levels or sound quality; slight changes to use or access: resulting in limited changes to historic landscape character.

Magnitude	Factors in the Assessment of Magnitude of Impact
Negligible	• Very minor changes to archaeological materials, or setting. • Slight changes to historic buildings elements or setting that hardly affect it. • Very minor changes to key historic landscape elements, parcels or components, virtually unchanged visual effects, very slight changes in noise levels or sound quality; very slight changes to use or access; resulting in a very small change to historic landscape character.
No Change	• No change to fabric, setting. • No change to elements, parcels or components; no visual or audible changes; no changes arising from in amenity or community factors.

7.3.6 Significance of effect

The significance of effect is determined through the combination of the value (sensitivity) of the asset and the magnitude of impact. In Table 7.3 below, five levels of significance of effect are defined which apply equally to adverse and beneficial impacts.

Table 7.3: Significance of effect

	Value/Sensitivity				
Magnitude	**Very High**	**High**	**Medium**	**Low**	**Negligible**
Major	Very Large	Large	Moderate /Large	Slight/ Moderate	Slight
Moderate	Large/Very Large	Moderate/ Large	Moderate	Slight	Neutral/ Slight
Minor	Moderate/ Large	Slight/ Moderate	Slight	Neutral/Slight	Neutral/ Slight
Negligible	Slight	Slight	Neutral/Slight	Neutral/Slight	Neutral
No Change	Neutral	Neutral	Neutral	Neutral	Neutral

7.3.7 Guidance

The assessment of setting impacts was undertaken in general accordance with the following guidance:

- Conservation Principles (English Heritage 2008); and
- Good Practice Advice Note 3: The Setting of Heritage Assets (Historic England 2017).

7.4 Existing environment

From the sources identified above, a total of 104 cultural heritage assets were identified within the 500m study area with the potential to be impacted by the Scheme. These assets comprise 44 in the category of Archaeological Remains, 29 in the category of Historic Buildings and 31 in the category of Historic Landscape - see Table 7.4 below.

Table 7.4: Summary of Identified Cultural Heritage Assets

Sub-topic	Value						
	Very High	High	Medium	Low	Negligible	Unknown	TOTAL
Archaeological remains	0	1	7	11	19	4	44
Historic buildings	0	1	3	25	0	0	29
Historic landscapes	0	0	0	12	19	0	31
TOTAL	0	2	10	50	38	4	104

These assets are discussed in each sub-topic section.

7.4.1 Archaeological remains

Designated assets

There is one Scheduled Monument within the Scheme.

*Ferriby Sluice (**Asset 1**)*

This asset comprises a sluice and lock over the New River Ancholme built between 1842 and 1844 (Photograph 13). The asset is located on the site of earlier sluices dating to 1640 and 1769 respectively. When originally built, the asset incorporated a lock that was crossed by a swing road bridge. This was replaced by a lifting bridge in 1982. This asset is of **high value.**

The immediate setting of this asset comprises its position on the New River Ancholme. The river to the south is straight with an engineered character instead of a natural more sinuous appearance. To the north is the Humber Estuary, to the east are a number of small dwellings, the Hope and Anchor public house and industrial yards, to the south and west are the New River Ancholme and the CEMEX cement factory. The asset is experienced, primarily, when traversing the A1077 road and there are wide ranging views to the north and south towards the Humber and along the New River Ancholme respectively. This immediate setting is considered to make a small positive contribution to the overall significance of the asset and allows for an appreciation of its evidential and historical values.

Photograph 13: Ferriby sluice, looking north-east

The Scheme forms a small part of the immediate setting of this asset and allows for a limited experience of the asset's evidential and historic values. As such, the Scheme is considered to make a neutral contribution to the asset's overall significance.

Non-designated assets

Prehistoric period

There are no prehistoric assets recorded within the Scheme.

In the study area, prehistoric assets include: the Middlegate Lane Trackway (**Asset 2**) which follows the edge of the chalk Wolds approximately 250m to the south-east of the Scheme. While a prehistoric date for the trackway is unproven, at the southern limit of the trackway it connects with another trackway that forms part of a complex of enclosures of Iron Age date; a possible prehistoric burial (**Asset 3**) found in a coracle-type vessel on the banks of a former creek within the former South Ferriby brick works approximately 350m to the south of the Scheme during the early 20th century; and a worked piece of flint (**Asset 4**) found approximately 370m to the south of the Scheme. These assets suggest a low-level of prehistoric activity within the study area and are of **low value.**

Roman period

There are no Roman assets recorded within the Scheme.

Traces of a south-east to north-west oriented Roman road or causeway (**Asset 5**) were identified on the foreshore to the immediate north of the western part of the Scheme in 1994.

Investigation of the road revealed it to have been constructed in two phases. The first phase consisted of a layer of brushwood overlying alluvium. The second phase was a layer of chalk blocks covered by a layer of compacted gravel. The northern edge of the road appears to have been delineated by a row of timber stakes. Pottery recovered from the road indicated a 2nd to 3rd century date. It was suggested that the road could have linked two Roman settlements at Old Winteringham to the west and at South Ferriby Cliff to the east.

This asset forms part of the wider Roman landscape surrounding the Scheme and is associated with the two important settlement sites and their arterial roads. Therefore, the asset is of **medium value.**

In the study area, Roman assets include: pottery and human remains (**Asset 6**) found during a housing development in South Ferriby during the 1950s approximately 180m to the south of the Scheme; fragments of pottery (**Assets 3 and 7**) recovered from the South Ferriby brickyard approximately 200m to the south of the Scheme; a Roman coin (**Asset 8**) found within South Ferriby approximately 370m to the south of the Scheme; the Roman settlement site at South Ferriby Cliff (Asset 9) approximately 450m to the north-east of the Scheme; and a Roman seal box fragment (**Asset 10**) found by a metal detectorist approximately 470m to the south-east of the Scheme.

The settlement site at South Ferriby Cliff (**Asset 9**) is of **medium value.** The remainder of the Roman assets have been removed from the study area and are of **negligible value.**

Further human remains and pottery (**Asset 11**) have also recently been identified eroding from the Humber foreshore at South Ferriby Cliff at the north-eastern limit of the study area. These finds are likely to relate to the known Roman settlement site (**Asset 9**) on the higher ground approximately 450m to the north-east of the Scheme. While these assets indicate a sustained Roman presence at South Ferriby, they have been removed from the study area and are therefore of **negligible value.**

Early medieval period

There are no early medieval assets recorded within the Scheme.

In the study area, early medieval assets are limited to a 9th century strap end and an annular brooch (**Asset 10**) found by a metal detectorist approximately 470m to the south-east of the Scheme. These assets have been removed from the study area and are of **negligible value.**

Medieval period

The eastern part of the Scheme crosses the medieval former channel of the River Ancholme (**Asset 12**) which led to a haven at South Ferriby. While not technically an archaeological feature, this asset contributes to the understanding of the development and economy of South Ferriby during the medieval period. The river appears to have experienced little chane in its course until it was superseded by the new canal in the post medieval period. It shares group value with **Assets 13-16**. it is of **medium value**. Its setting contributes to the significance of the medieval settlement and haven The geophysical survey undertaken for the Scheme identified the former channel (Appendix 7.3).

In the study area, the site of a bridge (**Asset 13**) and associated sluice (**Asset 14**) are recorded approximately 100m to the south of the Scheme. The bridge was first mentioned in documentary sources in c.1200 AD and is thought to have survived until the 17th century. Amateur investigation of the site in 1983 recorded an approach causeway (**Asset 15**) and the remains of a single arch with a 15-foot span. The geophysical survey for the Scheme identified a linear anomaly (Appendix 7.3: CW1) which is aligned south-east/north-west and is tentatively interpreted as part of the continuation of the medieval causeway. The medieval

haven (**Asset 16**) is located on the eastern bank of the former channel of the River Ancholme (**Asset 12**) approximately 130m to the south of the Scheme. South Ferriby appears to have been a wealthy parish in the medieval period and the port is likely to have contributed to this. The port and river complex is still legible within the landscape and share group value. These assets are of **medium** value

Further medieval assets include: the site of a possible medieval hermitage (**Asset 17**) identified from historic mapping approximately 160m to the south of the Scheme; the historic core of South Ferriby village (**Asset 18**) approximately 290m to the east of the Scheme; the site of a possible moat (**Asset 19**) approximately 350m to the south of the Scheme; a substantial drainage system and possible watermill site (**Asset 20**) approximately 360m to the south of the Scheme; and an area of extant ridge and furrow earthworks (**Asset 21**) approximately 400m to the north-east of the Scheme.

These assets contribute to the understanding of the development and economy of South Ferriby during the medieval period and are of **low value.**

Post medieval period

The eastern part of the Scheme crosses the area of a former brickyard (**Asset 22**) identified from historic mapping. A structure is shown on the 1908 OS map near Sluice Road within the proposed new embankment. This structure is likely part of the brickyards but was not visible on the walkover survey. A ruined brick building which was part of the brickworks is still visible north of the Scheme (Appendix 7.3: Illustration 4). The geophysical survey undertaken for the Scheme in 2018 identified anomalies interpreted as two areas of brick manufacture (Appendix 7.3: anomalies BY1 (BC1-B3) and BY2 (BC4-BC6)), including brick clamps and other structures and an infilled pond, likely for clay extraction (Appendix 7.3: IP). BY1 is not shown on historical mapping but BY2 is recorded on historical mapping and corresponds with Asset 22. This asset is of **negligible value.**

The geophysical survey also identified a number of anomalies interpreted as remains of agricultural activity, including boundary removal, ploughing and drainage. The historical mapping shows the pattern of enclosure has changed with several former boundaries having been removed to increase field size.

In the study area, numerous post medieval assets are recorded (**Assets 23 – 40**), mainly reflecting the industrial usage of the areas along the banks of the New River Ancholme and the sites of former buildings and farmsteads shown on historic mapping. These assets are summarised in Table 7.5 below.

Table 7.5: Summary of non-designated post medieval assets within the study area

Asset Number	HER Number	Name	Monument Type	Value
23	MLS2904	Mill House (site of), Ferriby Sluice	House	Low
24	MLS7787	Ferriby Sluice mill (site of)	Windmill	Low
25	MLS9481	New River Ancholme	Canal	Low
26	MLS10287	Workhouse and yard (site of), foot of Ferriby Hill	Workhouse	Negligible
27	MLS17656	Monson Sluice (site of), New Ancholme	Sluice	Negligible

Asset Number	HER Number	Name	Monument Type	Value
28	MLS17661	Frank's brick works (site of), Red Lane	Brick Works	Negligible
29	MLS17675	Abstainer's hall (site of), Low Street	Meeting hall	Negligible
30	MLS17683	White Cottage, Sluice Road (n side) (site of)	House	Negligible
31	MLS21409	Searchlight Battery, Sluice Road (site of)	WWII asset (site of)	Low
32	MLS22005	Brickyard (site of)	Brickyard	Negligible
33	MLS22006	Brickyard (site of)	Brickyard, brick works	Negligible
34	MLS22007	Brick works (site of)	Brick works	Negligible
35	MLS22218	Pinfold (site of), Sluice Road	Pound	Negligible
36	MLS22219	Rectory (site of), Horstow Road	Vicarage	Low
37	MLS22806	Pinfold (site of), Ferriby Hill	Pound	Negligible
38	MLS25073	Site of unnamed farmstead, South Ferriby	Farmstead	Negligible
39	MLS25075	Site of unnamed farmstead, South Ferriby	Farmstead	Negligible
40	MLS25098	Site of unnamed farmstead, Winteringham	Farmstead	Negligible

Undated

There are no undated assets recorded from the Historic Environment Area within the Scheme.

In the study area, undated assets include: two linear cropmarks (**Asset 41**) that extend towards the western limit of the Scheme; the site of a sundial (**Asset 42**) identified in the vicinity of the Hope and Anchor public house approximately 40m to the east of the Scheme; a large ditch (**Asset 43**) observed during an archaeological watching brief approximately 180m to the south-east of the Scheme; and another ditch (Asset 44) approximately 400m to the south of the Scheme identified as a non-antiquity by the HER. These assets are of **unknown cultural heritage value.**

The geophysical survey undertaken for the Scheme identified a series of curving anomalies which may indicated former beachlines and bars of the Humber Estuary (Appendix 7.3: FS1-FS5). A number of anomalies were interpreted as former silted up creeks or channels.

The geophysical survey also identified two linear anomalies of potential archaeological origin of unknown date (Appendix 7.3: D1, D2). D1 and D2 are parallel linear anomalies, aligned

south-east/north-west, which are tentatively interpreted as ditches on either side of a former trackway or road. This asset is of **low cultural heritage value.**

Archaeological potential

There is limited evidence for prehistoric activity within the Scheme, although it is acknowledged that there is a potential for paleoenvironmental deposits of prehistoric date. However, such deposits have been shown to be deeply buried under alluvial and warp deposits within the footprint of the Scheme at approximately 3-7m BGL. The data for the depths of deposits was identified within historical boreholes on BGS, GI investigations undertaken for the Scheme is 2016 and 2018 and past archaeological interventions.

The geology of the Scheme is dominated by alluvium and tidal flat deposits. The geophysical survey undertaken for the Scheme (Appendix 7.3) showed the magnetic background to be variable, with large parts of the survey area dominated by broad and amorphous high magnitude anomalies which are typical of alluvium and tidal flat deposits The topsoil thickness varies between 0.10 – 0.25m. The area near the sluice is topsoil overlying made ground of approximately 1m - 2m deep, which overlies sandy clay. Organic material with rootlets was recorded at 3.70m BGL GI interventions at the eastern end of the Scheme identified approximately 1m of made ground and topsoil, overlying 0.50m deep sandy clay which overlies chalk and gravels. Sandy peat was recorded here at 5.20m BGL (1m deep) and at 6.20m BGL (2.1m deep). The geology at the northern part of the new western embankment was recorded as being 0.10m thick topsoil overlying sandy clay. Organic sandy clay with rootlets was recorded here at 1.10m BGL (3.50m thick). The geology at the southern end of the new western embankment was recorded as being peaty clay of approximately 5m thickness. Brown fibrous peat was recoded at 5.05m BGL and was 1.25m thick (JBA 2018).

The archaeological evaluation at Fulseas Pumping Station recorded topsoil of 0.30m thick overlying clays at a maximum depth of 6.30m which overlay peat deposits. Survival of organic remains at 1.05-1.57 AOD was recorded. The stratigraphy at the Fulseas Pumping Station contained the same overall soil formation as the Humber Wetlands Project borehole transect which recorded two separate layers of peat. The results suggest channel aggradation followed by floodplain aggradation, first by organic (basal peat) and then by minerogenic (grey estuarine clay) deposits.

As the depth of impact is likely to be within the alluvium deposits, above to the level of organic peaty remains, like there is a low potential for finding settlement remains in the impact level of the Scheme.

The geophysical survey undertaken (Appendix 7.3) identified previously unknown buried remains relating to the brickyard (**Asset 22**) and some anomalies of archaeological potential in addition to agricultural features and field boundaries. However, due to the geology of alluvium and tidal flat deposits, weaker archaeological anomalies may not have been detected by the survey. The geophysical survey also identified a number of curvilinear anomalies, aligned broadly from east to west parallel with the foreshore of the estuary, which are interpreted to be caused by the accumulation of sediments along former beachlines and bars of the River Humber. There is the potential for fish traps along the Estuary, however none were identified from the geophysical survey Although a number of coherent sinuous curvilinear anomalies were identified, these have been interpreted as former silted up creeks or channels or old shorelines.

There is firm evidence for sustained Roman activity within the landscape surrounding the Scheme, particularly the settlements at Old Winteringham to the west and at South Ferriby Cliff to the east. A possible road connecting these settlements has been identified on the foreshore to the north of the Scheme (**Asset 5**) and the projected alignment of this feature crosses the western part of the Scheme. The retreating sea levels during the Roman period

would have made more of the land suitable for agriculture and this suggests there is potential for archaeological remains from this period within the Scheme. Peat formation occurred during the marine regression within the Roman period. However, this was short lived, and the deposition of marine clays continued within the period and continued after it. The Roman occupational layers likely lie beneath the alluvium.

In addition, numerous finds including coins, brooches and human remains have been found within South Ferriby, particularly along the Humber foreshore at South Ferriby Cliff. Given the above, a moderate potential for previously unknown Roman assets is identified. Given the low-lying topography of the Scheme, such evidence, if present, is anticipated to comprise further unstratified finds particularly towards the higher ground on the eastern fringe of the Scheme.

Medieval evidence within the study area focuses around South Ferriby itself and the crossing point (**Asset 13**) across the former channel of the River Ancholme (**Asset 12**) and associated haven (**Asset 16**). Given that the eastern part of the Scheme crosses the line of the former river channel and encroaches on the periphery of the village, a moderate/low potential for medieval evidence is identified (see Appendix 7.2). Such evidence, if present, is anticipated to comprise unstratified finds derived from peripheral village activity.

Post medieval assets within the footprint of the Scheme relate to a former brickyard (**Asset 22**) and associated areas of extraction/fish ponds. In addition, the courses of a number of former field boundaries are noted by the DBA at the western and eastern limits of the Scheme respectively (see Appendix 7.2).

The Portable Antiquities Scheme records numerous finds from the South Ferriby area dating from the prehistoric period onwards. A potential for further unstratified evidence is therefore acknowledged.

7.4.2 Historic buildings

Designated assets

There are no designated Listed Buildings within the Scheme, however in the study area, four Listed Buildings are present.

Woodside Farmhouse (Asset 45)

This asset comprises a Grade II listed farmhouse dating to the early 18th century located 170m to the north-east of the eastern limit of the Scheme within South Ferriby. This asset is of **medium value.**

The immediate setting of this asset comprises its position at the northern limit of South Ferriby, bounded to the north and west by associated agricultural buildings and a non-designated former farmhouse (**Asset 70**), to the east by a private garden, and to the south by further private dwellings within South Ferriby. There are no views from the ground floor of the asset towards the Scheme due to intervening vegetation and buildings. This immediate setting is considered to make a small positive contribution to the significance of the asset and allows for an appreciation of its evidential and historical values.

The Scheme forms part of the landscape setting of this asset but is mostly screened due to intervening vegetation and buildings. As such, the Scheme is considered to make a neutral contribution to the asset's overall significance.

South Ferriby Hall (Asset 46)

This asset comprises a Grade II listed 19th century hall, with earlier 17th elements, located approximately 250m to the north-east of the Scheme. This asset is of **medium value.**

The immediate setting of this asset comprises its position to the north of South Ferriby bounded to the north and south by woodland, to the east by agricultural land, and to the west by further small areas of agricultural land and private gardens. There are views to the north-west from the asset towards the Humber. This immediate setting allows for the quiet appreciation of the assets evidential and historical values and is considered to make a small positive contribution to its overall significance.

The Scheme forms part of the wider landscape setting of this asset but is mostly screened due to intervening vegetation and buildings. As such, and given the intervening distance, the Scheme is considered to make a neutral contribution to the asset's overall significance.

Glentworth House (Asset 47)

This asset comprises a Grade II listed 19th century house located approximately 300m to the south-east of the Scheme within South Ferriby. This asset is of **medium value.**

The immediate setting of this asset comprises its position on High Street, within South Ferriby, bounded to the north, south and west by further residential buildings, and to the east by an area of sloping grass. There are no views from the asset towards the Scheme due to intervening vegetation and buildings. This immediate setting is considered to make a small positive contribution to the significance of the asset and allows for an appreciation of its evidential and historical values.

The Scheme forms part of the wider landscape setting of this asset but is entirely screened due to intervening vegetation and buildings. As such, the Scheme is considered to make a neutral contribution to the asset's overall significance.

Church of Saint Nicholas (Asset 48)

This asset comprises a Grade II* listed medieval church located approximately 350m to the south-east of the Scheme within South Ferriby. This asset is of **high value.**

The immediate setting of this asset comprises its elevated position on the south-eastern periphery of South Ferriby. The asset is bounded to the north and south by woodland, to the east by its graveyard, Middlegate Lane and agricultural fields, and to the west by a grassed slope leading down towards South Ferriby itself.

This immediate setting is considered to make a small positive contribution to the significance of the asset and allows for an appreciation of its evidential, historical, aesthetic and communal values. Although the church is on an elevated position, there are no views of the Scheme from the church due to intervening vegetation and buildings.

The Scheme forms a small part of the wider landscape setting of this asset and is considered to make a neutral contribution to the asset's overall significance.

Non-designated assets

There are no non-designated historic buildings within the Scheme.

In the study area, 25 non-designated historic buildings are recorded (**Assets 49 – 73**), the majority of which are located within South Ferriby to the east of the Scheme. These assets are summarised in Table 7.6 below.

Table 7.6: Summary of non-designated historic buildings within the study area

Asset Number	HER Number	Name	Period	Value
49	MLS10288	Wesleyan Methodist Chapel	Post Medieval to Modern	Low
50	MLS10289	Former Primitive Methodist Chapel and Sunday School	Post Medieval	Low
51	MLS17670	Barn at Manor Farm (south side)	Post Medieval	Low
52	MLS17671	Nelthorpe Arms, School Lane (south side).	Post Medieval	Low
53	MLS17672	Humber Lodge, Old Post Office Lane (south side).	Post Medieval	Low
54	MLS17673	Mount Pleasant farmhouse and barn, Old Post Office Lane (north side)	Post Medieval	Low
55	MLS17674	Cottage Row, High Street	Post Medieval	Low
56	MLS17676	Rose Cottage, Low Street (north side)	Post Medieval	Low
57	MLS17677	Kingston Terrace, Skinner's Lane (south side)	Post Medieval	Low
58	MLS17678	The Manor House	Post Medieval	Low
59	MLS17680	School and outbuildings, Low Street (west side)	Post Medieval	Low
60	MLS17681	Cottage row, School Lane (north side)	Post Medieval	Low
61	MLS17682	Blacksmith's shop, Barton Road (west side)	Post Medieval	Low
62	MLS17684	The Elms, formerly known as`Coffins', Sluice Lane (north side)	Post Medieval	Low
63	MLS17685	Holly House Farmhouse, Farishes Lane (north side)	Post Medieval	Low
64	MLS21174	WWII Pillbox	Modern	Low
65	MLS21468	Simons Cottage, No. 3 School Lane	Post Medieval	Low
66	MLS21698	War Memorial, St Nicholas' Churchyard	Modern	Low
67	MLS22217	9 and 10 Sluice Road	Post Medieval to Modern	Low

Asset Number	HER Number	Name	Period	Value
68	MLS22220	The Old Reading Room	Post Medieval to Modern	Low
69	MLS22812	Air Raid Shelter, 1 Beaulah Villas	Modern	Low
70	MLS25071	Woodside Farm, South Ferriby	Post Medieval to Modern	Low
71	MLS25072	Elm Farm, South Ferriby	Post Medieval to Modern	Low
72	MLS25074	Elm Farm, South Ferriby	Post Medieval to Modern	Low
73	MLS25077	Unnamed Farmstead, South Ferriby	Post Medieval to Modern	Low

7.4.3 Historic landscape

Designated assets

There are no designated historic landscape assets (World Heritage Sites, Registered Parks and Gardens or Registered Battlefields) within the Scheme or study area.

