Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 9A: Flood Risk Assessment

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Prepared by: AECOM

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9A. Flood Risk Assessment

9.1 Introduction

9.1.1 This Flood Risk Assessment (FRA) has been prepared on behalf of Net Zero Teesside Power Limited (NZT Power) and Net Zero North Sea Storage Limited (NZNS Storage) for the Net Zero Teesside (NZT) Carbon Capture, Utilisation and Storage (CCUS) project on land at Redcar and Stockton-on-Tees on Teesside.

9.1.2 The Site boundary is shown on Figure 3-1: Site Boundary Plan (ES Volume II, Document. Ref. 6.3). The area within this boundary is defined as the "Site". For the purposes of this report the terms used to identify the various parts of the Site are outlined below and are consistent with the terms used elsewhere in the ES.

9.1.3 The Site is divided into the following areas (described in more detail in ES Chapter 3: Description of the Existing Environment and Chapter 4: Proposed Development (ES Volume I, Document. Ref. 6.2) and shown on the Figures below which are presented in ES Volume II (Document. Ref. 6.3):

- The Power, Capture and Compressor site (PCC Site) (Figure 3-1);
- Onshore CO_2 Export Corridor (Figure 3-2A);
- Natural Gas Connection Corridor (Figure 3-2B);
- Electrical Connection Corridor (Figure 3-2C);
- Water Connection Corridors (including water supply and discharge) (Figure 3-2D); and
- CO_2 Gathering Network (Figure 3-2E).

9.1.4 This FRA is also accompanied by Figure 9A-1 which specifically illustrates which development areas are located within Flood Zone 3[1]. There are no areas within the DCO boundary which are within Flood Zone 3b (see maps from the Redcar and Cleveland Borough Council (RCBC) and Stockton-on-Tees (STBC) Strategic Flood Risk Assessments (SFRA) in Annex B). ES Figure 9-4 in ES Volume II (Document Ref. 6.3) can be referred to for areas within Flood Zone 2.

9.2 Purpose and Scope of the Assessment

Context

9.2.1 The PCC Site is located entirely within Flood Zone 1. Only construction works on parts of the CO_2 Gathering Network, CO_2 Export Pipeline, Water Discharge Connection and Natural Gas Connection will be carried out in or under land in Flood Zones 2 and 3a. These works will be temporary in nature and will be involve either the construction of underground tunnels/ pipelines or the

[1] Note mapping data is not available to map all areas in FZ 3a and 3b therefore the RCBC and STBC SFRA plans attached as Annex B have been relied on for reference data for land within the DCO boundary.

installation of pipes on existing/extended pipe racks in existing service corridors. Where tunnels or borings are proposed, the launch and receiving areas are all outside Flood Zone 3, except for the launch pit for the HDD crossing of the River Tees required for Option 2 at the mouth of the Dabholm Gut which may be located in Flood Zones 1, 2 or 3a depending on the exact location.

Scope

9.2.2 The Environment Agency's (EA) 2021 Flood Map for Planning (Rivers and Sea) indicates that the entire PCC Site is located entirely within Flood Zone 1. Areas located within Flood Zone 1 are defined as having a 'low risk' of flooding from fluvial or tidal sources. The definition of flood zones, in accordance with the Planning Policy Guidance (PPG) (Department for Communities and Local Government, 2014) are summarised in Table 9A-5.

9.2.3 As shown on the EA's 'Flood Map for Planning' (see ES Figure 9-4: Environment Agency Fluvial Flood Zones in ES Volume II, Document Ref. 6.3) and the RCBC and STDC SFRA mapping (see Annex B), some of the development areas are located within Flood Zone 2 and Flood Zone 3 (all 3a) as identified from the SRFA mapping (see Figure 9A-1, ES Volume II, Document Ref. 6.3). In particular, whilst the electrical grid connection, water supply and discharge connections, the onshore element of the CO_2 Export Pipeline, connections to the National Gas Grid (NGG) and the CO_2 Gathering Network) are located predominantly in Flood Zone 1, some sections of these connection corridors are located in Flood Zone 2 (medium risk of flooding from fluvial or tidal sources) and Flood Zone 3a (high risk of flooding from fluvial or tidal sources), for example, where the connection corridors cross the River Tees.

9.2.4 The National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) specify that applications for development proposals greater than 1 ha in area, or located in Flood Zone 2 or 3, should be accompanied by an FRA that identifies and assesses all forms of flooding to and from the development. The FRA should demonstrate how flood risk will be managed so that the development remains safe throughout its lifetime, taking into account the vulnerability of the Proposed Development and the potential impact of climate change on risk.

9.2.5 The Overarching National Policy Statement (NPS) for Energy (EN-1), Section 5.7 (Flood Risk) (Department for Energy and Climate Change (DECC), 2011a) details that projects of 1 ha or greater in Flood Zone 1 in England and all proposals for energy projects located in Flood Zones 2 and 3 in England should be accompanied by an FRA.

9.2.6 This FRA is proportionate and appropriate to the nature and scale of the Proposed Development, which assesses existing flood risk at the Site and arising from the Proposed Development, and, where required, recommends suitable mitigation measures.

9.2.7 The objectives of this report are to:

- collect and review existing information relating to the flood risk posed to the Proposed Development from all sources (e.g. fluvial, tidal, surface water, artificial, groundwater, drain and sewer flooding);
- consult with the EA and Lead Local Flood Authorities (LLFAs) in relation to flood risk and their requirements for management of any risk;
- assess the flood risk to the Proposed Development under existing and post-development conditions (taking into account climate change); and
- outline any mitigation measures needed to ensure the Proposed Development and its occupants will be safe for the lifetime of the development and to meet the requirements of the NPPF.

9.3 Data Sources

9.3.1 The baseline conditions for the Site have been established through a desk study including a review of publicly available information and supporting modelling and hydrology study reports (where available), and via consultation with the associated LLFAs and the EA. Relevant consultation responses are provided in Annex A[2]. This information has been utilised to inform the assessment made within this FRA. Data collected during the course of this assessment is described in Table 9A-1.

[2] Not all data received has been included within Annex A due to file format and size of data files. This can be provided on request.

Table 9A-1: Sources of Data

Purpose	Data Source	Comment
Identification of Hydrological Features	1: 25:000 Ordnance Survey (OS) mapping	Identifies the position of the site and local hydrological features
Identification of Ground Levels	1: 25,000 Ordnance Survey (OS) mapping	Provides existing Site levels
Identification of Existing Flood Risk	EA Indicative Flood Zone Map	Identifies fluvial/ tidal inundation extents and historical flooding.
	EA Long-term Flood Information Mapping (Environment Agency, n.d.b)	Provides information on the risk of flooding from fluvial, tidal, surface water and reservoirs (artificial sources)
	Redcar and Cleveland Borough Council Level 1 Strategic Flood Risk Assessment (SFRA) (Redcar and Cleveland Borough Council, 2016) Redcar and Cleveland Borough Council Level 2 SFRA (JBA Consulting, 2016b)	Assesses flood risk across the Redcar and Cleveland Borough Council (RCBC) boundary area. Includes flood risk from fluvial/tidal, sewers, overland flow and groundwater
	Redcar and Cleveland Borough Council Preliminary Flood Risk Assessment (PFRA) (Redcar and Cleveland Borough Council, 2011)	
	British Geological Society (2020) Online Mapping Viewer 'GeoIndex' (BGS, 2020)	Provides details of geology and hydrogeology in the vicinity of the Site
Identification of Historical Flooding	SFRAs and PFRAs	Gives details of historical flooding
Details of the Proposed Works	Design of Proposed Works as outlined within Chapter 4: Proposed Development in ES Volume I, Document. Ref. 6.2	Provides indicative locations and layouts of the Proposed Development.
Surface Water Drainage	Assumed based on SuDS Principles	-

Consultation

9.3.2 Consultation was undertaken with the Planning Inspectorate, Environment Agency and RCBC and STBC as the LLFAs as part of this FRA. Formal consultation responses are provided in Annexe A. Any advisory recommendations are summarised and addressed in Table 9A-2, below.

Table 9A-2: Summary of Consultation

Consultee and Comment	Response
Planning Inspectorate EIA Scoping Opinion. Changes to surface water flows: It is not clear why the Scoping Report has identified the potential for changes to surface water flows during the construction phase within Flood Zones 2 and 3 only, when the Power, Capture and Compression site (PCC) is located within Flood Zone 1. Changes to surface water flows during construction should be assessed where significant effects are likely. The ES should also clarify the term 'temporary changes'.	Changes to surface water flows have been considered for the construction and operational phases of the Proposed Development. The findings are presented in this FRA which considers the entire Site i.e. everything within the Site boundary including areas within Flood Zone 1. For the purposes of assessing environmental effects temporary changes are those that only last for a duration of time and which are not permanent.
Planning Inspectorate EIA Scoping Opinion. Functional Floodplain. The Proposed Development includes works within Flood Zone 3. The ES should demonstrate that the Proposed Development would not result in a net loss of floodplain storage and would not impede water flows.	This FRA considers impacts on floodplain storage and impediment of flows. In summary there will be no net loss of floodplain storage area as a result of the Proposed Development.
Planning Inspectorate EIA Scoping Opinion. Flood Risk Assessment: All potential sources of flooding which could result in likely significant effects should be assessed in the ES. Consideration should be given to the potential for groundwater, surface water, sewer, tidal and fluvial flooding across all components of the Proposed Development. The assessment of flood risk should take into account the most recent climate change allowances. Figure 4 of the Scoping Report presents two options for water connections, both of which are located within tidal waters. The ES should include an assessment of impacts to tidal flooding from the Proposed Development, where significant effects are likely. The Applicant should make effort to discuss and agree the need for detailed consideration of flood warning and evacuation plans with relevant consultation bodies	This FRA considers all known potential sources of flooding and has been updated to take into account the most recent climate change allowances (EA Guidance 2020). The FRA includes the requirement for preparation of a flood warning and response plan (See Section 9.9 of this FRA)
Meeting with EA 8th May 2019 Climate Change Allowances (UKCP18) in FRA	AECOM confirmed that this will be taken into account within the DCO.

Table 9A-2: Summary of Consultation

Consultee and Comment	Response
EA Consultation Response Email 2nd September 2019 (see Annex A) Flood Risk Data: We will be remodelling the Tees in the near future: The Tees Tidal model will be updated to take into account the defences at Port Clarence and Greatham South. The new LiDAR captured over the winter of 17/18 will also be incorporated. We are currently reviewing the scope with JBA but unfortunately we are unable to provide exact timescales for the final delivery at the moment (though it should be within 2019). No breach scenario modelling is available for this site.	The 1,000-year + climate change 2020 Greatham and Port Clarence model update report has been used in this assessment (see Table 9A-15).
Meeting with EA 26th March 2020 RLB is generally low flood risk but there might be localised flood risk. Interested that FRA will include groundwater flood risk.	AECOM presented preliminary conclusions of the Desk Based elements of the FRA
EA Stage 2 Consultation Response 30th September 2020 (see Annex A): Sections of the Proposed Development are situated within flood zones 2 and 3 which is at high risk of flooding. Over the next 100 years, the development site will be impacted upon further with climate change. The proposed Flood Risk Assessment (FRA) submitted in support of the PEIR appears to provide appropriate appraisal, assessment and proposed mitigation measures. We would expect the FRA for the full DCO application to include the following considerations before it can be formally assessed: 1. Take the impacts of climate change into account strategically for all sites, and not piecemeal as the sites come forward. The climate change scenario should assess the impact of both the current allowance in 'Flood risk assessments: climate change allowances' and the 95th percentile of UKCP18 'RCP 8.5' scenario (high emissions scenario) Standard Method; 2. Ensure that the impacts of climate change are considered for both fluvial	This FRA: 1. takes into account climate change using the UKCP18 RCP 8.5 Scenario 2. assesses impacts of climate change for fluvial and tidal flood sources 3. Modelling for overtopping and breach of flood defences has not been undertaken given the low flood risk of the Proposed Development but worst-case assumptions used instead. 4. Considers how people will be kept safe from flood hazards identified. 5. Considers the requirement for emergency flood planning 6. Applies relevant mitigation for all parts of the Proposed Development Site as appropriate. The FRA uses the latest flood modelling data.

Table 9A-2: Summary of Consultation

Consultee and Comment	Response
and tidal flood sources across the site; 3. Provide modelled data for the overtopping and breach of flood defences; 4. Consider how people will be kept safe from flood hazards identified; 5. Consider the requirement for flood emergency planning including flood warning and evacuation of people for a range of flooding events up to and including the extreme event; and 6. We would expect mitigation measures to be applied for all sites and again not piece meal measures. The onus should not be on the individual sites to consider these risks and measures. It should be noted that the EA has recently procured additional flood modelling for the Proposed Development area. The applicant should ensure that the latest modelling is reflected within the final FRA submission.	
Meeting with the EA 18th January 2021 Flood risk not discussed – no issues identified or raised	-
Meeting with EA 23rd March 2021 Flood risk not discussed – no issues identified or raised	-
EA email 7th July 2021 (see Annex A) We've reviewed the summary list below/updated FRA and we are happy that this aligns with our understanding of flood risk at this location. The conclusions appear to reflect the appropriate vulnerability/flood zones classifications for the proposed development. We will review the CEMP once published to ensure that appropriate flood risk mitigation measures have been considered. Overall, we do not consider flood risk to be a significant issue for the proposed development.	Noted
Stockton-on-Tees email 14th August 2019 (Response to consultation as LLFA, see Annex A) A detailed site-specific flood risk assessment (FRA) and drainage strategy (DS) should be submitted at; the scope of the FRA and DS should be agreed with the Lead Local Flood Authority (LLFA).	See this Flood Risk Assessment. Only an outline drainage strategy is presented at this stage. The formal drainage strategy will be secured by a requirement of the DCO.

Table 9A-2: Summary of Consultation

Consultee and Comment	Response
The proposed development must not increase the risk of surface water runoff from the site. Any increase in surface water generated by the proposed development or existing surface water / groundwater issues on the site must be alleviated by the installation of sustainable drainage system within the site.	See above
If the applicant proposes to discharge surface water into an ordinary watercourse a land drainage consent will be LLFA. Any existing watercourses situated within the boundary of the proposed development site must be protected and the LLFA must be informed of any proposed works to the existing watercourses. Surface water discharges from the proposed development shall be flow regulated to greenfield run-off rates to ensure that flooding problems elsewhere in the catchment are not exacerbated.	There will be no new discharges to watercourses from the Proposed Development. All surface water from the PCC site will be discharged to Tees Bay
The drainage system must be designed to operate without flooding for up to the 1 in 30 year event and accommodate the 1 in 100 year plus climate change making sure sufficient steps are taken to ensure that any surface flows between the 1 in 30 and 1 in 100 year events plus climate change are stored within the proposed development site.	
The update guidance states the new allowances for climate change and we now require both +20% scenario and a +40% scenario.	

9.4 Site Information

Location

9.4.1 The PCC Site is located on the south bank of the River Tees, approximately 1.6 km east from the town of Redcar and 1.4 km north-east of Dormanstown.

9.4.2 The PCC Site is located within the east of former Redcar Steelworks site, comprising part of the former landholding to the east of the Redcar Bulk Terminal (RBT), on the south bank of the River Tees.

9.4.3 The PCC Site, together with the connection corridors for the electrical connection, water supply and discharge corridors and the onshore element of the CO_2 Export Pipeline, will be located within the administrative boundary of RCBC, in the ward of South Bank. Connections to the National Gas Grid and the CO_2 Gathering Network are intended to cross the River Tees to land within the administrative boundary of the Stockton on Tees Borough Council (STBC) in Billingham Ward.

9.4.4 The Site boundary also extends west of the PCC Site in order to accommodate the Natural Gas Connection and CO_2 Gathering Network.

9.4.5 The section of the Site comprising the Natural Gas Connection and CO_2 Gathering Network extends across the Tees north of Teesport. The Site boundary passes through the Seal Sands industrial area on the northern bank of the Tees on reclaimed land to the south of the Seal Sands inter-tidal mudflats following existing services corridors.

9.4.6 The Natural Gas Connection Corridor extends west as far as the brine field to the east of Cowpen Marsh. The CO_2 Gathering Network then follows existing pipeline routes around the perimeter of Salthome Nature Reserve, and into the industrial area at the eastern extent of Billingham, again following an existing services corridor.

9.4.7 The indicative boundary for the PCC Site currently encompasses an area of approximately 42.5 hectares (ha) within an overall Site boundary of 462.0 ha.

Existing Land Use

9.4.8 The land within the boundary of the former Redcar Steelworks site currently comprises large-scale redundant plant and buildings associated with the former Redcar Steelworks, with large open land areas that were previously utilised for raw materials storage and processing.

9.4.9 The other connection corridors include the Gas Connection Corridor and CO_2 Gathering Network comprise land and existing service corridors within the industrial areas of the north and south banks of the River Tees.

Access

9.4.10 The PCC Site will be accessed from the A1085.

9.4.11 Construction access routes to the Natural Gas Connection and CO_2 Gathering Network north of the River Tees are proposed via the A1046 Haverton Hill Rd / Port Clarence Road and the B1275 with compound access points proposed off the A178 Seaton Carew Road, A1185, Nelson Avenue, Cowpen Bewley

Road and the unnamed road to Seal Sands (commonly known as Seal Sands Road).

9.4.12 Construction access routes to the Natural Gas Connection and CO_2 Gathering Network south of the River Tees are proposed via Sembcorp operated routes via the Wilton site to enable construction and other personnel access adjacent to the Dabholm Gut and land under the control of the York Potash project. Access locations are shown on ES Figure 5-1 (ES Volume II, Document Ref. 6.3)

The Surrounding Area

9.4.13 The surrounding area is characterised by industrial land use with the nearest main settlements being the towns of Redcar, Eston and Middlesbrough. There is a concentration of industrial land uses around the mouth of the River Tees.

9.4.14 To the west of the PCC Site, there is large industrial plant and equipment from the former Redcar Steelworks. The operational RBT is located immediately northwest of the Redcar Steelworks site, on the south bank of the River Tees.

9.4.15 To the northeast of the PCC Site lie the coastal areas of South Gare and Cotham Sands that are local environmental and community assets and part of the Teesmouth and Cleveland Coast Special Protection Area (SPA) and Ramsar site. To the south lie the Northumbrian Water Bran Sands sewage treatment plant, operational land of PD Ports Teesport and the Wilton International site.

9.4.16 On the north bank of the River Tees, and west of the Redcar Steelworks site, industrial complexes are present at Seal Sands.

Hydrology and Flood Risk Management Infrastructure

Surface Water Features

9.4.17 For the purposes of the FRA a Study Area of 1 km from the Site boundary was adopted. As flood risk impact can also impact upstream and downstream, the FRA also considers a wider study area than 1 km outside of the Site boundary, where relevant. Professional judgement has been applied to identify the extent to which such features are considered.

9.4.18 A Site walkover was undertaken on 22nd January 2020 in cold, dry and fair conditions. Using observations taken on this visit, data from OS mapping and the Environment Agency Catchment Data Explorer website (Environment Agency, n.d.c) the surface waterbodies listed in Table 9A-3 were identified within the 1 km of the Site boundary and are presented on Figure 9-1: Surface Water Features and Their Attributes (ES Volume II, Document. Ref. 6.3).

