Net Zero Teesside

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9. Surface Water, Flood Risk and Water Resources

9.1 Overview

9.1.1 This chapter of the Preliminary Environmental Information (PEI) Report presents the findings of a preliminary assessment of likely significant effects on the surface water environment (including inland, transitional and coastal surface waters) and flood risk as a result of the Proposed Development, as described in Chapter 4: Proposed Development (PEI Report, Volume I).

9.1.2 The scope of the assessment includes water quality, water resources, hydromorphology, flood risk, and drainage.

9.1.3 The impact assessment has been undertaken in accordance with the following broad stages (as also described Chapter 2: Assessment Methodology, PEI Report, Volume I):

- reviewing the planning and legislative context;
- establishing the baseline;
- appraisal of potential impacts and determining the classification and significance of effects;
- identification of potential mitigation and enhancement measures; and
- identification of likely remaining residual effects.

9.1.4 Environmental effects have been assessed for the construction, operational and decommissioning phases of the Proposed Development. The residual effects reported at the end of this chapter take account of embedded mitigation and the implementation of additional mitigation measures as described in this chapter.

9.1.5 The chapter is supported by information presented in the following PEI Report chapters, figures and appendices:

- Chapter 4: Proposed Development;
- Chapter 10: Geology and Hydrogeology;
- Chapter 13: Aquatic Ecology and Nature Conservation;
- Chapter 14: Marine Ecology and Nature Conservation;
- Figure 9-1: Surface Water Features and their Attributes;
- Figure 9-2: Groundwater Features and their Attributes;
- Figure 9-3: Ecological Designations;
- Figure 9-4: Environment Agency Fluvial Flood Zones;
- Figure 9-5: Flood Risk from Surface Water;

- Appendix 9A: Flood Risk Assessment;
- Appendix 9B: Coastal Modelling Report; and
- Appendix 9C: Background Water Quality Data Tables and Water Resources Data.

9.2 Planning Policy and Legislation

9.2.1 A summary of the legislation and planning policy relevant to the assessment of impacts of the Proposed Development is provided in this section. These have been taken into account in the assessment, with particular regard given to potential impacts in relation to flood risk and water quality.

National Legislation

9.2.2 The following UK Legislation is of relevance to the Proposed Development:

- Water Act 2014;
- Floods and Water Management Act 2010;
- Marine and Coastal Access Act 2009;
- Environment Act 1995;
- Land Drainage Act 1991;
- Water Resources Act 1991;
- Environment Protection Act 1990;
- Salmon and Freshwater Fisheries Act 1975 (as amended);
- Water Environment (Water Framework Directive) (England Wales) Regulations 2017;
- Environmental Permitting (England and Wales) Regulations 2016;
- Control of Major Accident Hazards (COMAH) Regulations (2015);
- Environmental Damage (Prevention and Remediation) Regulations 2015;
- Bathing Water Regulations 2013;
- Eels (England and Wales) Regulation 2009;
- Groundwater (England and Wales) Regulations 2009;
- Flood Risk (England and Wales) Regulations 2009;
- Control of Pollution (Oil Storage) (England) Regulations 2001; and
- Control of Substances Hazardous to Human Health (COSHH) Regulations 2002.

National Policy Guidance

National Policy Statements

9.2.3 National Policy Statements (NPS) for energy infrastructure were designated under the Planning Act 2008. The Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change, 2011a) published by The Department of Energy and Climate Change (now the Department for Business, Energy and Industrial Strategy) in July 2011 is relevant to this assessment with the main sections being:

- Section 4.10: Pollution control and other environmental regulatory regimes;
- Section 5.15: Water Quality and Resources. Stating that: "*Where the project is likely to have effects on the water environment, the applicant 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.*" (Paragraph 5.15.2); and
- Paragraph 5.15.3 which provides advice on what the ES should describe in the baseline.

9.2.4 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011b) is also relevant and was published in July 2011. This describes the need for assessment of the water environment and potential mitigation measures.

National Planning Policy Framework

9.2.5 The National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012a), published by the Ministry of Housing, Communities and Local Government was updated in June 2019, superseding previously published versions. 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). The NPPF also contains a number of statements which are relevant to water quality. These include:

- strategic policies should set out an overall strategy for 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); and

- planning policies should contribute and enhance the natural environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as water quality, taking into account relevant information such as river basin management plans (paragraph 170e).

National Planning Practice Guidance

9.2.6 The Planning Practice Guidance (PPG) Water supply, wastewater and water quality (last updated July 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.

9.2.7 The NPPF (Department for Communities and Local Government, 2012a) and the Flood Risk and Coastal Change NPPG (Department for Communities and Local Government, 2014) recommends that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and should 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. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to public and property and manage any residual risk, taking account of the impacts of climate change.

Defra's '25 Year Environment Plan'

9.2.8 In 2018, Defra published the 25 Year Environment Plan (DEFRA, 2018) setting out the UK Governments goals for improving the environment within a generation and leaving it in a better state than we found it. The plan covers the provision of clean air and water; protection and enhancement of habitats, wildlife and biosecurity; reducing the risk from environmental hazards and mitigating and adapting to climate change; using resources more sustainable and efficiently, minimizing waste and managing exposure to chemicals; enhancing beauty, heritage and engagement with the natural environment.

9.2.9 The Plan includes specific goals to achieve good environmental status in our seas, reduce the environmental impact of water abstraction, meet the objectives of River Basin Management Plans under the Water Framework Directive (WFD), reduce leakage from water mains, improve the quality of bathing waters, restore protected freshwater sites to a favourable condition, and do more to protect communities and businesses from the impact of flooding, coastal erosion and drought. At the heart of the Plan's delivery is the natural capital approach with the aspiring goal of a net gain in biodiversity from new development.

Future Water, The Government's Water Strategy for England

9.2.10 The Government's Future Water Strategy (DEFRA, 2011) published in June 2011 sets out the Government's long-term vision for water and the framework for water management in England. It aims to enable sustainable and secure water supplies whilst ensuring an improved and protected water environment. Future Water brings together the issues of water demand, supply and water quality in the natural environment as well as surface water drainage and river/coastal flooding into a single coherent long-term strategy, in the context of the need to reduce greenhouse gas emissions.

9.2.11 The strategy also considers the issue of charging for water. The water environment and water quality have great economic, biodiversity, amenity and recreational value, playing an important role in many aspects of modern-day society, and thus the functions provided must be sustainably managed to ensure they remain available to future generations without compromising environmental quality.