Non-designated assets

There is one non-designated historic landscape within the study area. This comprises the formal gardens (**Asset 74**) surrounding the Grade II listed South Ferriby Hall (**Asset 46**) which lie approximately 150m to the east of the Scheme's eastern limit.

This asset forms part of the immediate setting of the designated South Ferriby Hall (**Asset 46**) and is of **low value**.

Historic Landscape Characterisation

The Lincolnshire Historic Landscape Characterisation (HLC) provides further detail on the character of historic landscape within the Scheme and study area.

In the west, the Scheme lies within the industrial landscape of the CEMEX cement factory (Asset 75) dating to the modern period. To the immediate north of the cement factory, the Scheme crosses through an area of marsh (Asset 76) of post medieval to modern date.

To the north-east of Ferriby Sluice (Asset 1), the Scheme intersect with another area of industrial activity identified along the New River Ancholme (Asset 77) of modern date. The remainder of the eastern part of the Scheme passes through an area of Parliamentary Planned Enclosure (Asset 78) of post medieval date.

The above modern industrial areas are of negligible value. The remainder of the HLC areas that the Scheme intersects with are of **low value**.

In the study area, a further 26 HLC areas are identified. These are summarised in Table 7.7 below.

Table 7.7: Summary of HLC areas within the study area

Asset Number	HLC Number	Broad Type	HLC Type	Period	Value
79	HLS782	Fields and Enclosed Land	Parliamentary Planned Enclosure	Post Medieval to Modern	Low
80	HLS793	Fields and Enclosed Land	Modern Fields	Modern	Negligible
81	HLS948	Recreational Open Space	Recreation Ground	Modern	Negligible
82	HLS1001	Fields and Enclosed Land	Parliamentary Planned Enclosure	Post Medieval to Modern	Low
83	HLS1002	Fields and Enclosed Land	Parliamentary Planned Enclosure	Post Medieval to Modern	Low
84	HLS1327	Fields and Enclosed Land	Modern Fields	Modern	Negligible
85	HLS1393	Fields and Enclosed Land	Modern Fields	Modern	Negligible
86	HLS1404	Fields and Enclosed Land	Modern Fields	Modern	Negligible
87	HLS1414	Fields and Enclosed Land	Modern Fields	Modern	Negligible
88	HLS1436	Industry	Derelict Industrial Land	Modern	Negligible
89	HLS1447	Industry	Derelict Industrial Land	Modern	Negligible
90	HLS1458	Fields and Enclosed Land	Modern Fields	Modern	Negligible
91	HLS1469	Fields and Enclosed Land	Modern Fields	Modern	Negligible
92	HLS1480	Fields and Enclosed Land	Parliamentary Planned Enclosure	Post Medieval to Modern	Low
93	HLS1316	Settlement	Historic Settlement Core	Early Medieval/Dark Age to Modern	Low
94	HLS1502	Water and Wetland	Marsh	Post Medieval to Modern	Low

Asset Number	HLC Number	Broad Type	HLC Type	Period	Value
95	HLS1513	Settlement	Detached Housing (C20th)	Modern	Negligible
96	HLS1522	Settlement	Detached Housing (C20th)	Modern	Negligible
97	HLS1533	Recreational Open Space	Recreation Ground	Modern	Negligible
98	HLS1555	Woodland	Ancient/Semi Natural Woodland	Unknown to Modern	Low
99	HLS1566	Woodland	Ancient/Semi Natural Woodland	Unknown to Modern	Low
100	HLS1588	Fields and Enclosed Land	Estate Fields	Modern	Negligible
101	HLS1577	Parkland	Country House	Post Medieval to Modern	Low
102	HLS1654	Agriculture	Fish Farm	Modern	Negligible
103	HLS1665	Fields and Enclosed Land	Ancient Enclosure	Post Medieval to Modern	Low
104	HLS1969	Recreational Open Space	Nature Reserves	Modern	Negligible

7.4.4 Evolution of the baseline without the Scheme

In the absence of the Scheme and following a breach of the existing front bank, flooding could affect low-lying areas which could impact negatively on historic buildings and sensitive archaeological remains. Flooding could physically impact on the fabric of historic buildings. Flood waters could also introduce contaminated or nutrient-rich deposits which could degrade buried archaeological remains. The soil chemistry and acidity levels may be altered which could impact on the survival of artefacts or organic matter. Land erosion could physically remove buried archaeological remains, including known archaeological remains, such as the brickyard and Roman road and previously unknown remains.

The changing shoreline of the Humber suggests there is the possibility of pre-medieval buried archaeological remains under the alluvium. There is also the potential for previously unknown waterlogged remains associated with river navigation and use, such as wooden boats or fish traps. The impact of current erosion on archaeological remains is shown at South Ferriby Cliff where Roman remains are being removed by erosion. Habitat would change as a result of the flooding of fields. This change of habitat could alter the hydrological processes and impact on buried archaeological remains. Section 9.4.7 provides further detail on the likely geomorphological changes associated with a breach.

7.5 Likely significant effects

7.5.1 During construction

Impacts arising from construction include:

- Removal of archaeological assets (known and unknown);
- Impacts on the geoarchaeological deposits during construction;
- Changes to historic landscape integrity as a result of construction of the Scheme; and
- Impacts on the setting of cultural heritage assets due to temporary construction works or operation of the Scheme.

Archaeological remains

The proposed construction works at Ferriby Sluice (**Asset 1**) would directly physically impact the fabric of the Scheduled Monument. Such works would need Scheduled Monument Clearance in addition to planning permission. The works requiring Scheduled Monument Clearance lie on the western side of the asset where a new floodwall is proposed. The magnitude of impact would be minor permanent negative and the significance of effect would be slight adverse.

The presence of construction machinery, noise, dust and vibration would have a minor temporary negative impact on the setting of this asset during the construction phase of the Scheme. The significance of effect would be slight adverse.

Groundworks in the western part of the Scheme, where the current embankment is to be widened with a new soak dyke in addition to two compounds, could impact on the remains of a Roman road (**Asset 5**) as its projected alignment is through the embankment. However, the depth at which the Roman road lies in this location, if present here, is unknown and therefore it is currently unknown if the depth of excavations here would impact on it. If remains are present which are impacted on, the magnitude of impact would be minor permanent negative, and the significance of effect would be slight adverse. Groundworks in the eastern part of the Scheme and the construction of a compound could directly physically impact on the non-designated medieval course of the River Ancholme (**Asset 12**). The magnitude of impact would be minor permanent negative, and the significance of effect would be slight adverse. There is the potential for archaeological remains associated with the river course and port to the south to be present within the area. Groundworks in the eastern part of the Scheme and the construction of a compound could directly physically impact on remains associated with the non-designated medieval haven (**Asset 16**) if remains are present within the Scheme. The magnitude of impact would be minor permanent negative, and the significance of effect would be slight adverse. There is the potential for archaeological remains associated with the river course and port to the south to be present within the area.

The medieval complex of the former course of the River Ancholme (**Asset 12**), haven or harbour (**Asset 16**), site of bridge (**Asset 13**), site of sluice (**Asset 14**) and causeway (**Asset 15**) form a coherent entity and contributes to the significance of medieval South Ferriby. The presence of construction machinery and activities would have a minor temporary negative impact on the setting of these assets during the construction phase of the Scheme. The magnitude of impact would be minor permanent negative, and the significance of effect would be slight adverse.

Groundworks in the eastern part of the Scheme would directly physically impact the non-designated site of a post medieval brickyard (**Asset 22**). There is a structure shown on the 1907 OS map which lies within the alignment of the new embankment and likely forms part

of the brickyard. The magnitude of impact would be moderate permanent negative and the significance of effect would be slight adverse.

Construction of the new embankment may directly physically impact on a number of anomalies of potential archaeological origin identified during the geophysical survey. The magnitude of impact would be moderate permanent negative and the significance of effect would be slight adverse.

No other archaeological assets would be directly impacted during the construction phase. However, it is acknowledged that there is a potential for unknown archaeological assets to be encountered during construction works. Evaluation by trial trenching will ascertain the presence or absence of archaeological remains and characterise any buried archaeological remains identified.

The value of such assets is currently unknown; however, it is anticipated that if such assets were identified they would have been subject to previous truncation from sustained agriculture and extractive activities and would be of low value at best. The magnitude of impact would be moderate permanent negative and the anticipated significance of effect would be slight adverse.

Historic buildings

There would be no direct physical impacts to any designated or non-designated historic buildings by the Scheme.

The presence of construction machinery, noise, dust and vibration would have a minor temporary negative impact on the setting of the Grade II listed Woodside Farmhouse (**Asset 45**) and the Grade II listed Glentworth House (**Asset 47**) during the construction phase of the Scheme. The significance of effect would be neutral/slight.

The presence of construction machinery, noise, dust and vibration would have a minor temporary negative impact on the setting the Grade II listed South Ferriby Hall (**Asset 46**) during the construction phase of the Scheme. The significance of effect would be slight.

The presence of construction machinery, noise, dust and vibration would have a negligible temporary negative impact on the setting of the Grade II* listed Church of Saint Nicholas (**Asset 48**) during the construction phase of the Scheme. The significance of effect would be slight.

The presence of construction machinery, noise, dust and vibration would have a minor temporary negative impact on the setting of numbers 9 and 10 Sluice Road (**Asset 67**), a former coastguard lookout located on the southern side of Sluice Road during the construction phase. The significance of effect would be slight.

The presence of construction machinery, noise, dust and vibration would have a minor temporary negative impact on the setting of the following non-designated historic buildings located to the western edge of South Ferriby during the construction phase: the Wesleyan Methodist Chapel (**Asset 49**); Cottage Row (**Asset 62**); Holly House Farmhouse (**Asset 63**); Woodside Farm (**Asset 70**); and Elm Farm (**Assets 71 and 74**). The significance of effect would be neutral/slight.

Historic landscape

There would be an impact on historic landscapes which have existed since the post medieval period, consisting of an area of marsh to the north of the CEMEX cement factory (**Asset 76**) and an area of parliamentary planned enclosure in the eastern part of the Scheme (**Asset 78**), due to partial removal as a result of the Scheme although there would

be no severance of the landscapes and they would still be understood. The magnitude of impact would be minor permanent negative and the significance of effect would be neutral/slight.

There would be an impact on historic landscapes which may have existed since the modern period, consisting of the industrial area of the CEMEX cement factory itself (**Asset 75**) and an area of former docks, wharves and havens along the New River Ancholme (**Asset 77**), due to partial removal as a result of the Scheme although there would be no severance of the landscapes and they would still be understood. The magnitude of impact would be minor adverse and the significance of effect would be neutral/slight.

7.5.2 During operation

Impacts arising during operation include:

- Enhanced flood protection; and
- Changes to the setting of cultural heritage assets due to deployment of demountable defences and addition of new landscape elements.
- Compression of archaeological remains

Archaeological remains

The operation of the Scheme would provide enhanced flood protection to the designated Ferriby Sluice (**Asset 1**) and non-designated assets. The magnitude of impact would be minor permanent positive and the significance of effect would be slight/moderate beneficial.

The introduction and operation of the new defences in the immediate setting of this asset (floodwalls, gates and demountable defences) would result in a negligible permanent negative impact on the asset. The significance of effect would slight adverse.

The two proposed embankments, to the west of the CEMEX cement factory and to the east of the Hope and Anchor public house, would be screened from this asset by intervening buildings and the cement factory itself. Raising of the extant embankment to the north-west of the asset would not preclude views of the Humber looking north-west from the asset, nor would it alter the ability to appreciate the asset's historical and evidential values, when traversing the A1077 road. Primary views from the asset are to the north and south towards the Humber and along the New River Ancholme respectively.

There would be an impact on the setting of the non-designated former course of the river **(Asset 12**) due to the introduction of the new embankment and the bisection of the river course. The Scheme would impact on the legibility of the river and further bisect it from the harbour complex. However, it was previously separated from the harbour complex by the construction of the A1077 road. The magnitude of impact would be minor permanent adverse and the significance of effect would be slight adverse.

Historic buildings

The operation of the Scheme would provide enhanced flood protection to the designated Listed Buildings (**Assets 45 – 48**) within South Ferriby. The magnitude of impact would be minor positive and the significance of effects would be slight (**Assets 45 – 47**) and slight/moderate (**Asset 48**) beneficial respectively.

The proposed embankment in the eastern part of the Scheme would be a new element within the wider landscape setting of South Ferriby Hall (**Asset 46**). However, the current embankment is contained within the principal view from the house. Therefore, a flood embankment is not an uncharacteristic element within the setting of the hall. There would be limited intervisibility between this asset and the Scheme due to intervening buildings and

vegetation. The principal view towards the Humber would not be impacted with the Scheme only visible in filtered views from the grounds. The magnitude of impact would be minor permanent negative and the significance of effect would be slight adverse.

The Scheme would impact on the setting of numbers 9 and 10 Sluice Road (**Asset 67**), a former coastguard lookout located on the southern side of Sluice Road. The views from the ground floor of the asset are screened from the Scheme but roadside hedges. However, the first floor of the asset views across the Scheme to the Humber, the relationship of the coastguard lookout to the river is an important relationship to be maintained. The new introduced embankment would likely curtail views from the first floor but is unlikely to break the line of sight from the lookout to the Humber. The magnitude of impact would be minor permanent negative and the significance of effect would be slight adverse.

There are no impacts predicted on the remainder of the historic buildings due to the distance of the assets to the Scheme and the presence of intervening vegetation and buildings.

Historic landscape

In the study area, the historic landscape (**Assets 75 – 104**) is of low or negligible cultural heritage value. As noted in the DBA (Appendix 7.2) the progressive erosion of the Humber foreshore and various modifications to the line of the Humber Embankment demonstrate the dynamic nature of this landscape. As such, the introduction of new embankments and flood defence features within this semi-industrial/semi-rural landscape would not be incongruous and would not alter the ability to appreciate or read the historic landscape itself. There are no impacts on the historic landscape predicted from the operation of the Scheme.

7.6 Mitigation

Mitigation would be undertaken in accordance with national standards and guidance including:

- Code of Conduct (Chartered Institute for Archaeologists (CIfA) 2014)); and
- Standard and guidance for an archaeological watching brief (CIFA 2014).

Scheduled Monument Clearance would be obtained in advance of any works directly physically impacting Ferriby Sluice (**Asset 1**).

A Written Scheme of Investigation (WSI) for the archaeological mitigation would be agreed d the Archaeological Advisor to North Lincolnshire Council. Any works which come under the Scheduled Monument Clearance will be agreed with Historic England.

7.6.1 Archaeological remains

Consultation with the Archaeological Advisor to North Lincolnshire Council and Historic England identified the requirement for further evaluation to be undertaken prior to determination of planning in order to ascertain the presence of absence of archaeological remains within the Scheme, to characterise any remains present and to determine the depth of topsoil. This would include archaeological trial trenching and geoarchaeological assessment.

Mitigation works for the archaeological remains within the footprint of the Scheme, including compounds and temporary working areas, will include:

- Archaeological monitoring of groundworks at Ferriby Sluice (**Asset 1**);
- Enhancement and repair works to the scheduled fabric of Ferriby Sluice (**Asset 1**);

- Targeted excavation of significant buried archaeological remains identified by the trial trenching;
- Targeted excavation of the Roman road (**Asset 5**) if identified as present within the Scheme and within depth of impact by the trial trenching.
- Targeted excavation of significant archaeological remains associated with the medieval course of the River Ancholme (**Asset 12**) and medieval haven (**Asset 16**) if identified by trial trenching and present within the depth of impact of the Scheme. A programme of geoarchaeological assessment should be undertaken on **Asset 12**.
- Archaeological monitoring brief during topsoil and subsoil stripping of any areas that evaluation cannot be undertaken for.
- Avoidance of any significant archaeological remains identified during the trial trenching should be undertaken where possible in order to preserve the remains in situ. This may include reducing the footprint of compounds or removing some.

7.6.2 Historic buildings

No significant adverse impacts on designated and non-designated historic buildings requiring mitigation have been identified.

7.6.3 Historic landscape

No significant adverse impacts on the historic landscape requiring mitigation have been identified.

7.7 Residual effects

The residual impacts of the Scheme on cultural heritage assets, after mitigation, are set out in Tables 7.8 and 7.9 below. Assets where no impact is predicted have been omitted for clarity. Mitigation requirements are also provided. Additional mitigation requirements may be identified after completion of the evaluation by trial trenching.

The significance of residual effects during the construction of the Scheme is predicted to be Slight adverse on 13 cultural heritage assets, Neutral/Slight adverse on 12 cultural heritage assets, and Neutral on one cultural heritage asset, with no residual impacts predicted for the remaining cultural heritage assets. The significance of residual impact during operation of the Scheme is predicted to be Slight/moderate beneficial on two cultural heritage assets, Slight beneficial on three cultural heritage assets and Slight adverse on three cultural heritage assets, with no residual impact predicted for the remaining cultural heritage assets.

After mitigation, no significant impacts on cultural heritage assets are predicted.

Table 7.8: Predicted residual effects during construction on cultural heritage assets

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 1 Ferriby Sluice (Scheduled Monument)	New floodwall would impact on the fabric on the sluice	Slight adverse	Archaeological monitoring during groundworks and enhanced repair works to the historical fabric	Slight adverse

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 1 Ferriby Sluice (Scheduled Monument)	Impact on its setting from construction machinery, noise, dust and vibration	Slight adverse	None proposed	Slight adverse
Asset 5 Roman road	Potential partial removal during construction works for the current western embankment	Slight adverse	Archaeological excavation if significant remains are identified within the depth of Scheme impact by trial trenching	Neutral
Asset 12 Former course of River Ancholme	Partial removal during construction works for the eastern embankment and compound	Slight adverse	Archaeological excavation if significant remains are identified within the depth of Scheme impact by trial trenching	Slight adverse
Asset 16 Medieval Haven (site of)	Potential partial removal during construction works for the current western embankment	Slight adverse	Archaeological excavation if significant remains are identified within the depth of Scheme impact by trial trenching	Slight adverse
Asset 12 Former course of River Ancholme	Impact on its setting from construction machinery and activities	Slight adverse	None proposed	Slight adverse
Asset 13 Medieval Bridge (site of)	Impact on its setting from construction machinery and activities	Slight adverse	None proposed	Slight adverse
Asset 14 Sluice (site of)	Impact on its setting from construction machinery and activities	Slight adverse	None proposed	Slight adverse
Asset 15 Medieval Causeway	Impact on its setting from construction machinery and activities	Slight adverse	None proposed	Slight adverse

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 16 Medieval Haven (site of)	Impact on its setting from construction machinery and activities	Slight adverse	None proposed	Slight adverse
Asset 22 Brickyard	Partial removal during construction works for the eastern embankment	Slight adverse	None proposed	Slight adverse
Geophysical Survey Anomaly D1-D2	Partial removal during construction works for the eastern embankment	Slight adverse	Archaeological trial trenching. If significant remains are found, then archaeological excavation should be undertaken	Neutral/Slight adverse
Geophysical Survey Anomaly CW1	Partial removal during construction works for the eastern embankment	Slight adverse	Archaeological trial trenching. If significant remains are found, then archaeological excavation should be undertaken	Neutral/Slight adverse
Asset 45 Woodside Farmhouse Grade II Listed Building	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 46 South Ferriby Hall Grade II Listed Building	Impact on its setting due to construction machinery, noise, dust and vibration	Slight adverse	None proposed	Slight adverse
Asset 47 Glentworth House Grade II Listed Building	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 48 Church of Saint Nicholas Grade II* Listed Building	Impact on its setting due to construction machinery, noise, dust and vibration	Slight adverse	None proposed	Slight adverse
Asset 67 Numbers 9 and 10 Sluice Road	Impact on its setting due to construction machinery, noise, dust and vibration	Slight adverse	None proposed	Slight adverse
Asset 49 Wesleyan Methodist Chapel	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 62 Cottage Row	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 63 Holly House Farmhouse	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 70 Woodside Farm	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 71 Elm Farm	Impact on its setting due to construction machinery, noise, dust and vibration	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 76 Parliamentary planned enclosure	Partial removal during groundworks	Neutral/Slight adverse	None proposed	Neutral/Slight adverse
Asset 75 Industrial	Partial removal during groundworks	Neutral/Slight adverse	None proposed	Neutral/Slight adverse

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 77 former docks, wharves and havens	Partial removal during groundworks	Neutral/Slight adverse	None proposed	Neutral/Slight adverse

Table 7.9: Predicted residual effects during the operation phase on cultural heritage assets

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 1 Ferriby Sluice (Scheduled Monument)	Enhanced flood protection	Slight/moderate beneficial	None proposed	Slight/moderate beneficial
Asset 12 Former course of River Ancholme	Impact on its setting due to the new eastern embankment	Slight adverse	None proposed	Slight adverse
Asset 45 Woodside Farmhouse Grade II Listed Building	Enhanced flood protection	Slight beneficial	None proposed	Slight beneficial
Asset 46 South Ferriby Hall Grade II Listed Building	Enhanced flood protection	Slight beneficial	None proposed	Slight beneficial
Asset 47 Glentworth House Grade II Listed Building	Enhanced flood protection	Slight beneficial	None proposed	Slight beneficial
Asset 48 Church of Saint Nicholas Grade II* Listed Building	Enhanced flood protection	Slight/moderate beneficial	None proposed	Slight/moderate beneficial

Receptor	Description of Potential Impact	Significance of Predicted Impact	Mitigation Measures	Significance of Residual Impact
Asset 46 South Ferriby Hall Grade II Listed Building	Impact on its setting due to introduced flood embankment	Slight adverse	None proposed	Slight adverse
Asset 67 Numbers 9 and 10 Sluice Road	Impact on its setting due to introduction of new embankment	Slight adverse	None proposed	Slight adverse

8. Water and Estuarine Processes

8.1 Introduction

This chapter describes the water environment within the Winteringham Ings to South Ferriby study area and assesses the impact on water quality and hydrology during operation of the Scheme. The impact of construction on the water environment was scoped out in the PEIR (Jacobs, 2017). This chapter is based on an assessment of the design drawings and the environmental baseline which is detailed below. Mitigation measures have been identified to minimise the impact of the Scheme on the water environment.