Table 9A-3: Surface Waterbodies

Waterbody	Coastal / Main River / Ordinary Watercourse / Stillwater	Tributary of	Watercourse Description	Additional Information
Tees Bay (North Sea)	Coastal (tidal)	N/A	Tees Bay stretches from approximately 20 km southeast of Redcar at Boulby, to approximately 13 km northwest of Redcar at Crimdon. It includes a total area of 88.31 km^2	The North Sea is approximately 0.6 km to the north of the PCC Site. The Tees Coastal waterbody was observed from Coatham Sands between Redcar and Teesmouth. The waterbody is backed by a wide sandy beach and sand dunes and is popular for recreation. Coatham Sands has, in places along its length, been strongly influenced by historic deposition of slag from local ironworks. This means that large parts of the dunes are a mix of slag deposits and natural marine-deposited and subsequently wind-blown sand. Within the sand dune complex are a number of ponds and wetland areas. Discharge infrastructure was not apparent and is presumably buried or only observable at very low tide. One pipe was noted across the beach emanating from the direction of Cleveland Links golf course and the area of Warrenby Industrial Estate and is likely to be for discharges to the Tees. The Teesside Offshore Wind Farm was observed approximately 1.5 km off the coast from Redcar.
Tees Estuary (River Tees)	Main River (tidal)	N/A	The Tees Estuary extends from the Tees Barrage, east of Stockton-on-Tees, to Teesmouth. This is a distance of approximately 16 km. It includes a total area of 11.44 km^2	The River Tees is approximately 1.6 km to the west of the PCC Site. The River Tees is tidal at this location, with the normal tidal limit approximately 14 km upstream (at the Tees Barrage). The Tees was observed from near the Dabholm Gut on the south bank. At this point the estuary is approximately 455 m wide. The estuary is also a busy route for navigation with docks and jetties on both banks. Land either side of

Waterbody	Coastal / Main River / Ordinary Watercourse / Stillwater	Tributary of	Watercourse Description	Additional Information
				the waterbody is flat, having been largely reclaimed in this area and is currently occupied by various heavy industries
The Fleet	Ordinary Watercourse (tidal)	Dabholm Gut	This watercourse is known on local mapping as The Fleet and is designated from adjacent to Longbeck Lane in Saltburn (NGR NZ 60988 20908). It continues north to the west of Redcar, and then flows west through the industrial works to discharge into Dabholm Gut at NGR NZ 56131 24038	The watercourse was observed in Coatham Marsh Nature Reserve, where the channel has been artificially widened to flow through a pond/wetland area that reduces the rate of flow. The channel is culverted beneath a bridge within the nature reserve through an overly constrained arch of around 2m width, which leads to backing up of flow upstream. Upstream of the bridge the channel is approximately 8-9 m wide but increases to approximately 25-30 m wide immediately downstream where the channel looks like it may have been artificially constructed for access. There is good connectivity with the floodplain upstream of the culvert but less so downstream. Flows upstream of the culvert may on occasion spill onto the surrounding marsh. Various service crossings were noted over the watercourse near this location. Flow is sluggish due to the culverted crossing and overwide nature of the channel. The watercourse flows into Dabholm Gut approximately 2 km downstream of this observation point in the Nature Reserve, although there are expected to be controlling structures before the confluence with Dabholm Gut. A tributary of The Fleet was also observed as it crosses Limerick Road in Dormanstown. This was an artificial, perfectly straight channel of around 5 m width with incised banks, rising steeply 1-2 m abruptly from the channel bed.
Main's Dike / Mill Race	Ordinary Watercourse	The Fleet	Main's Dike watercourse rises from a spring in Wilton Wood to the southeast of the Site at NZ 59328 19741. The	Main's Dike was observed along the eastern edge of the Wilton International Site where it was very straight, around

Waterbody	Coastal / Main River / Ordinary Watercourse / Stillwater	Tributary of	Watercourse Description	Additional Information
			watercourse then flows north along the eastern boundary of the Wilton International site, and into the Mill Race The course of the Mill Race is unclear as it is largely culverted but appears to flow north of the Wilton International site beneath the A1066. It remerges at NZ 57102 24152 and flows west into The Fleet	1 m in width and with steep incised banks rising around 4 m from the channel. The Mill Race was observed within the Wilton International Site to the south of the A1085. Here the watercourse was overly wide (around 3.5-4 m leading up to a circular culvert of around 2 m diameter, with artificial concrete banks in places. Banks were step and incised. There are numerous service crossings of the watercourse at this location. The Mill Race was also observed downstream of the A1085 adjacent to the Trunk Road roundabout where it was 2-3 m wide, and very straight. Road runoff appears to discharge into the channel.
Dabholm Gut	Ordinary Watercourse (tidal)	Tees Estuary	Dabholm Gut is a kilometre-long tidal channel on the east bank of the Tees, left when the land on both sides was reclaimed from the Tees estuary.	The Dabholm Gut flows to the River Tees approximately 0.8 km south of the Site Boundary. The Dabholm Gut is an artificial channel of around 1 km length left following historic land reclamation. Upstream is Dabholm Beck which is formed from the Coalescence of numerous small watercourses and drains through an area of freshwater marshland to the northwest of the Wilton International Site (upstream of the tidal limit). Dabholm Beck has a single stem channel is around 3-4 m wide, incised and straight, being indicative of extensive past modification. There are several large outfalls that discharge into the channel. At the tidal limit where it becomes Dabholm Gut, the channel widens to approximately 30 m and numerous other active outfalls were observed with relatively high rates of discharge. There are numerous consented discharges here from the adjacent industry. The channel width remains constant up to the confluence with the Tees. During especially high tides anecdotal evidence suggests
Dabholm Beck	Ordinary Watercourse	Dabholm Gut	Dabholm Beck is a drainage channel marked on mapping as flowing northeast above ground for 700 m between NZ 56161 23102 and NZ 56710 23730. It then flows northwest into the tidal Dabholm Gut.	

Waterbody	Coastal / Main River / Ordinary Watercourse / Stillwater	Tributary of	Watercourse Description	Additional Information
				the channel has been known to overtop onto the adjacent access road.
Kettle Beck	Ordinary Watercourse	Tees Estuary	Kettle Beck rises at Lazenby Bank and flows approximately 4 km generally north along the edge of the Wilton International site, beneath the A1085, beneath the Teesside Works (Lackenby), and beyond the A1053 before discharging to the Tees. The exact course of the watercourse is not clear from online mapping north of the A1085 as the watercourse is culverted.	Kettle Beck was observed at the western edge of the Wilton International Site. Here the channel was between 2 and 3 m wide, with an artificial, straightened character. Flow was impeded by a road culvert at the observation site, which consisted of 6 small diameter (~0.5 m) pipes. The banks rose steeply from the channel bed and were incised meaning the channel is likely disconnected from the floodplain.
Kinkerdale Beck	Ordinary Watercourse	Lackenby Channel	This watercourse is mapped as a surface waterbody for 320 m at the north-western extent of the Wilton International site (NZ 56071 20996) and is then in culvert. As such, the source and exact course of the watercourse is not known, although it is known to outfall to the Lackenby Channel.	Kinkerdale Beck is a 2-3 m wide ditch which appears to be fed from an overflow connection from Kettle Beck. It was observed just downstream of Kettle Beck where it has an artificial, straightened character with steep banks. Water in this section of the channel was largely ponded. Further downstream the watercourse is largely culverted beneath the Wilton International Site.
Knitting Wife Beck	Ordinary Watercourse	Lackenby Channel	This watercourse rises just north of the A66 in Grangetown (NZ 55172 20910), before flowing north for approximately 300 m towards the Lackenby Steelworks. The watercourse is then culverted and so the course is unclear but is known to outfall at the Lackenby Channel.	The watercourse was visited as it emerges from an approximately 1 m wide box culvert to the north of the A66. The channel was approximately 1-1.5 m wide, and artificial in nature being straight with steep incised banks rising 2-3 m from the channel bed.
Lackenby Channel	Ordinary Watercourse	Tees Estuary	The Lackenby Channel is a drainage cut between the Lackenby steelworks (NZ 55305 22207) and the eastern bank of the Tees estuary (NZ 54145 23341). It is approximately 1.6 km in length and conveys flows from Knitting Wife Beck, Kinkerdale Beck and Kettle Beck to the Tees.	Lackenby Channel was not visited during the site visit, but aerial photography available online indicates that it is an artificial, straight channel varying between 10 and 15 m in width. It is likely to be very similar to Dabholm Gut.

Waterbody	Coastal / Main River / Ordinary Watercourse / Stillwater	Tributary of	Watercourse Description	Additional Information
Holme Fleet	Main River	The Fleet	Holme Fleet is a marshland channel that meanders between Cowpen Marsh (NZ 50596 24732) and Port Clarence (NZ 50703 21620). It is around 5.6 km in length, and a large number of marshland channels join the Fleet, which also flows through several marshland open waterbodies and reedbeds.	Not visited during the site visit as it is outside of the Site boundary.
Belasis Beck	Ordinary Watercourse	Holme Fleet	Belasis Beck appears to rise from ponds in Belasis Hall Technology Park (NZ 47373 23267) and flows east for 2 km before its confluence with Holme Fleet within Salthome Nature Reserve at NZ 49071 23577.	Belasis Beck was observed in the pastoral fields adjacent to Cowpen Bewley Road, where the main channel appeared to be shallow and wide (~6-7 m). Water levels were high during the site visit and overtopping slightly onto the floodplain. Here the channel flows roughly parallel with an adjacent pipeline, which cuts through the fields either side of the road. Flow was sluggish as a result of the shallow gradient and probable tidal locking. The road crossing appeared largely buried at this location, and flows appeared to be backing up upstream of the road leading to the spillage onto the floodplain.
Greatham Creek	Main River	Tees Estuary	Greatham Creek is the estuarine section of Greatham Beck, which flows from the north of Elwick (NZ 45077 33468) to Seal Sands (NZ 51667 25568).	Not visited during the site visit as it is outside of the Site boundary.
Mucky Fleet Swallow Fleet	Ordinary Watercourse	Tees Estuary	Mucky Fleet and Swallow Fleet are meandering channels draining Cowpen Marsh. A large number of marshland channels intersect these channels, which ultimately drain to the Tees Estuary.	Not visited during the site visit because they are outside of the Site boundary.

9.4.19 In addition to the watercourses described in Table 9A-3, there are numerous drains and ditches in the study area. These are predominantly related to drainage infrastructure in the industrial areas, and many are culverted beneath ground and so their exact course is unclear. In places, the drainage channels are visible above ground and are typically of the order of 0.5 to 1 m in width, ephemeral (i.e. flowing for only part of the year or only after storms), have artificial engineered and sometimes concrete channels.

9.4.20 There is also a network of small watercourse channels throughout the saltmarsh and wetland area to the south and southwest of Seal Sands. Some of these channels were observed on site from the Saltholme RSPB Nature Reserve, and they are small (1-2 m wide) low gradient, single thread, meandering waterbodies that are closely connected to their floodplains.

9.4.21 Other waterbodies shown in ES Figure 9-1: Surface Water features and Their Attributes (ES Volume II, Document. Ref. 6.3) outside of the 1 km Study Area are not included in this assessment where they are upstream of any proposed works and so would not have any pathways through which to be impacted. This includes Skelton Beck, Cross Beck, Spencer Beck, Middle Beck, Marton West Beck, Lustrum Beck, Billingham Beck, Cowbridge Beck, North Burn, Claxton Beck and Greatham Beck.

9.4.22 In total, there are over a large number of still waterbodies within 200 m of the Site boundary (see Appendix 13: Aquatic Desk Based Assessment, ES Volume I, Document. Ref. 6.2) the majority of which are small ponds or artificial standing waterbodies. The majority of these on the southeast bank of the Tees are small artificial waterbodies and ponds related to the surrounding industrial land use. To the northeast of the Tees there are further artificial and industrial waterbodies, such as the large brine reservoirs immediately north of the Site boundary at Saltholme. The surrounding wetlands here also include several large, interconnecting waterbodies which attract a great deal of biodiversity interest, especially birdlife. The ponds within the Site boundary itself are predominantly very small and generally artificial, with the exception being several waterbodies within the South Gare and Coatham dunes.

9.4.23 The EA own and maintain a number of flood defence assets along the River Tees near the Site. These include a series of embankments and walls upstream and downstream of the Tees Transporter Bridge (See Map provided by the EA in Annex A). There are also demountable defences that when erected create a wall with the same standard of protection as the surrounding defences. These are privately owned and maintained by Wilton International site.

Topography

9.4.24 The PCC Site is coastal, being located immediately southwest of Teesmouth, currently approximately 4 – 8 m above ordnance datum (AOD). Following site clearance and remediation a construction platform will be prepared for the PCC Site which will be at a minimum elevation of 7.5 mAOD.

9.4.25 The topography across the DCO boundary extending south and southwest of the PCC Site in order to accommodate the Natural Gas Connection Corridor and Electrical Connection Corridor rises slightly to the south and west,

reaching 25 m AOD at Lazenby and 30 m AOD in Grangetown. The elevation of the area around Tod Point sub-station is around 10mAOD.

9.4.26 The section of the Site comprising the Natural Gas Connection Corridor and CO_2 Gathering Network Corridor is very flat, being between 0 m and 10 m AOD. As shown on ES Figure 3-2B: Development Areas Natural Gas Connection Corridor (ES Volume II, Document. Ref. 6.3) the Natural Gas Connection Corridor extends east across the Tees and west as far as the brine field to the east of Cowpen Marsh. As shown on ES Figure 3-2E: Development Areas CO_2 Gathering Network (ES Volume II, Document. Ref. 6.3) the CO_2 Gathering Network follows pipelines around the perimeter of Salthome Nature Reserve, and into the industrial area at the eastern extent of Billingham.

Anticipated Ground Conditions and Hydrogeological Significance

Geology

9.4.27 Full details on geology and groundwater are provided in Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, Document. Ref. 6.2). In summary, the British Geological Society Geoindex viewer (BGS, 2020) indicates that the solid geology beneath the study site consists of Jurassic and Triassic age strata. Immediately around the River Tees and to the south of Teesmouth the bedrock is Mercia Mudstone. To the south of the Tees, the northern section of the PCC Site is also underlain by Mercia Mudstone, while the southern half of the PCC Site consists of Redcar Mudstone which also stretches south to beyond the Wilton International site and includes the majority of the town of Redcar.

9.4.28 To the north of the Tees, Mercia Mudstone underlies the Seal Sand Industrial Estate, but then gives way to Sherwood Sandstone Group which is widespread and underlies Seal Sands, Cowpen Marsh, Saltholme and the town of Billingham.

9.4.29 The superficial deposits beneath the majority of the Site consist of Tidal Flat Deposits (sand, silt and clay). These are found beneath the Tees Estuary, Teesmouth, Seal Sands, Cowpen Marsh and Saltholme. To the northeast of the site in the coastal area adjacent to Coatham Sands there are deposits of Beach and Tidal Flat Deposits and Blown Sand. The Lackenby Steelworks, Grangetown and Lazenby are underlain by glaciolacustrine deposits, Redcar is underlain by Devensian Till (diamicton). The northwest of the Study Area towards Cowpen Bewley is underlain by glaciolacustrine deposits. There are marine beach deposits on the coastline north of Teesmouth.

9.4.30 Bedrock and superficial geology present beneath the Site boundary is summarised in Table 9A-4.

Table 9A-4: Geology

Part of the Site	Flood Zone	Artificial Ground	Superficial Geology	Bedrock Geology
PCC Site	FZ1	Present below the Site	Blown Sand - Sand Tidal Flat Deposits – Sand and Silt	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
Onshore CO_2 Export Corridor	FZ1, FZ2, FZ3a	Present below the south and centre of the Site	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand - Sand Tidal Flat Deposits – Sand and Silt	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
Water Connections Corridors (Supply and Discharge) Corridors	FZ1, FZ2, FZ3a	Present below the south of the site	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand – Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
CO_2 Gathering Network and Gas Connection Corridor	FZ1, FZ2, FZ3a	Present either side of the River Tees (including reclaimed areas of Seal Sands, Bran Sands and Saltholme Marsh)	Till, Devensian - Diamicton Glaciolacustrine Deposits – Clay and Silt Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay Peat	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone Sherwood Sandstone Group - Sandstone
Electrical Connection Corridor	FZ1, FZ2	Present below the north west of the site	Till, Devensian - Diamicton Glaciofluvial Deposits, Devensian – Sand and Gravel Glaciolacustrine Deposits, Devensian – Clay and Silt Glaciolacustrine Deposits, Devensian – Sand Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay Peat	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone

Hydrogeology

9.4.31 ES Figures 10-17: Bedrock Aquifer and 10-18: Superficial Aquifer (ES Volume II, Document. Ref. 6.3) present the designated superficial and bedrock aquifers below the Site, respectively. The designated aquifers have been defined by the EA below:

- **Principal Aquifer:** "layers of rock or drift deposits that have high intergranular and / or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".
- **Secondary Aquifer – A:** "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".
- **Secondary Aquifer – B:** "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers".
- **Secondary Aquifer – Undifferentiated**: "has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type".
- **Unproductive Strata: "**These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".

9.4.32 Hydrogeological conditions for each area of the Proposed Development are summarised in Table 9A-5.

Table 9A-5: Hydrogeology

Relevant Feature	Aquifer Designation	Strata
PCC Site		
Superficial Aquifer Designation	Secondary Aquifer - A	Blown Sand and Tidal Flat Deposits (sand and silt)
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Source Protection Zones	None (Magic Defra)	
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation – Mudstone
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	

Relevant Feature	Aquifer Designation	Strata
Bedrock Aquifer Designation	Secondary Aquifer – B	Mercia Mudstone Group – Mudstone and Penarth Group – Mudstone
Source Protection Zones	None (Magic Defra)	
Onshore CO_2 Export Pipeline		
Superficial Aquifer Designation	Secondary Aquifer - A	Blown Sand and Tidal Flat Deposits (sand and silt)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Redcar Mudstone Formation – Mudstone Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
Water Supply and Discharge Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Redcar Mudstone Formation – Mudstone Mercia Mudstone Group – Mudstone and Penarth Group – Mudstone
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
CO_2 Gathering Network and Natural Gas Connection Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated Unproductive Strata	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton) Glaciolacustrine Deposits (clay and silt) and peat
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group-Sandstone Penarth Group – Mudstone and Redcar Mudstone Formation - Mudstone Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability	Low to High Vulnerability	

Relevant Feature	Aquifer Designation	Strata
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
Electrical Connection Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A	Glaciofluvial Deposits (sand and gravel), Blown Sand, Tidal Flat Deposits (sand and silt) and Glaciolacustrine Deposits (sand)
	Secondary Aquifer – Undifferentiated	Tidal Flat Deposits (sand, silt and clay), Till (Diamicton)
	Unproductive Strata	Glaciolacustrine Deposits (clay and silt)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation – Mudstone - Mudstone
	Secondary Aquifer - B	
Groundwater Vulnerability	Superficial: Low to High Vulnerability	
	Bedrock: Low to Medium Vulnerability	
Productive Strata	Productive	

9.4.33 Cranfield University's Soilscapes website (Cranfield University, n.d.) indicates that the majority of the study area either side of the Tees is underlain by loamy and clayey soils of coastal flats with naturally high groundwater. Sand dune soils are found along the coastal areas to the north of the study area.

9.4.34 The Study Area is not within a drinking water safeguard zone for groundwater or surface water.

9.5 The Proposed Development

Introduction

9.5.1 The Proposed Development comprises the construction, operation and decommissioning of the landward elements of a Carbon Capture Utilisation and Storage (CCUS) project comprising a low carbon power station together with equipment required for the capture and compression of carbon dioxide (CO_2) emissions.

9.5.2 In addition, there is a need for supporting infrastructure and connections to facilitate the Proposed Development and to integrate it to a wider industrial carbon capture network in Teesside, the construction of which also forms part of this project. Further details on the key elements of the Proposed Development are discussed in Chapter 4: Proposed Development (ES Volume I, Document. Ref. 6.2).

9.5.3 The design of the Proposed Development at this stage of the project incorporates a degree of flexibility in the dimensions and configurations of

buildings and structures to allow for the future selection of the preferred technology and contractor.

9.5.4 In order to ensure a robust assessment of the likely significant environmental effects of the Proposed Development, the supporting Environmental Impact Assessment (EIA) has being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate. This involves assessing the maximum (or where relevant, minimum) parameters for the elements where flexibility needs to be retained (building dimensions for example). Justification for the need to retain flexibility in certain parameters is outlined in Chapter 6: Alternatives and Design Evolution (ES Volume I, Document. Ref. 6.2).

Components of the Proposed Development

9.5.5 This section provides a summary of the Proposed Development as described in detail in Chapter 4: Proposed Development (ES Volume I, Document Ref. 6.2). The Proposed Development will comprise of the following:

- **Generating Station**: A new build low-carbon gas-fired electricity generating station with associated carbon capture plant, low pressure CO_2 compression and associated utilities and buildings.
- **Natural Gas Connection:** Natural gas pipeline to supply the Low-Carbon Electricity Generating Station.
- **Electrical Connection:** Electrical power export lines from the substation at the Low-Carbon Electricity Generating Station to a new NZT sub-station adjacent to the extended NGET sub-station at Tod Point.
- Water Connections (including):
  - **Water supply connection** - a connection corridor to public utility raw water supply infrastructure, for the provision of water for the Proposed Development; and
  - **Water discharge connection** using an existing or replacement outfall and associated pipework for the discharge of treated effluent and surface water to Tees Bay (including a potential pipeline connection for transportation of process water to Bran Sands Waste Water Treatment Plant and return for discharge).
- **CO_2 Gathering Network:** Gaseous phase medium pressure CO_2 Gathering Network for the purpose of connecting various industrial installations across the Tees Valley.
- **High Pressure CO_2 Compression Facilities:** In order to facilitate the transport of the CO_2 stream to the selected storage site, the CO_2 will need to be conditioned and compressed prior to its export from the Site.
- **CO2 Export Pipeline:** High pressure dense-phase CO2 Export Pipeline

Chemical Storage on Site

9.5.6 A number of chemicals will be required to be stored and used on Site. The inventory of materials to be stored on Site will be developed through the design process. However, where storage of hazardous materials – individually

or in-combination – exceeds the relevant thresholds, separate permissions will be sought from the Health and Safety Executive (HSE) and local planning authority as appropriate for their storage, under the Hazardous Substance Consent and Control of Major Accident Hazards (COMAH) regimes.

Lifetime of the Development

9.5.7 The PCC Site is located on the site of the former Redcar Steelworks which is brownfield land that currently contains some above and below ground structures and redundant services associated with the former steelworks. The removal of those structures, clearance and any necessary remediation of Site will be required before the construction of the main structures of the Proposed Development. Construction of the Proposed Development will occur over the period of late 2022 to 2026.