Sustainable Drainage Systems Guidance

9.2.12 Planning policy encourages developers to include sustainable (urban) drainage systems (SuDS) in their proposals where practicable. SuDS provide a way to attenuate runoff from a site to the rate agreed with the Environment Agency (EA) to avoid increasing flood risk, but they are also important in reducing the quantities and concentration of diffuse urban pollutants found in the runoff.

9.2.13 Defra published guidance on the use, design and construction of SuDS in 'Non-statutory technical standards for SuDS' (DEFRA, 2015).

9.2.14 Industry good practice guidance on the planning for and design of SuDS is provided by:

- C753 The SuDS Manual (CIRIA, 2015a);
- DMRB HA 103/06 (Highways Agency, 2006a); and
- DMRB CG 501 Design of Highway Drainage Systems (Highways Agency, 2006b).

River Basin Management Plan

9.2.15 River Basin Management Plans (RBMPs) are prepared by the Environment Agency for six-year cycles and set out how organisations, stakeholders and communities will work together to improve the water environment. The most recent plans were published in 2015 (the second cycle) and will remain in place until after 2021. The waterbodies within the study area fall under the Tees Management Catchment within the Northumbria RBMP (DEFRA, 2016).).

Local Planning Policy

Redcar and Cleveland Local Plan (May 2018)

9.2.16 The Proposed Development is predominantly within the administrative area of Redcar and Cleveland Borough Council (RCBC). RCBC has published a Local Plan (RCBC, 2018) which was adopted in 2018 and which outlines the Council strategy up to the year 2032. The following policies of the local plan are of relevance to the water environment:

- Policy SD4 – General Development Principles – Development will not be permitted where it results in an unacceptable loss or significant adverse impact on important open spaces, or environmental, built or heritage assets which are considered important to the quality of the local environment; and development will not be permitted where it results in an increase in flood risk either on site or downstream of the development;

- 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. All development proposals will be expected to be designed to mitigate and adapt to climate change, taking account of flood risk by ensuring opportunities to contribute to the mitigation of flooding elsewhere are taken; prioritising use of SuDS; ensuring full separation of foul and surface water flows; and ensuring development is in accordance with the Redcar and Cleveland Strategic Flood Risk Assessment. Further detail is provided regarding requirements for site specific flood risk assessments, discharge of surface water, and runoff rates. Drainage plans must be submitted incorporating SuDS unless it is demonstrated that they would be inappropriate. The drainage system should not adversely impact water quality of receiving water bodies, both during construction and operation, and should seek to improve water quality where possible, as well as maintaining and enhancing biodiversity and habitat of watercourses.
- Policy N4 – Biodiversity and Geological Conservation – The Local Plan will protect and enhance biodiversity and geological resources. These factors should be considered at an early stage in the development process, with appropriate protection and enhancement measures incorporated into the design of the development proposals, recognising wider ecosystem services and providing net gains wherever possible. Priority will be given to protecting internationally important sites, including the Teesmouth and Cleveland Coast Special Protection Area/Ramsar and European Marine Site. Development which is likely to have a significant effect on any internationally designated site, will be subject to an appropriate assessment. Requirements relating to nationally important and locally important sites are also discussed.

Stockton-on-Tees Borough Council Local Plan (January 2019)

9.2.17 The elements of the Proposed Development to the north of the Tees Estuary (i.e. the eastern connection corridors) are located within the Stockton-on-Tees Borough Council administrative area. Stockton-on-Tees Borough Council published a Local Plan in 2019 (Stockton-on-Tees Borough Council, 2019) which outlines the Council strategy up to the year 2032. The following policies of the local plan are of relevance to the water environment:

- Policy EG4 – Seal Sands, North Tees and Billingham – Development proposals in the North Tees and Seal Sands are required, as appropriate, to be supported by a site-specific Flood Risk Assessment which considers, amongst other matters, emergency access/egress in the event of tidal flooding;
- Policy ENV4 – Reducing and Mitigating Flood Risk – All new development to be directed towards areas of lowest flood risk, with any such risk mitigated through design and implementing SuDS principles.

Development on Flood Zones 2 or 3 will only be permitted following successful completion of the Sequential and Exception Tests and a site-specific FRA. All development proposal should seek to minimise flood risk elsewhere, separate foul and surface water flows and prioritise use of SuDs. Surface water run-off should be managed at source and disposed of following the hierarchy of infiltration, discharge to a watercourse (open or closed), or sewer as a last resort. 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-100 year rainfall event should be as close as 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; and

- Policy ENV7 – Ground, Air, Water, Noise and Light Pollution – All development that may cause groundwater or surface water pollution individually or cumulatively will be required to incorporate measures as appropriate to prevent or reduce their pollution so as not to cause unacceptable impacts on living conditions of all existing and potential future occupants of land and buildings, the character and appearance of the surrounding area and environment. Where contamination may present a risk to the water environment, proposal must demonstrate appropriate mitigation measures and that there would not be unacceptable risks to human health or the environment or cause the surrounding environment to become contaminated. Groundwater and surface water quality will be improved in line with the requirements of the WFD and Northumbria River Basin Management Plan. The Council will support ecological improvements along riparian corridors; avoid net loss of sensitive inter-tidal or sub-tidal habitats and support creation of new habitats; protect natural water bodies from modification; and support improvement and naturalisation of heavily modified waterbodies (including deculverting and removing barriers to fish migration).

Tees Valley Authorities – Local Standards for Sustainable Drainage

9.2.18 The Tees Valley Authorities (i.e. the local authorities of Hartlepool, Middlesbrough, Redcar and Cleveland, Stockton-on-Tees and Darlington Borough Councils) produced a supplementary planning guidance (SPG) document entitled ‘Local Standards for Sustainable Drainage’ in 2015 (The Tees Valley Authorities, 2015). The document forms the standards for the local authorities and, together with the national standards, strongly promotes the use of SuDS. It indicates the minimum standards to ensure a satisfactory scheme is constructed under the Floods and Water Management Act 2010, but they are not intended to preclude any requirement for a higher standard that may be deemed necessary.

9.2.19 The SPG covers legislative requirements, the application process, design standards and criteria for SuDS, SuDS components, environmental considerations, water quality, green infrastructure, construction issues and maintenance.

9.3 Assessment Methodology

9.3.1 This section of the chapter presents the following:

- the basis of the assessment and the application of the Rochdale Envelope in accordance with the Planning Inspectorates (PINS) Advice Note 9 (The Planning Inspectorate, 2018);
- identification of the information sources that have been used;
- summary of consultations;
- assessment methodology;
- an explanation as to how the identification and assessment of water resources and flooding effects has been reached; and
- the significance criteria and terminology for assessment of the residual effects to water resources and flooding.