8.2 Legislation and policy

Water resources are managed and protected under UK legislation and regulations consistent with Directives set up within the European Community (EC). Where relevant, the assessment takes into account the legislative protection afforded to water resources, through relevant plans and national planning policies detailed below.

The main legal framework relevant to this Scheme is set by the following:

- Flood and Water Management Act 2010;
- Water Act 2003, as amended;
- Land Drainage Act 1991, as amended;
- The Conservation of Habitats and Species Regulations 2010;
- Water Framework Directive (2000/60/EC) and the Water Environment (Water Framework Directive) (England and Wales) Regulations (SI 3242/2003);
- Environmental Damage (Prevention & Remediation) Regulations 2009;
- The EC Groundwater Directive (2006/118/EC) and the Groundwater Regulations 2010.

Further non-statutory guidance is provided in:

- Pollution Prevention Guidelines (Environment Agency, publication dates vary).
- Control of Water Pollution from Construction Sites – A Guide to Good Practice (CIRIA/C532).

8.3 Methodology

For the purposes of this assessment, water resources include: water quantity (i.e. hydrology), surface water quality, groundwater (quantity and quality) and flood risk issues. This chapter assesses the surface and groundwater features at the site and hydraulically linked features in the surrounding environs. Groundwater in relation to contaminated land has been considered within the Chapter 9, Land and Soils, however where groundwater impacts may influence surface water quality or quantity this has been discussed in this chapter. A Preliminary Water Framework Directive (WFD) assessment has been undertaken and is included in Appendix 8.1.

Impacts upon freshwater bodies are assessed here. This includes consideration of changes in water quality as well as direct loss of features such as ponds.

The assessment methodology follows the source-pathway-receptor model. The receptor can only be exposed to a change if a pathway exists through which an impact can be transmitted between the source activity and the receptor.

Although waves and tides may be altered by the presence of a new structure, they largely represent ‘pathways’ as opposed to ‘receptors’. They are also the mechanisms that control local and regional patterns of sediment transport, erosion and deposition, and these in turn, directly influence short and long-term net morphological change on the seabed and intertidal areas. As such, it is typically the morphological features, such as intertidal mudflats and the shoreline, that form the key receptors in the physical processes domain.

Designated estuary features are also included in the list of physical process receptors. Importantly, the assessment of potential effects to nearby designated sites focuses upon the potential for significant modification of the naturally occurring physical processes that could indirectly impact the habitats they support.

8.3.1 Determination of effects

Establishing the baseline environment allows water receptors to be identified. A value is then assigned to each receptor, based on the criteria in Table 8.1. The indicative pathway for change is also highlighted as the fundamental reason for the change occurring. The information in this table should also be considered in the existing environment section.

Potential impacts resulting from the proposed scheme are then identified along with the magnitude of the impact. The criteria for identifying the magnitude are presented in Table 8.2. By considering the value of the receptor and the magnitude of the impact, the significance of the effect on the receptors and receptor’s attributes (such as water quality) during operation (as construction has been scoped out) can be established using Table 8.3.

Table 8.1: Indicative criteria for estimating the importance/sensitivity for environmental receptors

Value (Importance/ Sensitivity)	Criteria	Example of Receptor	Pathway
Very High (International importance)	An estuarine/ coastal receptor that has no capacity to accommodate the proposed form of change. The receptor is of international importance. Likely to be rare with minimal potential for substitution. May also be of high or very high socio-economic importance. A surface water resource of pristine or near pristine water quality, and/or international scale: ▪ 'High' or 'Good' overall WFD water quality status, and/or water feature is a valuable water supply; ▪ Protected/designated under EC legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site); ▪ Water feature appears in complete equilibrium with natural processes occurring; ▪ Annual probability of coastal or watercourse flooding is greater than 0.5% (1:200 years); and ▪ Water feature with direct flood risk to populated areas including residential properties or a very high risk to critical social infrastructure. A groundwater aquifer constituting a valuable resource because of high quality and yield, extensive exploitation for supply, or designated sites of nature conservation are dependent on groundwater.	Humber Estuary designated sites (SAC, SPA and Ramsar)	For example, coastal erosion by waves, tides, currents

Value (Importance/ Sensitivity)	Criteria	Example of Receptor	Pathway
High (National Importance)	An estuarine/ coastal receptor that has low to moderate capacity to accommodate the proposed form of change. The receptor is designated and/ or of national importance. Likely to be relatively rare. May also be of high socioeconomic importance. A surface water resource with a measurable degradation in its water quality as a result of anthropogenic factors, and/ or rarity on national scale: ▪ 'Moderate' overall WFD water quality status or considered to exhibit 'Moderate' water quality based on professional judgement; ▪ 'Moderate' overall ecology status or potential; ▪ Water feature with some natural processes, including varied flow types. ▪ Modifications and anthropogenic influences having an obvious impact on natural flow regime, flow pathways and processes; ▪ Annual probability of coastal or watercourse flooding is between 0.1% and 0.5% (1:1000 to 1:200 years); and/or ▪ A water feature with a possibility of direct flood risk to less populated areas without any critical social infrastructure units. A groundwater aquifer of limited value because its quality does not allow potable or other quality-sensitive uses (but which may be used for agricultural or industrial purposes) and where exploitation is not extensive, or where local areas of nature conservation are known to be sensitive to groundwater quality.	Humber Estuary designated site (SSSI)	As above and also flooding indices

Value (Importance/ Sensitivity)	Criteria	Example of Receptor	Pathway
Medium (Regional/County Importance)	An estuarine/ coastal receptor that has moderate to high capacity to accommodate the proposed form of change and/ or includes non-statutory sites of regional or local importance designated for water dependent ecosystems. A surface water resource with poor water quality resulting from anthropogenic factors, where the species diversity of flora and fauna is greatly affected by significant water quality degradation: ▪ 'Poor' overall WFD water quality status or potential, or considered to exhibit 'Poor' water quality based on professional judgement; ▪ 'Poor' overall ecology status; ▪ Water feature which shows limited evidence of active natural processes with unnatural flow regime or/and uniform flow types and minimal secondary currents; ▪ Annual probability of coastal or watercourse flooding is less than 0.1% (1:1000 years); and/or ▪ A water feature passing through uncultivated agricultural land where the socioeconomic impact from flooding is reduced. A groundwater aquifer of low water quality and/or very low permeability that make exploitation of the aquifer unfeasible, or where changes to groundwater are not expected to have an impact on local ecology.	Aquifers; River Ancholme; East Drain and West Drain; Fulseas Drain	Flooding, sheet piling allowing contamination of groundwater, waves, currents, tides, saline intrusion

Value (Importance/ Sensitivity)	Criteria	Example of Receptor	Pathway
Low (District/Parish Importance)	An estuarine/ coastal receptor that has high capacity to accommodate the proposed form of change and/ or is non-statutory sites of local importance. A surface water resource with bad water quality resulting from anthropogenic factors, where the species diversity of flora and fauna is greatly affected by significant water quality degradation: ▪ 'Bad' overall WFD water quality status or potential, or considered to exhibit 'Bad' water quality based on professional judgement; ▪ 'Bad' overall ecology status; ▪ Water feature which shows no evidence of active natural processes with unnatural flow regime or/and uniform flow types and minimal secondary currents; ▪ Annual probability of coastal or watercourse flooding is less than 0.1% (1:1000 years); ▪ A water feature passing through uncultivated agricultural land where the socioeconomic impact from flooding is reduced. A water body not included in the above categories.	Ponds	Saline intrusion, flood overtopping, siltation and contaminants from construction
Negligible	No listed importance	Groundwater, ditches and drains	

Table 8.2: Indicative criteria for determining the magnitude of the impact

Magnitude of Impact	Criteria
Major	Continuous change, over the whole development area and beyond (i.e. offsite extending into the far-field), of a scale that will change key characteristics or features of the particular environmental aspect's character or distinctiveness. Proposed development results in a reduction (or improvement) in the quality and integrity and/ or loss (or gain) of the water feature, i.e.: ▪ Significant changes to the baseline condition of the water feature, hydrology or hydrodynamics, and morphology which may be long-term or permanent; ▪ Effects that result in a fundamental change to water quality condition either by a relatively high amount over a long-term period or by a very high amount over an episodic event; ▪ Likely to result in a reduction in the overall WFD chemical/ecological status; ▪ Long-term loss or change to designated species/habitats or water supply; ▪ A loss of flood storage and/or significant increase in flood risk (i.e. an increase in the 0.5% annual exceedance probability (AEP) peak flood level >100 mm). For groundwater, a major permanent or long-term change to groundwater quality or available yield. Existing resource use is irreparably affected. Changes to quality or water table level that have a major impact on local ecology. If water availability is increased as a result of the development, this is considered a benefit.
Moderate	Noticeable, temporary (during the project duration) or infrequent change, over the far-field, of a scale that will partially change key characteristics or features of the particular environmental aspect's character or distinctiveness; or continuous change to the near-field environment of a scale that will change key characteristics Proposed development results in a moderate measurable change in the quality and integrity and/or the loss of the water feature, i.e. ▪ Moderate changes to the baseline condition of the water feature hydrology or hydrodynamics, and morphology which may be long-term or permanent; ▪ Likely to result in a decline in water quality but not sufficient to change the overall ▪ WFD chemical/ecological status; ▪ May result in temporary impacts on designated species/habitats or water supply; and /or ▪ A moderate increase in flood risk (i.e. an increase in the 0.5% AEP peak flood level>50 mm). Changes to the local groundwater regime predicted to have a measurable effect on resource use but not rule out any existing supplies.

Magnitude of Impact	Criteria
Minor	Noticeable, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area, to key characteristics or features of the particular environmental aspect's character or distinctiveness. Proposed development results in a minor measurable change in the quality or vulnerability of water feature, i.e. ▪ Observable changes to the water feature hydrology or hydrodynamics, and morphology but temporary in nature; ▪ A temporary decline in water quality during construction; and/or a slight decline in water quality during operation but insufficient to change the current WFD chemical/ecological status; and/or ▪ A slight increase in flood risk (i.e. an increase in the 0.5% AEP peak flood level >10 mm). Changes to groundwater quality, levels or yields that do not represent a risk to or benefit an existing resource use or ecology.
Negligible	Changes which are not discernible from background conditions. Proposed development results in an effect on water feature but of insufficient magnitude to affect the use or condition, i.e. ▪ No observable changes to the water feature, hydrology or hydrodynamics and morphology; ▪ No measurable change in water quality at any time during construction and/or operation, thus no change to WFD chemical / ecological status of waterbody; and/or ▪ An insignificant increase in flood risk (i.e. an increase in the 0.5% AEP peak flood level <±10 mm). Very slight change from groundwater baseline conditions approximating to a 'no change' situation.

The nature and characteristics of impacts have been described to enable their magnitude to be determined. The nature of the impacts has first been expressed as:

- Adverse – detrimental or negative impacts on an environmental resource or receptor;
- Beneficial – advantageous or positive impact on an environmental resource or receptor.

Table 8.3: Assessment of significance of environmental effects and residual effects

		Value/Sensitivity			
		Very High (International importance)	**High** (National importance)	**Medium** (Regional/ County Importance)	**Low** (District/ Parish importance)
Magnitude	**Major negative** (impact with serious consequences and/or on a large area)	Major adverse	Moderate adverse-Major adverse	Moderate adverse	Minor adverse-Moderate adverse
	Moderate negative (impact with undesirable consequences)	Moderate adverse-Major adverse	Moderate adverse	Minor adverse-Moderate adverse	Minor adverse
	Minor negative (Discernible negative impacts and/or on a small area)	Minor adverse-Moderate adverse	Minor adverse-Moderate adverse	Minor adverse	Minor adverse
	Negligible (no impact or no discernible impact)	Nil effect			
	Minor positive (Discernible positive impacts and/or on a small area)	Minor beneficial – moderate beneficial	Minor beneficial – moderate beneficial	Minor beneficial	Minor beneficial
	Moderate positive (impact with favourable consequences)	Moderate beneficial – major beneficial	Moderate beneficial	Minor beneficial-moderate beneficial	Minor beneficial
	Major positive (impact provides substantial gains and/or on a large area)	Major beneficial	Moderate beneficial – major beneficial	Moderate beneficial	Minor beneficial-moderate beneficial

Once the overall likely significance has been determined, a qualitative level of probability is assigned to the prediction (e.g. probable, unlikely, etc.). Confidence is based on the likelihood of the impact occurring, the abundance and quality of available baseline data used, and the degree of understanding of the stated impact 'pathways' and responses to the water features.

8.3.2 Receptor identification

Based upon the baseline data presented above, receptors which may potentially be affected by the proposed scheme at South Ferriby have been identified as the Humber Estuary due to its sensitivity as a designated site for SAC, SPA, Ramsar and SSSI; The Ancholme due to its importance as a surface water body, agricultural water source, recreational and navigational activity and habitat of freshwater importance; the drains (including Fulseas), the aquifer and also the ponds as freshwater habitat with numerous species within.

8.3.3 Study area

The study area for this chapter is the same as the Scheme boundary (Figure 1.2), plus a nominal buffer zone of approximately 250m, based on professional judgement.

Effects on the Humber Estuary SAC, SPA, Ramsar and SSSI were also included in this assessment due to their high sensitivity and they fall within the 250m buffer zone.

8.3.4 Data sources

The baseline information for the study area has been established primarily from a desk-based review of the following sources:

- Humber River Basin District River Basin Management Plan (DEFRA, 2015)
- Environment Agency data from http://apps.environment-agency.gov.uk/wiyby/default.aspx. This has included the following:
  - Identification of water bodies
  - Pollution Prevention Guidelines
  - Water quality data
  - Landfill sites
  - Nitrate Vulnerable Zone
  - Groundwater Aquifer Map and Source Protection Zones
  - Flood Maps.

The Flood Risk Assessment summarises the existing flood risk relevant to the Scheme and any constraints arising from flood risk to the Scheme.

A WFD preliminary compliance assessment has been undertaken (Appendix 8.1). This includes a review of the proposed various elements of the Scheme and a consideration of their impact on the adjacent water bodies as well as, where applicable, the current WFD status of the downstream transitional water body.

8.4 Existing environment

8.4.1 Estuary Geomorphology and hydrodynamics

The Humber Estuary is a macrotidal estuary (> 4 m range), with extensive intertidal areas in bank systems in the Inner and Middle Humber. The general hydrodynamic of the Inner Humber and around South Ferriby is a result of the interaction between the tidal dynamics of the North Sea, the fluvial inputs from major tributaries (Rivers Trent and Ouse), and meteorological forcing effects, i.e., surges, winds and wave climate.

Tides

The spring tidal range varies from 5.7 m at the mouth, increasing to 6.9 m at Humber Bridge, then decreasing to 5.9 m at Blacktoft located around 63 km inland. At Humber Bridge, the closest tidal gauge to South Ferriby, the tidal range varies between 3.5 m and 6.9 m during a neap-spring tide cycle. Tides are semi-diurnal with a slight diurnal inequality, amounting to a 0.2 m difference in high water spring tides at Immingham (British Transport Docks Board.

The Humber tides are driven by the amphidromic system centred off the west coast of Denmark in the central North Sea. As the tide passes south of North Shields, it enters shallow water conditions, which amplify the range from 4.3 m to 4.6 m at the River Tees entrance and 5.7 m at Spurn. This amplified tidal range drives the Humber tidal system so that the macro-tidal range within the estuary is a product of the general morphology of the east coast as well as the estuary itself.

Waves

Tidal effects dominate to 20 km upstream of Trent Falls before fluvial processes become dominant.

The action of offshore wind generated waves generally reduces landward within the Humber Estuary due to the tendency of waves to refraction and energy losses resulting from shallow water effects. Locally generated waves can, therefore, be important for sediment movement within estuaries. In the Humber the effect of waves propagating from offshore is limited to the Outer Humber. In terms of locally generated waves, significant wave energy can be generated from the fetches within the estuary, particularly in the area of Spurn Bight and the rear of Spurn, due to the prevailing south-westerly winds.

Freshwater flows into the Humber Estuary

The major flows of freshwater into the Humber Estuary are from the River Trent and River Ouse catchments with a combined monthly average flow of approximately 300 m^3/s. Minor components include the catchments of the River Hull, River Foulness, Mires Beck and the Ancholme as well as local land drainage along the Estuary, including Ferriby Sluice which drains across the South Ferriby. The Ouse catchment flows are derived mainly from the Rivers Don, Aire, Wharfe, Derwent and Upper Ouse.

8.4.2 Surface water features (freshwater)

The River Ancholme flows northwards through Ferriby Sluice in South Ferriby to enter the Humber Estuary within the Scheme extent. The River Ancholme is a freshwater watercourse originating near the village of Ingham (SK 96675 85014), north of Lincoln. West Drain and East Drain run parallel to the River Ancholme in the study area, both discharging into the River Ancholme downstream of Ferriby Sluice. The river is navigable from the Humber Estuary to Bishopbridge.

The River Ancholme Internal Drainage Board (IDB) maintains twelve pumping stations on the banks of the river, which pump water from the surrounding low-lying land to prevent flooding (which cannot drain away through gravity).

Water is also abstracted for the South Humber Bank industrial area for use as a public water supply. During the summer, water is transferred from Barlings Eau, near the River Witham, by the Trent Witham Ancholme Transfer Scheme, which is currently operated by the Environment Agency.

The River Ancholme flows northwards through Ferriby Sluice in South Ferriby to enter the Humber within the Scheme extent. The River Ancholme is a freshwater watercourse originating near the village of Ingham (SK 96675 85014), north of Lincoln. West Drain and East Drain run parallel to the River Ancholme in the study area, both discharging into the Ancholme downstream of Ferriby Sluice. The majority of the River Ancholme is a navigable waterway (from the Humber Estuary to Bishopbridge).

The Ancholme IDB maintains twelve pumping stations on the banks of the river, which pump water from the surrounding low-lying land to prevent flooding (which cannot drain away through gravity).

The river also supplies large volumes of water to the South Humber Bank industrial area for use as a public water supply. In order to maintain this volume of abstraction during the summer months, and other dry periods, water is transferred from Barlings Eau, near the River Witham, by the Trent Witham Ancholme transfer scheme.

A pumping station at Short Ferry on Barlings Eau, near its junction with the River Witham, pumps water through 17 km of pipeline to a reservoir at Toft Newton, which covers an area of 16.5 ha. During the summer months and other dry periods, water is released from the reservoir into the Ancholme to augment its flow and maintain its level.

The lock at Ferriby Sluice has two sets of gates to prevent tidal inundation. In order to minimise the ingress of brackish water into the Ancholme when the tide gates are used, the water is culverted into the West Drain when the lock is being emptied. Salinity in the river is further controlled by two bubble curtains, and is continuously measured at Saxby, with the information used to decide whether the flow should be supplemented by water from the Trent Witham Ancholme Transfer Scheme.

West Drain is therefore a brackish watercourse whereas East Drain (Weir Dyke) is a freshwater drain. Fulseas Drain is located at the eastern end of the Scheme. The pumping station for the Fulseas Drain is operated by the Ancholme Internal Drainage Board.

There are three freshwater ponds located between the existing embankment and north of Sluice Lane to the east of the River Ancholme (named 29, 31 and 42) in Figure 8.1). There is one waterbody located south of Sluice Lane, between Old Warp Lane and Andrew's Road (Pond 43). Ponds 21 and 22 are located within the CEMEX works site.

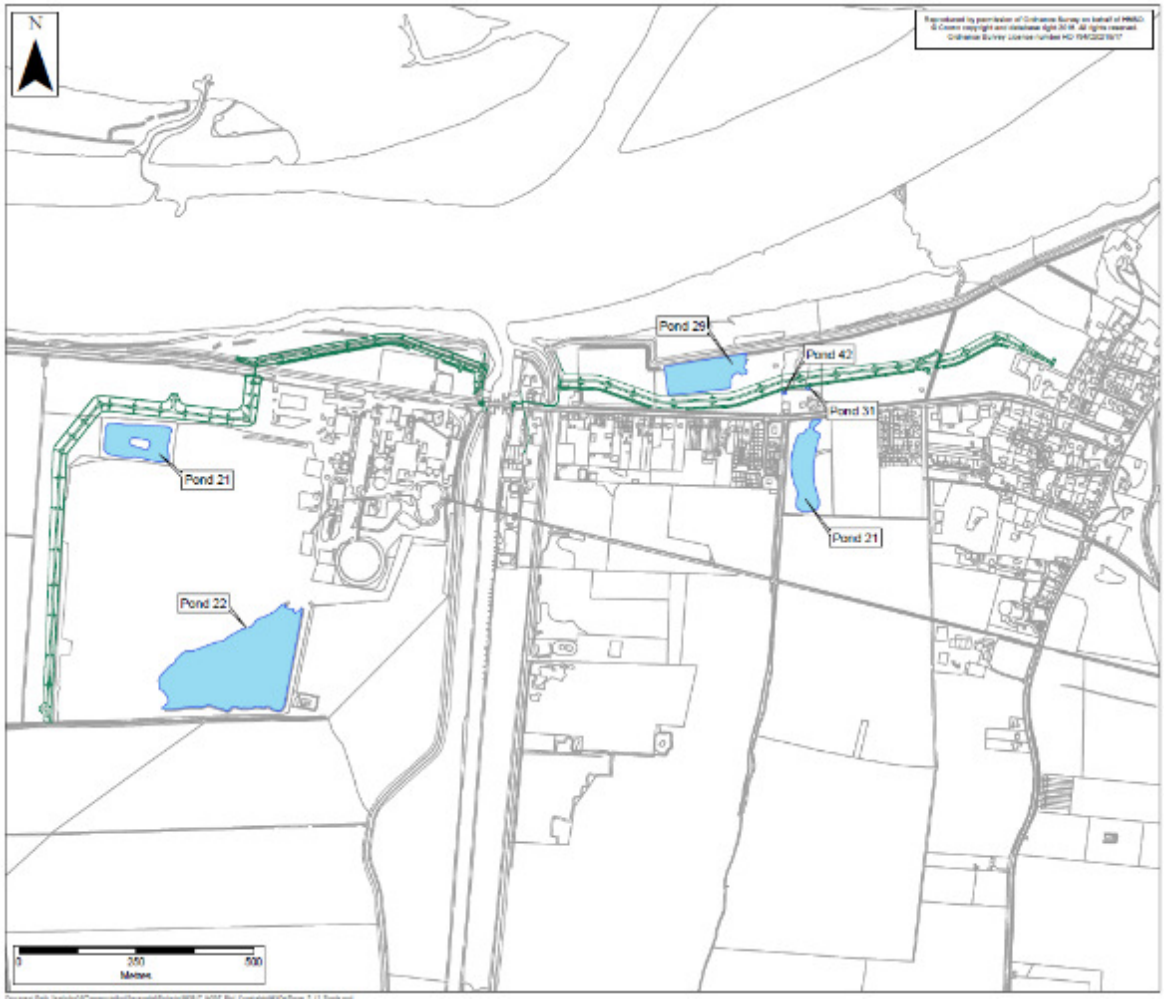

Figure 8.1: Location of freshwater ponds

8.4.3 Surface water features (tidal/ estuarine)

The Humber Estuary is one of the largest estuaries in the UK and has a macrotidal environment with a tidal range of between 6-8 m and drains a catchment area of around 24,500 km^2.