9.5.8 It is envisaged that the PCC Site will have a design life of around 25 years. At the end of the expected design life, these elements would be assessed for ongoing viability and, only if no longer viable, be decommissioned. It is therefore anticipated that, at the earliest, decommissioning of the PCC Site would be expected to commence at some point after 2051. The ES has assumed that the Proposed Development could operate for longer than a 25 year design life, and in relevant chapters has considered and assessed the potential for operational impacts / effects to continue beyond this timeframe.

9.5.9 The CO_2 Gathering Network and CO_2 Export Pipeline have been designed to operate independently of the PCC Site and will have a design life of around 40 years.

9.6 Planning Policy

9.6.1 The Sections below consider the planning policies and guidance of relevance to the Site with regards to the flood risks from all sources and appropriate mitigation measures which should be considered.

National Policy

National Policy Statements for Energy Infrastructure

9.6.2 A number of National Policy Statements (NPS) for energy Infrastructure were designated by the Secretary of State (SoS) under the Planning Act 2008 on 19th July 2011 (DECC 2011a – 2011d), specifically NPS EN-2 (NPS for Fossil Fuel Electricity Generating Infrastructure), NPS EN-4 (NPS for Gas Supply Infrastructure and Gas and Oil Pipelines) and NPS EN-5 (NPS for Electricity Networks Infrastructure) together with the Overarching NPS for Energy (EN-1). These cover Nationally Significant Infrastructure Projects that fall under the Planning Act 2008.

9.6.3 EN-1 states that “applications for energy projects of 1 hectare or greater in Flood Zone 1 and all proposals for energy projects located in Flood Zones 2 and 3 in should be accompanied by a NPPF compliant flood risk assessment”.

9.6.4 In determining an application for consent, EN-1 states that the decision-maker should be satisfied that where relevant:

- the application is supported by an appropriate FRA;

- the Sequential Test has been applied as part of site selection;
- a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk;
- the proposal is in line with the relevant national and local flood risk management strategy;
- priority has been given to the use of Sustainable Drainage Systems (SuDS); and
- in flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development.

9.6.5 Section 5.7.12 of NPS EN-1 also states that in England development should not be consented in Flood Zone 3 unless it is satisfied that the Sequential and Exception Test requirements have been met.

9.6.6 The technology-specific NPSs set out some exceptions to the application of the sequential test. However, when seeking development consent on a site allocated in a development plan through the application of the Sequential Test, informed by a strategic flood risk assessment, applicants need not apply the Sequential Test, but should apply the sequential approach to locating development within the site. Details of the Sequential Test and Exception Test requirements are provided in Sections 5.7.13-5.7.17 of the NPS EN-1; however, the PPG (Ministry of Housing, Communities and Local Government, 2019) provides more up to date policy definitions of these, as discussed below.

9.6.7 Section 5.15 of NPS EN-1 details that where the project is likely to have effects on the water environment, the applicant for development consent should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent.

National Planning Policy Framework

9.6.8 Published by the Ministry of Housing, Communities and Local Government, the NPPF (Ministry of Housing, Communities and Local Government, 2019a) was updated in June 2019. The NPPF has three overarching objectives to contribute to the achievement of sustainable development, one of which is the 'environmental objective'. This objective includes the requirement of "*helping to improve biodiversity, using natural resources prudently, and minimising waste and pollution*" (Paragraph 8c).

9.6.9 The NPPF contains several statements which are relevant to flood risk. These include:

- Strategic policies should set out an overall strategy for:
  - infrastructure for transport, telecommunications, security, waste management, water supply, wastewater, flood risk and coastal change management, and the provision of minerals and energy (including heat) (paragraph 20b); and
  - the pattern, scale and quality of development, and make provision for conservation and enhancement of the natural, built and historic

environment. This includes landscapes and green infrastructure, and planning measures to address climate change mitigation and adaptation (paragraph 20d).

- Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts. Development should not cause unacceptable levels of water pollution and should help improve water quality wherever possible (paragraph 149);
- Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere (paragraph 155);
- Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:
  - take account of advice from the lead local flood authority;
  - have appropriate proposed minimum operational standards;
  - have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
  - where possible, provide multifunctional benefits (paragraph 165).

9.6.10 The requirements of the NPPF with regards flood risk have been taken into account in the assessment.

National Planning Policy Guidance

9.6.11 The PPG (CLG, 2019) provides guidance for local planning authorities on assessing the significance of water environment effects of proposed developments. The guidance highlights that adequate water and wastewater infrastructure is needed to support sustainable development.

9.6.12 The NPPF and Flood Risk and Coastal Change section of the PPG recommend that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities (LLFAs) and Internal Drainage Boards (IDBs). Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:

- applying the Sequential Test;
- applying the Exception Test, if necessary;
- safeguarding land from development that is required for current and future flood management;

- using opportunities offered by new development to reduce the causes and impacts of flooding; and
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

9.6.13 The Flood Zone definitions used in both the NPS and NPPF as presented in Table 1 of the PPG are defined in Table 9A-6 below.

Table 9A-6: Flood Zone Definitions

Flood Zone	Definition	Probability of Flooding
Flood Zone 1	Land that has a low probability of flooding (less than 1 in 1,000 annual probability of river or sea flooding (<0.1%))	Low
Flood Zone 2	Land that has a medium probability of flooding (between 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1-1%), or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1-0.5%)	Medium
Flood Zone 3a	Land that has a high probability of flooding (1 in 100 year or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%)	High
Flood Zone 3b (Functional Floodplain)	Land where water has to flow or be stored in times of flood based on flood modelling of a 5% AEP event (1 in 20 chance of flooding in any one year) or greater, or land purposely designed to be flooded in an extreme flood event (0.1% AEP).	Very High

Source: Table 1 of the PPG[3]

9.6.14 As discussed in Section 9.2, the EA's 'Flood Map for Planning' identifies that the Site is located predominantly within Flood Zone 1 with some sections located in Flood Zones 2 and 3a. Further detail on these areas is provided below.

Vulnerability of the Proposed Development

9.6.15 As the Proposed Development (classified as essential infrastructure) is located across all flood zones the development proposals will need to satisfy both the Sequential and Exception Tests.

Sequential Test

9.6.16 A Sequential Test is required for developments in Flood Zones 2 and 3 and to assess flood risks across strategic development sites. The NPPF/PPG sets out the Sequential Test, which compares the Proposed Development site with other available sites to find out which has the lowest flood risk. The NPPF/PPG recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1). This section of the FRA sets out considers the results of the sequential test.

9.6.17 The Proposed Development is an NSIP. Requirements and restrictions in relation to the location of an NSIP within Flood Zone 3 are set out in para 5.7.13 of NPS EN-1. which states: "Preference should be given to locating projects in Flood Zone 1 in England. If there is no reasonably available site in

Flood Zone 1 then projects can be located in Flood Zone 2. If there is no reasonably available site in Flood Zones 1 or 2, then nationally significant energy infrastructure projects can be located in Flood Zone 3 subject to the Exception Test. Consideration of alternative sites should take account of the policy on alternatives set out in section 4.4 above".

9.6.18 The PCC Site, where the main operational Generating Station and associated carbon capture and compression infrastructure will be constructed and located, is entirely located within Flood Zone 1, the flood zone of lowest risk. The location of the PCC Site within the former Redcar Steelworks Site utilises previously developed land and specifically avoids the need for new built development in Flood Zone 2 or 3 therefore meets the requirements of the sequential test.

9.6.19 The site selection process for the location of the PCC Site is set out in Chapter 6: Alternatives and Design Evolution (ES Volume I, Document Ref. 6.2). In summary, the analysis of potential sites focussed on identifying a site that supports the development of a viable CCUS project that facilitates local regeneration industrial connectivity and the path to decarbonisation.

9.6.20 Prior to the Applicants' involvement in the Proposed Development, the project concept was initiated and developed by the Energy Technologies Institute and other parties. As part of that development work, an initial site selection process was conducted at a UK scale which identified Teesside or Humberside as the most suitable locations for CCUS deployment given the proximity to the North Sea and to clusters of industrial facilities. Teesside was selected as the preferred location based on the criteria used at the time.

- Within Teesside a number of sites were shortlisted including:
- the former Redcar Steelworks site;
- a brownfield plot on the Wilton International site near to Lazenby; and
- various sites within the Seal Sands area.

9.6.21 These sites (which are all located in Flood Zone 1) were ranked based on a series of criteria including site area, use of brownfield land, proximity to the coast for the export pipeline, access to natural gas supply, the electricity transmission system and a source of water, and potential for minimising environmental effects.

9.6.22 Through this process, a preferred site was identified as being most suitable for the Proposed Development location. This location also enabled linking to the Tees Valley Combined Authority work, to develop the Teesside industrial cluster.

9.6.23 This preferred site was identified as being brownfield, relatively distant from residential areas, of sufficient area to enable construction, having proximity to the necessary connections, being close to the North Sea coastline for off-shore export of CO_2 and of being accessible for construction including from port and jetty facilities.

9.6.24 When considering the Site as a whole and the development that will be carried out within parts of the Proposed Development (the connection corridors) are

of necessity partly located within Flood Zones 2 and 3a as defined in the Environment Agency's 'Flood Map for Planning'. These areas of land are:

- the coast at Coatham Sands (for the water discharge corridor and CO_2 Export Pipeline);
- along Dabholm Gut (for the CO_2 Gathering Network);
- the tidal River Tees (to be crossed by the Natural Gas Connection and CO_2 Gathering Network);
- land at Saltholme for the CO_2 Gathering Network including the two laydown areas - Work No. 9E in Flood Zone 2 and Work No. 9D in Flood Zone 3a (the latter benefiting from flood defences) (See Works Plans (Document Ref. 4.4) and Figure 5-1 (ES Volume II, Document Ref. 6.3)).

9.6.25 The Water Discharge Corridor and CO_2 Export Pipeline need to pass under Coatham Sands to allow discharge of surface water/cooling water and export of dense phase CO_2 to the off-shore Endurance Saline Aquifer CO_2 Store. Construction of these parts of the project does not require any above ground works directly within Flood Zones 2 or 3a as the launching/receiving areas for the tunnel and HDD bores would be located on the PCC Site on land in Flood Zone 1.

9.6.26 The Natural Gas Connection may need to cross the River Tees and pass under land in Flood Zones 2 and 3a via a Tunnel. The construction shafts will be located on land within Flood Zone 1 at Seal Sands and on Teesworks land. There will therefore be no direct works within Flood Zone 3a north of the Tees. The alternative routeing of the Natural Gas Connection from the eastern end of Dabholm Gut, north to the PCC Site commences with a new Above Ground Installation (AGI) constructed on land in Flood Zone 3a. Once operational, the site will be unattended except for maintenance work (e.g. pigging). The rest of this route of the Natural Gas Connection is within land in Flood Zone 1.

9.6.27 The CO_2 Gathering Network is located within land in Flood Zone 3a along the Dabholm Gut and passing through Saltholme. In both cases the CO_2 Gathering Network pipes will be installed on existing (or extended) pipe racking located in existing service corridors. If a crossing of the River Tees is required, the launch pit will be located within land in Flood Zone 1 at Seal Sands. The receiving pit would be located in land either in Flood Zone 1, 2 or Flood Zone 3a at the mouth or along the northern bank of the Dabholm Gut. The laydown areas are on agricultural land (Work 9E) an an existing compound (Work 9D).

9.6.28 Construction of a CO_2 Gathering Network through an existing operational pipeline corridor from Billingham to Seal Sands is essential to the Proposed Development, the objective of which is to facilitate the decarbonisation of industry in Teesside and helping achieve the UK Government's climate change targets. A similar routeing for the CO_2 Gathering Network would still be required for any similar carbon capture network development in Teesside since it needs to connect identified and existing industrial CO_2 emitters with the compression and CO_2 export facilities to offshore. The associated laydown areas are necessary to facilitate construction activity in the Saltholme area.

9.6.29 In the STBC Local Plan (STBC, 2019) Policy SD4 - Economic Growth Strategy states “The Seal Sands, North Tees and Billingham Chemical Complex areas are the main growth locations for hazardous installations including […] carbon capture and storage”. Much of the land within the Site connection corridors that lies in Flood Zone 3a is within the boundary of STBC.

9.6.30 Any construction works within Flood Zones 2 and 3a will be temporary in nature in terms of construction activities, and any permanent fixtures (required for the life of the Proposed Development) will only comprise a potential AGI at the eastern end of the Dabholm Gut and include buried pipelines or pipelines fixed to existing pipe-rack infrastructure.

9.6.31 Given the evidence provided above it is therefore considered that the Sequential Test is satisfied.

Exception Test

9.6.32 According to Table 2 of the PPG, the Proposed Development of a Power Station is classified as ‘Essential Infrastructure’. The definition of Essential Infrastructure includes ‘Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations’. The PPG provides a matrix (replicated in Table 9A-7, below) identifying which vulnerability classifications are appropriate within each Flood Zone.

9.6.33 As shown in Table 9A-7, whilst essential infrastructure is appropriate in Flood Zones 1 and 2 the application of the Exception Test is required for the elements of the Proposed Development located in Flood Zone 3a. As illustrated on Figure 9A-1, and discussed above, some of the Connection Corridors (as shown on Figure 3-2, ES Volume II, Document Ref. 6.3) are partially located within Flood Zone 3a. The only works directly in Flood Zone 3a are construction of the CO_2 Gathering Network and (if required) the AGI at the eastern end of Dabholm Gut. The available detailed maps presented within the Strategic Flood Risk Assessments (see Annex B) for STBC (Map 10,11,16,17 and 18) and RCBC (Map 1,2,14,15,16 and 17) confirm that the parts of the Proposed Development located within Flood 3 as outlined above are all within Flood Zone 3a.

Table 9A-7: Flood Risk Vulnerability and Flood Zone Compatibility

Flood risk Vulnerability classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b 'Functional Flood plain'	Exception test required	✓	×	×	×

Key
✓ Development is appropriate.
× Development should not be permitted

9.6.34 The detail of the exception test required for an NSIP is set at Paragraph 5.7.16 of the NPS EN-1 which states: "All three elements of the test will have to be passed for development to be consented. For the Exception Test to be passed:

1. "it must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;
2. the project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously developed land subject to any exceptions set out in the technology-specific NPSs; and
3. a FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere subject to the exception below and, where possible, will reduce flood risk overall."

Test 1. Sustainability Benefits

9.6.35 The Proposed Development will also have very clear wider sustainability benefits to the community and the UK as a whole. It will contribute to the security of electricity supplies and by providing low carbon generation and the necessary infrastructure to decarbonise local industries it will help support the transition to Net Zero by 2050.

9.6.36 Furthermore, the Proposed Development will have significant economic benefits in terms of safeguarding jobs associated with existing carbon intensive industries of Teesside while creating new jobs and supporting the development of green industries such as hydrogen production.

Test 2. Developable Land

9.6.37 Option 2 of the Gas Connection (Sembcorp pipeline connection) involves construction of an AGI in Flood Zone 3a at the eastern end of the Dabholm Gut. The area proposed for the AGI is previously developed land which is reclaimed marshland and currently used as a services corridor. This location

is required to be used since this is the location of the existing SembCorp pipeline that is to be connected to under Option 2.

9.6.38 The CO_2 Gathering Network is also developed on previously developed land, i.e. along the service corridors between Seal Sands and Billingham and along the northern bank of the Dabholm Gut.

Test 3. Project Safety

9.6.39 This site-wide FRA demonstrates (see Section 9.9) that the Proposed Development will be safe from the risk of flooding (through the implementation of various measures, including a Flood Emergency Response Plan) and will not increase the risk of flooding off-site.

9.6.40 Given the evidence provided above it is therefore considered that the Exception Test is satisfied.

Environment Agency Climate Change Guidance (2020)

9.6.41 The EA published updated climate change allowances in March 2020 (EA, 2020) to support NPPF, which supersede all previous allowances written in the 'PPG: Flood Risk & Coastal Change' and EA Climate Change Guidance 2019 (EA, 2019) are predictions of anticipated change for:

- peak river flow by River Basin District;
- peak rainfall intensity;
- sea level rise; and
- offshore wind speed and extreme wave height.

9.6.42 There are allowances for different climate scenarios over different epochs, or periods of time, over the coming century. They include figures for extreme climate change scenarios, known as High++ (H++) allowances.

9.6.43 To increase resilience to flooding these should be considered within an FRA in regard to future impacts from climate change on site specific planning applications. The EA's guidance outlines how and when allowances should be applied for FRAs.

Tidal Climate Change Allowances

9.6.44 Table 9A-8 is an extract replicated from Table 3 of the EA guidance detailing the revised anticipated rise in sea levels up to 2125.

Table 9A-8: Sea level allowance for each epoch in millimetres (mm) per year with total sea level rise for each epoch in brackets (use 1981 to 2000 baseline)

River Basin District	Allowance	2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125	Cumulative rise 2000 to 2125 / metres (m)
Northumbria	Higher central	4.6 (161 mm)	7.5 (225 mm)	10.1 (303 mm)	11.2 (336 mm)	1.03 m

River Basin District	Allowance	2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125	Cumulative rise 2000 to 2125 / metres (m)
	Upper end	5.8 (203 mm)	10.0 (300 mm)	14.3 (429 mm)	16.5 (495 mm)	1.43 m

9.6.45 As the Proposed Developments vulnerability is classified as Essential Infrastructure it is appropriate to apply the single H++ allowance. Table 9A-9 replicated from Table 4 of the EA guidance shows the H++ allowance total sea level rise to 2100.

Table 9A-9: H++ sea level rise allowance

Change to relative mean sea level	Total sea level rise to 2100*
H++	1.9m

*There is no H++ value beyond 2100

Fluvial Climate Change Allowances

9.6.46 For proposed developments in areas of fluvial flood risk, the flood risk vulnerability classification, flood zone and lifetime of development are of particular importance to determine the correct climate change allowance as detailed in Table 9A-10

Table 9A-10: Climate Change Allowances to apply based upon the Flood Zone and Development Lane Use Vulnerability

	Water Compatible	Less Vulnerable	More Vulnerable	Highly Vulnerable	Essential Infrastructure
Flood Zone 2	NA	CA	Assess CA & HCA	Assess HCA & UEA	Assess HCA & UEA
Flood Zone 3a	CA	Assess CA & HCA	Assess HCA & UEA	X	UEA
Flood Zone 3b	CA	X	X	X	UEA

NA = No Allowance; CA = Central Allowance; HCA = Higher Central Allowance; UEA = Upper End Allowance;
X = Development not permitted

9.6.47 As the Proposed Development is defined as 'Essential Infrastructure' from the vulnerability classifications in Table 2 of the NPPF, the corresponding percentages that should be assessed at sites within the Northumbria River Basin District are listed in Table 9A-11. The +30% Upper End and the 35% H++ allowances for climate change are therefore applicable to the Proposed Development as the proposed lifespan of the CO_2 Gathering Network, Compressor Station and CO_2 Export Pipeline could be up to 40 years.

Table 9A-11: EA Peak River Flow Climate Change Allowances for the Northumbria River Basin District

	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
H++	20%	35%	65%
Upper End Allowance	20%	30%	50%
Higher Central Allowance	15%	20%	25%
Central Allowance	10%	15%	20%

Pluvial Climate Change Allowances

9.6.48 To account for the anticipated changes in rainfall intensity, the EA's guidance (as shown in Table 9A-12) states that an FRA for an expected 25 plus year lifespan for parts of the Proposed Development should assess the 'Upper End' allowance to understand the potential impact and make suitable decisions to mitigate against pluvial flooding.

Table 9A-12: EA Peak Rainfall Intensity Climate Change Allowances across England

	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End Allowance	10%	20%	40%
Central Allowance	5%	10%	20%

9.6.49 Therefore, a +20% allowance for climate change is applicable to the Proposed Development at the Site. This will be taken into account in the calculations of surface water runoff rates and volumes in the Drainage Strategy for the Site.

9.6.50 When assessing a range of allowances for peak tidal, river flow or rainfall intensity, the following must be considered:

- likely depth, speed and extent of flooding for each of the assessed climate change allowances;
- vulnerability of the proposed development types or land use allocations to flooding;
- 'built in' resilience measures used, for example, raised floor levels; and
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

National Design Guide

9.6.51 The NPPF makes clear that creating high quality buildings and places is fundamental to what the planning and development process should achieve. The National Design Guide (Ministry of Housing, Communities and Local

Government, 2019b), published on 1st October 2019, illustrates how well-designed places that are beautiful, enduring and successful can be achieved in practice. It forms part of the Government's collection of planning practice guidance and should be read alongside the separate planning practice guidance.

9.6.52 Sections of the guidance relevant to the Proposed Development include:

- N2 Improve and enhance water management which states, "Well designed places integrate existing, and incorporate new natural features into a multifunctional network that supports quality of place, biodiversity and water management, and addresses climate change mitigation and resilience"; and
- R3 Maximise resilience which states "Well designed places contribute to community resilience and climate adaptation by addressing the potential effects of temperature extremes in summer and winter, increased flood risk, and more intense weather events such as rainstorms." R3 also states "Well designed places have sustainable drainage systems to manage surface water, flood risk and significant changes in rainfall. Urban environments make use of green sustainable drainage systems and natural flood resilience wherever possible. Homes and buildings also incorporate flood resistance and resilience measures where necessary and conserve water by harnessing rainfall or grey water for re-use on-site."