Basis of Assessment

9.3.2 The following sources of information that define the Proposed Development have been reviewed and form the basis of this assessment:

- Chapter 4: Proposed Development (PEI Report, Volume I);
- Chapter 5: Construction and Programme Management (PEI Report, Volume I);
- Figure 1-1: Site Location (PEI Report, Volume II);
- Figure 3-1: Site Boundary (PEI Report, Volume II);
- Figure 3-2A to E (PEI Report, Volume II); and
- Appendix 9A: Flood Risk Assessment (PEI Report, Volume III).

Consultation

9.3.3 An EIA Scoping Opinion was requested from PINS in February 2019. The response from PINS was received in April 2019 and a summary of the comments relevant to this assessment are outlined in Table 9-1, along with indications of how they have been addressed within the ES.

Table 9-1: Summary of Consultation Responses that have Informed the Scope and Methodology of the Surface Water Environment Assessment

Comments Raised in PINS Scoping Opinion	Response Provided in the ES / DCO Application
Water abstraction and discharge: Should existing abstraction and discharge assets be utilised, there will need to be a clear description and assessment within the ES as to the reliance on existing infrastructure, quantities and licenses and how these will vary in the context of the Proposed Development.	This chapter of the PEI Report provisionally assesses impacts relating to water abstraction and discharge, including use of existing assets, and modelling of thermal impacts of discharge to the Tees. This will be developed at the full impact assessment stage when detail on the use of these assets are finalised.
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 of the FRA (Appendix 9A: Flood Risk Assessment in PEI Report, Volume III) are summarised within this chapter of the PEI Report, which considers the entire Site i.e. everything within the Site Boundary. For the purposes of assessing environmental effects temporary changes are those that only last for a duration of time and which are not permanent.
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.	A FRA is appended to this chapter of the PEI Report and considers impacts on floodplain storage and impediment of flows. The findings of the FRA (Appendix 9A: Flood Risk Assessment in PEI Report, Volume III) are also summarised within this chapter of the PEI Report.
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.	A FRA is appended to this chapter of the PEI Report and considers flood risk from all sources, including tidal. The findings of the FRA (Appendix 9A: Flood Risk Assessment in PEI Report, Volume III) are also summarised within this chapter of the PEI Report.
Water Framework Directive: The Inspectorate welcomes that the ES will consider potential impacts from the direct discharge of effluents and/or cooling water under the WFD and notes that the following waterbodies could be impacted: • Tees Estuary WFD waterbody; • Tees Estuary (S Bank) WFD waterbody; and • Tees Coastal WFD waterbody. The ES should assess impacts on water quality, hydromorphology and geomorphology where significant effects are likely. The Applicant's attention is drawn to the Inspectorate's Advice Note Eighteen: The Water Framework Directive for further advice on undertaking a WFD assessment.	A WFD assessment will be prepared and will form a technical appendix to the ES. This will include assessment of surface and groundwater bodies and considers water quality and hydromorphology. Specifically, the assessment will consider whether there is potential for any deterioration in any WFD element or classification, or any prevention of future improvement. The methodology will adhere to advise presented in the Inspectorate's Advice Note Eighteen.

Comments Raised in PINS Scoping Opinion	Response Provided in the ES / DCO Application
Assessment methodology: There is a potential for impacts to water quality from effluent and/or cooling water; consideration should be given to both thermal and chemical changes to water. Thermal modelling should be undertaken and should take into account sea temperature rise due to climate change over the operational lifespan of the Proposed Development. Cumulative effects from all other thermal discharges within the Tees estuary should be considered. Relevant cross reference should be made to the Ecology and Nature Conservation chapter within the ES.	These comments were noted, and thermal discharge modelling has been undertaken. The results of this modelling are appended to this chapter of the PEI Report and summarised within. Cumulative effects are also considered as part of the thermal discharge modelling. Relevant cross reference has been made to Ecology and Nature Conservation within this chapter of the PEI Report, where appropriate.
Watercourse crossings: The Scoping Report states that the method for crossing the River Tees for the gas connection and CO2 gathering network is still under discussion, however there is no indication of whether any other watercourse crossings would be required. The Inspectorate expects the ES (and the FRA) to fully assess the impacts associated with the chosen crossing methods and any culverts or diversion to ordinary and main watercourses that may be required.	Details of watercourse crossings still remain under development, worst case scenarios have been considered for the purposes of the assessment within this PEI Report, which will be reconsidered in full at the ES stage and appropriate mitigation provided.
Drainage: The ES should describe the drainage arrangements for both the construction and operational phase of the Proposed Development.	A summary of potential drainage arrangements are outlined and an assessment of their suitability undertaken within this chapter of the PEI Report. This will be revisited once drainage plans are finalised at the ES stage.
Coastal Processes: The Scoping Report has not considered the potential impacts to coastal processes from any of the offshore works; any likely significant effects from the Proposed Development should be assessed within the ES.	The offshore works associated with construction and operation of the CO2 export pipeline beyond MLWS and operation of the off-shore storage facility are not covered by the Development Consent Order and will be consented through a separate Consent via a separate Marine Licence (ML) application to the Marine Management Organisation (MMO) supported by a separate EIA. However, environmental effects from the construction and operation of the offshore elements of the development will be considered as part of the cumulative impact assessment.
Receptors: The Scoping Report figures show reservoirs close to the electrical connection corridors around Lazenby; however, these have not been identified as environmental receptors in Chapter 2 of the Scoping Report. Any likely significant effects on these receptors should be identified and assessed within the ES.	Potentially impacted water environment receptors have been re-considered within the baseline of this chapter of the PEI Report, and any potential impacts assessed fully.

Baseline Data Collection

9.3.4 For the purposes of the water quality assessment, a study area of approximately 1 km around the Site has been considered in order to identify surface water bodies that could reasonably be affected by the Proposed Development. However, since watercourse flow and water quality impacts may propagate downstream, where relevant the assessment also considers a wider study area based on professional judgement. As flood risk impact can also impact upstream and downstream, the FRA will also consider a wider study area, where relevant. Professional judgement has been applied to identify the extent to which such features are considered. Additional indirect effects may also occur to other water environment receptors distant from the Study Area through increased demand on potable water supplies and foul water treatment (if the adjacent Brans Sands Waste Water Treatment Works (WwTW) does not have capacity).

Desk Study

9.3.5 Desk based research has been undertaken to identify the waterbodies within and adjacent to the Site, and to gather and critically evaluate relevant data and information on their condition and attributes. The Environment Agency's online Main Rivers and flood maps have also been reviewed.