At its entrance, the Humber is approximately 6.5 km wide, opening to 9.5 km wide immediately past its entrance at Spurn Head, and approximately 2 km wide some 60 km upstream in its upper reaches.

The Scheme location is characterised by mudflats and extensive intertidal silty sandbanks (Davidson, 1995; JBA, 2011) forming the channel banks. The channel form is one of a stabilised channel within its cross section, thought to have been fixed as a result of training walls in the River Trent in the mid-1930s, (Gameson, 1982). Prior to this, the channel intermittently changed position within the bed; its control being the varying magnitude of freshwater discharge from the Ouse and Trent. In the vicinity of Read's Island, the geomorphology within the channel has varied substantially. Historically, the channel and shoals have been dynamic, and have changed position as a result of combined changes in fluvial flows and discharge, the tidal regime and the geological controls of the channel position (antecedence) (cited in Townend et al., 2000; Jacobs, 2018a).

8.4.4 Groundwater features

The Environment Agency interactive groundwater map indicates that the existing defences are not located within a groundwater Source Protection Zone, however an Inner Zone (Zone 1) is located 600 m to the south within the area of Winteringham Ings, Winterton Ings and Winterton Carrs. The area to the west of the Inner Zone is identified as an Outer Zone (Zone 2), with small areas designated Total Catchment (Zone 3) around the perimeter of the Inner Zone.

The bedrock geology (Lincolnshire Limestone Formation) is classified as a Principal Aquifer. The chalk to the east of the site boundary in South Ferriby is also a Principal Aquifer. The presence of a spring within the study area boundary suggests that groundwater levels may be near to the surface across the study area.

The Grimsby Ancholme Louth Limestone Unit lies beneath the Ancholme valley, and is a source of water for the Public Water Supplies.

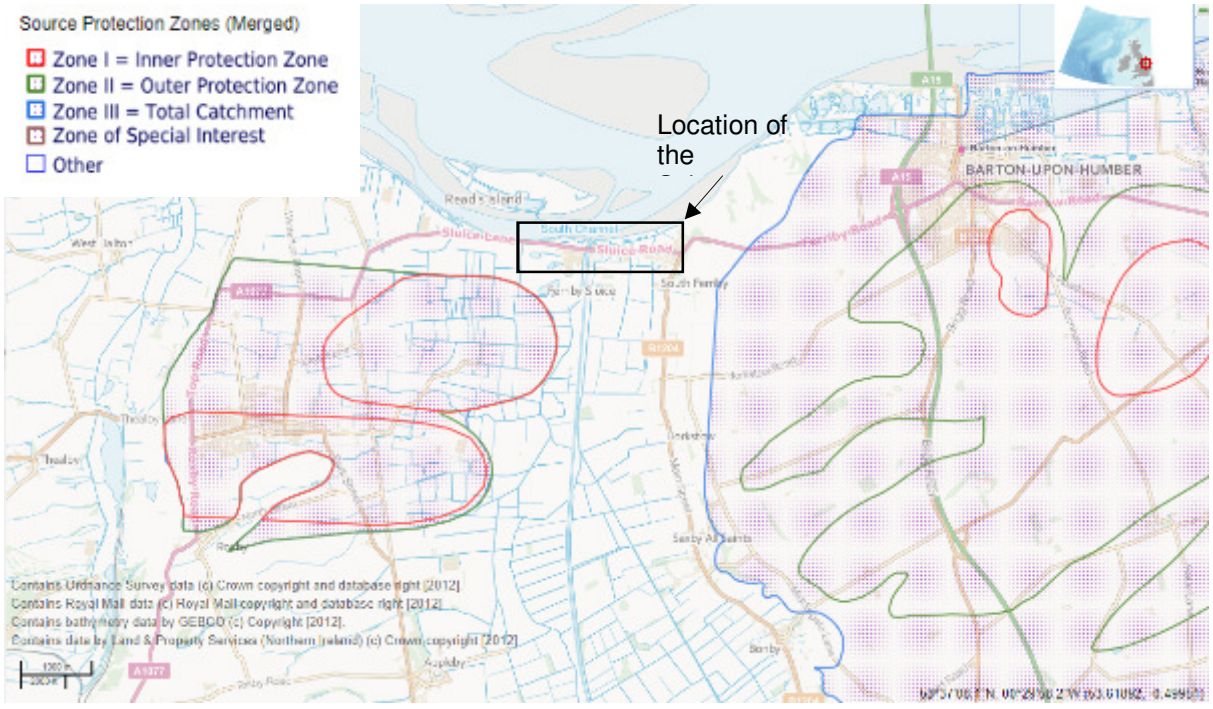

Figure 8.2: Location of Source Protection Zones for groundwater. Modified from: data.gov.uk

8.4.5 Water quality

The land use in the catchments of the Humber and the River Ancholme are mixed use, varying from infrastructure dominant, urbanised, industrialised and agricultural. The major sources of pollution are from urban and transport, including runoff carrying silts and

pollutants; nitrates and organic pollution from both agricultural and sewage sources; and pesticides.

The Ancholme catchment is predominantly rural with agriculture being the principal land use. With increasing distance downstream, as it reaches the Humber, the land use becomes more industrial. The River Ancholme provides a navigable route to the Humber and has many other recreational uses. The River Ancholme catchment is designated as a drinking water protected area to safeguard the drinking water supply at Cadney Reservoir. Barrow and Barton safeguard zones protect groundwater abstractions for public water supply.

Water Framework Directive

The WFD requires every designated water body to be classified by the Environment Agency (in England) according to the condition of its biological, hydromorphological, physico-chemical and/or chemical quality elements and for it to be assigned an overall status. Where waterbodies are not at 'high' or 'good' ecological status (GES) or 'good' ecological potential (GEP), we are required to identify and review the feasibility of improvement measures, and to set element objectives. This process is formalised via a River Basin Management Plan (RBMP). Under WFD, new activities and schemes should therefore not cause a deterioration of water body status or prevent RBMP improvements being achieved.

An assessment of compliance of the Scheme with the WFD has been undertaken (see Appendix 8.1 for the compliance assessment), using information from the Environment Agency's Catchment Data Explorer (Environment Agency). This assessment considers both: the water body within the Scheme boundary i.e. the River Ancholme (ID:GB104029067520) and the Humber Middle (GB530402609202); and the next upstream and downstream surface waterbodies. Groundwater bodies were scoped out of the assessment, as no WFD classified groundwater bodies are likely to be affected.

Under WFD, the River Ancholme from Bishopbridge to the Humber (ID:GB104029067520) is classified as having moderate ecological and good chemical quality in the 2016 Cycle 2. Overall the water body has a classification of Moderate. This is principally driven by unfavourable concentrations of phosphate and certain trace chemicals. Other water quality parameters (pH, ammonia, and dissolved oxygen) are classified as either 'high' or 'good' (i.e. favourable) condition. The main pressures on the WFD classification of the River Ancholme include surface water abstraction, point source pollution (sewage discharge), diffuse source pollution including poor nutrient management related to both agriculture and livestock.

The WFD classification for the Grimsby Ancholme Louth Chalk Unit summarises water quality within this aquifer as poor. The main reasons for this are groundwater abstraction, poor nutrient management (agriculture) and diffuse source pollution. The Trent Witham Ancholme Transfer Scheme helps to maintain flows and levels thus reducing eutrophication in the watercourse. The transfer scheme can also be used to flush out sediment into the Humber Estuary.

The Humber Middle Water WFD water body (ID: GB530402609202) is also classified as having moderate ecological status and failing chemical status in the 2016 cycle 2 data collection for WFD. Overall, the water body classification is Moderate. This is also principally driven by unfavourable concentrations of phosphate and certain trace chemicals. The WFD data also state there are four Nitrates Directive protected areas in the Humber.

8.4.6 Flooding

The area has a history of flooding, and most recently the east coast tidal surge in December 2013 inundated 129 properties in South Ferriby and flooded the adjacent cement plant, A1077 highway, poultry farms, utilities and over 1,000 ha of agricultural land. The existing tidal flood defences mainly comprise earth embankments along the estuary frontage. These

were damaged and overtopped by the 2013 surge tide and were close to overtopping again in January 2017.

Most of the Scheme sits within an area of high risk of surface water flooding and tidal flooding (Zone 3) on the Environment Agency flood maps (Figure 8.3).

8.4.7 Changes to water and hydromorphology in the absence of the Scheme

The current Humber Strategy (Environment Agency, 2008) defines the proposed managed approach for both Winteringham Ings (Flood area 18) and South Ferriby (Flood area 19), which are separated by the River Ancholme. As flooding in one area can affect the other, the proposed managed approach should be considered together, which is set out to be maintaining and improving the defences.

In the absence of the Scheme, the area would be prone to increased tidal inundation, particularly as a result of increased tidal surges, increased sea level and pluvial flooding because of climate change; flooding could potentially affect low-lying areas, which could be as much as the total flood area of 245.3 ha, considering the flood area of South Ferriby.

8.5 Likely significant effects

The likely significant effects on receptors are assessed within the following sections. The most likely affected receptors are The River Ancholme, Pond 29, and Fulseas Drain. The likelihood of impacts is also stated given the amount of information available for this assessment.

8.5.1 During construction

With standard mitigation in place, no significant impacts are anticipated during construction of the Scheme, therefore construction impacts are scoped out of the assessment.

8.5.2 During operation

Table 8.1 summarised the existing environmental receptors and their value and should be considered here.

Impacts to geomorphology process in River Ancholme – changes in flow and processes

Existing defences will be raised along both banks of the River Ancholme north of Ferriby Sluice. New walls will be constructed on both upstream and downstream sides of the sluice on the right bank. Under normal flow conditions, flow and hydrodynamic processes within the River Ancholme (i.e. all those that remain within the top of the bank) will not be affected by the presence of the defences. Raising of the defences, which already restrict natural processes along the river bank and disconnect the river from its floodplain (although at the mouth, this is not a natural floodplain and has been developed on) will occur over a localised area compared to the overall length of the River Ancholme and would only have an effect should out of bank flows occur (the defences usually constrain flows within the channel). The raising of existing defences and construction of new defences therefore has a negligible impact upon the flows and hydrodynamic processes within the River Ancholme. As the River Ancholme is classed as a receptor of medium value, and the magnitude is minor, this will result in a minor adverse effect upon the receptor. Given the conclusions in the FRA and the current scenario of existing defences, this outcome is likely.

Impacts to geomorphology process in Humber Estuary– changes in flow and processes

Raising of existing defences will have a negligible impact on the Humber Estuary due to the scale of the water body and the nature of the works and is unlikely to alter flow conditions within the Humber. The defences do not have direct contact with the water as they are protected on their seaward side by intertidal mudflats and saltmarsh areas. The Humber is classed as a receptor of very high value, and the magnitude is negligible. The significance of the effect is nil. Given the conclusions in the FRA and the current scenario of existing defences, this outcome is likely.

Impacts to water quality

During operation the new raised defence will prevent overtopping and flooding. It will also prevent silt laden water from flooding returning immediately back into the River Ancholme and the Humber Estuary. As the River Ancholme is classed as a receptor of medium value, and the magnitude is minor, this will result in a minor adverse effect upon the receptor. The Humber Estuary is classed as a receptor with very high value, and the magnitude is negligible. This impact is likely to only have a negligible(nil) impact on the receptor. No significant effects upon water quality during operation requiring mitigation have been identified.

Impacts to surface water features – Pond 29

Pond 29 will undergo partial loss to the south of the pond due to the construction of the embankment. This pond is of low value. The impact to the western ponds is minor adverse due to the low value of the pond, and the minor negative effect on the feature because of loss of the pond's footprint, and therefore loss of habitat. This impact is probable given the location of the pond adjacent to the defences, and the changes to be made.

Changes to Fulseas Drain

Culverting will increase the flow conveyance to the outfall drain where the proposed new embankment will cross the drain. The additional culverting of Fulseas Drain has an impact of minor adverse magnitude resulting in a minor effect upon the receptor which has a negligible value. This impact is likely.

Impacts to groundwater

The presence of the defences will not impact upon groundwaters. In locations where piling is proposed there may be localised impacts upon groundwater flows. If piling is required, sheet piles will be up to 10m below ground level. For such small distances of piles this is unlikely to have any impact upon general groundwater flows through the site and this impact is anticipated to be negligible resulting in no effect. Given the nature of the aquifer, and the geological characteristics of the bedrock, this impact is likely. A summary is contained in the following table (Table 8.4).

Table 8.4: Indicative criteria for estimating the importance/sensitivity for environmental receptors

Source	Value of receptor (Importance/ Sensitivity)	Magnitude on Receptor	Signficance of effect on receptor
Flow in River Ancholme - geomorphology	Medium	Minor	Minor adverse effect
Flow in Humber Estuary - geomorphology	Very high	Negligible	Nil
Water quality – River Ancholme	Medium	Minor	Minor adverse effect
Water quality – Humber Estuary	Very high	Negligible	Nil
Pond 29	Low value	Minor negative	Minor adverse
Fulseas Drain	Medium	Minor	Nil
Groundwater	Medium	Negligible	Nil

8.6 Mitigation

As construction impacts have been scoped out, standard mitigation will be defined in the CEMP for the Scheme, and will include:

- Implementation of standard spill/leak control measures (e.g. bunded fuel storage area, spill kits, interceptors).
- Consideration and mitigation of the risk of silt generation from temporary stockpile areas from rainfall/flood events, and of leachate generation from excavated materials, e.g. by the use of impermeable bases, flood bunds, and temporary covering of exposed material: this will be included in the scope of a silt management plan for the Scheme.
- The mitigation for surface water level changes on biodiversity is described in Chapter 5, Biodiversity.

Mitigation for the compounds should include double bunded fuel containers, spill kits and siting materials and potential sources of contamination in a location away from each other and there should be bunds to protect from spillage. If located near to any pathways or river banks, the potential sources of pollution should be sufficiently away from the banks, so they are not surcharged by plant. No runoff should be allowed into the river from the compound.

There are no other effects upon water quality or related to physical impacts identified as being of significance in terms of the EIA Regulations that would require mitigation to reduce the effect. There are no significant effects upon the estuarine environment physical processes which would require mitigation according to the EIA Regulations.

8.7 Residual effects

Residual impacts refer to impacts that may persist despite the successful implementation of mitigation proposed above. There are no significant residual effects associated with the Scheme. All other water quality and physical impacts upon the freshwater and estuarine

environment are determined to be nil effect or minor effect and do not require mitigation. Their residual effect therefore remains the same.

9. Land and Soils

9.1 Introduction

This chapter considers the potential impacts and effects of the proposed scheme on the land and soils within the study area. It also considers any foreseeable impacts and effects to human health, controlled waters and the proposed scheme from the presence of contamination and aggressive ground conditions.

9.2 Legislation and policy

9.2.1 Environmental Protection Act 1990

Legislation covering the assessment of contaminated sites is provided under Part 2A of the Environmental Protection Act 1990 (EPA 1990), as introduced by Section 57 of the Environment Act 1995. This came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000. These regulations were subsequently revoked with the provision of the Contaminated Land (England) Regulations 2006, which consolidated the previous regulations and amendments. The Regulations were further amended in 2012.

Contaminated land is defined in Part 2A of the EPA 1990 as “any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that:

- Significant harm is being caused or there is a significant possibility of such harm being caused; or
- Pollution of controlled waters is being, or is likely to be, caused”

As described in the Defra document ‘Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance’ (2012), the principal objectives of the legislation are:

- “To identify and remove unacceptable risks to human health and the environment;
- To seek to ensure that contaminated land is made suitable for its current use; and
- To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.”

These three objectives underlie the ‘suitable for use’ approach to the assessment and remediation of land contamination. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected.

9.2.2 National Planning Policy Framework

Paragraph 170 of the National Planning Policy Framework (NPPF) states that “the planning system should contribute to and enhance the natural and local environment by:

- Protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

- Recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;
- Preventing new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution, or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and
- Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

Based on this statement, planning policies and decisions should ensure that the site is suitable for its new intended use, taking into account both natural and man-made hazards. Also, as a minimum whether the site should be determined to be 'contaminated land', as defined under Part 2A of the Environmental Protection Act 1990. This should be determined by adequate site investigation, prepared and reviewed by a competent person.

9.2.3 Model Procedures for the Management of Land Contamination (CLR11)

Guidance for assessing and managing land contamination is presented in the Contaminated Land Report (CLR) 11. This provides a technical framework for identifying and remediating land affected by contamination through the application of a risk management process.

9.2.4 CL:AIRE Definitions of Waste

Excavated soils should be re-used on site where geotechnically and chemically suitable for use (subject to waste regulatory controls) e.g. CL:AIRE Definitions of Waste: Development Industry Code of Practice (2011) Material Management Plan (MMP), Environmental Permit or Exemption from Permitting to minimize the need for disposal.

It is recommended that a Soil Resource Plan also be prepared for the proposed development following the guidance provided in Defra (2009) Code of Practice for the Sustainable Use of Soils on Construction Sites. The Soil Resource Plan will include:

- Areas of soil to be protected from earthworks and construction activities;
- The areas and types of topsoil and subsoil to be stripped, haul routes, stockpile locations; and
- The methods for stripping, stockpiling, re-spreading and ameliorating landscape soils.

The following mitigation measures will be employed during the construction phase:

- Stripping, stockpiling or placing soil, should be undertaken during dry conditions;
- Tracked equipment should be used for reducing soil compaction;
- Traffic movement should be confined to designated routes;
- Soil should be stored for as short a time as possible; and
- Stockpiles of different soil materials should be clearly defined.

Guidelines on the stripping and stockpiling of subsoils and topsoil's is given in BS 8601:2013, Specification for subsoil and requirements for use, and BS 3882:2015, Specification for topsoil, respectively.

Where direct re-use on-site is not possible, or appropriate, these materials should, if possible, be sent off-site for reuse in the improvement of agricultural land (e.g. for land levelling, contouring or improving land quality) again, subject to the appropriate waste legislative controls.

Disposal at landfill should only be considered if there are no other options available.

9.3 Methodology

In order to determine if there are any significant constraints presented by the existing ground conditions and geology, a review of the desk study and available ground investigation information will be undertaken. In relation to contamination at the site which may pose a risk of harm to human health, controlled waters, the environment or site structures, a risk-based approach to the assessment of environmental impacts and effects will be adopted.

This follows the guidance in the Environment Agency Publication CLR11 "Model Procedures for the Management of Land Contamination" (Environment Agency, 2004), which advocates the source-pathway-receptor concept which, when all three are present, constitutes a potential contaminant linkage. Should any element of the potential contaminant linkage not be present, then, although a contaminant source may be present, the contaminant is not considered to pose a risk. Such contaminant linkages are identified through the development and iterative review of a Conceptual Site Model (CSM).

The sensitivity of the resources identified will be determined using criteria detailed in Table 9.1. Table 9.2 shows the magnitude and criteria of each. Table 9.3 shows the significance of impacts and will be used to assess impacts of the Scheme.

Table 9.1: Sensitivity rating and criteria of each sensitivity

Sensitivity	Criteria
Very high	Any internationally designated geological site and/or the presence of non-substitutable or highly sensitive geological / hydrogeological / hydrological and soil attributes.
High	Any nationally designated geological site and/or the presence of non-substitutable or highly sensitive geological / hydrogeological / hydrological and soil attributes. Human beings, controlled waters, buildings or structures susceptible to acute damage through exposure to harmful materials or aggressive ground conditions.
Medium	Any regionally or locally designated sites and/or the presence of geological/hydrogeological/hydrological and soil attributes with limited potential for substitution or moderate sensitivity. Human beings, controlled waters, buildings or structures susceptible to chronic damage through exposure to harmful materials or aggressive ground conditions.
Low	Non-designated sites and/or the presence of geological / hydrogeological / hydrological and soil attributes easily substitutable or with low sensitivity. Human beings, controlled waters, buildings or structures unlikely to be susceptible to damage through exposure to harmful materials or aggressive ground conditions.

Table 9.2: Magnitude and definition of each magnitude

Magnitude	Criteria
Major	Designated geological features or high productivity agricultural soils will be destroyed. Soils on a large proportion (greater than 50%) of the site will be removed (or improved) by the development. The quality of soils or groundwaters will be greatly reduced or improved, for example a change in waterbody status. Significant increase in the probability of harm or pollution, e.g. a permanent pathway from a known contaminant source to a receptor is introduced, or users of the site will be exposed to significantly higher risk of significant harm than users of the site in the baseline condition. Buildings and services are at increased risk of damage as a result of development. Development would significantly increase the risk from contaminant sources to neighbouring properties in the long term.
Moderate	Access to important geological features will be restricted (or improved) by the development. Localised (for example a hotspot within the site) damage (or improvement) to moderate productivity agricultural soils or geological features. Low level reduction or improvement in quality of soils or waters. The scheme introduces uncertainty that contaminant pathways are inactive, or an increased risk of slight harm or slight damage to buildings or structures.
Minor	No damage to important soil or mineral resources or geological features and only minor disturbance of soils. Minor changes to soil or groundwater. The increase in risk to receptors from contaminant sources, aggressive ground conditions or geotechnical hazards as a result of the Scheme is not expected to be material or will be reduced to an acceptable level.
Negligible	Very slight change from baseline condition. Change hardly discernible, approximating to a 'no change' condition. Very slight change from baseline condition. Change hardly discernible, approximating to a 'no change' condition.