Non-Statutory SuDS Guidance

9.6.53 Defra published their Sustainable Drainage Systems: Non-Statutory Technical Standards (NSTS) in March 2015 (DEFRA, 2015) setting the requirements for the design, construction, maintenance and operation of SuDS. The NSTS are intended to be used alongside the NPPF and PPG.

9.6.54 The NSTS that are of chief concern in relation to the consideration of surface water flood risk to and from development relate to runoff destinations, peak flow control and volume control. Additional guidance is provided for structural integrity, designing for maintenance considerations and construction.

Regional Policy

Northumbria River Basin District Flood Risk Management Plan

9.6.55 The EA is required to prepare Flood Risk Management Plan's (FRMPs) for all of England covering flooding from Main Rivers, the sea and reservoirs.

9.6.56 The Northumbria River Basin District FRMP (EA, 2016) has been published by the EA and sets out objectives to manage flood risk for the region for the period 2015 to 2021. The Proposed Development is located within the Tees Management Catchment. The following relevant objectives are to be met in the Tees Catchment:

- Social Objectives
  - Reduce the number of people exposed to each category of flood hazard particularly high and extreme hazard;

  - Ensure that critical infrastructure remains operational during flood events; and
  - Reduce the social impact of flooding on communities at risk, especially in areas where there are high proportions of properties and social assets at risk.
- Economic Objectives
  - Reduce the direct economic damages to property and agriculture from flooding; and
  - Ensure that FRM expenditure follows the level of flood risk in the catchment.
- Environmental
  - Protect heritage sites from the effects of flooding and where possible use FRM activities to enhance the landscape;
  - Maintain and where possible improve the ecological function of designated sites through FRM activities;
  - Allow river channel processes to operate naturally within the catchment; and
  - No adverse impact on water quality as a result of flooding.

Tees Catchment Flood Management Plan

9.6.57 The role of Catchment Flood Management Plans (CFMP) are to identify flood risk management policies which will assist all key decision makers in the catchment to deliver sustainable flood risk management for the long term. The Tees CFMP (EA, 2009) considers all types of inland flooding, from rivers, ground water, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding).

9.6.58 The CFMP splits the Tees catchment into 8 sub-areas which have similar physical characteristics, sources of flooding and level of risk. The most appropriate approach to managing flood risk for each of the sub-areas is identified and one of six generic flood risk management policies is allocated to the area.

9.6.59 The Proposed Development is located in Sub-area 4 – Eastern and identifies that flooding from rivers and surface water flooding problems from the drainage systems are the main sources of flood risk in the sub-area.

9.6.60 The key factors affecting Sub-area 4, which contains Stockton-On-Tees, include future coastal flood risk as a result of sea level rise, high urban flood risk due to increasing use of culverts and channel straightening, and increasing development pressure in the sub-area. Because of this, the CFMP policy is to take further action to reduce flood risk there by actions such as investigating flood storage options, developing a Surface Water Maintenance and Management Plan (SWMP) and developing an asset management plan for flood defences and channel maintenance.

River Tyne to Flamborough Head Shoreline Management Plan

9.6.61 The purpose of a Shoreline Management Plan is to identify the most sustainable approach to managing the flood and coastal erosion risks to the coastline in the short-term (0 to 20 years), medium term (20 to 50 years) and long term (50 to 100 years).

9.6.62 In the River Tyne to Flamborough Head SMP (Royal Haskoning, 2007), the Site location falls into 'Policy Development Zone 5 - Hartlepool Headland to Saltburn Scar and Management Area 13 (MA13) - Little Scar to Coatham Sands.

9.6.63 The report identifies MA13 to be an area of low to high flood risk where the LLFA and the EA are already working towards managing the risk (the Site itself is located in an area shown to be at low risk of flooding from tidal sources). However, it is also an area that will be affected by climate change due to the low-lying land and its coastal location, and so will need ongoing maintenance and defence improvements. Overall, the policy for MA13 is to "*hold the line/ maintain the structure - maintain or change the level of protection provided by defences. This would include work or operations carried out in front of the existing defences or where, while maintaining existing defences, policies involve operations to the back of defences (such as secondary flood defences) as an essential part of maintaining the current defence system*". To the south and east of the Estuary, where the Site is located), the policy is for "*no active intervention allowing natural development of the Coatham Sands and potential enhancement of habitat behind*".

Local Policy

9.6.64 The Site lies within the administrative areas of RCBC (the PCC Site, together with the connection corridors for the electrical grid connection, water supply and discharge and the onshore element of the CO_2 Export Pipeline) and STBC (connections to the NGG and a CO_2 Gathering Network).

9.6.65 The local development plans for these areas, which EN-1 confirms may be 'important and relevant' in the determination of a DCO application, currently comprise the following documents:

- Redcar & Cleveland Local Plan – adopted 2018 (RCBC, 2018); and
- Stockton on Tees Borough Council Local Development Plan (adopted 2019) (STBC, 2019).

9.6.66 The Redcar and Cleveland Local Plan sets out the vision and overall development strategy for the Council's area and how it will be achieved for the period until 2032. Specific policies are highlighted in Table 9A-13.

Table 9A-13: Relevant RCBC Local Planning Policies

Document	Policy/Guidance
Redcar & Cleveland Local Plan	Policy SD1 – Sustainable Development When considering development proposals, the Council will take a positive approach that reflects the presumption in favour of sustainable development contained in the NPPF.
	Policy SD2 - Locational Policy

Document	Policy/Guidance
	Development will be directed to the most sustainable locations in the borough. The majority of development will be focused in the urban and coastal areas. The location of new development will avoid areas at risk of flooding in line with the requirements set out in PPG25. (NB. PPS 25 as referenced in objective 1 is now superseded as discussed in Section 15.2).
	Policy SD4 – General Development Principles In assessing the suitability of a site or location, development will be permitted where it; f. will not increase flood risk either on site or downstream of the development; and l. be sustainable in design and construction, incorporating best practice in resource management, energy efficiency and climate change adaptation.
	Policy SD7 – Flood and Water Management Flood risk will be taken into account at all stages in the planning process to avoid inappropriate development in areas at current or future risk. Development in areas at risk of flooding, as identified by the EA flood risk maps, will only be granted where all the following criteria are met: a) the proposal meets the sequential and exception tests (where required) in relation to the NPPF; b) a site-specific flood risk assessment demonstrates that the development will be safe, including the access and egress, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall; and c) new site drainage systems are well designed, taking account of events that exceed normal design standard (e.g. consideration of flood flow routing and utilising temporary storage areas). All development proposals will be expected to be designed to mitigate and adapt to climate change, taking account of flood risk by: d) ensuring opportunities to contribute to the mitigation of flooding elsewhere are taken; e) prioritising the use of sustainable drainage systems (SuDS) f) ensuring the full separation of foul and surface water flows; and g) ensuring development is in accordance with the Redcar and Cleveland SFRA. A site-specific flood risk assessment will be required to be carried out to demonstrate that the development is not at risk from flooding and that it does not increase flood risk downstream in the following circumstances: h) proposals of 1 ha in size or greater in Flood Zone 1; or i) proposals for new development (including minor development and change of use) in Flood Zones 3a or Flood Zone 2; or j) proposals for new development in areas susceptible to surface water flooding; or k) proposals situated in an area currently benefitting from defences; or l) proposals within 20m of a bank top of a main river; or

Document	Policy/Guidance
	m) proposals over a culverted watercourse or where development will be required to control or influence the flow of any watercourse; or n) where the Proposed Development may be subject to other sources of flooding. Surface water runoff not collected.

9.6.67 The STBC Local Development Plan was adopted in January 2019 and sets out the Council's policies and proposals to guide planning decisions and establishes the framework for the sustainable economic growth and development of the Borough up to 2032. Specific policies are highlighted in Table 9A-14.

Table 9A-14: Relevant STBC Local Planning Policies

Document	Policy/Guidance
Stockton on Tees Local Development Plan (2019) 1.0	Strategic Development Policy SD5 – Natural, Built and Historic Environment To ensure the conservation and enhancement of the environment alongside meeting the challenge of climate change the Council will 2). Meet the challenge of climate change, flooding and coastal change through a variety of methods including: • Supporting sustainable water management within development proposals; • Directing new development towards areas of low flood risk (Flood Zone 1) ensuring flood risk is not increased elsewhere, and working with developers and partners to reduce flood risk; • Ensuring development takes into account the risks and opportunities associated with future changes to climate and are adaptable to changing social, technological and economic conditions such as incorporating suitable and effective climate change adaptation principle; and • Ensuring development minimises the effects of climate change and encourage new development to meet the highest feasible environmental standards.
	Policy ENV4 – Reducing and Mitigating Flood Risk All new development will be directed towards areas of the lowest risk to minimise the risk of flooding from all sources and will mitigate any such risk through design and implementing sustainable drainage (SuDS) principles. Development on land in Flood Zones 2 or 3 will only be permitted following: a) The successful completion of the Sequential and Exception Tests (where required); and b) A site-specific flood risk assessment, demonstrating development will be safe over the lifetime of the development, including access and egress, without increasing flood risk elsewhere and where possible reducing flood risk overall. Site specific flood risk assessments will be required in accordance with national policy. All development proposals will be designed to ensure that:

Document	Policy/Guidance
	a) Opportunities are taken to mitigate the risk of flooding elsewhere; Foul and surface water flows are separated; b) Appropriate surface water drainage mitigation measures are incorporated, and Sustainable Drainage Systems are prioritised; and c) SuDs have regards to Tees Valley Authorities Local Standards for Sustainable drainage (2015) or successor document. Surface water runoff should be managed at source wherever possible and disposed of in the following hierarchy of preference sequence: a) To an infiltration or soak away system; then b) To a watercourse open or closed; then c) To a sewer. For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1-in-1 rainfall event and the 1-in-100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event. Within critical drainage areas or other areas identified as having particular flood risk issues the Council may: a) Support reduced runoff rates; and b) Seek contributions, where appropriate, towards off-site enhancements directly related to flow paths from the development, to provide increased flood risk benefits to the site and surrounding areas. SuDS should be provided on major development unless demonstrated to be inappropriate. The incorporation of SuDS should be integral to the design process and be integrated with green infrastructure. Where SuDS are provided, arrangements must be put in place for their whole life management and maintenance. Through partnership working the Council will work to achieve the goals of the Stockton on Tees Local Flood Risk Management Strategy and the Northumbria Catchment Flood Management Plan. To reduce the risk of flooding the Council is working in partnership with the Environment Agency to deliver a Flood Alleviation Scheme on Lustrum Beck.

Other Relevant Policy and Guidance

Local Flood Risk Management Strategies

9.6.68 The vision of both the Stockton-on-Tees Local Flood Risk Management Strategy (FRMS) (STBC, 2015) and the Redcar and Cleveland FRMS (RCBC, 2017) is "*To work with our partners in the Borough of Stockton-On-Tees to reduce the risk of flooding to residents and businesses and ensure that flood risk is managed in the most effective and sustainable way*".

9.6.69 The strategies assess local flood risk (from surface water, groundwater and ordinary watercourses) within the boroughs and set objectives for managing this risk. The strategy will detail mechanisms for achieving the objectives and seeks to reduce the risk of flooding to residents in both boroughs.

Strategic Flood Risk Assessments

9.6.70 A Strategic Flood Risk Assessment (SFRA) provides the central source of all relevant flood risk information. An SFRA is required to initiate the sequential risk-based approach to the allocation of land for development in the Councils Local Plans and to identify whether the application of the Exception Test is likely to be necessary.

9.6.71 The STBC Level 1 SFRA (Stockton-on-Tees Borough Council, 2018a) indicates that the majority of fluvial flood risk comes from the River Tees. The tidal flood risk is particularly extensive, placing large parts of the industrial area on the north bank of the Tees Estuary and other, more central parts of the Borough, at risk. Tide locking (prevention of fluvial flow discharging due to high tide levels) is also a contributing flood risk factor on many watercourses that flow into the tidal Tees. In the Level 2 SFRA (Stockton-on-Tees Borough Council, 2018b) three allocation sites have been taken forward from the Level 1 SFRA for a more detailed Level 2 screening assessment.

9.6.72 The RCBC Level 1 SFRA (Redcar and Cleveland Borough Council, 2010) notes that fluvial flood risk in the borough is low and tidal risk mainly comes from the Tees Estuary in the west of the borough though is confined to the Docklands area. The Level 2 SFRA (JBA Consulting, 2010) provides a detailed assessment of flood hazards for the area at risk of tidal flooding and how this risk impacts on allocated development sites and available employment land. The study has identified three areas in the Borough which have critical drainage problems. These are Redcar, Eston and Guisborough.

Preliminary Flood Risk Assessments

9.6.73 In their roles as LLFAs, STBC and RCBC have produced Preliminary Flood Risk Assessment (PFRA) reports to meet their statutory duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations 2009. The Regulations require LLFAs, through the PFRA process, to determine whether there is a significant risk in their area based on local flooding (surface water, groundwater, ordinary watercourses and canals) and to identify the part of the area affected by these risks.

9.6.74 The purpose of a PFRA report is to provide a strategic assessment of flood risk from local sources including surface water, groundwater, ordinary watercourses and canals. The reports are high-level screening exercises using readily available data held by the Councils and partnering organisations. The reports look at historical flood events and consider the potential future flood events that may have a significant consequence on human health, economic activity and the environment including cultural heritage.

9.6.75 The STBC PFRA (STBC, 2011) identifies six locations which have been subject to historical flooding. Of these locations Port Clarence and Lustrum Beck, although located outside the proposed Site boundary, fall within the Study Area.

9.6.76 The RCBC PFRA (Redcar and Cleveland Borough Council, 2011) notes that there are a number of locations across Redcar and Cleveland that are subject to frequent flooding from local sources, particularly from surface water.

Tees Valley Authorities Local Standards for Sustainable Drainage

9.6.77 The Tees Valley Authorities Local Standards for Sustainable Drainage document (Tees Valley Authorities, 2015) has been produced by a working group from the Local Authorities of Hartlepool, Middlesbrough, Redcar and Cleveland, Stockton-on-Tees and Darlington Borough Councils. This document forms the local standards for the Local Authorities and, together with the National Standards, strongly promotes the use of SuDS which help to reduce surface water runoff and mitigate flood risk.

9.6.78 The document indicates the minimum standards to ensure a satisfactory scheme is constructed under the Flood and Water Management Act 2010 (FMWA), although they are not intended to preclude any requirement for a higher standard that may be deemed necessary. Adherence to the standards set out in the document will ensure that the Local Authority is willing to maintain the new systems on completion.

9.6.79 Local principles and requirements include:

- Plan for SuDS - SuDS should be incorporated into the early design process (as feasible). Investing in good design and identifying the requirements, issues and opportunities for SuDS at the early stages of a project is likely to be repaid in the long-term;
- Integrate with public spaces - Where possible SuDS should be combined with public space to create multi-functional use areas and provide amenity. For example, SuDS features could be incorporated into traffic calming and parking areas (on street and car parks);
- Manage rainfall at source - Surface water runoff should be captured as close to where it falls as possible. Management and conveyance of surface runoff should be kept on the surface as far as possible;
- Mimic natural drainage - SuDS networks will be designed to match natural drainage routes, infiltration rates and discharges as far as possible;
- Design for water scarcity - New development should consider incorporating rainwater/grey water re-use facilities;
- Enhance Biodiversity - Consideration for landscape and biodiversity is critical to delivering contextually appropriate SuDS schemes;
- Link to wider landscape - Opportunities to link SuDS to existing or potential future blue and green infrastructure should be explored. Suds schemes should fit with the local landscape character. Designers should take advantage of local topography and other landscape features such as trees, hedgerows, fence lines and local materials to enhance local character;
- Design to be maintainable - It is extremely important that from the outset maintenance requirements for SuDS are considered and reflected in the design. Throughout the process, it should be considered how features can be accessed, who will be responsible for maintaining them and how much it is likely to cost. Good management and design go together;

- Use a precautionary approach - The natural floodplain must be protected and considered in design. Developments within the fluvial floodplain need to be avoided because SuDS will be ineffective when flooded. SuDS should be carefully designed where there is the presence of contaminated soils. System components should be designed to maximise their adaptive capacity;
- Have regard to the historic environment - SuDS design and construction should be complementary to the heritage of the area;
- Show attention to detail - SuDS must be carefully designed using attention to detail to ensure they function as intended; and
- All SuDS elements should be designed to minimise risk to the general public.

Building Standards Regulations 2000 Part H

9.6.80 The Building Standards Regulations 2000 Part H (Her Majesty's Government, 2015) requires that surface water runoff be preferentially discharged first to soakaway, then to surface watercourse and finally to sewer.

9.7 Flood Risk Sources

9.7.1 The NPS requires the effects of all forms of flood risk, both to and from the Proposed Development, are considered within the FRA. There should be demonstration of how these should be managed so that the development remains safe throughout its lifetime, taking into account current climate change predictions.

9.7.2 This section discusses these potential risks in relation to tidal, fluvial, surface water runoff, groundwater and man-made/artificial sources.

Historical Flooding Incidents

9.7.3 The history of tidal flooding from the Tees Estuary dates back as far as 1836, according to the online BHS Chronology of British Hydrological Events (University of Dundee, 2020), there was severe tidal flooding of Stockton on Tees in this year and then again in Middlesbrough in 1903.

9.7.4 STBC hold no records of historical flooding for Ordinary Watercourses in the vicinity of the Site.

9.7.5 The main source of historic flooding in RCBC is from the other local sources e.g. surface water sewers, water authority combined sewers, smaller (ordinary) watercourses and drains. All of the main urban areas in RCBC have been subject to this type of local flooding at different times. In total, nearly 800 flooding incidents have been recorded by the different data holders, effecting around 10 main locations. The main local flood risk locations, identified in the SFRA are Eston, Guisborough and Redcar. These have been classed as Critical Drainage Areas (CDAs) within the SFRA.

9.7.6 Records of historical flooding are summarised in Table 9A-15.

Table 9A-15: Records of Historical Flooding

Date	Flooding Source	Overview
1953	Tidal	An area of low pressure, in conjunction with North Westerly winds and a high spring tide, caused a large tidal surge and flooding of Port Clarence to a depth of 1.2 m, the peak water level was 4.01 m above ordnance datum (AOD) at the Tees Estuary. There were two breaches of the embankments at Greatham Creek on both the North and South embankment, in the vicinity of the A178. Other areas affected include Billingham Reach Industrial Estate, Tees Marshalling Yard, along with, many of the lower reaches of the tidal River Tees.
January 1978	Tidal	A breach of the Greatham Creek defences where both the North and South banks were breached downstream of the A178.
1983	Tidal	A breach of the Greatham Creek Southern flood defence embankment both upstream and downstream of the A178, with a peak tide level of 3.65 m AOD.
March 1999	Fluvial	Substantial flooding occurred due to heavy rain and peak flows unable to pass through Holme Fleet culvert, which is located to the north of Port Clarence. It was reported that the culvert was blocked at the time by material which had entered the access chambers
8th November 2000	Fluvial	Between 2 - 4am an intense storm hit the area of Port Clarence, approximately 16 properties suffered from internal flooding with flood water reaching ground floor level. It was reported that the flooding occurred due to Holme Fleet Beck overtopping due to heavy rainfall.
Unknown	Groundwater	Flooding to the south of Marske, directly below Errington Wood.
25/26th September 2012	Fluvial and Surface Water	24 hours of persistent heavy rain followed the wettest summer on record, resulting in fluvial and surface water flooding of several communities. The most severely affected were those along Lustrum Beck, and those in Norton near Billingham Beck. Traffic disruption also occurred following flooding of the A19/A66 trunk road. The report estimates that 150 properties and businesses were flooded internally.
5th December 2013	Tidal	Tidal flooding occurred within the Stockton borough due to a combination of a high spring tide and a low-pressure system causing a positive tidal surge. The total tide height was 4.09 m AOD, which surpassed the recorded historic events in the area. 32 residential properties were internally flooded at Port Clarence, as well as 20 businesses across Port Clarence, Billingham Reach Industrial Estate and Seal Sands. There was significant infrastructure damage, including the closure of the A19 Portrack interchange and partial closure of the A66 trunk road at Teesside Park. Breach of the flood defences at Greatham Creek flooded a large area of land.
1st April 2017	Fluvial/ Surface Water/ Drainage Infrastructure	Cross Beck catchment in Eston and Spencer Beck catchment in Teesville affected. Met Office confirmed that 1 weeks' worth of rain fell in 1 hour and Northumbrian Water

Date	Flooding Source	Overview
		Limited confirmed the event was a 1 in 197-year storm. Ground conditions were very dry prior to the event which exacerbated the speed of run off from land to watercourses. Intensity of rainfall resulted in all drainage systems being inundated and overwhelmed.

Tidal Sources

9.7.7 The PCC Site is situated in a coastal location, with the North Sea approximately 0.6 km to the north.

9.7.8 The River Tees is classified as an EA Main River on the Digital Mapping Network and is located approximately 1.6 km to the west of the proposed DCO Site boundary. The River Tees is tidal at this location, with the normal tidal limit approximately 14 km upstream (at the Tees Barrage).