9.3.6 In summary, the key background reports, websites and data used include the following (all web sources last accessed in January 2020):

- Redcar and Cleveland Borough Council's Local Plan (2018) (RCBC, 2018);
- Stockton-on-Tees Borough Council's Local Plan (2019) (Stockton-on-Tees Borough Council, 2019);
- British Geological Survey's Geological Mapping Viewer, 'Geoindex' (British Geological Society, n.d.);
- Environment Agency's Catchment Data Explorer (Environment Agency, n.d.a);
- Environment Agency's Guidance on discharges to surface water and groundwater: environmental permits (Environment Agency, 2016);
- Environment Agency's Flood Risk Maps (Environment Agency, n.d.b);
- Centre for Ecology and Hydrology (CEH)'s National River Flow Archive (CEH, n.d.);
- Cranfield University's 'Soilscapes' (Cranfield University, n.d.);
- Met Office's Climate averages data (Met Office, n.d.);
- DEFRA's Multi-Agency Geographic Information for the Countryside (MAGIC) website (DEFRA, n.d.);
- Ordnance Survey (OS) maps and aerial photography (Bing, n.d.);
- Data requested from the Environment Agency with regard to water quality of receptors in the study area, water resources (licensed abstractions and discharge consents), pollution incidents, fisheries and aquatic ecology data and WFD information and data; and
- Information available in previous Planning Applications relating to Tees Estuary and Tees Bay – Improvement of the Inter Terminals (MLA/2019/00151), Teesside Offshore Windfarm (32421/040319/14), Able Seaton Berth Dredging (MLA/2015/00334/4), York Potash Harbour Facilities Order (TR 030002).

Site Surveys

9.3.7 A Site walkover was undertaken on 22 January 2020 by a surface water quality specialist and hydro morphologist in cold, dry and fair conditions. The walkover focused on surface waterbodies in the study area, observing their current character and condition, the presence of existing risks and any potential pathways for construction and operational impacts from the Proposed Development. Further site visits are planned as part of the full impact assessment to be undertaken as part of the DCO application.

Source-Pathway-Receptor Approach

9.3.8 The impact assessment is based on a source-pathway-receptor approach. For an impact on the water environment to exist the following is required:

- an impact source (such as the release of polluting chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or the loss or damage to all or part of a water body);
- a receptor that is sensitive to that impact (i.e. water bodies and the services they support); and
- a pathway or pathways by which the two are linked.

9.3.9 The first stage in applying the Source-Pathway-Receptor model is to identify the causes or 'sources' of potential impact from a development. The sources have been identified through a review of the details of the Proposed Development, including the size and nature of the development, potential construction methodologies and timescales. The next step in the model is to undertake a review of the potential receptors, that is, the water environment receptors that have the potential to be affected. Water bodies including their attributes have been identified through desk study and site surveys. The last stage of the model is, therefore, to determine if there is a viable exposure pathway or a 'mechanism' linking the source to the receptor. This has been undertaken in the context of local conditions relative to the water receptors within the study area, such as topography, geology, climatic conditions and the nature of the impact (e.g. the mobility of a liquid pollutant or the proximity to works that may physically impact a water body).

9.3.10 The assessment of the likely significant effects is qualitative, and considers construction, operational and decommissioning phases, as well as cumulative effects with other developments. This assessment has considered the risk of pollution to surface water bodies directly and indirectly from construction, operational and decommissioning activities, particularly in relation to those water features which are within or close to the Site. The risk of pollution from urban runoff and the increased demand on water resources has also been considered so that appropriate measures (e.g. SuDS, proprietary treatment devices, and water conservation measures) can be incorporated into the design of the Proposed Development.

9.3.11 Some specific assessments have been undertaken to support this impact assessment process. These are described in more detail in the following sections.

Assessment of Surface Water Runoff for the Operational Phase

9.3.12 During operation, surface water runoff from the Proposed Development may contain pollutants derived from urban surfaces (e.g. inert particulates, litter, hydrocarbons, metals, nutrients and de-icing salts). This is mixture of pollutants is collectively known as 'urban diffuse pollutants,' and although each pollutant may itself not be present in harmful concentrations, the combined effects over the long term can cause chronic adverse impacts. Changes in impermeable surfaced area within the Proposed Development may lead to increases in the rate and quantities of these pollutants from the

Site to receiving watercourses. An assessment is therefore needed to determine the potential risk to the receiving watercourses and to inform the development of suitable treatment measures.

9.3.13 The appropriateness of the surface water drainage measures in terms of providing adequate treatment of diffuse urban pollutants has been assessed with reference to the Simple Index Assessment method described in the SuDS Manual (CIRIA, 2015a). The Simple Index Approach follows three steps:

- Step 1 – Determine suitable pollution hazard indices for the land use(s);
- Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index (for three key types of pollutants - total suspended solids, heavy metals and hydrocarbons). Only 50% efficiency should be applied to second, third etc. treatment train components; and
- Step 3 – If the discharge is to a water body protected for drinking water, consider a more precautionary approach.

9.3.14 The SuDS Manual (CIRIA, 2015a) only provides a limited number of land use types so these have been chosen as the most suitable for the components of the Proposed Development. Where more than one pollution hazard category applies to a component of the Proposed Development, the worst pollution hazard has been selected. Please note that for areas where site specific industrial activities may take place or there is a greater risk of a chemical spillage, a process specific risk assessment may need to be undertaken at the full impact assessment stage, where appropriate.

Water Framework Directive Assessment

9.3.15 A preliminary qualitative assessment of the compliance of the Proposed Development against the WFD objectives for those WFD waterbodies that could be affected is being undertaken. This includes the assessment of the potential construction/decommissioning (where they are of sufficient scale and duration that they may affect status) and operational phase impacts of the Proposed Development on hydromorphological, biological and physico-chemical parameters with respect to the WFD objectives of no deterioration and failure to prevent improvement. For the purposes of the assessment decommissioning phase impacts would be likely to be similar to construction phase impacts and therefore are not considered separately. It will also take into account proposed mitigation measures where the water body is not at Good Ecological Status/Potential or better, the objectives of relevant Protected Area designated under other EU Directives, and adjacent WFD waterbodies. The Preliminary WFD Assessment will be appended to the ES.

Flood Risk Assessment

9.3.16 A Site-wide FRA is provided as Appendix 9A: Flood Risk Assessment (PEI Report, Volume III), which assesses the current risk of flooding from all sources including fluvial, surface water, groundwater, tidal, artificial sources and drainage infrastructure. Refer to the FRA (Appendix 9A: Flood Risk Assessment, PEI Report, Volume III) for a full description of the flood risk baseline, which is also summarised in Section 9.4 of this PEI Report chapter.