Table 9.3: Assessment of significance of environmental effects and residual effects

	Value/Sensitivity			
Magnitude	**Very High**	**High**	**Medium**	**Low**
Major negative	Major Adverse	Moderate adverse- Major adverse	Moderate adverse	Minor adverse-Moderate adverse
Moderate negative	Moderate adverse- Major adverse	Moderate adverse	Minor adverse-moderate adverse	Minor adverse

	Value/Sensitivity			
Magnitude	**Very High**	**High**	**Medium**	**Low**
Minor negative	Minor adverse-Moderate adverse	Minor adverse-Moderate adverse	Minor adverse	Minor adverse
Negligible	No impact			
Minor positive	Minor beneficial-Moderate beneficial	Minor beneficial-Moderate beneficial	Minor beneficial	Minor beneficial
Moderate positive	Moderate beneficial- Major beneficial	Moderate beneficial	Minor beneficial-Moderate beneficial	Minor beneficial
Major positive	Major beneficial	Moderate beneficial- Major beneficial	Moderate beneficial	Minor beneficial-Moderate beneficial

9.4 Existing environment

The land within the Scheme area is primarily agricultural, but also includes residential and industrial land uses. The majority of the agricultural land within the Scheme area is classed as Grade 3 (Good to Moderate quality) in accordance with the Agricultural Land Classification (ALC) system, which means it is potentially 'best and most versatile' (Sub-Grade 3a) and thus of greater importance. All other agricultural land is classed as Grade 2 (Very Good) within the Scheme area.

9.4.1 Superficial geology

Made Ground

Two ground investigations have been undertaken across the site in 1997 and 2016 (CH2M, 2017) which have been used to inform this chapter. The majority of the boreholes from both these ground investigations were undertaken on the existing flood defence embankment, therefore encountered on average 2 m of Made Ground (embankment fill). The vast majority of the Made Ground described in the 1997 and 2016 ground investigations were of a cohesive nature and was generally describes as soft to very stiff brown sandy gravelly clay. Four descriptions of granular Made Ground were shown on the borehole logs, outside of the existing defences, and were not consistent in their descriptions. No visual or olfactory evidence of contamination were observed in the Made Ground from either investigation.

Tidal Flat Deposits

The foreshore area at the site beneath the existing flood defences is shown by the British Geological Survey (BGS) GeoIndex (BGS, 2018) 1:50,000 scale superficial geology mapping to be underlain by Tidal Flat Deposits. Which are described within the BGS Lexicon of Rock Units as '*normally a consolidated soft silty clay, with layers of sand, gravel and peat. Characteristically low relief, from the tidal zone*'.

All the exploratory hole locations from the two ground investigations encountered the Tidal Flat Deposits and were generally described as very soft to firm dark brown and grey organic silty clay or clayey silt and these were present from beneath the topsoil on site. Granular layers were recorded to be present throughout the sequence and were generally described as very loose to medium dense brown and grey silty sand.

The granular Tidal Flat Deposits are spatially more prevalent in the western part of the site between -40m Ordnance Datum (OD) and -10mOD. An area of granular Tidal Flat Deposits is also present in the central part of the site at approximately -4mOD and -21mOD (between borehole (BH) BH07 and BH10). The extent of this area may be greater, but the surrounding boreholes were too shallow to confirm this.

Peat layers were encountered in nine locations from the two investigations, and were recorded with variable thickness, and appear to be inconsistent across the site. For example, the top of the peat layers varies between -1.99mOD to -8.86mOD, and the base of the layers varied between -2.49mOD to -8.96mOD.

Glacial Till

Devensian till is shown by the BGS GeoIndex superficial geology mapping in the west of the study area, but also extending to the east towards the New River Ancholme at Winterton Homes.

All exploratory hole locations deeper than 20 m from the two ground investigations encountered glacial till. Both granular and cohesive layers of the till were encountered. Cohesive layers were generally described as firm to very stiff blueish grey to brown sandy gravelly silty clay. Gravel was typically sub-angular to sub-rounded fine to medium of flint and chalk. Granular layers were generally described as loose to medium dense brown slightly silty sand. These granular layers are interpreted as Glacial Till rather than Glaciofluvial Deposits in part due to the relative absence of gravel layers. It is anticipated that glacial till underlies most of the site, but at considerable depth.

Through assessing the BGS digital mapping through the GeoIndex, while the ground investigations did not identify them, Alluvial, Head and Glaciofluvial Deposits may also be present on site.

9.4.2 Bedrock geology

The 1:50,000 scale BGS digital mapping (BGS, 1983) indicated that bedrock geology dips at a shallow angle to the east, and as such the existing flood defences overlie the boundary of several geological units. The 2016 ground investigation only encountered the youngest of the bedrock formations, the Ampthill Formation, which was generally described as weak to extremely weak dark grey and blueish grey siltstone.

9.4.3 Mineral extraction

The BGS 1:100,000 scale Humberside Mineral Resources Map (BGS, 2005) shows a number of Mineral Planning Permissions within the site boundary for Chalk (Sluice Lane - Middlegate, South Ferriby Brickyard), Clay (Winteringham Ings –South Ferriby Sluice, Sluice Lane - Middlegate, Ancholme Brickworks, South Ferriby Cement Works) and Sand and Gravel (Winteringham Grange, Winteringham Ings, Eastfield Farm). It should be noted that the chalk extraction is off site to the east, but the permission is held by the factory at Ferriby Sluice as described below.

An area of Glacio-fluvial Deposits is shown on the mapping between Winteringham and Winterton and is described in the legend of the map as forming elongate ridges and mounds

on top of the Glacial till and can be up to 7m of well sorted gravel, composed mainly of chalk with minor flint and sandstone pebbles.

The Middle Jurassic buff-coloured, oolitic and sheely limestones of the Lincolnshire Limestone Formation (Inferior Oolite Group) in the area around Winteringham has been used locally as building stone (BGS, 2005).

The Chalk is the dominant bedrock in the Humberside region and is harder and contains less moisture than the Chalk from Southern England, hence it is of value as low-grade aggregate. Large scale extraction of Chalk for cement occurs at South Ferriby east of the B1204 outside the site boundary.

The site is not in a coal mining area, the mapping suggests the coal measures are between 500 to 3000 metres below ground level (mbgl) at the site.

9.4.4 Designated sites

The SSSI that covers the Humber Estuary includes the geomorphology of Spurn Point, which is significantly downstream of the Scheme, and South Ferriby Cliff from a geological perspective.

A designation of 'Geological Conservation Review', an initiative to identify and describe the most important geological sites in the UK, is also assigned to the estuary, which is for various geological strata within the Humber Estuary.

9.4.5 Contaminative sources

Landfill Sites

There are two active landfill sites located adjacent to the existing flood defences, south of the A1077 and within the CEMEX cement works (Figure 9.1). The landfill sites generally occupy the same area, suggesting that the larger of the two represents an extension of the original perimeter. The larger of the two extends 1 km west from the West Drain, running parallel with the southern edge of the A1077. It extends 800 m south from the A1077, to an unnamed field drain. Both sites are identified as South Ferriby Works Landfill and are operated by CEMEX UK Cement Limited. Both licences are classified as being effective and relate to "waste landfilling; over 10 tonnes per day with capacity over 25,000 Tons Excluding Inert Waste" (CH2M, 2017).

Three historical landfill sites are present within the site boundary, Winteringham Grange, Eastfield Farm and Part OS Field No. 3714. Winteringham Grange is located adjacent to Winteringham Farm in the west of the study area north of Sluice Road. Eastfield Farm is located approximately 300 m further east along Sluice Road from Winteringham Grange towards Ermine Street. Winteringham Grange has a history or accepting industrial waste such as waste from factories or industrial processes, but excluding waste from mines, quarries and agricultural waste. No information relating to the type of waste accepted is listed for Eastfield Farm. Part OS Field No. 3714 first accepted waste in 1994. The site accepted inert waste; waste which remains largely unaltered once buried.

A historical landfill site is identified within the eastern area of South Ferriby outside the study area, south of the A1077 and approximately 440 m southeast of the existing defences. The site is entitled Ferriby Hill, however no details of the waste accepted are listed. Another historical landfill, active from 1900 to 1977, is present just outside the site boundary at Winteringham Haven. This site accepted inert, industrial, commercial and household wastes.

Historical Land Use

Historical land use in the Scheme are includes:

- A flood defence embankment along the Humber Estuary edge is present on the historical maps since 1886. The alignment of the defence changes on the 1906 map. The present alignment was in place in the 1967 map.
- A brick yard on the eastern bank of the New River Ancholme on the 1886 map
- Flour Mills south of Silver Street in Winteringham shown on the 1886 map
- Clay Pits are indicated on the 1906 map between the Old River Ancholme and New River Ancholme, and are later filled in according to the 1967 map
- Cement works and clay pits south of Sluice Lane are shown on the 1956 map, and later expand in the 1967 map, the clay pits being redeveloped on the 1972 map. On the 1994 map the ponds at the cement works increased in size
- Poultry Farms are shown on the 1994 map and are still present.

9.4.6 Geo-environmental assessment

21 soil samples from the 2016 ground investigation were scheduled for a suite including general inorganics, asbestos, heavy metals, speciated polyaromatic hydrocarbons and petroleum hydrocarbons. The results were screened against the Land Quality Management (LQM) and Chartered Institute of Environmental Health 'Suitable 4 Use Levels'; Based on these criteria, no exceedances were recorded (CH2M, 2017).

The available data from the 2016 ground investigation suggests that there is no source of contaminated material on site, and no risk to human health or controlled waters. However, due to the nature of the Made Ground, there remains a possibility of a source of contaminated material at the site.

The construction of new flood defences at the site may generate surplus waste soil. A generic waste classification suite shall be adopted to classify the potential waste materials under the waste management regulations (WM3). There may be an opportunity to use surplus material in flood defence embankments, should this be the preferred solution. However, the likely high moisture content of these materials will likely preclude the use of site won material for anything other than landscaping fill.

Potential sources of contamination

Through assessing the historical maps supplied by Groundsure Ltd, the historical potentially contaminative land uses within the site, and surrounding area, have been determined and are listed below:

- Made Ground (embankment fill);
- Run-off from highways;
- Cement Works;
- Infrastructure around harbour;
- Cement works landfill – waste is likely to be Cement Kiln Dust (CKD);
- Poultry farms (Ogg Farm and Winteringham Farm);
- Farms (general); and
- Historical wharfs

No as-built information is available on the construction of the existing flood defence embankments. It is considered that the material is likely to be re-worked site-won natural material (CH2M, 2017).

Receptors

The following receptors have been identified at the site:

- The Humber Estuary (Ramsar, SAC, SAC and SSSI) and associated species. High Sensitivity
- The New River Ancholme (canal) -Medium Sensitivity
- Land drains and ponds – Low Sensitivity
- The Alluvium Secondary 'A' Aquifer – Medium Sensitivity
- Footpath users – High Sensitivity
- Adjacent residents – High Sensitivity
- Construction workers - High Sensitivity

Pathways

Five pathways were identified between the potential sources of contamination and receptors:

- Dermal contact (construction workers and general public);
- Ingestion of soil particles (construction workers and general public);
- Inhalation of soil particles (construction workers and general public);
- Mobilisation of leachate to aquifers (during construction and post construction); and
- Surface runoff to controlled waters (during construction)

Results from the previous ground investigations imply that no contamination is present within the site, therefore these pathways would not be present. However, unknown contamination may be present within the site.

9.4.7 Evolution of the baseline without the Scheme

The Humber Estuary is an ever-evolving and changing river, its changing nature can be identified from historical mapping and geological and hydrological studies. Upstream of the Humber Bridge, the estuary represents an older estuary system formed in the late Pleistocene / early Holocene periods 120,000 to 80,000 years before present when the estuary mouth was located close to the current Humber bridge. The former river channel underwent marine transgression and estuarine sedimentation during the post-glacial period of sea level rise.

The estuary has maintained a balance since the 1850s with sedimentation keeping pace with relative sea level rise and a general trend of accretion up to the 1930s. It has been identified that the main estuary channel switches over the width of the Humber over time. Historical bathymetric charts show that the main channel alternates between a meandering route on the northern side of the estuary (the Ancholme Channel), south of Read's Island, and a straighter route along the northern side of the estuary (the Redcliffe Channel), occupying the North Read's Island reach.

Although this historical switching has been identified, it is suggested that future channel switching is unlikely if the channel remains in its current formation (Jacobs, 2018a; 5-2). The greater channel depth and reduced size of Read's Island suggests that the channel will

remain in its current configuration in the long term, which would indicate that erosion rates would continue at a similar level to present.

The existing embankment east of the Ferriby Sluice is predicted to breach naturally, due to current bank erosion rates. Bank erosion rates at South Ferriby were compared with bathymetry in Jacobs (2018), showing that the highest rates of bank erosion occurred near the apex of the meander in the subtidal channel. Without major repairs and significant investment in erosion protection along the channel edge, the channel is expected to continue to erode, ultimately undermining the current defence line and causing it to fail by 2020, inundating the area behind it. The land behind the existing embankment is likely to be subject to erosion by the Humber and by the new channels formed by breaches. Where coastal squeeze is happening, the saltmarsh/mudflat profile starts to steepen, exacerbating erosion rates, and the shoreline starts to narrow.

The erosion is likely to be a slow process with no instantaneous loss of land because it would have to denude the horizontal surface as well as cutting away at the seaward unless a rotational slip occurs. If a rotational slip occurs, then large areas of land could be eroded.

Long-term change in the estuary is likely due to sea level rise and coastal squeeze and historical analyses shows that the Humber is an area of geological change, as illustrated on the landscape change between the 1622 and the 1719 maps of the Manor of Winteringham (see Appendix 7.2). The Humber is also controlled, to a degree, by discharge and sediment load, and sediment load is possibly diminishing due to dredging and land use changes further up the catchment. These natural contemporary processes are occurring and likely to be exacerbated by human management and influence.

A natural breach, if it occurs, of the existing embankments would have an impact on the Land and Soils over time, through inundation of the area. This could potentially change the geotechnical properties of the site, in particular the Tidal Flat Deposits. Where they are desiccated, they would revert to being soft and would no longer support the agricultural activities or be suitable as a resource in the future.

9.5 Likely significant effects

Given the location of the historical landfill sites it is considered unlikely that they will pose a constraint to the proposed scheme, therefore having a Negligible impact with respect to contaminated land. However, the active South Ferriby Works Landfill are likely to impact any proposals to upgrade the existing defences, and therefore further investigation is recommended.

Some material for the embankments will need to be imported as much of the site-won materials are not anticipated to be suitable for construction of the embankments. However, the imported material will be locally sourced where possible, and is anticipated to be approximately 50% of the embankment construction.

Whilst it is not anticipated that significant quantities of contaminated material will be exposed during the proposed works, it is recognised that any excavation can encounter unexpected materials, potentially from Made Ground used to construct the areas of raised ground along the Scheme route.

Concrete aggressivity testing

A number of samples from the 2016 ground investigation underwent testing for pyritic ground suite and 2:1 water soluble sulphate and pH (BRE, 2005). The Made Ground and natural ground results were assessed separately to determine the design sulphate class and aggressive chemical environment for concrete (ACEC) class. It is considered that pyrite may be present in the Made Ground as it is predominantly clay, assumed to be from a local

borrow pit. It therefore could be Oxford Clay Formation, which is at surface within a kilometre of the site. This therefore will impact any concrete design required for the Scheme.

Table 9.4: Likely significant effects

Likely Significant Effect	Characterisation of Effect	Receptors
Unknown contamination may be encountered during construction phase, which would be dealt with through the mitigation measures described in this chapter within the construction phase. Any contamination identified would have a short-term impact, but a long-term improvement of ground conditions would be caused by dealing with the contamination.	Short-term, minor beneficial/moderate beneficial	Groundwater and River Ancholme (Medium sensitivity) Construction workers and general public (High sensitivity)
The construction of the Scheme requires a large amount of imported material, due to the site won material not being suitable for the construction of new embankments	Long-term, minor adverse/moderate adverse	Geology/soils, therefore groundwater (Medium sensitivity)
Potential for run-off during construction phase (sediment runoff only), however with mitigation measures in place to prevent run-off reaching the estuary, this should not be significant.	Short-term, Negligible	Humber Estuary (High Sensitivity)
Larger footprint of the proposed embankments, therefore acquisition of farmland is required. The design has mitigated this as far as reasonably possible.	Long term, minor adverse/moderate adverse	Adjacent land owner (medium sensitivity due to loss of income)

9.6 Mitigation

The objective of this section is to identify standard or anticipated mitigation, which should be incorporated into the Scheme to minimise the likely significant effects of the Scheme, taking into account legislation, policy and best practice guidance within the context of the CSM and Risk Assessment.

The construction of the new embankments will require imported material. Material for the embankments will be locally sourced where possible, with approximately 50% being sourced from CEMEX, and the remaining 50% from an as yet unknown source, therefore the imported material will be as close to the existing material present within the Scheme as possible.

The lab testing undertaken as part of the 2016 ground investigation identified that the Tidal Flat Deposits are unsuitable for use as engineered fill in their current condition, due to the natural moisture content of approximately 45%, and an average optimum moisture content of 19% being required (CH2M, 2017). Further to this, more geotechnical laboratory data from across the site, including the other geological strata present, would aid in the design, and help mitigate any issues identified for the design of the Scheme.

Unforeseen contamination

All excavations will need to be undertaken carefully and should the ground conditions differ from those anticipated, or there are visual or olfactory signs of contamination, the excavation must cease, and the designer informed. Works will be unable to proceed until such a time as the excavation can be inspected by a competent person and/or testing undertaken to prove the absence of any material that could pose a risk to human health or the environment. Any materials which are considered to pose a risk to human health or the environment will need to be carefully excavated and quarantined prior to assessment and remediation/off-site disposal.

The Environment Agency's 'Guiding Principles for Land Contamination' (Environment Agency, 2010) series and CLR11 will be referred to in the case of unexpected contamination. These provide guidance in terms of preventing contaminated land, and the appropriate management of land and water which is already contaminated.

Contaminated material (if encountered) must be appropriately stockpiled to prevent leaching or mobilization of contaminants either as in surface water run off or as dust. This may be achieved by storing the material on an impermeable surface, covering the stockpile and installing drainage to intercept any surface run-off. This material will require testing prior to re-use or disposal and must be segregated depending on material type and nature of contamination. Such materials must be stored away from surface waters and drains to prevent the migration of leachate.

An Emergency Pollution Response Plan will be produced as part of the CEMP which will provide a full list of management activities and communication channels with the Environment Agency in the event of an accidental pollution incident. Appropriate equipment spill kits and absorption mats will also be made available, by the Principal Contractor, and easily accessible around site for use is the event of an accidental spillage or pollution incident. Plant nappies and/or drip trays will be used when refuelling plant and equipment in order to provide spill containment whilst also catching drips. Furthermore, biodegradable oils and grease should be used wherever practical to further reduce risks on site.

Signage will be erected by the Principal Contractor showing who to contact in the event of a spill or emergency. Procedures will be in place to ensure that the Environment Agency is informed of any pollution incident and action taken.

All earthworks will need an assessment of whether the Control of Asbestos Regulations 2012 apply if asbestos is identified, and if so, be carried out in compliance with the regulations.

9.7 Residual effects

The residual effect of the Scheme on the Land and Soils after mitigation is the small reduction in agricultural land use, due to the proposed schemes footprint being larger than that of the existing banks. This will be mitigated as far as is reasonable by designing the Scheme to reduce the amount of land take as possible, while still protecting the area from flooding.

10. Population and Human Health

10.1 Introduction

Flooding can have numerous adverse physical, mental and socio-economic impacts on people from the risk of mortality, injury, illness or stress, loss of income, and reduced recreation opportunities or amenity provision. Regular flooding can also have a long-term detrimental effect on property and could discourage investor or property developer confidence in flood risk areas and lead to gradual economic decline.

As described in Chapter 1, South Ferriby has had a long history of flooding and associated disruption and property damage, owing to its location adjacent to the Humber Estuary. This chapter therefore assesses the potential for long-term positive socio-economic effects associated with the operation of the proposed scheme, as well as adverse effects associated with building a major development, and the potential disruption to recreation and amenity resources both in the long-term and during the construction period. The following topics are assessed:

- Health and well-being of the local community during construction and operation;
- Impacts on recreational activities including long distance footpaths during construction and operation; and
- A high-level assessment on the disruption to local businesses during construction and operation.

Issues that are of relevance to the themes of this chapter, but which are addressed elsewhere in this ES, include:

- Public consultation (Chapter 1.7);
- Visual and townscape/landscape impacts (Chapter 6);
- Cultural heritage impacts (Chapter 7); and
- Material Assets- Infrastructure, Industry, Traffic and Transport (Chapter 10).

10.2 Legislation and policy

10.2.1 North Lincolnshire Core Strategy (adopted June 2011)

The Core Strategy sets out the long term spatial planning framework for the development of North Lincolnshire up to 2026 by providing strategic policies and guidance to deliver the vision for the area. Policies relating to population and human health relevant to the Scheme are set out below.

Spatial Objective 8: Promoting Community Health and Well Being

"To promote an improvement in the health and well-being of North Lincolnshire's people by maintaining and providing quality open spaces, play and sports facilities, better access to the countryside and improved health facilities".

CS19: Community facilities and services

"*The provision of new community facilities, or the improvement of existing community facilities, which meet the needs of local residents will be supported in principle. Good quality*

services and facilities will be provided that meet the needs of local communities and are accessible by public transport, cycling or on foot".

"*The provision of services and facilities will be of the scale appropriate to the type and size of the settlement. The loss of community facilities or land allocated for such purposes will be resisted, unless there is no longer a need for the land or building in any form of community use, or there is an acceptable alternative means of meeting such need*".

"*Developers will be expected to make an appropriate contribution towards necessary improvements or additional provision for community services and facilities arising from their development proposals*".

CS23: Sport, recreation and open space

"*The council will work with its partners, appropriate agencies and the voluntary sector to ensure the provision of good quality, well maintained leisure, recreation and open space facilities, which meet the needs of the local communities, will be secured and improved. In particular, provision will be sought to address identified deficiencies or that will benefit deprived groups and meet the needs of local communities*".

CS24: Health Care Provision

"*The council will support the implementation of health care provision in North Lincolnshire, in order to modernise and improve the primary health care facilities, and to improve the health of residents through safeguarding and enhancing open space, facilities for sports and recreation and improving walking and cycling routes*".

North Lincolnshire Strategic Assessment

The North Lincolnshire Strategic Assessment 2016 is a joint assessment. It aims to bring together all of the local intelligence about the health, wellbeing and social care needs of the local population. The North Lincolnshire Strategic Assessment helps inform the priorities of the Joint Health and Wellbeing Board. It aids decisions about how services should be provided both now and in the future.