9.7.9 Greatham Creek, an EA Main River, is a tidal watercourse which flows in a westerly direction, following the STBC boundary, and discharges into the Tees at Seal Sands. Its tidal limit extends to a weir, which is 300 m upstream of the confluence with Cowbridge Beck, outside of Stockton Borough. The Creek is crossed by bridges which carry the A178 trunk road and the emergency access road to Seal Sands. There is a history of tidal flooding and breach of the defences at Greatham Creek.

9.7.10 The STBC SFRA states “The tidal flood risk is particularly extensive, placing large parts of the industrial area on the north bank of the Tees Estuary and other, more central parts of the Borough, at risk. In addition, tide locking (prevention of fluvial flow discharging due to high tide levels) is also a contributing flood risk factor on many watercourses that flow into the tidal Tees”.

9.7.11 Flood defence and artificial ground raising protect much of Stockton BC from tidal flooding. There is the potential for some defences to be outflanked, notably those at Port Clarence, Old River Tees and at Greatham Creek.

Flood Map for Planning

9.7.12 The EA’s ‘Flood Map for Planning’ (available to view on their website) identifies areas subject to fluvial/tidal flood risk for the present day but does not include the benefits or impacts of any existing flood defences or climate change respectively.

9.7.13 The available Flood Maps illustrate that the entirety of the PCC Site is located within Flood Zone 1 (low risk of flooding from fluvial and/ or tidal sources). The exceptions to this are as outlined in Section 9.6 above (i.e. sections of the connection corridors which extend into Flood Zone 3a (high risk of flooding from fluvial and/ or tidal sources). Furthermore, the only works directly in Flood Zone 3a are construction of the CO_2 Gathering Network and (if required) the AGI at the eastern end of Dabholm Gut. The available detailed maps presented within the Strategic Flood Risk Assessments for STBC (Map 10,11,16,17 and 18) and RCBC (Map 1,2,14,15,16 and 17) (see Annex B) confirm that the parts of the Proposed Development located within Flood Zone 3 are all within Flood Zone 3a. There is no land within the proposed DCO boundary within Flood Zone 3b (Functional Floodplain).

9.7.14 Flooding is more extensive to the north bank of the River Tees with flooding predominantly associated with Greatham Creek, Mucky Fleet and Swallow Fleet. The connection corridor that extends out towards Billingham is located in Flood Zone 1 (low risk), Flood Zone 2 (medium risk) and Flood Zone 3a (high risk) with the main area at risk located to the north of Port Clarence.

9.7.15 Flood zone definitions are summarised in Section 9.6 Table 9A-6 and the supporting flood risk mapping is presented on ES Figure 9-4: Environment Agency Fluvial Flood Zones (ES Volume II, Document Ref. 6.3).

Flood Defences

9.7.16 In accordance with the NPPF, the requirements are to ensure any proposed developments are built to withstand tidal flooding up to a 0.5% AEP (1 in 200 chance) event taking into account the potential impacts of climate change.

9.7.17 It is noted in the STBC SFRA that “flood defence and artificial ground raising protect much of Stockton BC from tidal flooding”.

9.7.18 Consultation with the EA (see Annex A) identifies that the EA own and maintain a number of flood defence assets along the River Tees near the Site. This includes a series of embankments and walls upstream and downstream of the Transporter Bridge (see map in Annex A). There are also demountable defences (that when erected create a wall with the same standard of protection as the surrounding defences). These are privately owned and maintained by Wilton International site.

9.7.19 According to the additional information provided by the EA (see Annex A), the tidal defences protecting this Site consist of a combination of high ground and raised defences, including floodwalls and flood banks. They are in ‘very good to good’ condition and reduce the risk of flooding up to a 0.5% AEP (1 in 200 chance in any year) event. The EA inspects these defences routinely to ensure potential defects are identified.

9.7.20 The Environment Agency has recently undertaken a major flood defence scheme to protect Port Clarence and some of the surrounding industrial areas from tidal flooding. The work started in 2015 and completed in 2019.

9.7.21 Phase 1 of the works involved improving the defences along the north bank of the river Tees both up and downstream of the Transporter Bridge. This involved a new flood wall through the Wilton International site, a road hump just before the access to the bridge and improvements to the flood bank downstream of the bridge. This work is now complete and is the main protection for Port Clarence.

9.7.22 Phase 2 involved improving the defences along the south bank of Greatham Creek. This work has improved the protection of the industrial complexes near Seal Sands and also prevents Port Clarence flooding from the north during extreme tidal events.

Modelled Tidal Water Levels

9.7.23 The EA provided modelled tidal peak water levels for the tidal Tees area for the 0.5% AEP (1 in 200 year), 0.1% AEP (1 in 1000 year) and 0.1% AEP with climate change scenario flood events to inform this FRA (see Annex A).

9.7.24 The current day outputs are from the 2020 Greatham and Port Clarence model update report 2011 Tidal Tees Integrated Flood Risk Modelling Study and the 1,000-year +climate change levels are from the 2015 Tidal Tees Integrated Flood Risk Modelling Study. The 1,000-year + climate change events was not provided in the 2020 update modelling, however, the 2015 results were deemed appropriate as climate change uplifts have not changed in this time period and current day levels have slightly decreased in the new modelling. This means that the 2015 estimates still accurately represent flood risk in the area. Running the 1,000-year + climate change scenario, the maximum water levels along the reach are presented in Table 9A-16. These are the current best estimate for extreme tide levels in the vicinity.

9.7.25 The EA's model demonstrated that during a 0.1% AEP (1 in 1000 chance) event based upon the existing (2019) scenario, tidal levels in the Tees Estuary could rise up to 4.33 m AOD at the mouth of the estuary and up to 4.40 m AOD where the A19 crosses the Tees near Portrack.

Table 9A-16: Modelled water levels for the Tidal River Tees

Location	Return Period Undefended Scenario Water Levels (mAOD)			Return Period Defended Scenario Water Levels (mAOD)		
Location	0.5%	0.1%	0.1% + cc	0.5%	0.1%	0.1% + cc
NZ 55096 28427 (Teesmouth)	4.0810	4.33	5.25	4.08-	4.33-	-
NZ 54455 26362 (opp. RBT)	4.0811	4.33	5.26	4.0811	4.33	5.26
NZ 54745 24769 (opp. Dabholme Gut)	4.0911	4.33	5.27	4.0912	4.34	5.26
NZ 51605 20997 (opp. Clarence Wharf)	4.12	4.36	5.29	4.12	4.37	5.27
NZ 50618 21103 (opp. Port Clarence)	4.13	4.3640	5.30	4.13	4.37	5.26
NZ 47863 19935 (Newport Bridge)	4.15	4.40	5.32	4.15	4.40	5.29
NZ 47539 19485 (Portrack)	4.16	4.40	5.33	4.15	4.40	5.29

Source: 2011 Tidal Tees Integrated Flood Risk Modelling Study and 2015 Tidal Tees Integrated Flood Risk Modelling Study: Running the 1,000-year + climate change 2020 Greatham and Port Clarence model update report. (EA Consultation – Annex A)

9.7.26 The 0.1% AEP (1 in 1000 chance) including climate change modelled water levels were taken from the 2015 Tidal Tees Integrated Flood Risk Modelling Study and demonstrate that during a 0.1% AEP event based upon the future 2115 scenario, tidal levels in the Tees Estuary could rise up to 5.25 m AOD at the mouth of the estuary and up to 5.33 m AOD where the A19 crosses the Tees near Portrack.

9.7.27 The EA climate change guidance was recently updated with revised sea level allowances (see Table 9A-8 up to the year 2125. Applying these sea level allowances to the existing (2019) scenarios indicates water levels along the estuary could increase by 0.94 m using the Higher Central allowance and 1.32 m using the Upper End allowance. Table 9A-17 below shows the water levels for a 0.5% AEP and 0.1% AEP flood event when the Higher Central Upper End and H++ allowances are applied.

Table 9A-17: Tidal water levels for the Tidal River Tees with climate change allowances (m AOD)

Location	Higher Central (total increase 0.94m to 2125)		Upper End (total increase 1.32m to 2125)		H++ (1.9m increase to 2100)	
	0.5%	0.1%	0.5%	0.1%	0.5%	0.1%
NZ 55096 28427 (Teesmouth)	5.02	5.27	5.40	5.65	5.98	6.23
NZ 47539 19485 (Portrack)	5.10	5.34	5.48	5.72	6.06	6.30

In reality, given the expected lifetime of the development (up to 40 years), climate change flood water levels will be significantly less than those shown in Table 9A-17 above with a decrease of 0.5m for the Higher Central allowance water levels and a 0.68m decrease for the Upper End allowance water levels.

Residual Flood Risk- Overtopping and/ or Breach of Flood Defences

Overtopping of Flood Defences

9.7.28 Existing flood defences along both banks of the River Tees generally comprise high ground and provide protection against flooding up to and including the 0.5% AEP (1 in 200) flood event.

9.7.29 Historically, flood defences comprising flood walls and flood banks have been known to overtop in the Port Clarence area flooding land to the north of the River Tees, however, a new flood defence scheme has recently been constructed to a minimum standard of 0.5% AEP to protect against the risk of flooding in this area.

9.7.30 There is no overtopping scenario hazard mapping data available from the EA to inform this assessment, therefore it is assumed that overtopping of the flood defences, as a worst-case scenario, would result in a similar flood extent to the undefended Flood Zone 2 and Flood Zone 3a flood extents provided by the EA.

9.7.31 In accordance with the NPPF, the assessment of overtopping should be undertaken using the 0.5% AEP (1 in 200 year event) plus climate change design tidal event.

9.7.32 The PCC Site is located in Flood Zone 1 and the Proposed Development will be sited at a level no lower than 7.5 m AOD. In addition, the topography across the DCO boundary, extending south and southwest of the PCC Site in the areas of the Natural Gas Connection Corridor and Electrical Connection

Corridor, rises slightly to the south and west, reaching 25 m AOD at Lazenby and 30 m AOD in Grangetown.

9.7.33 The 0.5% AEP climate change water level (adjusted using the Upper End allowance) is calculated as 5.40m AOD at the mouth of the Tees Estuary and therefore significantly below the site levels in this area. Even if the assessment were to be undertaken using the H++ water level of 5.98m AOD (for a 0.5% AEP tidal event) and 6.23m AOD (for a 0.1% AEP tidal event) the risk to the PCC Site would remain at low risk of flooding (i.e. within Flood Zone 1) should overtopping of the high ground occur.

9.7.34 The Proposed Development located to the south and southwest of the PCC Site (the Water Connection Corridor, Water Supply Corridor and the Electrical Connection Corridor) are all located below ground and will remain at low risk of flooding.

9.7.35 The Natural Gas Corridor and CO_2 Gathering Network, both buried at the point where they cross the River Tees will also be at low risk during a flood event.

9.7.36 In the Port Clarence/ Portrack area, should overtopping occur for the present day scenario along the River Tees or Greatham Brook, the CO_2 Gathering network, to the east of Billingham, which will use an existing above ground pipe racking network, existing culverts and overbridges, would be flooded and assuming a worst case scenario, the area flooded would be similar to the Flood Zone 3a extent shown on the current EA flood map.

9.7.37 Overtopping of the flood defences in this area for the Upper End and H++ scenarios would result in an increase in flood depth and an increase in flood extents meaning a greater area of the CO_2 Gathering network, i.e. the area currently located within Flood Zone 1 to the east of Billingham, would be at risk of flooding

Breach/ Failure of Flood Defences

9.7.38 Existing flood defences along both banks of the River Tees generally comprise high ground and provide protection against flooding up to and including the 0.5% AEP (1 in 200) flood event. High ground is generally not susceptible to breach and/or failure therefore the main residual tidal flood risk along the Tees Estuary is from overtopping, as outlined above.

9.7.39 Historically, flood defences at Port Clarence (flood walls and flood banks) and flood embankments along Greatham Creek have breached flooding land between the two watercourses where ground levels are between 0 to 10m AOD. In 2019 a major flood defence scheme to protect Port Clarence and some of the surrounding industrial areas from tidal flooding was completed. This included improving defences along the north bank of the River Tees and along the south bank of Greatham Creek, providing a 0.5% AEP Standard of Protection.

9.7.40 There is no breach scenario hazard mapping data available from the EA to inform this assessment. It is assumed that a breach or failure of the flood defences, (present day scenario) as a worst-case, would result in a similar flood extent to the undefended Flood Zone 2 and Flood Zone 3a flood extents provided by the EA. The CO_2 Gathering Network, to the east of Billingham, which will use an existing above ground pipe racking network, existing culverts

and overbridges, would be flooded under this scenario. A breach in the flood defences for the Upper End and H++ scenarios would result in an increase in flood depth and an increase in flood extents meaning a greater area of the CO_2 Gathering Network, i.e. the area currently located within Flood Zone 1 to the east of Billingham, would be at risk of flooding.

Risk of Flooding

9.7.41 Based on the information provided by the EA, it has been determined that the PCC Site and the majority of the connection corridors (the Water Connection Corridor, Water Supply Corridor, the Electrical Connection Corridor and the Natural Gas Corridor and CO_2 Gathering Network where located within Flood Zone 1 on the left and right bank of the River Tees) are at a 'low' risk of flooding from tidal sources.

9.7.42 The section of the Natural Gas Connection Corridor and CO_2 Gathering Network crossing the River Tees and the section to the east of Billingham (located in Flood Zone 3a on the left bank of the River Tees) are at 'high' risk of tidal flooding.

9.7.43 The PCC Site, with ground elevations no lower than 7.5 mAOD, would remain at low risk of flooding from overtopping of the high ground (informal flood defences) during events that exceed a 0.5% AEP (1 in 200 chance) of flooding, during a 0.1% AEP (1 in 1000 chance) event taking into account climate change, including the H++ climate change scenario.

9.7.44 If the defences adjacent to Port Clarence and along the southern bank of Greatham Creek were to overtop or fail/breach the CO_2 Gathering Network, located between the two watercourses, would be at 'high' risk of flooding from both the existing scenario 0.5% or 0.1% AEP (1 in 1000 chance) events and future climate change scenarios, including the H++.

Fluvial Sources

9.7.45 A review of OS mapping identified that the nearest watercourse to the PCC Site is The Fleet, located approximately 273 m to the south east of the PCC Site and Dabholm Gut, located approximately 1.1 km to the south.

9.7.46 Numerous ordinary watercourses intersect the connection corridor routes including; Mains Dike, The Mill Race, Kinkerdale Beck and Knitting Wife Beck to the south of the River Tees and Belasis Beck, Mucky Fleet and Swallow Fleet to the north of the River Tees near Billingham. These watercourses all pose a potential risk of fluvial flooding to the connection corridors.

Flood Map for Planning

9.7.47 The EA's 'Flood Map for Planning' illustrates that the entirety of the land required for the PCC Site and the Water Connection Corridor, Electrical Connection, Natural Gas Corridors and CO_2 Gathering Network on the south bank of the River Tees are located within Flood Zone 1 (low risk of flooding from fluvial sources). The exception to this is an area of Flood Zone 2 (medium risk of flooding) associated with The Fleet, located approximately 273 m to the south east of the PCC Site, and an area of Flood Zone 2 and Flood Zone 3a (high risk of fluvial flooding) associated with The Fleet and Dabholm Gut, located approximately 1.1 km to the south of the PCC Site.

9.7.48 Flooding is more extensive to the north bank of the River Tees where flooding is predominantly from tidal sources however, there are ordinary watercourses, such as the Mucky Fleet, Swallow Fleet and Belasis Beck that could pose a risk to small sections of the CO_2 Gathering Network, predominantly where the connection corridor passes over a watercourse/ drain.

9.7.49 Flood zone definitions are summarised in Section 9.6, Table 9A-6 and the supporting flood risk mapping is presented on ES Figure 9-4: Environment Agency Fluvial Flood Zones (ES Volume II, Document Ref. 6.3).

Flood Defences

9.7.50 The EA Flood Map for Planning (Rivers and Sea) indicates that the Proposed Development is not located in an area benefitting from flood defences. The EA Flood Map for Planning (Rivers and Sea) shows small sections of raised tidal flood defences located along the River Tees to the west and south west of the PCC Site however; there is no information regarding fluvial flood defences along the smaller watercourses in the area.

Modelled Fluvial Water Levels

9.7.51 No modelled fluvial flood level data is available for the smaller watercourses in the Study Area.

9.7.52 It is known that tide locking (prevention of fluvial flow discharging due to high tide levels) is a contributing flood risk factor on many watercourses that flow into the tidal Tees.

9.7.53 Analysis of the mapped flood extents associated with ordinary watercourses indicates that for the present -day flooding is not significant, and should a flood occur the area of inundation remains local to the watercourse.

Risk of Flooding

9.7.54 It considered that during the existing scenario the PCC Site and the majority of the connection corridors to the north and south of the River Tees are at ‘low’ risk of flooding from fluvial sources.

9.7.55 Climate change is assessed using the +25% central allowance for areas of the Site located in Flood Zone 1, as required by the EA climate change guidance. The PCC Site, with levels no lower than 7.5 mAOD would remain at low risk of flooding from the 1% AEP with 25% allowance for climate change flood event.

9.7.56 For areas of the Site located in Flood Zones 2 and 3a, where connection corridor routes cross watercourses, the EA guidance is that for essential infrastructure the upper end and climate change allowance (50%) is used to assess climate change from fluvial sources. In addition, the H++ scenario (65%) is also considered.

9.7.57 Taking the climate change scenarios into account, the risk of flooding to the PCC site itself will remain low as high ground levels ensure that the site remains in Flood Zone 1.

9.7.58 Both the Upper End and H++ climate change scenarios will increase the risk of flooding from the Fleet and Dabholm Gut with the depth and extent of flooding increasing across a larger area. This flooding will also be exacerbated by potential tidelocking. The Water Connection, Water Supply, Electrical

Connection, Natural Gas Corridors that cross these areas will be below ground and therefore the risk of flooding to these elements of the Proposed Development will remain low.

9.7.59 On the north bank of the River Tees, both climate change scenarios will have a similar impact on flooding from the Mucky Fleet, Swallow Fleet and Belasis Beck. An increase in the extent and depth of flooding is likely to increase the flood risk to the sections of the CO_2 Gathering Network located in proximity to these ordinary watercourses.

9.7.60 Given the short-term nature of the construction period it is not expected that fluvial flooding associated with climate change will affect this phase of the development.

Groundwater Sources

9.7.61 Groundwater flooding can occur when groundwater levels rise above ground surface levels. The underlying geology has a major influence on where this type of flooding takes place; it is most likely to occur in low-lying areas underlain by permeable rocks (aquifers).

9.7.62 Both the RCBC SFRA and the PFRA state that the overall risk of groundwater flooding in Redcar and Cleveland is low. It is noted, however, that the majority of the borough may be subject to very wet ground conditions as a result of winter waterlogging.

9.7.63 The Tees CFMP states that there is little documented evidence of groundwater flooding in the Tees catchment and groundwater flooding is not known to be a major problem due to the geology of the catchment. This is particularly true for STBC as the main geology is of sandstone and mudstone. There are no sources of groundwater flooding as the aquifers within these sandstones are not artesian even in very wet conditions.

9.7.64 STBC hold no records of groundwater flooding problems in the area.

9.7.65 The EA's 'Areas Susceptible to Groundwater Flooding' map is illustrated in the RCBC and STDC PFRA reports. The Areas Susceptible to Groundwater Flooding map is divided into 1 km2 grid-squares in which a percentage is given for what proportion of the 1 km2 is considered to be susceptible to groundwater emergence.

9.7.66 Within both the RCBC and STBC areas the map shows the Site lies predominantly in an area with a 75% or greater considered to potentially be at risk of groundwater emergence.

9.7.67 The EA have no groundwater level monitoring sites either inside the search area or within 2 km of the search area (the closest groundwater level data held is from a site approximately 8.2 km north-north-west of the Site boundary) however, the EA have indicated that the bedrock groundwater level is expected to be around Ordnance Datum given the proximity to the coast.

9.7.68 Based on the above available information, the risk of flooding from groundwater sources is assessed as a medium risk.

Surface Water Runoff to the Site

Overland Flow of Rainfall Runoff

9.7.69 Overland flow results from rainfall that fails to infiltrate the surface and travels over the ground surface; this is exacerbated where the permeability of the ground is low due to the type of soil and geology (such as clayey soils) or urban development with impermeable surfaces.

9.7.70 Surface water flooding is the main source of flood risk in RCBC with regular flooding in Eston, Redcar and Guisborough. This flooding is due to insufficient surface water, combined sewer and culverted watercourse capacity. The RCBC PFRA states "*In general, this local flooding occurs regularly, but it is not particularly hazardous and individual incidents do not affect a large number of properties*".

9.7.71 STBC have confirmed that flooding did affect parts of the Site following the September 2012 rainfall event, however there are no official recorded locations.