Classification of Effects and Significance Criteria for EIA Assessment

9.3.17 There is no standard guidance in place for the assessment of the likely significant effects on the water environment from developments of this type. Based on professional judgement and experience of other similar schemes, a qualitative assessment of the likely significant effects on surface water quality and water resources has been undertaken.

9.3.18 The classification and significance of effects has been determined using the principles of the guidance and the criteria set out in DMRB LA 113 (Highways England, 2019) adapted to take account of hydromorphology. Although these assessment criteria were developed for road infrastructure projects, this method is suitable for use on any development project and it provides a robust and well tested method for predicting the significance of effects. The methodology also considers advice set out in Department of Transport TAG Unit A3, Environmental Impact Appraisal (Department for Transport, 2019).

9.3.19 Approaches to mitigating potential impacts during construction and operational phases have been described with reference to good practice guidance and design.

9.3.20 Following the DMRB LA 13 (Highways England, 2019) guidance, the importance of the receptor (Table 9-2) and the magnitude of impact (Table 9-3) are determined independently and are then used to determine the overall classification and significance of effects (see Table 9-4). Where significant adverse effects are predicted, options for mitigation have been considered and proposed where possible. The residual effects of the Proposed Development with identified mitigation in place have also been assessed.

9.3.21 Whilst other disciplines may consider ‘receptor sensitivity’, ‘receptor importance’ is considered here. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes, is very sensitive to impacts, whereas an important regional scale watercourse, that may have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

Table 9-2: Evaluating the Importance for Surface Water, Flood Risk, and Water Resources

Importance	Surface Water[1]	Morphology[2]	Flood Risk
Very High	Watercourse having a WFD classification shown in a RBMP and Q95≥1.0 m^3/s. Sites protected/designated under a EC or UK legislation (SAC, SPA, SSSI, Ramsar, salmonid water) / Species protected by EC legislation Ecology and Nature Conservation.	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type.	Essential infrastructure or highly vulnerable development
High	Watercourse having a WFD classification shown in a RBMP and Q95<1.0 m^3/s. Species protected under EC or UK legislation Ecology and Nature Conservation.	Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures.	More vulnerable development
Medium	Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s.	Shows signs of previous alteration and / or minor flow regulation but still retains some natural features or may be recovering towards conditions indicative of the higher category.	Less vulnerable development
Low	Watercourses not having a WFD classification shown in a RBMP and Q95 <0.001m^3/s.	Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (e.g. trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.	Water compatible development

Note 1 Professional judgement is applied when assigning an importance category to all water features.
All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulations 2016 and the Water Resources Act 1991 (as amended), and future WFD targets also need to be considered.

Note 2 Based on the water body 'Reach Conservation Status' presently being adopted for the High Speed 2 project (developed originally by Atkins) and developed from EA conservation status guidance (Environment Agency 1998a, Environment Agency, 1998b) as DMRB guidance does not currently provide any importance criteria for morphology.

9.3.22 The magnitude of impact will be determined based on the criteria in Table 9-3 taking into account the likelihood of the effect occurring. The likelihood of an impact occurring is based on a scale of certain, likely or unlikely. Likelihood has been considered in the case of water resources only, as likelihood is inherently included within the flood risk assessment.

Table 9-3: Evaluating Magnitude for Surface Water, Flood Risk, and Water Resources

Impact	Criteria	Description and Examples
Major Adverse	Results in a loss of attribute and/or quality and integrity of the attribute	Loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated Nature Conservation Site. Reduction in water body WFD classification Increase in peak flood level (>100mm)[1]
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Partial loss in productivity of a fishery. Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification. Increase in peak flood level (>50 mm).
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability	Minor effects of water supplies. Increase in peak flood level (>10mm).
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	No risk identified to surface water quality or hydromorphology Negligible change in peak flood level (≤+/- 10 mm).
Minor Beneficial	Results in some beneficial impact on attribute or a reduced risk of negative effect occurring	Contribution to minor improvement in water quality, but insufficient to raise WFD classification. Creation of flood storage and decrease in peak flood level (>10 mm).
Moderate beneficial	Results in moderate improvement of attribute quality	Contribution to improvement in waterbody WFD classification. Creation of flood storage and decrease in peak flood level (>50 mm).
Major beneficial	Results in major improvement of attribute quality	Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse. Improvement in water body WFD classiciation. Creation of flood storage and decrease in peak flood level (>100 mm).

[1] All references to peak flood level in this table are for a 1% annual probability event, including climate change. Note: adapted from DMRB LA113 (Highways England, 2019)

Classification and Significance of Effect

9.3.23 Once the magnitude of impact and the receptor importance have been defined, the classification and significance of the potential effect can be derived by combining both assessments in a simple matrix as shown in Table 9-4. Effects classed as moderate or greater are considered significant in EIA terms (i.e. shaded cells). Where there is a range of effects (e.g. large / very large) professional judgement has been used to determine the residual effect.

Table 9-4: Classification and Significance of Effect

Magnitude of Impact	Importance of Attribute			
	Low	**Medium**	**High**	**Very High**
No change	Neutral	Neutral	Neutral	Neutral
Negligible	Neutral / Slight	Neutral / Slight	Neutral	Slight
Minor	Neutral / Slight	Slight	Slight / Moderate	Moderate / Large
Moderate	Slight	Moderate	Moderate / Large	Large / Very Large
Major	Slight / Moderate	Moderate / Large	Large / Very Large	Very Large

Note: adapted from DMRB LA104

Rochdale Envelope

9.3.24 The assessment contained herein makes use of the ‘Rochdale Envelope’ approach under the Planning Act (2008). The approach is employed where the nature of the Proposed Development means that some details of the whole project have not been confirmed when the application is submitted, and flexibility is sought to address the uncertainty.

9.3.25 Key principles in the context of the DCO application process are given in the Planning Inspectorate’s Advice Note Nine: Using the Rochdale Envelope (The Planning Inspectorate, 2018). This includes the need to outline timescales associated with the flexibility sought, and that the assessment should establish those parameters likely to result in the maximum adverse effect (the reasonable worst-case scenario) and be undertaken accordingly to determine significant effects from the Proposed Development and to allow for the identification of necessary mitigation.