10.3 Methodology

The study area for this assessment is outlined in Figure 10.1 (Appendix 1.1). The study area encompasses the village of South Ferriby which is deemed to be the most sensitive receptor with regards to the proposed works. Notable features are outlined in Figure 10.1 (Appendix 1.1) and described further in Section 10.4.

For the purposes of this assessment, the baseline socio-economic/health data was gathered as a desk-top study using publicly available information from a range of online resources (e.g. North Lincolnshire Council, Office of National Statistics, The Index of Multiple Deprivation for England and other relevant websites).

The assessment of impacts on population and health follows the broad assessment methodology outlined in Table 10.1-10.2 below. The assessment of significance is classed as major, moderate, minor or negligible; either beneficial (positive) or adverse (negative). This is standard for an EIA categorisation which is derived from the Guidelines for Environmental Impact Assessment (IEMA, 2004).

The Population and human health assessment has assumed that 'people and their health' and 'recreational facilities, residential, commercial and community buildings' have a 'very high' value or sensitivity, based on professional judgement.

Table 10.1: Methodology for Determining Impact Magnitude

Magnitude of Impact	Criteria for assessing impact
Major	Total loss of major/substantial alteration to key elements/features of the baseline (pre-development) conditions such that the post development character/composition/elements will be fundamentally changed (adverse) Large scale improvement of resource or attribute quality; extensive restoration or enhancement (beneficial).
Moderate	Loss of alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed (adverse). Improvement to, or addition of, key characteristics, features or elements of the resource; improvement of attribute quality (beneficial).
Minor	A minor shift from baseline conditions. Change arising from the loss/alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre-development circumstances/situation (adverse). Minor improvement to, or addition of one (maybe more) key characteristics, feature or element; very minor improvement to attribute quality (beneficial).
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

Table 10.2: Assessment of significance of environmental effects and residual effects

	Value/Sensitivity			
Magnitude	**Very High**	**High**	**Medium**	**Low**
Major negative	Major Adverse	Moderate adverse- Major adverse	Moderate adverse	Minor adverse-Moderate adverse
Moderate negative	Moderate adverse- Major adverse	Moderate adverse	Minor adverse-moderate adverse	Minor adverse
Minor negative	Minor adverse-Moderate adverse	Minor adverse-Moderate adverse	Minor adverse	Minor adverse
Negligible	No impact			
Minor positive	Minor beneficial-Moderate beneficial	Minor beneficial-Moderate beneficial	Minor beneficial	Minor beneficial

	Value/Sensitivity			
Moderate positive	Moderate beneficial- Major beneficial	Moderate beneficial	Minor beneficial- Moderate beneficial	Minor beneficial
Major positive	Major beneficial	Moderate beneficial- Major beneficial	Moderate beneficial	Minor beneficial- Moderate beneficial

10.4 Existing environment

10.4.1 Socio-economic

South Ferriby is located within the county of North Lincolnshire within the Brigg and the Wolds ward. This ward extends from South Ferriby in the north, down through the Wolds villages to Brigg and Barnetby in the south. South Ferriby is a village located on the south bank of the Humber Estuary, and has a population of 651 (2011 Census). The next nearest villages to the study area are Winteringham (population about 1,000) approximately 2.5 km to the west, Barton-Upon-Humber (population 11,066) approximately 3 km to the east, and the village of Horkstow (population about 100) approximately 2 km to the south.

The study area consists of mainly residential buildings and Ferriby Sluice. The Environment Agency has an operational base at South Ferriby, from which the lock/swing bridge is operated from. In addition, within the study area there is a garage and service station, a pub (The Hope and Anchor) and the CEMEX cement processing works which is an important source of employment in the local area. Immediately east of the study area there are various community facilities, including South Ferriby Primary School, a pre-school, St Nicholas Church, South Ferriby Methodist Chapel, a village hall, a post office with corner shop and public open space.

In the Brigg and Wolds ward, 11.97% of those employed are employed as managers, directors, and senior officials, 15% within professional occupations, 9.97% within associate professional and technical occupations, 9.86% within administrative and secretarial occupations, 13.51% within skilled trade occupations, 9.42% within personal service occupations, 7.01% within sales and customer service occupations, 12.48% as process plant and machine operatives and 10.79% within elementary occupations[3].

The Index of Multiple Deprivation (IMD) is the official measure of relative deprivation for small areas in England. The IMD ranks every small area (defined as Lower-layer Super Output Areas (LSOAs)) in England from 1 (most deprived area) to 32,844 (least deprived area). South Ferriby falls within the North Lincolnshire 011B LSOA, which is ranked 15,549 out of 32,844 LSOAs in England[4]. This LSOA is amongst the 50% most deprived neighbourhoods in the country.

[3] http://nldo.northlincs.gov.uk/IAS_Live/profiles/profile?profileId=100&geoTypeId=2&geoIds=00FDMY

[4] http://dclgapps.communities.gov.uk/imd/idmap.html

10.4.2 Health, safety and well-being

Regarding health, the World Health Organisation (WHO) recommends definitions thereof to include “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO 2009[5]).

In the context of the current study, the synergistic nature of health impacts with impacts on safety and well-being can result from exposure to flood risk (safety, mental health, well-being), income (economic capacity to cope with flooding), access to greenspaces and recreational opportunities (well-being) and the quality of the local environment (amenity).

The North Lincolnshire Local Economic Assessment 2017[6] Update states that North Lincolnshire residents have a lower than average life expectancy (78.7 years for males and 82.5 years for females) when compared to the England average (79.5 years for males and 83.1 years for females). In North Lincolnshire the gap in life expectancy between the ten percent most and least deprived is 10 years for males and 8.5 years for females. With 9.6%, a higher proportion of adults aged 18+ in North Lincolnshire have been diagnosed with depression than regionally (8.7%) and nationally (8.3%).

As part of Census 2011, the resident population were asked to assess their general health on a five-point scale: very good, good, fair, bad or very bad rather than having a clinical assessment of their health. In the Brigg and Wolds ward, 43.6% of the resident population assessed their general health as 'Very good' compared to the average for North Lincolnshire of 43.7%, with 1% in Brigg and Wolds stating their general health was 'Very bad' compared to 1.2% in North Lincolnshire.

10.4.3 Recreation and amenity

Footpaths

There are two long-distance paths within the study area (shown on the LPA’s definitive map – PRoWs): the Nev Cole Way which follows the south bank of the Humber Estuary, and the Viking Way which passes south of South Ferriby Hall (Figure 10.1 (Appendix 1.1)). In addition, there are several PRoWs within and immediately adjacent to the study area. These are listed below and shown on Figure 10.1 (Appendix 1.1):

- PROW 11 runs in a northerly direction from an existing bridleway at the eastern end of Ings Lane (footpath 25) to the southernmost point of footpath 24
- PRoW 32 runs south of South Ferriby Hall (which is to the east of South Ferriby) and west of Leggotts Quarry.
- PRoW 30 runs south of Ferriby Sluice alongside the eastern bank of the River Ancholme
- PRoW 24 runs from Winteringham Road some 62 m west of the bridge over the River Ancholme, proceeding along a track to the bank of the River Ancholme in a south-easterly direction (east of the CEMEX cement plant). The path continues in a southernly direction along the western bank of the River Ancholme, where the path then crosses a field in a westerly direction to join the existing footpath midway along the southern steel boundary fence belonging to the CEMEX cement plant.

10.4.4 Greenspaces

The study area is an important resource for recreation by locals and visitors, including activities such as walking and bird watching. In addition, there is a football pitch to the north

[5] http://www.who.int/

[6] nldo.northlincs.gov.uk/IAS_Live/resource/view?resourceId=568

of the CEMEX cement plant and a Bowling Green south of Sluice Road, immediately adjacent to Fulseas Drain.

10.4.5 Recreation facilities

The River Ancholme is used for boating, rowing and fishing. South Ferriby Lock (including a swing bridge), which is situated at the confluence with the Humber, allows registered boats and visitors to the River Ancholme every day from approximately three hours before to three hours after high water, until official sunset time. South Ferriby Marina is to the south of the sluice area.

10.4.6 Evolution of the baseline without the Scheme

A large area of land may be at risk of flooding if the front embankment breaches (depending on the scale of the event) without the Scheme in place. This could result in the flooding of a significant area of land including agricultural, industrial and residential land with consequent adverse socio-economic and health effects.

Breaching of the front embankment is likely to make the Nev Cole Way impassable at the point of the breach.

10.5 Likely significant effects

10.5.1 Socio-economic

Construction impacts

The scheme will result in a range of social impacts on the settlement of South Ferriby which include elevated noise and dust levels (most notably properties situated within close proximity to the proposed flood embankment - Glebe House, Halfway House, Packet House, Seafield, River Villa, Elm Farm and properties along Farrishes Lane). In addition, site compounds are located immediately adjacent to the properties outlined above. Standard mitigation measures during the construction works would prevent significant impacts on residents and visitors resulting in a minor to moderate adverse impact based on a very high value receptor and a minor negative magnitude.

It is assumed that the Scheme will provide opportunities for local income and employment through construction and an associated marginal increase in local employment and spending within the local economy. However, the number of people anticipated to gain employment through the Scheme is considered very small with respect to the population of South Ferriby as a whole. The impact of the Scheme in income and employment terms is therefore considered to be a minor beneficial impact based on a negligible to minor positive magnitude and very high value receptor.

The scheme is also likely to result in moderate adverse impacts from disturbance activities including use of machinery, presence of personnel/vehicles and associated noise, to residents adjacent to the works (most notably Glebe House, Halfway House, Packet House, Seafield, River Villa, Elm Farm and properties along Farrishes Lane) as a result of construction activities and from localised increases in vehicle movements due to the delivery of materials, machinery and site personnel throughout the construction period.

Operational impacts

As there is no mechanism for significant noise and vibration effects to be caused during operation, noise and vibration issues were scoped out of this assessment.

With regard to the economic benefit derived from damages avoided as a result of flood risk reduction, the proposed scheme is anticipated to benefit properties (this is estimated to be 129 properties based on the number of properties flooded in 2013) and businesses (most notably CEMEX) which are currently at risk of flooding within South Ferriby. These positive changes represent a major beneficial impact to local businesses and the community within South Ferriby and the surrounding area (based on a major positive magnitude and high value receptors).

Upon completion of the Scheme there could be some adverse effects associated with disruption when the demountable defence closures at Ferriby Sluice could reduce access along the A1077 for businesses and the local community. This impact is considered to be minor adverse (based on very high value receptors and a minor negative magnitude i.e. affecting local receptors within South Ferriby and adjacent settlements, such as Winteringham and Winterton, and also the demountable defences are likely to be closed only occasionally (once or twice a year on average) and for a short duration).

10.5.2 Health, safety and well-being

Construction impacts

There may be some adverse impacts on health, safety and well-being through disturbance to the local community during the construction phase, particularly in relation to the disruption from the presence of works affecting access and nearby residents, and also safety risk resulting from:

- Continued and changing traffic diversions and associated driver confusion / frustration;
- Local movements of large plant and machinery through rural and urban areas;
- Constrained pedestrian and cyclist access and crossing points;
- Risks associated with people accessing construction areas; and
- Risks to construction workers working adjacent to watercourses over several months to years.

There is a moderate increase in the risk to human safety during the construction period, resulting in an impact of minor significance based on very high value receptors and a minor negative magnitude.

During construction, potential temporary adverse effects on human health may result from the temporary and permanent loss of recreational land, temporary/permanent severance of footpaths and permissive paths and loss of public open space. These changes may reduce levels of physical activity and result in changes to walking patterns associated with the changes to PRoWs and permissive paths. These effects are considered to be minor adverse based on very high value receptors and a minor negative magnitude.

The scheme is likely to result in temporary increases in traffic flows along the A1077 due to the delivery of materials, machinery. This is likely to increase anxiety in vehicle travellers during construction. In addition, the increased traffic flows during the construction period may reduce the number of people walking and cycling throughout the Scheme extents with associated physical or psychological (e.g. reduced confidence and feeling unsafe) effects. Such effects maybe more pronounced in vulnerable groups such as children, those with physical and/or learning difficulties and the elderly. These temporary effects are considered to be minor adverse based on very high value receptors and a minor negative magnitude.

There is also an additional effect resulting from the direct loss of public open space on recreational users, which is assessed separately in ‘Recreation and amenity’ below.

Operational impacts

A reduction in flood risk would have a positive benefit to the health, safety and well-being of the community located within South Ferriby and adjacent settlements. In terms of tangible health issues (physical health), the magnitude of the positive impact gained from the proposed scheme reducing flood risk is anticipated to be of a large scale. In terms of intangible health issues, i.e. reduced stress associated with flood risk, dealing with insurers, finding alternative accommodation etc., the magnitude of the positive impact gained from the proposed scheme reducing flood risk is anticipated to be of a large scale. As such, the impact of the Scheme on those with reduced flood risk will be of moderate to major beneficial based on very high value receptors and a moderate positive magnitude.

The proposed scheme will be designed to reduce the health and safety risks of workers completing inspections and maintenance works during the operation phase, but the positive impact is negligible given the occasional nature and scale of risk.

10.5.3 Recreation and amenity

Construction impacts

The construction period will render large sections of the Scheme extents inaccessible during construction, most notably the areas surrounding the existing and proposed flood embankment, which will impact upon recreational activities such as walking and bird watching. Public open spaces on the existing flood embankment are also likely to be inaccessible during the construction period. Large sections of footpaths and permissive paths including the Nev Cole Way will be (partially) inaccessible during the construction period. As such, impacts on recreation and amenity features during the construction period are considered to range from minor to moderate adverse based on very high value receptors and a minor negative magnitude.

Operational impacts

A number of footpaths and permissive paths, most notably the Nev Cole Way, will be reopened upon completion of the Scheme. These closures are considered to have a minor beneficial impact based on very high value receptors and a minor positive magnitude on the physical activity of those recreational users.

10.6 Mitigation

10.6.1 Socio-economic

Although assumed to be of minor significance overall, the positive impact of the proposed scheme on increased opportunities for local income and employment through construction is enhanced through requirements at the procurement stages to include community benefits. Under the Environment Agency's framework, contractors are encouraged to employ and upskill a local workforce.

Mitigation will be put in place to address or offset the worst potential disruption, such as:

- Ensuring effective liaison with businesses to understand access needs and busy periods;
- Implementing a traffic management plan;
- Sign-posting diversions; and
- Providing clear and accessible public information.

10.6.2 Health, safety and well-being

Mitigation to reduce nuisance impacts on residents and visitors to South Ferriby during construction include following compliance with current regulations including the Environmental Protection Act 1990. Contractors will be required to submit a Construction Environmental Management Plan (CEMP) and Code of Practice which meet the requirements of the Environmental Action Plan (Appendix 1.2). Such documentation is expected to address not only noise, but other nuisance impacts such as the timing of works, dust, visual impacts and contamination risk and traffic disruption among others.

10.6.3 Recreation and amenity

Mitigation to reduce adverse impacts on recreational and amenity facilities aimed at minimising disruption to residents and visitors will include:

- Works that require the temporary closure or diversion of footpaths, cycle routes and areas available for recreation should be phased wherever possible to limit the spatial extent of the impact on the whole network;
- Where feasible, alternative routes / diversions or locations should be identified to offset impacts for the duration of construction;
- Informing the local community of the nature and duration of the temporary and permanent footpath closures (and diversions) and alternative provisions of access through signage and webpage updates; and
- Severance and reduced access to public spaces and footpaths could be reduced further, or deliver more benefits to the community and visitors given sensitive design and further enhancements to the public spaces and footpath network (e.g. enhancing the Nev Cole Way and installing noticeboards with information about the Humber Estuary and its environmental importance)

10.7 Residual effects

Residual impacts refer to impacts that may persist despite the successful implementation of mitigation proposed above. A summary of the residual impacts associated with the proposed Scheme is summarised below.

10.7.1 Construction phase

Socio-economic

The short-term economic benefit of increased jobs (including local jobs) is assumed to be of minor positive significance overall but could be enhanced further by selecting contractors which aim to employ their workforce from South Ferriby and the surrounding areas (e.g. contractors which actively advertise work opportunities within the locality of South Ferriby and neighbouring communities).

Health, safety and well-being

The short-term adverse impacts associated with traffic, noise, dust, mud, health and safety, disruption during the construction period will require close monitoring of compliance with contractual obligations imposed upon contractors to minimise potential impacts and ensure sensitive working. With effective mitigation in place, the nuisance impact is anticipated to be reduced in magnitude to small, resulting in an impact of minor adverse significance.

Recreation and amenity

Short-term adverse impacts associated with disrupted/ reduced access to greenspace and pathway provision, noise, dust, visual impact during the construction period would have the same mitigation as for safety and well-being above, also resulting in a temporary residual effect of minor adverse significance.

10.7.2 Operational phase

Socio-economic

Long-term positive impact of improved flood protection (the main aim of the Scheme) with major-beneficial significance effects are anticipated from damages to residential and commercial properties avoided as a result of flood protection.

Health, safety and wellbeing

Long-term positive impacts from improved flood protection of the residents and visitors to South Ferriby, with moderate positive impacts anticipated on health.

Recreation and amenity

No residual impacts anticipated during operational phase.

Conclusion

Of these residual impacts, two are considered to be significant effects of the proposed scheme associated with the improved levels of flood protection, namely:

- Long-term benefits to the local economy; and
- Long-term benefits to human health and wellbeing.

There are some minor adverse effects from the disruption of the construction works but the adverse impacts anticipated from severance and reduced access could be reduced further given sensitive design and further enhancements to the public spaces and footpath network.

11. Material Assets – Infrastructure, Industry, Traffic and Transport

11.1 Introduction

This chapter of the ES considers the potential impacts on infrastructure of the area including industry, navigation and road traffic.

This chapter considers the potential access and traffic impacts associated with the construction and operation related to the Scheme, including:

- The type and volume of road traffic generation related to the Scheme during construction;
- Proposed routes to be taken by construction vehicles;
- The potential environmental effects that may arise from traffic associated with the proposed scheme;
- Proposed mitigation for traffic impacts.

In addition to the traffic impacts identified within this chapter, specific impacts during the construction and operational phases of the development are to be managed through a Construction Traffic Management Plan (CTMP) and Operational Traffic Management Plan (OTMP).

Impact on Public Rights of Way (PRoW) is described in Chapter 10 – Population and Human Health and impact on agricultural land is in Chapter 9 – Land and Soils. They are therefore not covered in this chapter.

11.2 Legislation and policy

11.2.1 National legislation and policy

Revised National Planning Policy Framework 2018

The National Planning Policy Framework (NPPF) was initially adopted in March 2012 and updated in 2018 and replaces Planning Policy Guidance 13: Transport. The revised National Planning Policy Framework was published on 24 July 2018 and it sets out the Government's revised requirements for the planning system; providing a presumption in favour of sustainable development and seeking positive improvements to the quality of the built, natural and historic environment, as well as in people's quality of life.

The NPPF (2018) states; "Development should only be prevented or refused on highways grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe". The impacts from vehicular traffic during the construction phase and long-term are not deemed to be severe, considering the proposed mitigation as discussed within this chapter.

Department for Transport (DfT) Circular 02/2013

Circular 02/2013 is Highways England's policy on how sustainable development and economic growth are to be provided, whilst ensuring the primary functions and purpose of the strategic road network are preserved.

Paragraph 9 states that:

'*Development proposals are likely to be acceptable if they can be accommodated within the existing capacity of a section (link or junction) of the strategic road network, or they do not increase demand for use of a section that is already operating at over-capacity levels, taking account of any travel plan, traffic management and/or capacity enhancement measures that may be agreed. However, development should only be prevented or refused on transport grounds where the residual cumulative impacts of development are severe*.'

Paragraph 27 states that:

'*Where the overall forecast demand at the time of opening of the development can be accommodated by the existing infrastructure, further capacity mitigation will not be sought*.'

11.2.2 Local legislation and policy

The North Lincolnshire Local Plan was adopted in 2003 and is the current statutory planning document in North Lincolnshire. Chapter 12 outlines the Local Plan's policy direction on Landscape and Conservation. Paragraph 1 states;

'*North Lincolnshire has a high quality natural environment and the protection and enhancement of these assets is fundamental to sustainable development and to improving the quality of life for both residents and visitors to the area'*.

As per the requirements of the North Lincolnshire Local Plan, a CTMP and OTMP have been prepared to minimise traffic impacts.

11.3 Methodology

The volume of construction traffic has been generated using a "first principles" trip generation approach, identifying the total number of heavy goods vehicles (HGVs) expected to arrive and depart during the construction phase in addition to the total staff numbers.

Routing of construction traffic has been identified for the purposes of the CTMP, which has been produced alongside the ES to manage construction traffic impacts throughout the construction phase.

In addition to the construction traffic, there will be operational traffic generated by the proposed development. The routing and mitigation measures identified from vehicles related to long-term operation of the development have been informed from the OTMP and is discussed within this chapter.

Consideration of impacts on navigation and other infrastructure, such as industry, is given in this chapter. The assessment of significance is a qualitative assessment using professional judgement. Confidence is based on the likelihood of the impact occurring, the abundance and quality of available baseline data used, and the degree of understanding of the stated impact 'pathways'.

11.4 Existing environment

11.4.1 Highways

The site is situated on the Humber Estuary, immediately to the west of the village of South Ferriby. The A1077 is the primary access road to the site and forms a priority T-junction with Sluice Road in South Ferriby. Sluice Road is the primary access road into the site. The A1077 originates to the west of Scunthorpe, runs north towards Winterton, then northwards and eastwards towards South Ferriby, where it continues towards Barton-upon-Humber and southwards towards South Killingholme. The A1077 is the main route for emergency

vehicles to South Ferriby and for evacuation of the cement plant. The geographical extent of the of the study area of this chapter is shown on Figure 11.1.

A CEMEX plant is located adjacent to the site boundary, also indicated within Figure 11.1. It is expected that some material to be brought into the site will come from this plant.