9.7.72 The EA 'Risk of Flooding from Surface Water' maps available on the EA website and presented on ES Figure 9-5: Flood Risk from Surface Water (ES Volume II, Document. Ref. 6.3) indicate areas at risk from surface water flooding, when rainwater does not drain away through the normal drainage systems or soak into the ground, but instead lies on or flows over the ground.

9.7.73 The maps delineate risk into the four following categories:

- Very Low - each year, this area has a chance of flooding of less than 1 in 1,000 (<0.1 %);
- Low - each year, this area has a chance of flooding of between 1 in 1,000 (0.1 %) and 1 in 100 (1 %);
- Medium - each year, this area has a chance of flooding of between 1 in 100 (1 %) and 1 in 30 (3.3 %); and
- High - each year, this area has a chance of flooding of greater than 1 in 30 (3.3 %).

9.7.74 EA mapping indicates that the PCC Site and the associated connection corridors within STBC and RCBC are generally at very low risk (<0.1% AEP event) of flooding from surface water. There are isolated areas of high, medium and low flood risk where water is seen to pond during more significant rainfall events, however, these areas are constrained to low spots in topography within the Proposed Development boundary.

9.7.75 The main locations of identified surface water flooding are:

- approximately 275 m to the south east of the PCC Site where water is seen to flood around the A1085/ Broadway East roundabout junction. Land in this area is at low to high risk of surface water flooding; and
- land located to the west between the A1085 and Cowpen Bewley Road, approximately 8 km to the west of the PCC Site. Land in this area is at low to medium risk of surface water flooding.

9.7.76 The risk of surface water flooding within the PCC Site area as the main development area within the Site from elsewhere is therefore considered to be 'low' to 'very low'.

9.7.77 Climate change must be taken into account when considering surface water runoff generated by development sites. This is usually represented by increasing the peak rainfall intensities. An increase in intensity will increase surface water rates and volumes. Additional surface water drainage will be required to allow increased surface water to be contained and managed.

9.7.78 The conceptual drainage strategy for surface water management on the Site has included a precautionary measure of a 40% increase in peak rainfall intensities, summarised in Section 9.9. As a result, surface water runoff increasing over the lifetime of the development as a result of climate change is expected to be managed and not increase flood risk to the Site or elsewhere.

Existing Drainage Infrastructure

9.7.79 No information was available regarding the private drainage falling within the Site boundary at the time of preparing the ES. It is assumed the existing surface water drainage system collects runoff from the buildings, hardstanding areas and gullies, which then discharge into the surrounding sewer network and/ or watercourses.

9.7.80 The Northumbrian Water Bran Sands waste water treatment works (to the immediate south of the Redcar Steelworks site) discharges into the Dabholm Gut.

9.7.81 In total, there are 234 records of historic sewer flooding incidents in RCBC. Information provided in the RCBC SFRA indicates that no historical sewer flooding has occurred in close proximity to the PCC Site and connection corridors to the south of the River Tees. Flooding from drainage infrastructure within RCBC tends to occur in predominantly residential areas with Eston, located to the south west of the Site identified as a critical drainage area.

9.7.82 Based on the available records and information, the Site is considered to be at low to medium risk of flooding from drainage infrastructure.

Artificial Waterbodies

9.7.83 Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs.

Flood Risk from Canals

9.7.84 There no canal systems within close proximity to the PCC Site and connection corridors.

Flood Risk from Reservoirs

9.7.85 The Reservoir Act 1975 defines a large reservoir as one that holds over 25,000 cubic metres (m^3) of water, although this is expected to be reduced to 10,000 m^3 under a review into the safety legislation and regulation of reservoirs and is expected to be phased in by the EA once this comes into effect under the Flood and Water Management Act.

9.7.86 The risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or dam breaching. This risk is reduced through

regular maintenance by the operating authority. Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

9.7.87 The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. Local Authorities are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared.

9.7.88 The EA's Long-term Flood Risk Mapping shows the largest area that might be flooded if a reservoir were to fail and release the water it holds but do not give any information about the depth or speed of the flood waters.

9.7.89 The mapping shows that the connection corridor, located to the north of the River Tees, crosses an area at residual risk of flooding from a reservoir as a result of structural failure or breach. This area, across Cowpen Marshes in proximity to the Holme Fleet (to the east of Billingham), is the only section of the Site at residual risk from reservoir flooding.

9.7.90 The RCBC Level 1 SFRA states that "the reservoirs within the borough do not receive flow from river catchments and would therefore not be subject to large inflows of water during storm conditions. The risk is therefore perceived to be low and further assessment not required". This statement correlates with the EA's Long-term Flood Risk Mapping which shows land to the south of the River Tees is not located in an area at residual risk from reservoir flooding.

Summary of Flood Risks to the Site

9.7.91 Table 9A-18 presents a summary of key flood risks to the Proposed Development. Based on the information above the current risk of flooding from artificial sources is considered to be low.

Table 9A-18: Summary of Key Flood Risks to the Proposed Development

Flood Risk	Risk to the Site	Notes	Mitigation Required
Tidal	PCC Site – Low Connection Corridors – Low with areas of high risk identified to the north of the River Tees	The Site is predominantly located in Flood Zone 1 and the PCC Site and the majority of the connection corridor routes also remain in Flood Zone 1 when relevant climate change allowances are applied for tidal and fluvial flooding. Localised areas of the Site are located within Flood Zone 2 and 3 and the application of climate change allowances will increase the risk of	Yes
Fluvial	PCC Site – Low Connection Corridors – Low with areas of high risk identified to the north of the River Tees		Yes

Flood Risk	Risk to the Site	Notes	Mitigation Required
		flooding from tidal and fluvial sources.	
Surface Water	Low/ Very Low	When climate change is considered surface water runoff from the Site will increase over the lifetime of the development.	Yes
Groundwater	Medium	Excavation during the construction phase and below ground development may be at risk.	Yes
Drainage Infrastructure	Low to Medium	Historical flood records in the SFRAs suggest the risk of flooding is low to medium.	No
Artificial Sources	South Bank of the Tees – Low North Bank of the Tees – High residual risk	No canals are located in close proximity to the Site. Land to the north of the River Tees is located in an area effected by flooding should a failure or breach of a reservoir occur. However, the probability of a failure/ breach occurring is very low.	No

9.8 Management of Surface Water from the Site

9.8.1 The following provides a summary of the outline drainage strategy for the Proposed Development as a whole and outlines the likely impact on surface water flows across the Site.

Existing Surface Water Runoff

9.8.2 The main land use within the PCC Site and is currently industrial-based development and is predominantly impermeable brownfield land. The proposed connection corridors are located along existing infrastructure routes which are a mixture of permeable and impermeable land.

9.8.3 An Outline Drainage Strategy for the Proposed Development will be prepared which will allow surface water runoff rates for the PCC Site and connection connections corridors to be assessed. It is however not expected that the surface water run off rates will change greatly to the degree that it would pose a risk as a result of the Proposed Development given that the proposed location of the PCC Site is already for the most part hard standing. In addition, the connection corridors are not expected to increase the impermeable area and therefore would not be expected to increase surface water runoff.

9.8.4 The Drainage Strategy to be prepared will provide further detail on the anticipate un-attenuated surface water runoff rates. It is not expected that any additional surface water storage will be required as surface water from the site will discharge to the Tees Bay using the existing (or replacement) discharge within the Water Discharge Corridor (which will ensure that the development does not increase flood risk elsewhere).

Policy Requirements

9.8.5 There are a number of national, regional, and local policy requirements which are relevant to this outline drainage strategy. These policy requirements ensure that the Proposed Development will be sustainable and can, if possible, contribute to a decreased flood risk beyond the Site in the local area. The policy requirements are outlined below and discussed in the context of the Proposed Development.

National Planning Policy Framework

9.8.6 The NPPF requires that the Proposed Development should not increase flood risk both on the Site and in the area surrounding it. Surface water runoff should therefore not exceed the volumes already generated by the existing Site and betterment should be provided where possible.

The Building Regulations 2010

9.8.7 The Building Regulations 2010 Approved Document H, Drainage and Waste Disposal (2015 Edition) (HM Government, 2015), has been issued by the Secretary of State for the purpose of providing practical guidance with respect to the requirements of Schedule 1 and Schedule 7 of the Building regulations 2010 for England and Wales.

9.8.8 This requires that surface water runoff be discharged according to the following discharge hierarchy:

- Discharge to soakaway or some other adequate infiltration system;
- Discharge to surface watercourses; or
- Discharge to sewers.

Local Planning Policy

9.8.9 STBC and RCBC, as LLFAs, are the risk management authorities responsible for local flood risk. The LLFA is required to provide consultation responses on the surface water drainage provisions associated with major development.

9.8.10 Both LLFAs promote the following through policies in their Local Plans:

- Appropriate surface water drainage mitigation measures are incorporated, and Sustainable Drainage Systems are prioritised;
- SuDs have regards to Tees Valley Authorities Local Standards for Sustainable drainage (2015) or successor document; and
- Surface water runoff should be managed at source wherever possible and disposed of in the following hierarchy.

9.8.11 Further information is provided in Tables 9A-9 and 9A-10.

Proposed Conceptual Surface Water Drainage Strategy

9.8.12 The Proposed Development is unlikely to significantly increase the area of impermeable surfaces within the Site and connection corridors. However, over the lifetime of the development increasing rainfall intensities, because of climate change, will increase surface water runoff from the Site, therefore without effective management runoff rates and volumes would increase. The proposed conceptual surface water drainage strategy demonstrates that surface water shall be effectively managed in accordance with the hierarchy of drainage and all relevant policies. The proposed drainage strategy is described in the following subsections.

Allowable Discharge Rates

9.8.13 The NPPF requires that new development should not increase flood risk both within and outside of the Site. In the context of surface water drainage, this effectively means that surface water runoff from the Proposed Development should not exceed the runoff rates and volumes currently generated on Site.

9.8.14 Defra's Sustainable Drainage Systems NSTS sets out the requirements for the design, construction, maintenance and operation of SuDS. The NSTS that are of primary concern in relation to the drainage strategy are provided in Table 9A-19.

Table 9A-19: Relevant Defra SuDS Non-Statutory Technical Standards

Concern	NSTS
Peak flow control	S3 – "For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface waterbody for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.."
Volume control	S5 – "Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface waterbody in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event." S6 – "Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5 […], the runoff volume must be discharged at a rate that does not adversely affect flood risk."
Flood risk within the development	S7 – "The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event."
	S8 – "The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development."
	S9 – "The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall

Concern	NSTS
	event are managed in exceedance routes that minimise the risks to people and property."

Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

Discharge Hierarchy

9.8.15 The aim of Hierarchy of Drainage is to drain surface water run-off as sustainable, as reasonably practicable.

9.8.16 As stated in the National Planning Practice Guidance, the aim should be to discharge surface water run-off as high up the drainage hierarchy, as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system; or
4. to a combined sewer.

Points of Discharge

9.8.17 At the PCC Site, it is assumed that surface water drainage will continue to drain via a new drainage system to the Tees via the existing or an upgraded discharge or to the sewerage network for treatment by Northumbrian Water.

9.8.18 As the connection corridors follow existing infrastructure corridors, it is assumed that surface water generated within the connection corridors will continue to drain to the existing drainage infrastructure in the area and the points of discharge will remain as currently.

Surface Water Attenuation

9.8.19 The required attenuation storage for the 1% AEP (1 in 100 years) for discharges to surface watercourses in which any flooding must be managed within the PCC Site is usually calculated using industry standard software based on the worst case assumption of the Site being 100% impermeable and the maximum allowable discharge rate in l/s. However, as surface water from the site will discharge to the Tees Bay via the Water Discharge Corridor no attenuation is required.

Sustainable Drainage Systems

9.8.20 Table 9A-20 summarises the SuDS components which have been identified as having the most potential for use at the Site.

Table 9A-20: SuDS Components

Component	Primary use	Description
Rainwater Harvesting Systems	Source Control	Rainwater from roofs and hard surfaces can be stored and used for non-potable purposes. This can provide a reduction of surface water runoff through control at source as well as reducing the demand on the water supply system. In the case

Component	Primary use	Description
		of the Proposed Development, harvested rainwater could be used to supplement grey water uses.
Green Roofs	Source Control	A planted soil layer is constructed on the roof of a building to create a living surface. Rainwater is taken up by evapotranspiration; excess is treated as it slowly percolates through the medium before being released to the drainage system at a controlled rate.
Swales	Conveyance & Attenuation	Swales are shallow open channels designed to capture, convey, treat and attenuate surface water runoff. With appropriate planting, they can enhance the natural landscape and provide aesthetic and biodiversity benefits. They can be lined, or unlined to allow infiltration.
Filter Drains	Conveyance	Filter drains are shallow trenches filled with gravel, providing attenuation, conveyance and treatment.
Proprietary Treatment Systems	Treatment	Proprietary treatment systems are designed to provide treatment of water through the removal of contaminants.

9.8.21 Areas of soft landscaping will be designed into the project within the PCC Site where possible.

Pollution Control

9.8.22 Treatment should be provided as far upstream in the drainage system as possible. This protects the drainage system downstream from contamination, clogging and blockage, and aids the identification of any residual contamination sources.

9.8.23 Where a sufficient SuDS train is not feasible, proprietary treatment systems, such as oil interceptors, are to be utilised.

Adoption Strategy

9.8.24 It is anticipated that drainage infrastructure serving the development will become the responsibility of operator and where required an adoption policy will be sought for any connections to Northumbria Water assets should they be required.

9.9 Mitigation of Residual Flood Risks and Off-Site Impacts

9.9.1 Consideration should be given to measures that protect the Proposed Development from the residual risk of flooding in the event that the existing tidal defences fail in the vicinity of the site, or in the event of heavy rainfall that could result in surface water flooding at the site if the design capacity of the drainage network is exceeded.

9.9.2 This Section therefore provides recommendations for the construction and operation phases of the Proposed Development in accordance with the

guidance provided in the NPS, SFRAs and by EA guidance on how the Proposed Development can be designed to withstand predicted flood risks and mitigate the impact. During construction these measures will be secured through the Final CEMP to be discharged by a requirement of the DCO and are included within the Framework CEMP (Appendix 5A, ES Volume III, Document Ref. 6.4). During operations, these measures will be secured through the DCO under a flood risk mitigation requirement.

Construction works in Flood Zone 1

9.9.3 No specific additional mitigation measures are required for construction works at the PCC Site or in other areas within Flood Zone 1.

Construction Works in Flood Zones 2 and 3a

9.9.4 Part of the proposed trenchless crossings of the River Tees are located in Flood Zones 2 and 3a. As outlined in Section 9.6 only construction works related to tunnelling/ drilling under the Tees will be required. With the exception of the launch pit for the HDD crossing of the Tees by the CO_2 Gathering Network which may be in Flood Zones 2 or 3a, the above groundworks for the Tees crossings are in Flood Zone 1.

9.9.5 The construction works for the AGI at the eastern end of Dabholm Gut (if required) are in Flood Zones 2 and 3a. If this option is selected, there is no alternative location for the AGI since this would be connecting to an existing underground pipeline. The construction works required for the CO_2 Gathering Network within Flood Zones 2 and 3a will be temporary and involve the installation of pipelines installed on existing racking or pipe bridges (or extensions to these).

9.9.6 There are no construction related activities that will reduce the overall area of functional floodplain as a result of construction works associated with the Connection Corridors where they are located in Flood Zone 3a.

9.9.7 With the possibility that the River Tees could flood at some point during the duration of the construction works for the crossings (which is a relatively short-term phase, around 9 to 12 months), the emphasis is placed on managing and mitigating the risks to the proposed temporary works located in Flood Zone 3a as well as not increasing the flood risk elsewhere. With this in mind, the following mitigation measures are required.

9.9.8 For crossings of the Tees there must be a minimum clearance of 1 m below hard bed level. Any proposed works to the watercourses may require Land Drainage Consent and may also require a Water Framework Directive (WFD) Assessment.

9.9.9 The Final Construction Environmental Management Plan (CEMP) will incorporate measures (as outlined within the Framework CEMP (Appendix 5A, ES Volume III, Document Ref. 6.4) to prevent an increase in flood risk during the construction works. Such measures will include:

- topsoil and other construction materials will be stored outside of the 1 in 200-year floodplain extent and only moved to the temporary works area immediately prior to use;

- connectivity will be maintained between the floodplain, the River Tees and Greatham Creek, with no changes in ground levels within the floodplain;
- the construction laydown areas, site office, and supervisor will be notified of any potential flood occurring by use of the 'Floodline Warnings Direct' service;
- the Contractor will be required to produce a Flood Risk Management Action Plan/ Method Statement which will provide details of the response to an impending flood and include:
  - a 24-hour availability and ability to mobilise staff in the event of a flood warning;
  - the removal of all plant, machinery and material capable of being mobilised in a flood for the duration of any holiday close down period;
  - details of the evacuation and site closedown procedures; and
  - arrangements for removing any potentially hazardous material and anything capable of becoming entrained in floodwaters, from the temporary works area.
- if perched groundwater is encountered during establishment of core foundations and the crossing of the River Tees or any other watercourse via tunnelling methods, dewatering may be required. The most appropriate methods to dewater excavations will be selected, for example, prior to dewatering the perimeter of the excavation could be enclosed with either sheet-pile or a diaphragm wall;
- during the construction of the Tees Crossing (and other works in Flood Zone 2 and 3a) the EA's GPP pollution prevention guidelines will be observed, and formal consent where required will be obtained from the EA for works within 16 m of a tidal main river, from the LLFAs for works within 8 m of a non-tidal main river and from the Marine Management Organisation for works below Mean High Water Springs.
- Construction works undertaken adjacent to, beneath and within watercourses would comply with relevant guidance during construction, including the requirements of any Environmental Permit, Ordinary Watercourse Consent and IDB Bylaws;
- Activities carried out within the floodplain of a main river are considered regulated activities and as such require permission from the Environment Agency. A FRAP is likely to be required for certain works close to Environment Agency main rivers and flood defences;

Operation

9.9.10 The following mitigation measures were considered to protect the Proposed Development at the PCC Site in accordance with the legislative and regulatory authority requirements:

- flood resistance and resilience measures;
- flood Emergency Response Plans

- flood Warnings and Alerts;
- emergency access and egress; and
- design capacity exceedance.

Flood Resistance and Resilience Measures

9.9.11 The following flood resilience and resistance mitigation measures were considered to ensure the operation of the development is maintained during inundation, and to ensure the safety of people:

- flood resistant/resilient design;
- raising external ground levels; and
- elevating critical plant equipment and/or internal finished floor levels above the peak flood inundation level.

9.9.12 CIRIA Report C688 'Flood Resilience and Resistance for Critical Infrastructure' (CIRIA, 2010), states that "Flood resilience involves designing an infrastructure asset or adapting an existing infrastructure asset so that although it comes into contact with floodwater during floods, no permanent damage is caused, structural integrity is maintained and, if operational disruption does occur, normal operation can resume rapidly after a flood has receded. Flood resistance involves designing an infrastructure asset or adapting an existing infrastructure asset so that floodwater is excluded during flood events and normal operation can continue with no disruption occurring to the essential services the asset provides".

9.9.13 The following measures are also considered appropriate and have been included within the design and layout of the Proposed Development:

- preparation of a construction platform for the PCC Site at a level no lower than 7.5 mAOD;
- pipelines and storage tanks designed to withstand the water pressures associated with high return period event flooding;
- tanks (if required) securely tethered in such a way to ensure the infrastructure remains secure should flooding occur;
- protecting wiring for operational control of the Proposed Development, telephone, internet and other services by suitable insulation in the distribution ducts to prevent damage;
- materials with low permeability up to 0.3 m and accept water passage through building at higher water depths;
- flood proofing including the use of flood resistant building materials, use of water-resistant coatings, use of galvanised and stainless-steel fixings and raising electrical sockets and switches;
- utilising floor materials that are able to withstand exposure to floodwater without significant deterioration and that can be easily cleaned, e.g. concrete-based or stone;
- incorporating water resistant services within the buildings, i.e. avoid services using ferrous materials;

- design development to drain water away after flooding;
- provide access to all spaces to permit drying and cleaning;
- carefully considering the type of usage and layout of ground floor areas to minimise the potential impact on business operations following a flood; and
- suitable waterproofing measures to development located below ground i.e. tanking below ground storage areas etc;
- pollution control will be implemented to prevent/ reduce the chance of any fuel/ material stored on site leaking;
- site drainage and landscape design will follow such guidance as CIRIA C635 (CIRIA, 2005) to minimise the risk from exceedance flows and any overland flow entering the Proposed Development buildings;
- landscaping of the Site or building curtilage will be designed to direct or divert floodwater away from buildings; and
- sustainable drainage systems (SuDS) will be designed to manage surface water flood risk and water quality.

9.9.14 Although the elevation of the PCC Site will be raised to a minimum of 7.5 m AOD following site clearance and remediation, there are no proposals to raise land in Flood Zones 2 and 3a for the purposes of protecting the Proposed Development. Therefore, flood water will not be displaced, and this will not pose an increased risk of flooding off-site to adjacent land uses. No flood volume compensation is therefore required.