9.3.26 The following are the reasonable worst-case scenario assumptions (maximum parameters) for the purposes of the Water Environment assessment:

- It is assumed that during construction the Contractor will as a minimum conform to all permit/consent/licence requirements and best practice measures to avoid, reduce and minimise the risk of water pollution or unacceptable physical impacts (without mitigation) on water bodies. Details of this mitigation and best practice standards are described later in this report.
- It is assumed as a worst case that the former steelworks abstraction intake point in the Tees Estuary is to be used for supplying water to the

Proposed Development and that the amount of water required would be agreed with the Environment Agency ensuring that no significant environmental impact or impact to a third party would occur. The existing abstraction licence is for 30,000 te/h, however it is expected as a worse case assumption that up to 90,000 te/h would be needed for the Proposed Development (OGCI, 2019a).

- It is assumed that some refurbishment works will be required to the existing abstraction intake and that this will involve some minor preparatory dredging followed by the installation of a coffer dam in close proximity to the intake structure (which may be of the order of 150 m long). Water would be pumped out after any necessary fish rescue and at a suitable rate and way as to avoid where practicable scour of the estuarine bed or nearby intertidal substrate just to the north.
- It is assumed that the preparatory dredging would be done using a bucket operated by a mechanical excavator working off a jacked-up barge or dredger and without any silt curtain installed.
- The dredging works will be below MHWS and would be undertaken in accordance with a Deemed Marine Licence from the Marine Management Organisation (MMO) and following chemical testing of the sediments. If suitable, sediments would be deposited at a suitable licensed off-shore site, or otherwise will be disposed of on land in accordance with UK waste management legislation.
- This assessment assumes that, as a worst case, the existing Tees Bay outfall from the former steelworks is not suitable and that a new outfall consisting of a pipeline and diffuser head weighed down with rock armour will be provided. The route and terminal point of the new pipeline will be similar to the existing. The new pipeline will be buried beneath the seabed until close to the position of the diffuser head.
- The assessment assumes that an effluent treatment plant will be provided on site for treatment of the main sources of wastewater, which will include process effluent. The existing outfall is subject to an existing EA permit (reference EPR/JP3638HM). The current discharge licence states that, where a parameter value is not set, the concentration must not exceed the background concentration and so will require treatment. New discharge limits are likely to be sought via an application for an Environmental Permit.
- It is assumed at this stage that as a minimum, bypass oil water separators will be provided for surface water runoff to a retention pond situated upstream of the main outfall from the Site. It is also assumed that penstocks would be provided to isolate any accidental spillages or fire water on Site that enter the surface water drainage system or process water system, so that they can be disposed of accordingly.
- As a worst case, it has been assumed that open-cut methods will be required for the connection corridor crossings of all watercourses other than the Tees estuary. In such cases, it is assumed that flow would be temporarily over-pumped, diverted around or flumed through the working area and the watercourse fully reinstated as before.

- It is assumed that the Tees crossings for the gas connection and CO_2 gathering network will be constructed using trenchless technologies, and at a sufficient depth below the estuary bed to ensure that there is no risk of exposure.
- For the purposes of this assessment it has been assumed that all foul water from welfare facilities will either be directed to the nearby Brans Sands Northumbrian WwTW, or, given the relatively small volumes involved, to an on-site package plant for treatment of both construction and operational foul discharges.

9.3.27 Assumptions relating to the thermal discharge modelling from the Tees Bay outfall are all outlined in the modelling report (see Appendix 9B: Coastal Modelling Report in PEI Report, Volume III).

Limitations and General Assumptions

9.3.28 The EIA process enables good decision-making based on the best possible available information about the environmental implications of a proposed development. However, there is often a degree of uncertainty as to the exact scale and nature of the environmental impacts, and in such cases the worst-case scenario has been considered under a Rochdale Envelope approach as outlined above.

9.3.29 The assessment has been undertaken using available data and Proposed Development design details at the time of writing in March 2020. It is also based on understanding of flow pathways as observed during the site walkover. However, many of the watercourses in the study area are in culvert and underground for significant sections, and so assumptions have been made regarding flow pathways for these culverted sections, based on Ordnance Survey mapping. Understanding of flow pathways is described for each watercourse in the baseline (Section 9.4).

9.3.30 Assumptions and limitations relating to flood risk are outlined in the FRA (Appendix 9A: Flood Risk Assessment, PEI Report, Volume III).

9.3.31 Assumptions and limitations relating to the thermal discharge modelling from the Tees Bay outfall are all outlined in the coastal modelling report (Appendix 9B: Coastal Modelling Report, PEI Report, Volume III).

9.3.32 The ES will include an assessment of site clearance and remediation prior to construction.

9.3.33 No Construction Method Statements are available at the time of writing, although a reasonable assumption has been made that all works will take place using best practice, as set out in the Outline Construction Environmental Management Plan (CEMP) to be submitted with the DCO application.

9.3.34 No water quality monitoring has been undertaken. Background water quality has been determined from the nearest data available of the Environment Agency's Water Quality Archive website.

9.3.35 As described in the Rochdale Envelope assumptions, the need to use the existing abstraction point within the River Tees (within 100 m of NZ 547 259) for industrial water supply has not yet been confirmed. It was not accessible during the site visit, and so the existing condition of the abstraction point is unknown. As a worst-case scenario it is assumed that the former steelworks abstraction point in the River Tees is to be used for supplying water to the Proposed Development with no exceedance of the previously licensed rates and volumes. Furthermore, it is assumed for the purposes of this PEI Report that some refurbishment works will be required to the existing intake, but that these will be undertaken behind a coffer dam or similar installed around the intake to provide a dry working area. It is expected that some localised dredging of fine sediments that have built up in front of the intakes will need to be removed and disposed of at a suitable marine deposition site in accordance with marine licencing procedures. If the existing intakes are not be re-used, the alternative would be to use water supplied by Northumbrian Water.

9.3.36 The understanding of drainage arrangements assessed herein is based the options presented in the OGCI (2019a) Gas Power – Water Treatment Options Assessment Report (OGCI, 2019a). The drainage strategy is subject to further development, in consultation with the Environment Agency and LLFA, and will be presented and assessed at the full impact assessment stage. An indicative assessment is provided herein.

9.3.37 The expected treatment performance of different SuDS options is based on advice reported in CIRIA C753 The SuDS Manual (CIRIA, 2015a) for use with the Simple Index Approach. This approach gives a number of example land uses which are not all directly applicable to the Proposed Development. Professional judgement has been used when deciding the example land use used, and what treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be ‘optimum’ or ‘sub-optimum’ for whatever reason.

9.4 Baseline

9.4.1 The relevant baseline physical characteristics of the study area and the water features present are described in this section. Please refer to Figure 9-1: Surface Water Features and Their Attributes throughout.