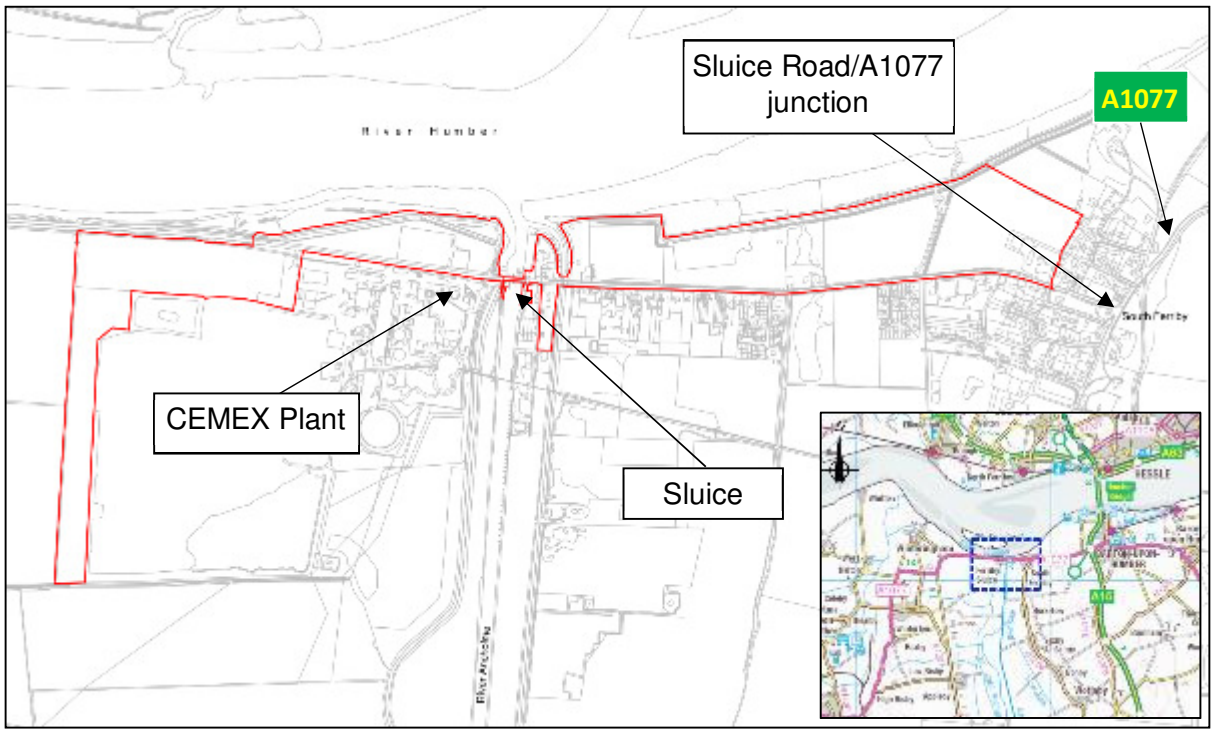

Figure 11.1: Study area for Material Assets.

11.4.2 Navigation

The Humber Estuary is one of the busiest waterways in the UK, with an average 40,000 ship movements per year. Numerous shipping routes traverse the estuary, with one main shipping route providing access to the Ports of Hull.

The River Ancholme was previously an important route for the transportation of cargo, linking rural areas with the industrial towns of Yorkshire and beyond. All commercial carrying had ceased above Brigg by the 1970s and stopped altogether in the 1980s. All current navigation is for recreation. There is a lock at Ferriby Sluice that is used to access the River Ancholme/ Humber Estuary. The A1077 is closed for brief periods when the lock is in use. It is operated by the Environment Agency, who also has a small operational base at Ferriby Sluice.

11.4.3 Other infrastructure/industry

In addition to the road network and navigational structures described above, other key infrastructure in the study area includes utilities, such as overhead electricity powerline crossing the farmland at the eastern end of the Scheme (near Elms Farm) and telephone cables. There are a number of other underground utilities (such as water, wastewater, electric, gas and communications) in the study area, many of which run under the A1077.

There is also a large network of drains in the study area, managed by the Internal Drainage Board (IDB). The Fulseas Drain pumping station is situated on the existing flood defence bank at the eastern end of the study area.

The CEMEX cement plant, described above, is the key industry in the area. There is an overhead conveyor belt that provides a link between a quarry (Middlegate Lane Quarry) to the east to CEMEX cement plant.

11.4.4 Evolution of the baseline without the Scheme

Without the Scheme in place, breach of the front embankment (if it occurs) could result in temporary flooding of the A1077 at South Ferriby, with possible damage to the road. There may also be flooding of infrastructure and industry in the area, including the CEMEX plant.

11.5 Likely significant effects

11.5.1 During construction

Highways

Construction works are anticipated to commence in 2018 and would last approximately two years. The proposed access for construction traffic for the Scheme will be from the A1077, which runs through the site and is classified as a class 'A' principal road in a rural area.

Construction Workers

Throughout the construction period there will be varying numbers of construction staff on site, as shown in Table 3.2. These numbers have been informed from the contractor and based upon information included within the CTMP.

Parking will be provided for workers near to their relevant workface. Space will be provided as part of secondary compounds located along length of works. Working hours for construction workers will be from 07:30 to 17:00 hours.

Construction workers are expected to travel to the construction site primarily by car. It is assumed that, for a robust assessment, there will be one car to one construction worker accessing the site, meaning 60 two-way trips for most of the construction phase, in the AM and PM peak periods (07:30-08:30 and 17:00-18:00 hours). All construction workers are assumed to access the site via the A1077, either from the eastern side of the site or the western side. The impact from traffic associated with construction workers shall be minor and temporary.

Construction Traffic

Construction traffic and abnormal loads are expected to access the site via South Ferriby (to the east of the site), as this is the route from the A15. It is expected that most of the construction traffic shall access the site through South Ferriby via the A1077/Sluice Road junction and the A1077/A15; this route along the local road network is tarmacked and suitable for HGV access.

The greatest number of HGV movements at the construction site in a month will be approximately 3030 (Table 3.2) (for two months, other months are less), indicating approximately 23 HGV movements per hour as a maximum number, expected to be accessing the construction site. Annual average daily traffic (AADT) figures for the A1077 in 2016 east of South Ferriby, were 7955 vehicles. During the construction period there is predicted to be an increase of up to 3% of vehicles in the two months with the most HGV movements. The increase will be less for all other months of construction.

Table 3.2 outlines the profile of construction traffic throughout the construction period in terms of HGV movements. Approximately 50% of the material is expected to come from the CEMEX plant and the other 50% from an, as yet unspecified, source. Material from CEMEX

will be transported by their conveyor to a storage area and then HGVs will move it to the construction areas.

The scheme is expected to have no significant adverse effects on the highway network. Construction impacts will be minor and temporary; any short-term construction impacts are to be managed through the CTMP.

Abnormal Loads

Abnormal loads are expected to access the site during the construction phase. Large construction machinery will arrive on site at the beginning of earthworks in April 2019 and will leave when earthworks pause in October 2019. They will return at recommencing of earthworks in February 2020 and will leave again at end of earthworks in August 2020. It is expected that there will be negligible environmental impact arising from the level of trips generated by this machinery, due to the small windows when equipment shall be moved, and the small number of abnormal loads involved.

Navigation

Ferriby Lock is expected to remain operational during construction and there will therefore be no impacts.

Other infrastructure/industry

There will be no further impacts on CEMEX (beyond those described above with respect to the supply of material) during construction. Part of the land owned by CEMEX will be used as site compound/storage, but this is not expected to affect the operations at CEMEX as the land is currently unused by them.

The overhead electricity powerline mentioned above will not be affected by the works. All other utilities will be managed by the contractor during construction. There are therefore expected to be no significant impacts on other infrastructure/industry.

11.5.2 During operation

Highways

During operation demountable defences will be used in times of potential flood risk to South Ferriby. Due to the nature of flood events at South Ferriby, this will be an infrequent event. The demountable defences are proposed to be demountable and will be used in times of flood events and once annually for the purposes of testing. The number of staff and vehicle movements attributed to the operation of moving the demountable defences will be small. Existing traffic on the highway network will be diverted away from the village during this period and the demountable defences will be re-opened once the risk of flooding has passed. If the risk of flooding is tidal, the demountable defences will be re-opened in between the tides if possible.

As the demountable defences are due to be closed only occasionally and for short periods, and a diversion route will be set up (Figure 11.2), impacts on Highways are considered to be not significant.

The Scheme will result in minor protection of the highways during periods of coastal flooding. This is considered to be a significant benefit of the Scheme.

Navigation

There will be no change to the navigational use of Ferriby Lock during the operation of the Scheme, and therefore no effects are predicted to occur.

Other infrastructure/industry

There will be no change to the infrastructure/industry of the area during operation of the Scheme and therefore no effects are predicted to occur. The land used for site compound/storage at CEMEX will be restored to its former use.

The proposed scheme will provide protection from coastal flooding of the CEMEX works. This is considered a moderate significant benefit of the Scheme as CEMEX is the main industry in the area.

The impact on drains/pumping station is considered further in Chapter 8, Water and Estuarine Processes.

11.6 Mitigation

11.6.1 Highways

Vehicle routing and timing of movements of construction traffic shall be organised so they do not impact on schools or peak hour movements. Much of the material to be brought onto site will come from the CEMEX plant adjacent to the site, which will also minimise impact as 50% of the total loads that would have been transported along the local road network shall be transported from this site. The impacts during construction and operation will be managed through the CTMP and OTMP.

For the operational mitigation, when the demountable defences are operated, traffic will be diverted away from the village of South Ferriby during this period and a section of road will be closed. Manually operated signs will be changed by the Environment Agency (Operations) to indicate that the road is closed (except for access prior to the demountable defences) and that the diversion should be followed. There shall be a road closure sign located at the A1077/Sluice Road junction and another sign located at the A1077/A15 junction. The diversion route from the A1077/A15 junction to the site will be via the A15, M180 and the B1207. The diversion route from the A1077/Sluice Road junction will be the reverse of the route from the A1077/A15 junction. Figure 11.2 shows the proposed diversion route and the location of the road closure along with signage locations. An alternative, non-motorway diversion route will also be set up, also shown in Figure 11.2.

In addition to the at risk of flood condition, the demountable defences will be erected once a year by the Environment Agency (Operations) to ensure that they are operational. The road will be closed during this period. This will be carried out at a time to minimise traffic impacts. Due to the times of the diversion, the impact of the diversion on the road network will be minor and temporary.

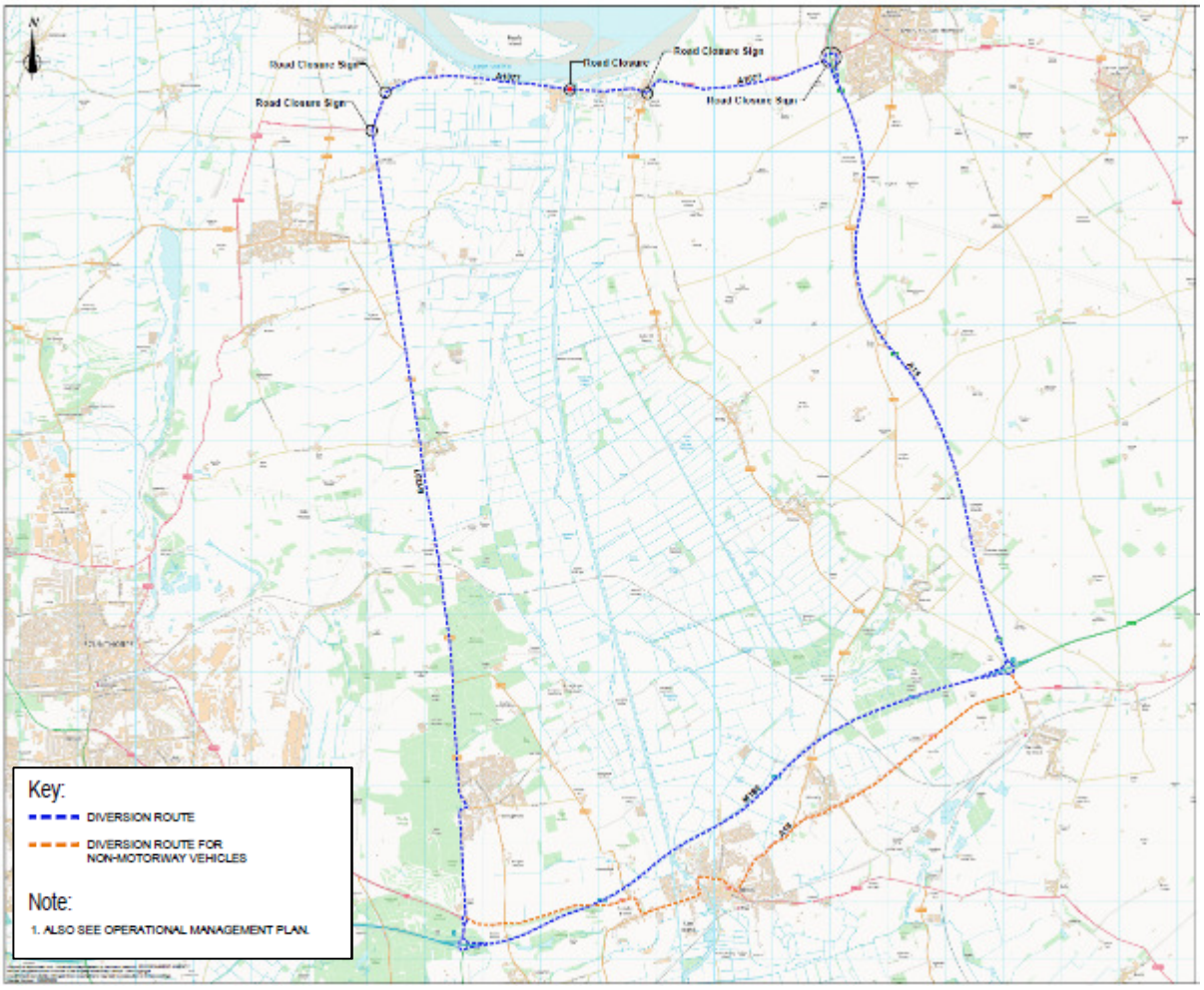

Figure 11.2: Diversion Route During Demountable defence Operation

11.7 Residual effects

The impacts during construction and operation can be fully managed through the CTMP and OTMP, therefore there are **no adverse significant residual effects** arising from traffic either during construction or operation.

The Scheme will result in the protection of highways, infrastructure and industry during periods of coastal flooding. This is considered a **moderate beneficial effect** of the proposed Scheme.

12. Cumulative Effects

12.1 Introduction

The requirement for cumulative (or in-combination) assessment comes from the EIA Directive (Directive 85/337/EEC) and its amendments. Cumulative impacts result from the combined impacts of multiple developments or the combined effect of individual impacts, e.g. where different project elements in different locations have a cumulative impact on a particular receptor, or where different impacts such as noise, air pollution and traffic disruption all affect the same receptor. Individual impacts may not be significant on their own but when combined with other impacts, these could become significant.

Cumulative effects can also be considered as effects resulting from incremental change caused by other past, present or reasonably foreseeable activities, developments or plans together with the Scheme, i.e. multiple projects acting in combination. 'Reasonably foreseeable' is interpreted to include other proposals that already have consent or are awaiting determination in the planning process with design information in the public domain.

12.2 Methodology

The 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' (European Commission 1999) were used in the assessment of cumulative impacts. The assessment considers beneficial cumulative effects as well as potential adverse effects. This included a desk-based review of relevant plans, strategies and planning applications within 2 km of the proposed development. North Lincolnshire Council was contacted regarding its knowledge of any other planning submissions which may have the potential for cumulative effects with the Scheme.

12.2.1 In-combination effects

The cumulative impacts identified in this section are those multiple actions or combined impacts from various elements of the Scheme acting on a single environmental receptor or resource. Any impacts identified in earlier sections to be 'negligible', 'neutral' or 'neutral/slight' are not considered in this section. The primary focus was upon significant residual effects, however, non-significant effects (slight or above) were also considered to allow for consideration of a number of minor impacts affecting one receptor to make a cumulative significant impact. A two-step process was carried out, as explained below.

Step 1: The methodology was as follows:

- A review (see Table 13.1, 2nd column) was carried out of the residual effects from the individual topic assessments, as set out in chapters 5 to 12;
- Consideration was then made as to the potential for interaction with other topic areas;
- Identification of relevant sensitive receptors was made.
- Where the same sensitive receptor was identified in relation to two or more individual topics, this receptor was considered further at Step 2.

Table 13.1: Identification of in-combination effects

Topic	Residual effects	Potential for interaction with other topics in this ES	Sensitive receptors affected
Biodiversity During construction and operation	No significant residual effects identified.	None	
Landscape During construction	Views from long-distance PRoW (including Long Distance Trail SFER 32 and Nev Cole Way Long Distance Route) – **moderate adverse** impact	None	
	Views from PRoW (FP/SFER/30, FP/SFER/24) – **slight adverse** impact	None	
	Views from residential receptors where the embankment is close to Sluice Road – **moderate adverse** impact (**slight adverse** for houses set further away).	Yes, with Population and human health	Residential receptors
Landscape During operation	Setting of Listed Buildings in the landscape (including South Ferriby Hall, Woodside Farmhouse, Glentworth House, Church of Saint Nicholas). **Slight adverse** impacts.	None (same impact as identified in Cultural Heritage)	
	Views from residential receptors where the embankment is close to Sluice Road – **moderate adverse** impact (**slight adverse** for houses set further away).	Yes, with Population and human health	Residential receptors
	Views from commercial and industrial premises (CEMEX, The Marina) – **slight adverse** impact.	None	
	Local Character areas of high / medium value (Settled Wooded Slopes, Ribbon settlement along Sluice Road (A1077), Estuarine Flats and Farmland, Marina) – **Moderate/slight adverse** impact.	None	
	Local Authority Character Areas - Flat Drained Farmland. **Moderate/slight adverse** impact.	None	
Cultural heritage	Asset 1 - Ferriby Sluice SM – new floodwall would impact on the fabric and setting of the SM. **Slight adverse** impacts.	None	

Topic	Residual effects	Potential for interaction with other topics in this ES	Sensitive receptors affected
Short term (during construction)	Asset 46 – South Ferriby Hall Grade II Listed Building – impact on its setting during construction. **Slight adverse** impact.	None	
	Asset 48 – Church of St Nicholas Grade II* Listed Building – impact on its setting during construction. **Slight adverse** impact.	None	
	Asset 67 – Nos. 9 & 10 Sluice Road – impact on its setting during construction. **Slight adverse** impact.	None	
Cultural heritage Long term (during operation)	Asset 1 – Ferriby Sluice SM – enhanced flood protection – **slight/moderate beneficial** impact.	None	
	Asset 45 – Woohouse Famhouse, Asset 46 South Ferriby Hall, Asset 47 Glentworth House Grade II Listed Buildings – all enhanced flood protection gives them **slight beneficial** impact.	None	
	Asset 48 – Church of St. Nicholas Grade II* Listed Building – enhanced Listed Building – **slight/moderate beneficial** impact.	None	
	Asset 46 – South Ferriby Hall and Asset 67 – Nos. 9 and 10 Sluice Road – impact on setting due to new embankment – **slight adverse** impact.	None	
Water During construction and operation	No significant residual effects identified.	None	
Land and soils During construction and operation	Loss of farmland – **minor adverse** impact	None	
Population and human health	Socio-economic - the short-term economic benefit of increased jobs (including local jobs) is assumed to be of **minor positive significance** overall.	None	

Topic	Residual effects	Potential for interaction with other topics in this ES	Sensitive receptors affected
During construction	Health, safety and well-being - the short-term adverse impacts associated with traffic, noise, dust, mud, health and safety, disruption during the construction period **minor adverse significance**	Yes, with visual impacts during construction	Residents and visitors to the area
	Recreation and amenity - short-term adverse impacts associated with disrupted/ reduced access to greenspace and pathway provision, noise, dust, visual impact during the construction period in a temporary residual effect of **minor adverse significance**	Yes, with visual impacts during construction	Residents and visitors to the area
Population and human health During operation	Socio-economic - Long-term positive impact of improved flood protection with **major-beneficial** significance effects are anticipated from damages to residential and commercial properties avoided as a result of flood protection.	Yes, with visual impact during operation	Residential and commercial property
	Health, safety and wellbeing - Long-term positive impacts from improved flood protection of the residents and visitors to South Ferriby, with **moderate positive impacts** anticipated on health.	Yes, with visual impact during operation	Residents and visitors

Step 2: Consideration of the potential for resultant combined effects both during the construction and/ or operation of the proposed scheme. This step focused on the sensitive receptors for combined effects identified in Step 1. The relevant residual inter-topic effects were considered and, applying professional judgement, the potential for significant combined effects upon the receptors was assessed with supporting commentary provided.

Table 13.2: Assessment of in-combination effects

Sensitive Receptors with Potential for Combined Effects (from Table 13.1)	Residual effects interactions (across topics)	Predicted combined effects and significance
Construction		
Residential receptors	Views from residential receptors where the embankment is close to Sluice Road – **moderate**	A combination of three adverse impacts occur for residential receptors, one of moderate and two of minor. Overall, due to the

Sensitive Receptors with Potential for Combined Effects (from Table 13.1)	Residual effects interactions (across topics)	Predicted combined effects and significance
	adverse impact (**slight adverse** for houses set further away). Health, safety and well-being - the short-term adverse impacts associated with traffic, noise, dust, mud, health and safety, disruption during the construction period **minor adverse** significance Recreation and amenity - short-term adverse impacts associated with disrupted/ reduced access to greenspace and pathway provision, noise, dust, visual impact during the construction period in a temporary residual effect of **minor adverse** significance	temporary nature of the impacts, they are not considered significant.
Operation		
Residential receptors	Views from residential receptors where the embankment is close to Sluice Road – **moderate adverse** impact (**slight adverse** for houses set further away). Socio-economic - Long-term positive impact of improved flood protection with **major-beneficial** significance effects are anticipated from damages to residential and commercial properties avoided as a result of flood protection. Health, safety and wellbeing - Long-term positive impacts from improved flood protection of the residents and visitors to South Ferriby, with **moderate positive impacts** anticipated on health.	There is predicted to be one moderate adverse (views of embankment) and two moderate or major beneficial impacts (improved flood protection to property and improved health, safety and wellbeing). Overall the impact is therefore considered to be positive.

12.2.2 Cumulative effects

Assessment of cumulative effects in this EIA has included a review of the local plans and strategies for recent, current or proposed developments, flood risk management, minerals, waste and transport projects, along with the Council's planning application information, to understand the potential for cumulative effects with other developments in the study area. Below are the developments that were considered in the cumulative effects assessment, alongside the proposed scheme:

- Humber: Hull Frontage Improvements Scheme
- Skeffling Managed Realignment Scheme
- Planning Application for clay extraction (PA/SCR/2018/2)

These are considered further below.