9.9.15 The predicted (undefended) peak flood level for the PCC Site during a 0.1% AEP (1 in 1000 chance) H++ climate change flood scenario up to 2100 is calculated by AECOM to be 6.23 mAOD. This estimation is based on the updated EA climate change sea level allowances (UKCIP18) and the 2019 existing baseline water level information. In order to protect all critical equipment assets on site, these items will be elevated above the estimated peak flood level by the construction of a development platform with a minimum elevation of at least 7.5 mAOD.

9.9.16 Relevant pieces of critical equipment include:

- Electrical equipment, switchboards and control panels;
- Transformers;
- Main boiler feed pumps;
- Condensate extraction pumps; and
- Primary air fan and induced draught fan.

9.9.17 If required, identification will also be undertaken of items of critical plant for which spares can be kept on Site, and storage of those items on Site will be implemented to reduce the potential recovery time in the event of a major flood event.

Flood Emergency Response Plan

9.9.18 It is recommended that a Flood Emergency Response Plan be developed for the Proposed Development to ensure the residual risk to the site over the lifetime of the development is sufficiently managed and mitigated. A management system will be implemented to respond to a variety of emergency situations both during normal hours (24/7) and over holiday periods.

9.9.19 A Flood Emergency Response Plan will be prepared in consultation with the EA. This will define access and egress routes from the site, which will include recommendations on the best route, signage strategy in and around the area and congregation points. It and will ensure that the development is registered to receive flood warnings from the EA's 'Floodline Warnings Direct' service to inform if there is a risk of flooding from a tidal storm surge type event which could result in overtopping or breach of defences. This will include the recommendation of at least one Flood Warden for the plant.

9.9.20 As the Flood Emergency Response Plan will be set up to manage the residual risk of flooding, careful consideration will be undertaken as to what action will be taken at each level of warning. The plan will define how occupants of the Site will be evacuated to an appropriate safe place of refuge should there be a real risk of flooding, as the safety of all occupants is essential. However, it is also important to ensure that the site is only evacuated when necessary.

Flood Warnings and Alerts

9.9.21 The EA operates a Flood Warning Service for many areas at risk of fluvial and tidal flooding. The service currently consists of three stages:

- **Flood Alert** - flooding is possible and that you need to be prepared;
- **Flood Warning** - flooding is expected and that you should take immediate action. Action should be taken when a flood warning is issued and not wait for a severe flood warning; and
- **Severe Flood Warning** - there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

9.9.22 Each code gives an indication of the expected level of danger. Although some members of the public find Flood Watches useful, they are predominantly targeted towards professional partners, alerting them to expected flooding of low-lying land and roads.

9.9.23 All stages of warning are disseminated via the 'Floodline Warnings Direct', which is a free service that provides warnings to registered customers by telephone, mobile, email, SMS text message and fax. Local radio, TV, loudhailers, sirens and Floodline are also used to deliver flood warning messages. The Floodline number is 0845 988 1188, and it is always kept up to date with the EA's latest flooding information.

9.9.24 More detailed information on the likely extent and time scale of these warnings can be obtained by request from the EA, by their 'Quick dial' recorded information service, or via their website.

9.9.25 For any proposed commercial or industrial developments within a designated floodplain (as in the case of some areas of the Site), a system for monitoring flood warnings should be developed with designated responsible persons (site managers) able to monitor and disseminate the warnings. This will provide more time to enable emergency access and egress of staff occupants away from the local area which may become flooded during a flood event (including routes for egress) prior to inundation. They should also enable sufficient time to implement protection measures for any equipment on site. This is particularly relevant to the construction phase.

9.9.26 The Site is located within a designated EA Flood Alert Area (short code **121WAT926** covering low lying land surrounding Tidal River Tees, downstream of the Tees Barrage, including areas of Middlesbrough and Billingham).

9.9.27 The connection corridors at Seal Sands and Saltholme are located within a designated EA Flood Warning Area (FWA) (short code name **121FWT565** covering industrial properties on Seal Sands, Southern Graythorp and Billingham Fire Station). Due to the 24 hour a day nature of the operations at the Site, the Site will be registered with the EA's Flood Warnings Direct service and monitoring of the warnings is adopted at the Site to mitigate the residual risk of tidal/fluvial flooding in the event of overtopping or defence failure in the vicinity.

Emergency Access and Egress to/from the Site

9.9.28 An emergency access and egress route is a route that is 'safe' for use by occupiers without the intervention of the emergency services or others. A route can only be completely 'safe' in flood risk terms if it is dry at all times.

9.9.29 For developments located in areas at flood risk, the EA consider 'safe' access and egress to be in accordance with paragraph 039 of the NPPF PPG, and 'FRA Guidance for new Developments FD2320 (DEFRA and Environment Agency, 2005), where the requirements for safe access and egress from new developments are as follows in order of preference:

- safe, dry route for people and vehicles;
- safe, dry route for people;
- if a dry route for people is not possible, a route for people where the flood hazard in terms of depth and velocity of flooding) is low and should not cause risk to people; and
- if a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.

9.9.30 For 'essential infrastructure' development, it is considered that dry access and egress from the site will be desirable during times of extreme floods.

9.9.31 Surface water flood maps indicate the access road to and from the PCC Site is affected by surface water flooding during higher return period events. Mapping shows flooding to a depth of 300 to 900 mm at the A1085/West Coatham Lane roundabout junction. Should flooding occur in this location members of staff will remain within the PCC Site area until it is safe to exit the

Site. Alternatively, staff could be evacuated from the site, via the northern gate from the PCC Site onto South Gare Road and then east to Redcar via Warrenby.

Place of Safe Refuge

9.9.32 Safe places of refuge are generally considered an acceptable approach to flood risk management in areas adjacent to sea defences as in the event of a defence breach, inundation is likely to be rapid and therefore evacuation from the Site and local area can sometimes be an unsafe option.

9.9.33 The PCC Site is located within Flood Zone 1 for both the current flood risk and all climate change scenarios, including the H++ allowance for the 0.5% AEP and 0.1% AEP flood events therefore a place of safe refuge is unlikely to be required.

Drainage System Failure, Capacity Exceedance and Maintenance

9.9.34 Following the completion of the Proposed Development, an additional residual risk relates to maintenance of the on-site drainage infrastructure. Failure, blockage and capacity exceedance above that of the design events for the drainage system are a potential risk to the Site and the surrounding area.

9.9.35 In order to reduce the risks, maintenance of the system will be incorporated in general site management and remains the responsibility of the operator. A manual will be prepared detailing each drainage feature on site, the maintenance required, timescales for maintenance and who is responsible for undertaking the maintenance. It is expected the Site owners will ultimately be responsible for maintenance of the site drainage system including all pipes, discharge structures and any SuDS implemented on site in accordance with the recommendations in the SuDS Manual.

9.9.36 CIRIA C635 (CIRIA, 2005) provides guidance on measures that can be incorporated into the detailed design of developments to steer surface water that has exceeded the capacity of the drainage system away from buildings and route it towards the intended point of discharge (for example along swales and roads using raised kerbing and through parking areas).

Decommissioning

9.9.37 At the end of its operating life, it is anticipated most of the above-ground equipment associated with the Proposed Development will be decommissioned and removed from the Site. Prior to removing the plant and equipment, all residues and operating chemicals will be cleaned out from the plant and disposed of in an appropriate manner to manage any potential for pollution risk.

9.9.38 Prevention of contamination is a specific requirement of the Environmental Permit for the operation of the Proposed Development and therefore it is being designed such that it will not create any new areas of ground contamination or pathways to receptors as a result of construction or operation. Once the plant and equipment have been removed to ground level, it is expected that the hardstanding and sealed concrete areas will be left in place. Any areas of

the Proposed Development that are below ground level will be backfilled to ground level to leave a levelled area.

9.9.39 A Decommissioning Plan (including Decommissioning Environmental Management Plan (DEMP)) will be produced and agreed with the Environment Agency as part of the Environmental Permitting and site surrender process. The DEMP will consider in detail all potential environmental risks and contain guidance on how risks can be removed, mitigated or managed. This will include details of how surface water drainage should be managed on the PCC Site during decommissioning and demolition.

9.10 Summary and Conclusions

Flood Risk Summary

Tidal Sources

9.10.1 Flooding from tidal sources is the predominant flood risk to the Proposed Development.

9.10.2 Based on the EA Flood Map for Planning, it has been determined that during the existing scenario the PCC Site and the majority of the connection corridor routes are at a 'low' risk of flooding from tidal sources (River Tees and Greatham Creek) during events that exceed a 0.5% AEP (1 in 200 chance) flood event.

9.10.3 Even during a future scenario resulting from climate change up to 2125 and a H++ scenario to 2100 the PCC Site remains at 'low' risk of flooding during events that exceed a 0.5% AEP (1 in 200 chance) of flooding and the 0.1% AEP (1 in 1000 chance) event.

9.10.4 The western extent of the connection corridor located between the tidal River Tees and Greatham Creek is at high risk of flooding from tidal sources during events that exceed a 0.5% AEP (1 in 200 chance) flood event and the climate change flooding scenarios. This section of the Site is also at high residual risk of flooding should a failure or breach of the flood defences occur. However, works in this area comprise either underground pipework or installation of pipelines on existing pipe racking. The need to develop the pipelines in this location is essential to connect to existing industrial sources seeking to decarbonise through the proposed CO_2 gathering network and export infrastructure. Development in these locations therefore fulfils the Sequential and Exception Tests.

9.10.5 Appropriate mitigation measures are therefore proposed in this area of higher flood risk to be implemented at the Site to mitigate this risk. These measures will be secured through the CEMP to be discharged by DCO requirement.

9.10.6 Elements of the Proposed Development that are located within Flood Zone 3a will not result in a loss of floodplain storage volume and will not result in a change in flood routes therefore flood risk to third parties will not increase.

Fluvial Sources

9.10.7 The information provided by the EA Flood Map for Planning identifies the PCC Site to be at 'low' risk of fluvial flooding from Ordinary watercourses located in proximity to the Proposed Development boundary.

9.10.8 During a future scenario resulting from climate change up to 2125 the PCC Site remains at 'low' risk of fluvial flooding therefore appropriate mitigation measures are not required to be implemented at the Site to mitigate this risk.

9.10.9 The connection corridors to the south and south west of the PCC Site will generally be located below ground therefore will remain at low risk of flooding from fluvial sources, including all climate change scenarios. The only exception is the proposed AGI at the eastern end of Dabholm Gut in land which is within Flood Zone 3a.

9.10.10 Appropriate mitigation measures are therefore proposed to be implemented at the Site in this location to mitigate this risk. These measures will be secured through the CEMP to be discharged by DCO requirement in the event that this option is selected.

9.10.11 Flood risk from fluvial sources (ordinary watercourses) on the north bank of the River Tees, between Billingham and Seal Sands, will increase for all climate change scenarios. As a consequence, the CO_2 Gathering Network will be at risk of flooding over the lifetime of the development. However, it is located in an existing unattended service corridor and is acceptable development within Flood Zone 3a. Any maintenance work (e.g. pigging) will be undertaken in accordance with the Flood Emergency Response Plan.

Surface Water Runoff to the Site

9.10.12 The risk of surface water flooding within the Site from elsewhere or generated within the Site is considered to be 'low to very low'.

Groundwater

9.10.13 The risk of groundwater flooding within the Site is considered to be 'medium'. However, should the Proposed Development comprise below ground development within strata where groundwater is recorded as present, mitigation measures, including those outlined in British Standard 8102 (BS8102) will be required to reduce the risk of groundwater flooding to underground structures.

Artificial Sources

9.10.14 There are no canals located in close proximity to the Site, however, land between the north bank of the River Tees and the south bank of Greatham Creek is located in an area at residual risk of flooding should a failure or breach of a reservoir occur.

Sequential Test

9.10.15 A Sequential Test is required for developments in Flood Zones 2 and 3 and to assess flood risks across strategic development sites. The NPPF/PPG sets out the Sequential Test, which compares the Proposed Development site with other available sites to find out which has the lowest flood risk. The sequential test is passed as the Proposed Development site has similar risk of flooding to the other potential alternative sites considered in Teesside.

Exception Test

9.10.16 NPS EN-1 (paragraph 5.7.16) states that all three elements of the Exception Test need to be satisfied for consent to be grated. For the Exception Test to be passed:

- it must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;
- the project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonably alternative sites on developable previously developed land subject to any exceptions set out in the technology-specific NPSs; and
- an FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

9.10.17 In relation to the above:

- The Proposed Development will have very clear wider sustainability benefits to the community. It will contribute to the security of electricity supplies and by providing low carbon generation and the necessary infrastructure to decarbonise local industries it will help support the transition to Net Zero by 2050. Furthermore, the Proposed Development will have significant economic benefits in terms of safeguarding jobs associated with existing carbon intensive industries of Teesside while creating new jobs and supporting the development of green industries such as hydrogen production.
- The PCC Site comprises previously developed land and the other elements of the Proposed Development, notably the connection corridors where feasible, involve previously developed land and/or existing infrastructure corridors.
- The site-wide FRA undertaken demonstrates (see Section 9.9 of the FRA) that the Proposed Development will be safe from the risk of flooding (through the implementation of various measures, including a Flood Emergency Response Plan) and will not increase the risk of flooding off-site.

9.10.18 It is therefore considered that the Exception Test is satisfied.

Management of Surface Water Runoff from the Site

9.10.19 As surface water from the Site will discharge to the Tees Bay using the existing (or replacement) outfall within the Water Discharge Corridor (which will ensure that the Proposed Development does not increase the flood risk elsewhere) there will be no requirement for surface water discharge from the Site to be restricted in accordance with the requirements of the NPPF, LLFA local policies and SuDS guidance.

Residual Risk Mitigation Measures

9.10.20 A number of mitigation measures are proposed in areas of the Site where construction will take place in Flood Zone 3a as set out in this assessment. These measures will be secured through the final CEMP to be discharged by requirement of the draft DCO and will be considered during the design process for the Proposed Development to ensure the operation of the Site is maintained in the event of an extreme flood. These strategies include, designing for failure, maintenance and capacity exceedance of the surface water drainage network.

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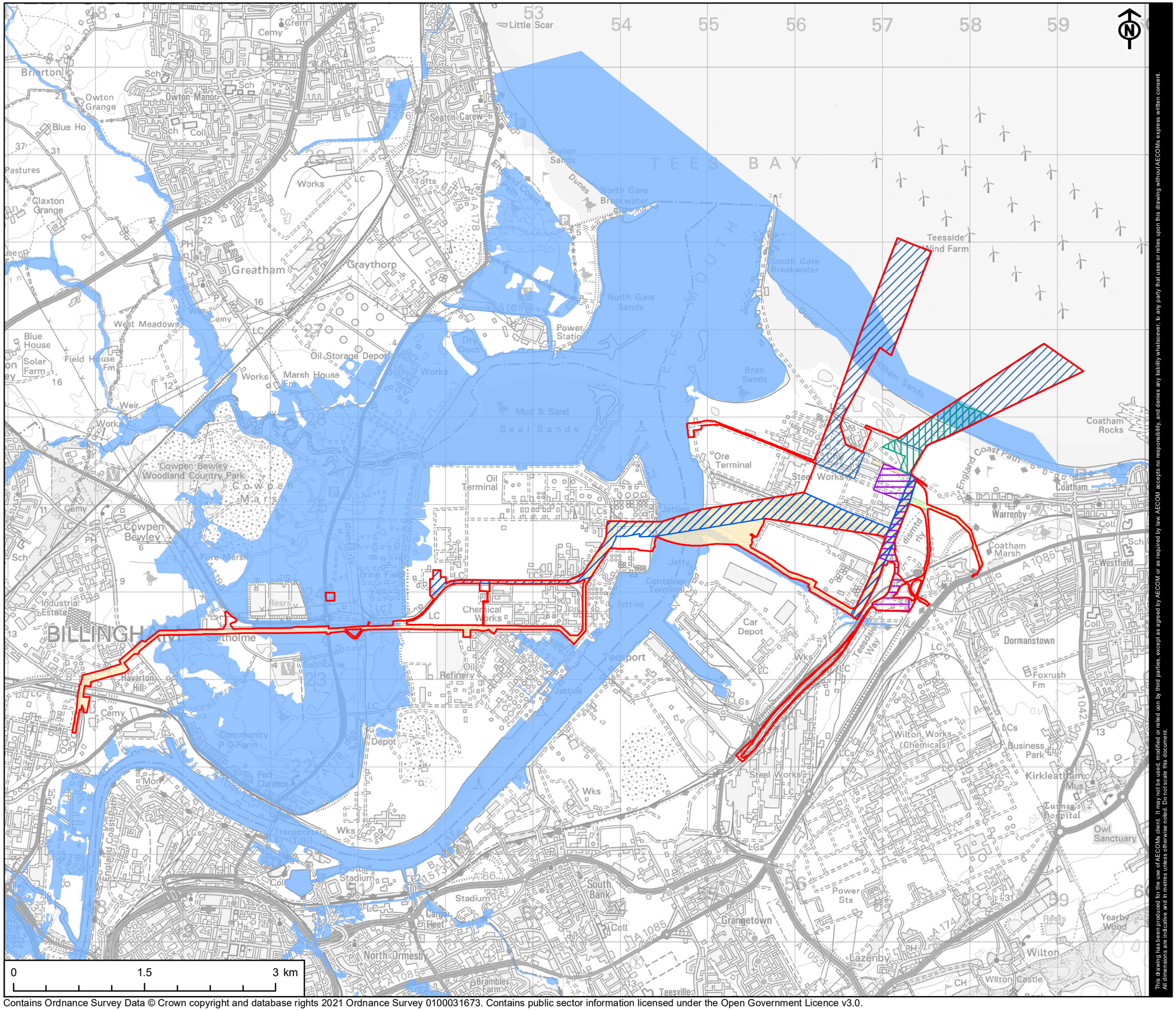
Figure 9A-1: Development Areas in Flood Zone 3

Project Management Initials: RL Designer: LC Checked: LK Approved: IC



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AECOM

PROJECT
NET ZERO TEESSIDE PROJECT

Net Zero Teesside

APPLICANTS
NZT POWER LTD. AND NZNS STORAGE LTD.

KEY

- Site Boundary
- CO_2 Export Pipeline
- CO_2 Gathering Network
- Natural Gas Connection Corridor
- Electrical Connection Corridor
- Water Supply Connection
- Water Discharge Corridor
- Flood Zone 3 (Environment Agency)

TITLE
FIGURE 9A-1
DEVELOPMENT AREAS WITHIN FLOOD ZONE 3

REFERENCE
NZT_210629_TA_9A-1_v1

SHEET NUMBER
1 of 1

DATE
29/06/21

Annex A- Consultation Responses

2nd August 2019

External Relations Team
Environment Agency
Lateral
8 City Walk
Leeds
LS11 9AT

Our Ref: Teesside Cluster Carbon Capture and Usage Project

Your Ref:

Dear Sir/Madam,

Re: Teesside Cluster Carbon Capture and Usage Project, Redcar, South Teesside

AECOM has been commissioned to prepare a Flood Risk Assessment to support an application for a proposed full chain Carbon Capture Usage and Storage (CCUS) project to be located in Redcar, South Teesside. The project comprises the development of a Combined Cycle Gas Turbine (CCGT) gas fired generating station and gas, electricity and cooling water connections, with post combustion carbon capture and compression plant, together with a gathering station for carbon dioxide (CO2) from the generating station and other industrial sources, low pressure CO2 pipeline connections to potential industrial sources, and a high pressure CO2 pipeline for the onward transport CO2 to an offshore geological storage site in the North Sea. The indicative boundary for the Main Site currently comprises an area of approximately 52 hectares (ha). A location plan is provided at the end of this letter.

Flood Risk Data Request

In line with the Environment Agency's standing advice, AECOM proposes to produce a Flood Risk Assessment that considers the risk to the site from all sources, rivers and the sea, streams, surface water run-off, sewers, groundwater, etc. AECOM will also make recommendations for managing surface water runoff according to sustainable drainage principles.

The entire Main Site currently lies within Flood Zone 1 (low risk of flooding), defined by the Environment Agency's online Flood Map for Planning.

AECOM requires the Package 4 information for the Site to inform the FRA, to include the following:

- Confirmation of the sites flood zoning;
- Any detailed maps of historical flood extents at the site and details of any other flood level or flood extent data related to the site that may be relevant, including any photographs or other anecdotal information;
- Details of any flood defences for the area, their condition, anticipated lifetime and statutory flood defence levels;
- Modelled flood levels for the River Tees, including the recently updated climate change flood extents and flood levels;
- Information on breach assessments undertaken for flood defences (appropriate related to the location of the site) and associated extent, depth and velocity maps;

- Details of any known surface water flooding problems in the area and confirmation of any designated critical drainage areas (CDAs);
- Provision of mapping showing the areas susceptible to surface water flooding and the flood map for surface water (AStSWF and uFMfSW);
- Details of groundwater levels in the vicinity of the site and of the risk of rising groundwater levels and provision of mapping (AStGWF); and
- An indication of what final floor levels are acceptable at the site.