Land Use, Topography and Rainfall

9.4.2 The PCC, part of the former SSI steel works, is coastal, being located immediately southwest of Teesmouth, at approximately 5 - 11 m above ordnance datum (AOD). Coatham Dunes and Coatham Sands are immediately to the north and Bran Sands is to the west (see Figure 9-1: Surface Water Features and Their Attributes). The PCC is currently industrial, comprising former steelworks structures. The Dormanstown area of Redcar is located southeast of the PCC.

9.4.3 The Site boundary extends north of the PCC across Coatham Dunes and Coatham Sands into Tees Bay, and west into the Tees Estuary at the southern extent of Bran Sands (see Figure 9-1: Surface Water Features and

Their Attributes). These areas of the Site are included in order to incorporate existing water abstraction and discharge infrastructure that are to be retained for use by the Proposed Development (see Figure 9-1: Surface Water Features and Their Attributes).

9.4.4 The Site boundary extends south and southwest of the PCC in order to accommodate the Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network.

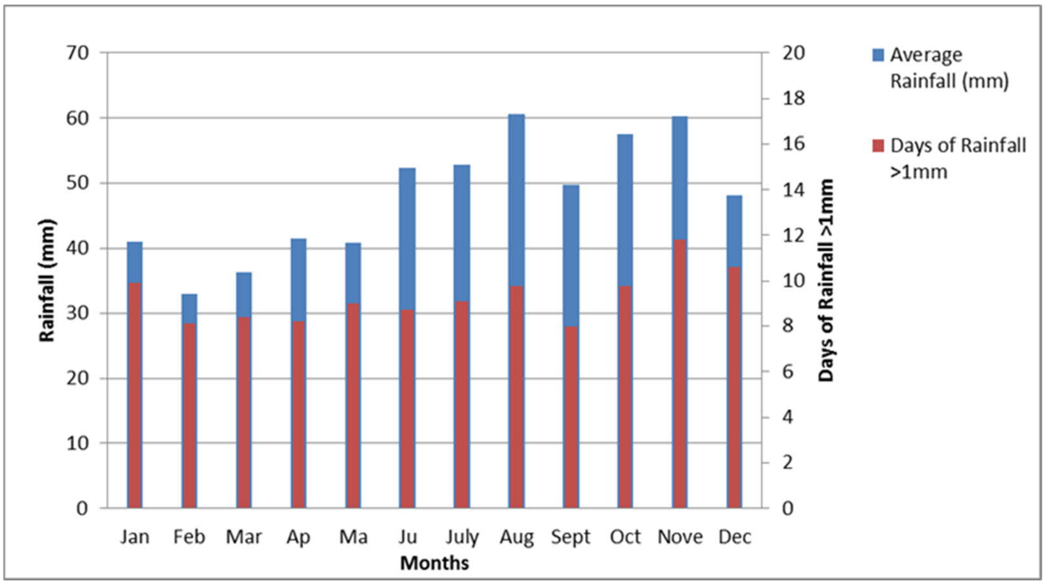
9.4.5 To the south of the PCC, the Electrical Connection Corridor extends around the perimeter of the Wilton International Site and British Steel Lackenby steelworks site, with both being outside of the Site boundary (see Figure 9-1: Surface Water Features and Their Attributes). The Electrical Connection Corridor also extends towards Lazenby Bank to the south, and to the Grangetown urban area at the eastern edge of Middlesbrough. The topography across this part of the Site rises slightly to the south and west, reaching 25 m AOD at Lazenby and 30m AOD in Grangetown. Small watercourses drain from these areas towards the Tees, often within culverts. Beyond the Site boundary to the south, but within the study area is Wilton and Eston Moor, including the Wilton Moor Plantations. To the east the land use is more urban in character, incorporating the outer fringes of Middlesbrough.

9.4.6 The section of the Site comprising the Natural Gas Connection Corridor and CO_2 Gathering Network extends to the west of the Electrical Connection Corridor. Here the Site boundary extends across the Tees adjacent to Dabholm Gut (see Figure 9-1: Surface Water Features and Their Attributes). The Site boundary extends across the chemical works on the western bank of the Tees on reclaimed land to the south of the Seal Sands inter-tidal mudflats. The Natural Gas Connection Corridor extends west as far as the Central Area Transmission System (CATS) terminal. The CO_2 gathering network then follows pipelines using wayleaves between parts of Salthome Nature Reserve, and into the industrial area at the eastern edge of Billingham. This whole section of the Site is very flat, being between 0 and 10 m AOD. The immediate surroundings include heavy industry on the banks of the Tees, mudflats to the north, marshland at Saltholme and Cowpen Marsh (including Cowpen Bewley Woodland Country Park), and the Tees Estuary itself. There are numerous large standing bodies of water in the marshland areas as well as small watercourses draining towards Seal Sands (which is included within local SSSI and SAC designations).

9.4.7 The nearest weather station on the Met Office website (Met Office, n.d.) with historical data is located at Stockton-on-Tees, approximately 5.5 km southeast of the eastern extent of the Site, at NGR NZ 43846 19831. Based on the average climate data ((for the period 1981 to 2010 (as the most recent data available)) for this weather station, it is estimated that the study area experiences an average of 574 mm of rainfall per year, with it raining more than 1 mm on around 112 days per year. This is a relatively low level of rainfall for England.

9.4.8 Diagram 9-1 illustrates this data to show how the average rainfall varies throughout the year, with the wettest period being in the late summer to autumn, and driest in late winter to early spring. Average monthly rainfall is generally less than 60 mm throughout the year, except in August and November when it is between 60 and 65 mm. February is the driest month with an average of approximately 33 mm between 1981 and 2010.

Diagram 9-1 Stockton-on-Tees Weather Station – Average rainfall per month (1981-2010) and average days per month with >1mm of rainfall (1981-2010)



Water Features

9.4.9 A Site Walkover was undertaken on 22nd January 2020 in cold, dry but overcast conditions. Using observations taken on this visit, data from OS mapping and the Environment Agency Catchment Data Explorer website[2], a summary list of the surface waterbodies and where relevant to the assessment, groundwater waterbodies are listed in Table 9-5 were identified within the study area and are presented on Figure 9-1: Surface Water Features and Their Attributes and 9-2: Groundwater Features and Their Attributes (PEI Report, Volume II). Further detail on these are presented in Tables 9-6 to 9-7 below.