Humber: Hull Frontage Flood Defence Improvement Scheme

Following a detailed review of the existing tidal flood defences along the Humber edge of the city of Hull, funding was secured in December 2017 to deliver a £42 million flood defence scheme to upgrade this stretch of tidal flood defences. This is in order to better protect homes and businesses that are at risk of flooding from the Humber Estuary. This work is delivered by Hull City Council in partnership with the Environment Agency. The scheme will reduce the risk of flooding to 113,000 properties. The Environment Agency has applied for planning permission for the Humber: Hull Frontage scheme. Subject to planning approval, work on the Humber: Hull Frontage scheme will start in winter 2018 and be completed by 2020.

Given that the Humber: Hull Frontage scheme is on the north bank of the Humber and some distance away, there are considered to be no cumulative effects with the Winteringham to South Ferriby Scheme, which is on the south bank.

Skeffling Managed Realignment Scheme

We are progressing the design of a managed realignment scheme at Skeffling on the north bank of the Humber. The planning application is due to be submitted February 2019. We expect, subject to planning, enabling works to take place in summer 2019, with the main construction works to start in early 2020. Completion is expected by 2021.

Due to the distance between the Skeffling scheme (which is close to Spurn Point) and the Winteringham to South Ferriby scheme, no significant cumulative effects are predicted to occur.

Planning Application PA/SCR/2018/2 – clay extraction

This planning application is for proposed extraction of clay for engineering purposes and is located at Sluice Lane, Winteringham. The site is located approximately 500m to the west of the Winteringham to South Ferriby scheme (at the closest location). A request for an EIA Screening Opinion was made in February 2018. NLC gave the opinion, in April 2018, that an Environmental Statement was not required. The Planning Application is still pending (as at 2 October 2018).

This Planning Application, if it receives approval, would involve the transport of clay for engineering purposes, including flood defence schemes. The number of HGVs is estimated to be up to 34 vehicle movements per day. Routes will depend on the final destination but is likely to include the A1077 initially.

Assuming worst case, that this scheme goes ahead at the same time as the Winteringham Ings to South Ferriby scheme and does not supply material to the Scheme, this would result in up to 34 HGV vehicle movements per day, plus approximately 74 vehicle movements per day from the Winteringham Ings to South Ferriby scheme using the A1077 in the vicinity of South Ferriby. This number of HGVs per day (108) is not considered likely to have a significant cumulative effect.

13. Summary

Table 13.1 summarises the likely residual impacts of the Scheme following the implementation of mitigation.

Table 13.1: Summary or residual impacts

Topic	Residual impacts	Significance of residual impact
Biodiversity During construction and operation	No significant residual effects identified.	Not significant
Landscape During construction	Views from long-distance PRoW (including Long Distance Trail SFER 32 and Nev Cole Way Long Distance Route).	Moderate adverse
	Views from PRoW (FP/SFER/30, FP/SFER/24)	Slight adverse
	Views from residential receptors where the embankment is close to Sluice Road.	Moderate adverse
Landscape During operation	Setting of Listed Buildings in the landscape (including South Ferriby Hall, Woodside Farmhouse, Glentworth House, Church of Saint Nicholas).	Slight adverse
	Views from residential receptors where the embankment is close to Sluice Road.	Moderate adverse
	Views from commercial and industrial premises (CEMEX, The Marina).	Slight adverse
	Local Character areas of high / medium value (Settled Wooded Slopes, Ribbon settlement along Sluice Road (A1077), Estuarine Flats and Farmland, Marina).	Moderate/slight adverse
	Local Authority Character Areas - Flat Drained Farmland.	Moderate/slight adverse
Cultural heritage Short term (during construction)	Asset 1 - Ferriby Sluice SM – new floodwall would impact on the fabric and setting of the SM.	Slight adverse
	Asset 46 – South Ferriby Hall Grade II Listed Building – impact on its setting during construction.	Slight adverse
	Asset 48 – Church of St Nicholas Grade II* Listed Building – impact on its setting during construction.	Slight adverse
	Asset 67 – Nos. 9 & 10 Sluice Road – impact on its setting during construction.	Slight adverse

Topic	Residual impacts	Significance of residual impact
Cultural heritage Long term (during operation)	Asset 1 – Ferriby Sluice SM – enhanced flood protection.	Slight/moderate beneficial
	Asset 45 – Woohouse Famhouse, Asset 46 South Ferriby Hall, Asset 47 Glentworth House Grade II Listed Buildings – all receive enhanced flood protection.	Slight beneficial
	Asset 48 – Church of St. Nicholas Grade II* Listed Building – enhanced Listed Building.	Slight/moderate beneficial
	Asset 46 – South Ferriby Hall and Asset 67 – Nos. 9 and 10 Sluice Road – impact on setting due to new embankment.	Slight adverse
Water During construction and operation	No significant residual effects identified.	Not significant
Land and soils During construction and operation	Loss of farmland	Minor adverse
Population and human health During construction	Socio-economic - the short-term economic benefit of increased jobs (including local jobs).	Minor beneficial
	Health, safety and well-being - the short-term adverse impacts associated with traffic, noise, dust, mud, health and safety, disruption during the construction period.	Minor adverse
	Recreation and amenity - short-term adverse impacts associated with disrupted/ reduced access to greenspace and pathway provision, noise, dust, visual impact during the construction period.	Minor adverse
Population and human health During operation	Socio-economic - Long-term positive impact of improved flood protection is anticipated from avoiding damages to residential and commercial properties as a result of flood protection.	Major beneficial
	Health, safety and wellbeing - Long-term positive impacts from improved flood protection of the residents and visitors to South Ferriby.	Moderate beneficial

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Abbreviations

ACEC	Aggressive Chemical Environment for Concrete
AD	Anno Domini
AEP	Annual Exceedance Probability
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BH	Borehole
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute for Ecology and Environmental Management
CIFA	Chartered Institute for Archaeologists
CLR	Contaminated Land Report
CSM	Conceptual Site Model
CTMP	Construction Traffic Management Plan
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EC	European Community
ECoW	Ecological Clerk of Works
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
ES	Environmental Statement
FRM	Flood Risk Management
GCN	Great crested newt
GES	Good Ecological Status
GEP	Good Ecological Potential
GI	Ground investigation
HER	Historic Environment Records

HFRMS	Humber Flood Risk Management Strategy
HGV	Heavy Goods Vehicle
HLC	Historic Landscape Classification
HRA	Habitats Regulations Assessment
IDB	Internal Drainage Board
IECS	Institute of Estuarine and Coastal Studies
IEMA	Institute of Environmental Management and Assessment
IMD	Index of Multiple Deprivation
JNCC	Joint Committee for Nature Conservation
LBRC	Lincolnshire Biological Records Centre
LDF	Local Development Framework
LERC	Lincolnshire Environmental Records Centre
LiDAR	Light Detection and Ranging
LNR	Local Nature Reserve
LPA	Local Planning Authority
LQM	Land Quality Management
LSOA	Lower layer super output area
LWS	Local Wildlife Site
MAGIC	Multi-Agency Geographic Information for the Countryside
mbgl	Metres below ground level
MMP	Material Management Plan
NERC	Natural Environment and Rural Communities
NGR	National Grid Reference
NHLE	National Heritage List for England
NLC	North Lincolnshire Council
NPPF	National Planning Policy Framework
OD	Ordnance Datum
OTMP	Outline Traffic Management Plan
PAS	Portable Antiques Scheme
PEIR	Preliminary Environmental Information Report

PRoW	Public Right of Way
PWMS	Precautionary Working Method Statement
RBMP	River Basin Management Plan
RTE	Regulated Tidal Exchange
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WFD	Water Framework Directive
WHO	World Health Organisation

Glossary

Agricultural Land classification	A series of six grades classifying soil in terms of its suitability for agriculture, from 1 (excellent) to 5 (very poor)
Ancient Woodland	Land continuously wooded since 1600 in England and Wales or 1750 in Scotland.
Aquifer	An underground layer of rock with water storage capability.
Baseline	A description of the present state of the environment with the consideration of how the environment would change in the future in the absence of the plan/programme/project as a result of natural events and other human activities.
Baseline studies/ survey	Collection of information about the environment which is likely to be affected by the project
Biodiversity Action Plan (BAP)	An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity in response to the Convention on Biological Diversity, Rio de Janeiro 1992
Catchment	A surface water catchment is the total area that drains into a river. A groundwater catchment is the total area that supplies the groundwater part of the river flow.
Character area	An area of land with distinctive landscape features resulting from an interaction of wildlife, landforms, geology, land use and human activity as defined by the Countryside Agency.
Conservation Area	An area designated under the Town and Country Planning Act, 1990 to protect its architectural or historic character.
Cumulative Impacts	The combined impacts of several projects within an area, which individually are not significant, but together amount to a significant impact.
Department for Environment, Food and Rural Affairs (DEFRA)	The government department responsible for flood management policy in England
Ecological Impact Assessment (EcIA)	An assessment of the potential effects of a proposed development on species, habitats and sites that are of value to conservation or protected by national and/or international legislation.
English Heritage (EH)	Government statutory advisor on the historic environment, funded jointly by the government and by revenue from properties and members.
Environmental Action Plan (EAP)	A standalone report or section within another environmental impact assessment document which ensures that constraints, objectives and targets set in the main Environmental Statement are actually carried out on the ground. Actions are separated into those to be carried out before, during and after construction.
Environmental Impact Assessment (EIA)	"EIA is an assessment process applied to both new development proposals and changes or extensions to existing developments that are likely to have significant effects on the environment. The EIA process ensures that potential effects on the environment are considered, including natural resources such as water, air and soil; conservation of species and habitats; and community issues such as visual effects and impacts on the population. EIA provides a mechanism by which the interaction of environmental effects resulting from development can be

	predicted, allowing them to be avoided or reduced through the development of mitigation measures. As such, it is a critical part of the decision-making process." www.iema.net/eiareport
Environmental Statement (ES)	The document produced to describe the environmental impact assessment process where statutory environmental impact assessment is required.
Flood alleviation scheme (FAS)	Scheme designed to reduce the risk of flooding in a given area
Flood defence	A structure (or system of structures) that reduce flooding from rivers or the sea
Flood risk management strategy (FRMS)	A long term (50 years or more) plan for coastal or river management to reduce the risk of flooding and carry out. They are more detailed than CFMPs.
Habitats Directive	EC Directive (92/43/EEC) on the Conservation of natural habitats and of wild flora and fauna. Implemented (with the Birds Directive (79/409/EEC)) in the UK as the Conservation (Natural habitats and wild flora and fauna) Regulations (1994). This establishes a system of protection of certain flora, fauna and habitats considered to be of International or European conservation importance. Sites are designated as Special areas of conservation (SACs), special protection areas (SPAs) and/or Ramsar sites. Any developments in or close to these designated areas are subject to the Habitat Regulations for approval of English Nature. Together these sites are referred to as the Natura 2000 network.
Indicative landscape plan (ILP)	Overlay of existing environment and scheme proposals to highlight environmental constraints and opportunities including designated sites and landscape character.
Local Biodiversity Action Plan (LBAP)	A local plan with targets to protect and enhance biodiversity to achieve national targets and also to protect locally important species
Local Nature Reserve (LNR)	Nature reserves designated under the National Parks and Countryside Act (1949) for locally important wildlife or geological features. They are controlled by local authorities in liaison with English Nature.
Mitigation measures	Actions that are taken to minimise, prevent or compensate for adverse effects of the development.
Natural England	Natural England is an Executive Non-departmental Public Body responsible to the Secretary of State for Environment, Food and Rural Affairs. Their purpose is to protect and improve England's natural environment and encourage people to enjoy and get involved in their surroundings. Their aim is to create a better natural environment that covers all of our urban, country and coastal landscapes, along with all of the animals, plants and other organisms that live with us.
Nitrate vulnerable zone (NVZ)	Area where surface or ground waters are above the standards set by the Nitrates Directive (91/676), as implemented in England and Wales by SI2164/2002
Ramsar site	Wetland site of international importance listed under the Convention on Wetlands of International Importance under the Conservation of Waterfowl Habitat (Ramsar) Convention 1973.
Scheduled Monument	Nationally important historic sites, buildings or monuments identified by English Heritage and designated by the Secretary of State for Culture, Media and Sport. Any work affecting a scheduled monument must gain consent from English Heritage under the Ancient Monuments and Archaeological Areas Act (1979).

Scoping	The process of deciding the scope or level of detail of an EIA/ SEA. During this stage the key environmental issues (likely significant effects) of a project/strategy are identified so that the rest of the process can focus on these issues. Issues may result from the proposal itself or from sensitivities of the site.
Screening	(1) For environmental impact assessment, the process of deciding which developments require an environmental impact assessment to be carried out and whether this will be statutory
Screening opinion	Statutory opinion from the competent authority as to whether a proposed project requires statutory environmental impact assessment according to the Environmental Impact Assessment Regulations.
Site of Special Scientific Interest (SSSI)	Nationally important sites designated for their flora, fauna, geological or physiographical features under the Wildlife and Countryside Act (1981) (as amended) and the Countryside Rights of Way (CRoW) Act (2000).
Special Area for Conservation (SAC)	Sites of European importance for habitats and non-bird species. Above mean low water mark they are also SSSIs.
Special Protection Area (SPA) and proposed Special Protection Area (pSPA)	An area designated for rare or vulnerable birds, or migratory birds and their habitats, classified under Article 4 of the EC Directive on the Conservation of Wild Birds (79/409/EEC). They are also SSSIs. Proposed sites receive the same protection as fully protected sites
Standard of protection (SoP)	The level of protection from flooding, for example a SoP of 1 in 100 means that the flood defences in an area provide protection from floods up to a size of flood with a probability of occurring of 1 in 100 in any year
Sustainable development	A concept defined by the Brundtland Report (1987) as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”
Water Framework Directive (WFD)	EC Directive (2000/60/EC) on integrated river basin management. The WFD sets out environmental objectives for water status based on ecological and chemical parameters, common monitoring and assessment strategies, arrangements for river basin administration and planning and a programme of measures in order to meet the objectives.

Appendices

Appendix 1.1 – Figures

Figures issued as separate PDF files as part of Appendix 1.1 are listed in the below table.

Description	File name	Revision
Planning Drawings		
Site Location	IMAN002289-CH2-DE-3A0-DR-PL-0001	CO1
Proposed Layout Plan Frontage 1-4 (4 drawings)	IMAN002289-CH2-DE-3A0-DR-PL-0001	CO1
Long Section Frontage 1, 3 &4 (3 drawings)	IMAN002289-CH2-DE-3A0-DR-PL-0002	CO1
Typical Wall Sections	IMAN002289-CH2-DE-3C0-DR-PL-0002	CO1
Existing Situation	IMAN002289-CH2-DE-300-DR-PL-0002	CO1
Site Services	IMAN002289-CH2-DE-300-DR-PL-0003	CO1
Proposed Site Layout	IMAN002289-CH2-DE-300-DR-PL-0004	CO1
Typical Embankment Cross Sections	IMAN002289-CH2-DE-300-DR-PL-0005	CO1
Typical Wall Sections and Embankment Section D-D	IMAN002289-CH2-DE-300-DR-PL-0006	CO1
Compound and Stockpile Location	IMAN002289-CH2-DE-300-DR-PL-0007	CO1
Road Diversion	IMAN002289-CH2-DE-300-DR-PL-0008	CO1
Extended Cross Sections	IMAN002289-CH2-DE-300-DR-PL-0009	CO1
Environmental Drawings		
Figure 5.1 – Nature Conservation Sites	IMAN002289-CH2-00-300-DR-EN-0001	C02
Figure 5.2 – Phase 1 Habitat Survey	IMAN002289-CH2-00-300-DR-EN-0002	C02

Description	File name	Revision
Figure 5.3 – Ferriby Sluice Bat Roost	IMAN002289-CH2-00-300-DR-EN-0003	C02
Figure 5.4 – Water Vole Mitigation	IMAN002289-CH2-00-300-DR-EN-0004	C02
Figure 5.5 – Estuarine SPA Birds Mitigation	IMAN002289-CH2-00-300-DR-EN-0005	C02
Figure 5.6 – Barn Owl Mitigation	IMAN002289-CH2-00-300-DR-EN-0006	C02
Figure 5.7 – Great Crested Newt Habitat Loss and Mitigation	IMAN002289-CH2-00-300-DR-EN-0007	C02
Figure 5.8 – Reptiles	IMAN002289-CH2-00-300-DR-EN-0008	C02
Figure 6.1 – Indicative Visual Envelope (Part 1 of 2) Figure 6.1 – Indicative Visual Envelope (Part 2 of 2)	IMAN002289-CH2-00-300-DR-EN-0015 IMAN002289-CH2-00-300-DR-EN-0016	C02 C02
Figure 6.2 – Site Specific Character Areas (Part 1 of 2) Figure 6.2 – Site Specific Character Areas (Part 2 of 2)	IMAN002289-CH2-00-300-DR-EN-0017 IMAN002289-CH2-00-300-DR-EN-0018	C02 C02
Figure 6.3 – Environmental Design General Arrangement Plan (Part 1 of 2) Figure 6.3 – Environmental Design General Arrangement Plan (Part 2 of 2)	IMAN002289-CH2-00-300-DR-EN-0019 IMAN002289-CH2-00-300-DR-EN-0020	C02 C02
Figure 7.1 – Archaeological Remains	IMAN002289-CH2-00-300-DR-EN-0009	C02
Figure 7.2 – Historic Buildings	IMAN002289-CH2-00-300-DR-EN-0010	C02
Figure 7.3 – Historic Character	IMAN002289-CH2-00-300-DR-EN-0011	C02

Description	File name	Revision
Figure 8.3 – South Ferriby Flood Zones	IMAN002289-CH2-00-300-DR-EN-0012	C02
Figure 9.1 – Superficial Geology	IMAN002289-CH2-00-300-DR-EN-0013	C02
Figure 9.2 – Bedrock Geology	IMAN002289-CH2-00-300-DR-EN-0014	C02
Figure 10.1 – Population and Human Health	IMAN002289-CH2-00-300-DR-EN-0021	C02

Appendix 1.2 – Environmental Action Plan

The Environmental Action Plan is issued as a separate document as described below.

Description	File name	Revision
Environmental Action Plan	IMAN002289-CH2-00-300-RP-EN-0002	C02

Appendix 5.1 – Ecological Survey Reports

Ecological survey reports, as described in the below table, are issued as separate PDF files.

Description	File name	Revision
Water Vole Report (Haycock and Jay, 2018)	IMAN002289-CH2-00-300-RP-BD-0001	C02
Ecology Survey Report (Haycock and Jay, 2017) Appendices to the Ecology Survey Report	IMAN002289-CH2-00-300-RP-BD-0002 IMAN002289-CH2-00-300-RP-BD-0003	C02
Phase 1 Ecology Survey (CH2M, 2017)	IMAN002289-CH2-00-300-RP-BD-0004	C02
Breeding Bird Survey (Nyctea Ltd, 2016)	IMAN002289-CH2-00-300-RP-BD-0005	C02
Breeding Bird Survey (Institute for Estuarine and Coastal Studies, University of Hull, 2018)	IMAN002289-CH2-00-300-RP-BD-0006	C02
Ecology survey of a pond at Ferriby Sluice, North Lincolnshire (Martin Hammond Ecology, 2018)	IMAN002289-CH2-00-300-RP-BD-0007	C02
Coastal Bird Data (Institute for Estuarine and Coastal Studies, University of Hull, 2015)	IMAN002289-CH2-00-300-DA-BD-0001	C02
Bird Survey Data (Institute for Estuarine and Coastal Studies, University of Hull, 2016/2017)	IMAN002289-CH2-00-300-DA-BD-0002	C02

Appendix 5.2 – Ecological Mitigation Reports

Ecological mitigation reports, as described in the below table, are issued as separate PDF files.

Description	File name	Revision
Barn Owl Survey and Mitigation Report (CH2M, 2018)	IMAN002289-CH2-00-300-RP-BD-0008	C02
Water Vole Mitigation Strategy (CH2M, 2018)	IMAN002289-CH2-00-300-RP-BD-0009	C02
Appendix E to the Water Vole Mitigation Strategy	IMAN002289-CH2-00-300-RP-BD-0010	C02

Appendix 5.3 – Habitats Regulations Assessment

The Habitats Regulations Assessments, as described in the below table, are issued as separate PDF files.

Description	File name	Revision
Habitats Regulations Assessment Stage 1	IMAN002289-CH2-00-300-RP-BD-0011	
Appendix A to HRA Stage 1 - Waterbird Assemblage Survey	IMAN002289-CH2-00-300-RP-BD-0012	
Habitats Regulations Assessment Stage 2	IMAN002289-CH2-00-300-RP-BD-0013	

Appendix 6.1 – General Views

Appendix 6.1, General Views, is issued as separate file.

Description	File name	Revision
General Views	IMAN002289-CH2-00-300-RP-L-0001	C02

Appendix 7.1 – Gazetteer

Appendix 7.1, Gazetteer, is issued as separate file.

Description	File name	Revision
Gazetteer	IMAN002289-CH2-00-300-RP-AR-0001	C02

Appendix 7.2 – Desk Based Assessment

The Desk Based Assessment and associated files as described below are is issued as separate files.

Description	File name	Revision
Desk Based Assessment	IMAN002289-CH2-00-300-RP-AR-0002	C04
Figures 1 – 12 (Appendix A to DBA)	IMAN002289-CH2-00-300-DR-AR-0001 IMAN002289-CH2-00-300-DR-AR-0002 IMAN002289-CH2-00-300-DR-AR-0003 IMAN002289-CH2-00-300-DR-AR-0004 IMAN002289-CH2-00-300-DR-AR-0005 IMAN002289-CH2-00-300-DR-AR-0006 IMAN002289-CH2-00-300-DR-AR-0007 IMAN002289-CH2-00-300-DR-AR-0008 IMAN002289-CH2-00-300-DR-AR-0009 IMAN002289-CH2-00-300-DR-AR-0010 IMAN002289-CH2-00-300-DR-AR-0011 IMAN002289-CH2-00-300-DR-AR-0012	C04
Historic England Air Photographs (Appendix B to DBA)	IMAN002289-CH2-00-300-DA-AR-0001	C04

Appendix 7.3 – Geophysical Survey Results

This appendix is issued as a separate document as described below.

Description	File name	Revision
GeoReport	IMAN002289-CH2-00-300-RP-AR-0003	C01

Appendix 8.1 – Preliminary Water Framework Directive Assessment

This document is issued as a separate file as described below.

Description	File name	Revision
Preliminary Water Framework Directive Assessment (CH2M, 2018)	IMAN002289-CH2-00-300-RP-EN-0001	C03

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