Water Quality, Resources, WFD and Biological Data Request

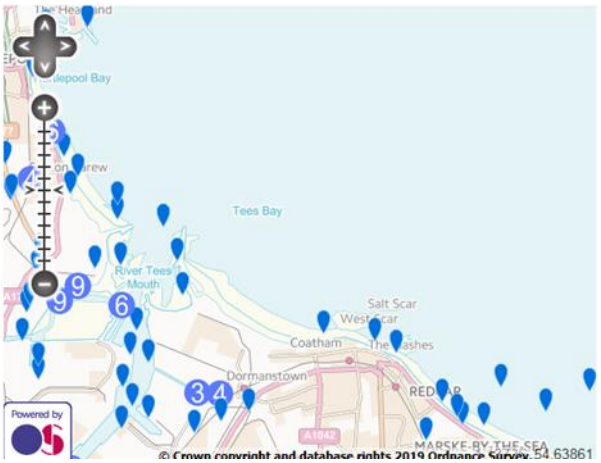
There are a number of surface water features in the vicinity of the proposed development Site for which we are in the process of gathering baseline information. These include:

- The River Tees is approximately 1.6 km to the west of the indicative DCO site boundary, with the North Sea approximately 0.6 km to the north. The River Tees is tidal at the location, with the normal tidal limit approximately 14 km upstream (at the Tees Barrage);
- The Dabholm Gut off the Tees Estuary which is fed by the Fleet (that runs from Coatham Marsh, to the west of Redcar), the Mill Race (from east of the Wilton International complex), and Kettle Beck (from the west of the Wilton International complex); and
- Numerous lakes, ponds and watercourses around Saltholme and the Saltholme Nature Reserve including Belasis Beck and Saltholme Brine Reservoirs.

WFD water bodies include the Tees Estuary, Tees Coastal, Tees Estuary (South Bank) (fluvial). These water bodies are also associated with numerous ecological designated sites such as: Teesmouth and Cleveland Coast SPA/pSPA/Ramsar (including the Bran Sands Lagoon), Teesmouth and Cleveland Coast (including the Bran Sands Lagoon), Recar Rocks SSSI, the South Gare and Coatham Sands SSSIs, and Teesmouth National Nature Reserve. Other nearby Protected Areas include: Seal Sands, Tees Estuary Coastal Sensitive Areas (Eutrophic) under UWWTD (UKENCA98); Seaton Carew North Gare, Seaton Carew Centre, Seaton Carew North, Redcar Coatham and Redcar Lifeboat Station Bathing Waters. As far as we can confirm from online data there are no designated Shellfish Waters, although local habitat types do include mussel beds to the south of Teesmouth.

For a **2 km study area around the RLB** can you please provide where possible any data covering or relevant to the following points:

- Please confirm the specific WFD Water Body Typology for Tees Estuary, Tees Coastal, Tees Estuary (South Bank) (fluvial) water bodies;
- Please provide copies of any WFD investigation reports that have been compiled for the Tees Estuary, Tees Coastal, Tees Estuary (South Bank) (fluvial) water bodies (e.g. catchment walkovers, water quality/biological/NNIS risk assessments);
- Please provide details of any mitigation measures being proposed by the Environment Agency to tackle existing pressures and risks and that are currently in place and those that are not in place for the Tees Estuary, Tees Coastal, Tees Estuary (South Bank) (fluvial) water bodies;
- Please provide copies of the latest survey data for biological quality elements for the nearest u/s and d/s monitoring points for the Tees Estuary, Tees Coastal, Tees Estuary (South Bank) (fluvial) water bodies. We are particularly interested in macrobenthic sampling data from the WFD Tees subtidal microbenthic sampling site (NE-45401422).
- Please provide water quality and sediment quality data in an MS Excel format for the monitoring points on the Tees estuary and adjacent coastal waters as shown in the image below:



- Active abstraction licences (groundwater and surface water) including location (NGR), user, and purpose;
- Active water activity permits (i.e. formerly discharge consents) including location (NGR) and effluent type;
- Any Category 3 or worse water pollution incidents within the past 5 years as recorded on NIRS (including location (NGR), pollution source, category and affected water body);
- Aquifer status and groundwater levels;
- Comments on any issues of concern regarding water resources, both surface and groundwater, in the study area; and
- Details (including anecdotal observations) of any other water attribute or recreational / amenity activity that we should be aware of.
- Bathymetric survey of the estuary bed;
- Topographic survey of intertidal areas (other than data available on the open source website);
- Fixed station measurements of water levels, current speed/direction, salinity, and temperature (spring and neap tides);
- Meteorology data including wind speed/direction and air temperature;
- River flow data - Time-series flow rates including yearly statistical data (min, max and average) at the Tees Barrage;
- Water temperature measurements for the Tees Estuary and Tees coastal water bodies (for has high a sampling frequency as possible and preferably covering the past 5 years as a minimum). If there are any remotely sensed measurements of the plume temperature near the site from the previous sites operation that would also be useful; and
- Copies of Environment Agency thermal maps if available.

We realise that this is a large request for data and we understand that not all of this information will be available. However, we would be very grateful if you could please review this list and advise and send us what data you do hold.

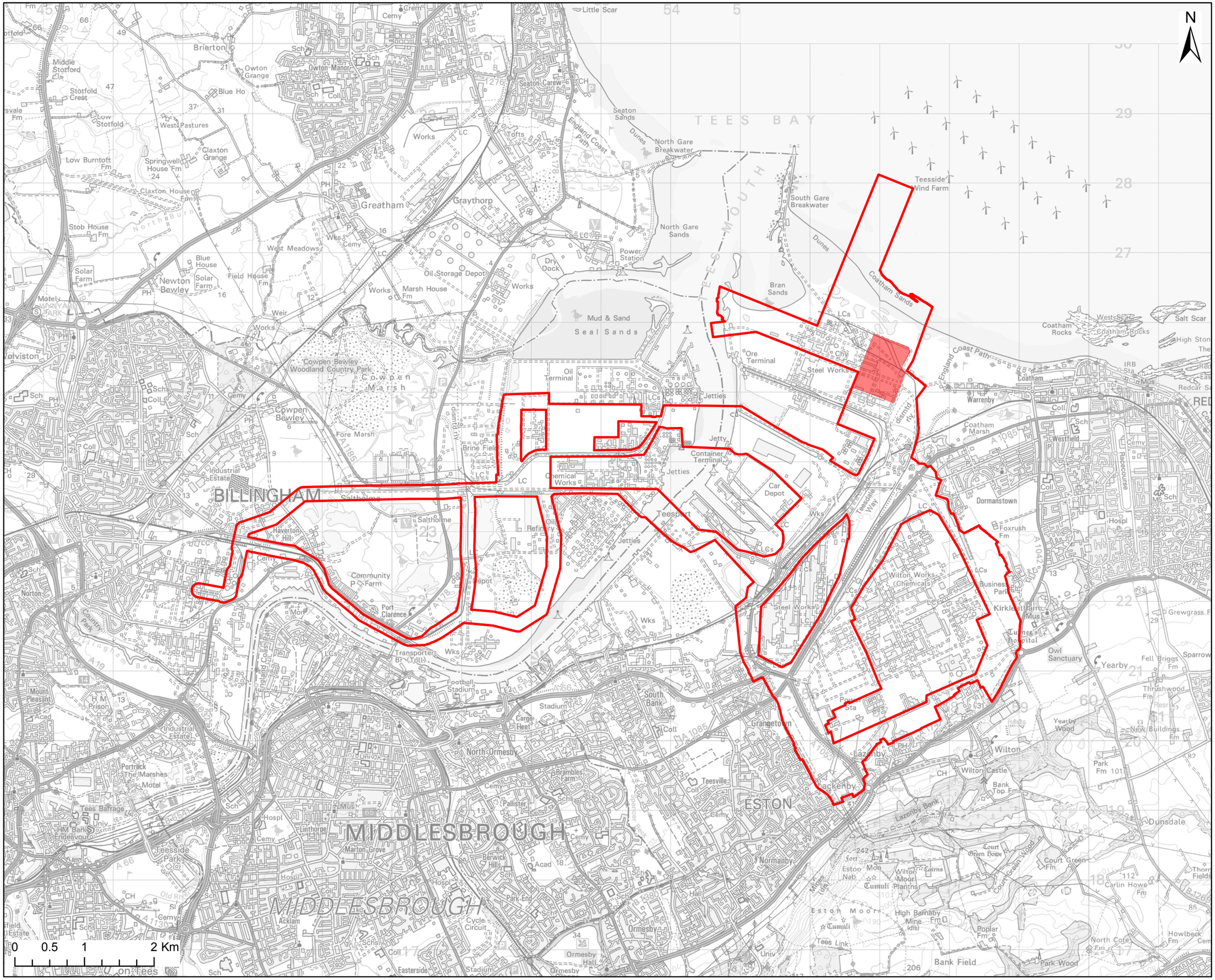
I look forward to hearing from you.

Yours sincerely for
AECOM Limited

Anna Ashbridge
Graduate Water Consultant

Direct Line: +44 (0)113 301 2444
anna.ashbridge@aecom.com

Location Map attached below:



AECOM Limited
2 City Walk
Leeds, LS11 9AR
+44 (0)113 204 5000
www.aecom.com

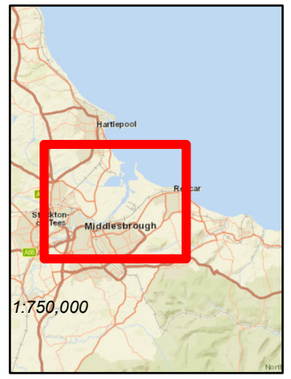
Project Title:

TEESSIDE CLUSTER CARBON CAPTURE & USAGE PROJECT

Client:

OGCI CLIMATE INVESTMENTS HOLDINGS LLP

Location Inset:



LEGEND

- DCO Application Boundary
- Main Site (Generating Station including CO2 capture and CCUS booster station)

Copyright:

AECOM Internal Project No:

60559231

Drawing Title:

RED LINE BOUNDARY (FOR DATA SEARCHES)

Scale at A3: 1:50,000

Drawing No:	Rev:
N / A	03

Drawn:	Chk'd:	App'd:	Date:
RT	RT	RL	02/08/19

Filename: C:\Users\ross.taylor3\Documents\AECOM\03. Projects\01. Clean Gas\04. Work\00. PROJECT MANAGEMENT\02. Data\60559231 - RLB for Data Requests.mxd

Ashbridge, Anna

From:	Northeast Newcastle, Customer Contact <northeast-newcastle@environment-agency.gov.uk>
Sent:	02 September 2019 16:09
To:	Ashbridge, Anna
Subject:	Our ref: 138145 - Data Consultation Request - Teesside Cluster Carbon Capture and Usage Project, Redcar, South Teesside

Our Ref: 138145

Dear Anna

Enquiry regarding Teesside Cluster Carbon Capture and Usage Project

Thank you for your enquiry which was received on 2 August 2019.

Please find enclosed in the following sharefile link and our response below: https://ea.sharefile.com/d-sa0cc3a77b084279a. Please note the link will expire shortly, we therefore recommend saving a copy of the information as soon as possible.

Flood risk data

The Environment Agency is currently undertaking a major flood defence scheme to protect Port Clarence and some of the surrounding industrial areas from tidal flooding. The work started in 2015 and is due for completion later this year.

Phase 1 of the works involved improving the defences along the north bank of the river Tees both up and downstream of the Transporter Bridge. This involved a new flood wall through the Wilton site, a road hump just before the access to the bridge and improvements to the flood bank downstream of the bridge. This work is now complete and is the main protection for Port Clarence

Phase 2 involves improving the defences along the south bank of Greatham Creek. This work will improve the protection of the industrial complexes near Seal Sands and will also prevent Port Clarence flooding from the north during extreme tidal events. This phase of the works will be completed in October this year.

We will be remodelling the Tees in the near future: The Tees Tidal model will be updated to take into account the defences at Port Clarence and Greatham South. The new LiDAR captured over the winter of 17/18 will also be incorporated. We are currently reviewing the scope with JBA but unfortunately we are unable to provide exact timescales for the final delivery at the moment (though it should be within 2019). No breach scenario modelling is available for this site.

Following examination of our records of historic flooding, we have no record of flooding in the area. This does not necessarily mean that the area of the property / site has never flooded, only that we do not currently have records of flooding in this area.

Please use the link to access the breach and survey data. Our records suggest that the River Tees modelling referenced Bathymetric data obtained from the Tees Port Authority – please contact them for more information.

For general advice about assessing flood risk when completing planning applications, and in particular how to complete a flood risk assessment (FRA) as part of a planning application go to https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

Our Sustainable Places Team can give more detailed advice although there is a charge for this. Here is the link to the standard terms and conditions that apply to our charged planning advice service https://www.gov.uk/government/publications/planning-advice-environment-agency-standard-terms-and-conditions. The standard charge is £100 per hour.

Any works near a main river may require approval from the Environment Agency. You may need to apply for a Flood Risk Activity Permit if:
- the works are within 8 metres(m) from a non-tidal Main river and from any flood defence structure or culvert.
- the works are within 16m from the a tidal Main river and from any flood defence structure or culvert.
- the works are within 16m from a sea defence structure.

To determine whether you actually need a permit please visit https://www.gov.uk/guidance/flood-risk-activities-environmental-permits Or you can send a brief explanation of what works you plan to do (and where) so we can confirm.

Some of the data you have requested is available online as open data. Full details of supporting information and licensing are available when you access this data online:

Areas Susceptible to Groundwater Flooding
https://data.gov.uk/dataset/groundwater-flooding-susceptibility

Areas susceptible to Surface Water – extent maps for 1/30, 1/100 and 1/1000 and the SW suitability map – https://data.gov.uk/data/search?sort=&q=Risk+of+Flooding+from+Surface+Water+Extent

Critical drainage areas
https://data.gov.uk/dataset/areas-with-critical-drainage-problems

FZ2 = https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-2
FZ3 = https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-3

Water Quality, resources, WFD and biological data

The following information is available online as open data. Full details of supporting information and licensing are available when you access this data online:

Water Quality data is available online as open data: https://environment.data.gov.uk/water-quality/view/download/new
Consented Discharges to Controlled Waters with Conditions: https://data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions
Pollution incidents: https://data.gov.uk/dataset/c8625e18-c329-4032-b4c7-444b33af6780/environmental-pollution-incidents-category-1-and-2
Bathymetric survey: https://data.gov.uk/dataset/52b3a813-69c6-4b6f-8684-fd0bdc4aa71b/multibeam-bathymetry
Any biological data for the requested waterbodies will be available from https://data.gov.uk/
Data from our fish population database, including trac fish data from the Tees estuary, fish counter information from the Tees is available online as open data: https://data.gov.uk/. This is only an index of salmon and sea trout numbers using the fish pass at the Tees barrage.
Please see online for any concerns regarding water resources: https://www.gov.uk/government/publications/tees-abstraction-licensing-strategy
Regarding the availability of thermal imaging please contact our geomatics team to request this: geomatics_data@environment-agency.gov.uk

Meteorology data will need to be requested from the Met Office.

Please see the sharefile link for the WFD data we hold.

Abstraction information can be found in the sharefile link.

Aquifer status – the site spans across and above three aquifers;

- Mercia Mudstone Group – Secondary B aquifer– ~50% of site
- Redcar Mudstone Formation – Secondary B aquifer – ~ 35% of site
- Sherwood Sandstone Group – Principal aquifer – ~ 15% of site

We have no groundwater level monitoring sites either inside the search area or within 2km of the search area (the closest groundwater level data we hold is from a site approximately 8.2km north-north-west of the site boundary). The bedrock groundwater level is expected to be around the ordnance datum given the proximity to the coast.

2019 mitigation measures update can be found in the sharefile link – no measures are currently in place

Please see the sharefile link for:

- Tees dock level site: 15 minute levels from 08/06/2009 – 14/08/2019
- Tees barrage and Tees barrage downstream sites: 15 min level, Water Year Average, Water Year Maximum and Water Year Minimum covering the period 05/08/1998 – 14/08/2019.

We don't have any rainfall sites within the radius.

The information is supplied for use under our Conditional Licence. Please see below specific conditions applied to certain datasets:

- Water Abstractions (AfA135) – detailed information about this dataset including conditions can be found on the Register Licence Abstract (you will need to download this spreadsheet to access the information about AfA135).

Name	Product 4 and 5
Description	Detailed Flood Risk Assessment Map and Tees 2011 ISIS-TUFLOW Model Report and Tees 2015 1000+CC ISIS-TUFLOW Model Report
Licence	Environment Agency Conditional Licence
Information Warnings	None

Conditions – product 5	1.0 You may use the Information for your internal or personal purposes and may only sublicense others to use it if you do so under a written licence which includes the terms of these conditions and the agreement and in particular may not allow any period of use longer than the period licensed to you. 2.0 Notwithstanding the fact that the standard wording of the Environment Agency Conditional Licence indicates that it is perpetual, this Licence has a limited duration of 5 years at the end of which it will terminate automatically without notice. 3.0 We have restricted use of the Information as a result of legal restrictions placed upon us to protect the rights or confidentialities of others. In this instance it is because of third party data. If you contact us in writing (this includes email) we will, as far as confidentiality rules allow, provide you with details including, if available, how you might seek permission from a third party to extend your use rights. 4.1 The Information may contain some data that we believe is within the definition of "personal data" under the Data Protection Act 1998 but we consider that we will not be in breach of the Act if we disclose it to you with conditions set out in this condition and the conditions above. This personal data comprises names of individuals or commentary relating to property that may be owned by an individual or commentary relating to the activities of an individual. 4.2 Under the Act a person who holds and uses or passes to others personal data is responsible for any compliance with the Act and so we have no option but to warn you that this means you have responsibility to check that you are compliant with the Act in respect of this personal data. 5.0 The location of public water supply abstraction sources must not be published to a resolution more detailed than 1km2. Information about the operation of flood assets should not be published. 6.1 Where we have supplied model data which may include model inputs or outputs you agree to supply to the Environment Agency copies of any assessments/studies and related outputs, modifications or derivatives created pursuant to the supply to you of the Information, all of which are hereinafter referred to as "the Data". 6.2 You agree, in the public interest to grant to the Environment Agency a perpetual royalty free non-exclusive licence to use the Data or any part thereof for its internal purposes or to use it in any way as part of Environment Agency derivative products which it supplies free of charge to others such as incorporation into the Environment Agency's Open Data mapping products.
Information Warning – product 4 - OS background mapping	The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.
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However, you must first check the supporting information available online to determine if the conditions on use are suitable for your purposes. If they aren't, this information is not provided with a licence for use, and the data is provided for read right only.

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

Please don't hesitate to contact me if you have any further queries.

Kind regards

Gemma Loeland
Customers and Engagement Officer
Environment Agency | Tyneside House, Skinnerburn Road, Newcastle Business Park, Newcastle upon Tyne, NE4 7AR

northeast-newcastle@environment-agency.gov.uk
External: 02084746461

Working days: Monday to Wednesday

From: Ashbridge, Anna [mailto:Anna.Ashbridge@aecom.com]
Sent: 02 August 2019 12:24
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Cc: Taylor, Ross <Ross.Taylor3@aecom.com>; Tucker, Owen <owen.tucker@aecom.com>
Subject: Data Consultation Request - Teesside Cluster Carbon Capture and Usage Project, Redcar, South Teesside

Good Afternoon,

Please find attached a Data Consultation Request for the Teesside Cluster Carbon Capture and Usage Project, at Redcar, South Teesside

I look forward to hearing from you soon.

Kind regards,
Anna

Anna Ashbridge BSc (Hons), MSc, GradCIWEM
Graduate Consultant, Water
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Modelling Information

Data for this request has been taken from the 2011 Tidal Tees Integrated Flood Risk Modelling Study. This study by Jeremy Benn Associates Consulting (JBA) created a new ISIS-TUFLOW model from the Tees Barrage to Teesmouth.

Outlines from the 2015 Tidal Tees Integrated Flood Risk Modelling Study: Running the 1000-year + climate change have also been provided.

The flood zones at this site are based on the modelled undefended tidal flood outlines of the 2011 Tidal Tees Integrated Flood Risk Modelling Study.

Historic Flood Event Information

5th December 2013

A storm surge caused by high spring tides, low pressure in the North Sea and strong winds affected the east coast and caused flooding across the north east. This included areas of Teesside.

We cannot currently provide a mapped outline for this event but can provide you with the following details.

The embankment that runs downstream from the Transporter Bridge (that has recently been increased in height) was sand bagged by the Environment Agency, as were subways in the area, to try to interrupt flood water. These defences were overtopped in places.

The Flood Warning was issued for Port Clarence and Haverton Hill. Residents from the area were evacuated and flooding was experienced along Port Clarence Road.

Flood Defence Information

The Environment Agency own and maintain a number of flood defence assets along the River Tees near this site. This includes a series of embankments and walls upstream and downstream of the Transporter Bridge (please see map). There are also demountable defences (that when erected create a wall with the same standard of protection as the surrounding defences). These are privately owned and maintained by Wilton Engineering Works.

The defended modelled flood outlines that have been provided as part of this request do not show the effect of the new defences and their increased standard of protection. We do not plan to update the defended outlines until all flood alleviation works have been completed in the Greatham area.