[2] https://environment.data.gov.uk/catchment-planning/

Table 9-5: Surface and Groundwater Waterbodies Identified Within the Study Area

Waterbody	Type of waterbody	WFD designation or associated WFD waterbody (where applicable)
Tees Bay	Coastal	Tees Coastal Water (GB650301500005)
Tees Estuary	Watercourse (Main River)	TEES Transitional Waterbody (GB510302509900)
The Fleet	Watercourse (Ordinary)	Tees Estuary (S Bank) (GB1030250723320)
Main's Dike	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Mill Race	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Dabholm Gut	Watercourse (Ordinary)	Designated under the TEES Transitional Waterbody (GB510302509900)
Dabholm Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Kettle Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Kinkerdale Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Knitting Wife Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Holme Fleet	Watercourse (Main River)	Tributary of the Tees Transitional WFD Waterbody
Belasis Beck	Watercourse (Ordinary)	Tributary of Holme Fleet and therefore associated with the Tees Transitional WFD Waterbody
Cross Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Greatham Creek	Watercourse (Main River)	Designated under the Tees Transitional WFD Waterbody
Mucky Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Swallow Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Salthome Nature Reservoir Ponds, Brine Reservoirs, Brine Field and refinery ponds	Stillwater	Catchment of Tees Transitional WFD Waterbody
Lake at Charlton's Pond Nature Reserve	Stillwater	Catchment of Tees Transitional WFD Waterbody
Ponds at Billingham Technology Park	Stillwater	Catchment of Tees Transitional WFD Waterbody
Ponds within Coatham Dunes and Bran Sands	Stillwater	Catchment of Tees Coastal WFD waterbody
Ponds at Coatham Marsh	Stillwater	Catchment of Tees Estuary (S Bank)
Numerous industrial ponds and artificial waterbodies across the area including Lazenby Reservoirs and Salthouse Brine Reservoirs	Stillwater	Catchment of Tees Transitional WFD Waterbody
Tees Sherwood Sandstone	Groundwater	WFD designation (GB40301G702000)
Tees Mercia Mudstone & Redcar Mudstone	Groundwater	WFD designation (GB40302G701300)

Surface Waterbodies

9.4.10 The Environment Agency's Catchment Data Explorer website (Environment Agency, n.d.a) confirms that the estuarine and coastal waterbodies in the study area are contained within the Northumbria River Basin District, the Northumbria Transitional and Coastal (TraC) Management Catchment, and the Tees Lower and Estuary TraC Operational Catchment. The fluvial waterbodies are contained within the Northumbria River Basin District, Tees Management Catchment and Tees Lower and Estuary Operational Catchment.

9.4.11 There are four WFD designated surface water bodies within the study area, and these are described briefly in Table 9-6 (see also Figure 9-1: Surface Water Features and Their Attributes in PEI Report, Volume II). Although these are the WFD reporting reaches, WFD principles and objectives apply to all tributaries of these watercourses. The WFD waterbodies include one coastal waterbody (Tees Coastal Water), one estuarine waterbody (TEES transitional waterbody) and one river (The Fleet - designated as Tees Estuary (S Bank)).

Table 9-6: WFD Surface Waterbodies in the Study Area

Waterbody	Ecological Status / Potential	Chemical Status	Overall Target Objective	Hydromorphological Designation	Designated Reach
Tees Coastal Water (GB650301500005)	Moderate Ecological Potential	Good	Good (2027)	Heavily Modified	The Tees Coastal waterbody 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.
Site observations: 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 historical 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 Transitional Waterbody (GB510302509900)	Moderate Ecological Potential	Fail	Moderate (2015)	Heavily Modified	The TEES Transitional Waterbody extends from the Tees Barrage to the 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 designation includes the mud and sand flats at Seal Sands,Tees Dock, Greatham Creek and Dabholm Gut, 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) and into the Seaton on Tees Channel. 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.
Site observations: The Tees waterbody 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 the waterbody is flat, having been largely reclaimed in this area and is currently occupied by various heavy industries. Further details regarding hydrodynamics, tides and sediments are provided later in the baseline. The Dabholm Gut is an artificial channel of around 1km length left following historical 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, and lacking bedform features of interest, being indicative of extensive past modification. Reeds surround the channel on both banks and 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, with some visible foaming suggesting potential presence of agitated chemicals. There are numerous consented discharges here from the adjacent industry, and consents are shown in Figure 9-1: Surface Water Features and Their Attributes and Table 9-14 (Water Activity Permits). The channel width remains constant up to the confluence with the Tees. At low tide, fine sediments are exposed in the channel and are dark in colour suggesting potential presence of pollutants. During especially high tides anecdotal evidence suggests the channel has been known to overtop onto the adjacent access road. The site is popular with birdlife and is included in the Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI).					

Waterbody	Ecological Status / Potential	Chemical Status	Overall Target Objective	Hydromorphological Designation	Designated Reach
Tees Estuary (South Bank) (GB1030250723320)	Moderate Ecological Potential	Good	Good (2027)	Heavily Modified	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.

Site observations: 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 and likely alters the character of water quality. 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. The channel is also choked by submerged and emergent macrophytes, the extent of which suggests some enrichment by nutrients. 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 crossing were noted over the watercourse near this location. Flow is sluggish as a result of the widespread macrophytes, 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. The bed was smothered in fine sediment and pollution pressures were notable with an oil sheen on the water. There were very few macrophytes and the channel has incised banks, rising steeply 1-2 m abruptly from the channel bed.

9.4.12 Within the catchments of the WFD waterbodies outlined in Table 9-6, there are also a number of named watercourses shown on Ordnance Survey mapping (Bing, n.d.), and these are described in Table 9-7 (please refer to Figure 9-1: Surface Water Features and Their Attributes throughout).

Table 9-7: Other Named Watercourses in the Study Area that are Not Defined WFD Water Bodies

Name	Tributary of	Watercourse Description	Site Observations
Belasis Beck	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. This creates a depositional environment, encouraging the growth of submerged and emergent macrophytes. Although these will take up nutrients during their growth, if they are not removed these are released back into the water column resulting in permanent recycling of nutrients and enriched conditions that support further growth of invasive macrophytes. Sediments are fine with little evidence of any transportation. They are also likely to be contaminated due to the past and current industry in this location. 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. A brown surface scum was observed and was thought to be indicative of organics.
Dabholm Beck	Tees Transitional Waterbody	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 Cut.	Refer to the Dabholm Gut description under the Tees Transitional Waterbody description above.
Cross Beck	Tees Transitional Waterbody	Cross Beck rises on Eston Moor at NZ 55920 17053. It flows generally north to become Knitting Wife Beck at NZ 55172 20910 in Grangetown. The watercourse is upstream of any works relating to the Proposed Development and so is scoped out of further assessment.	This watercourse has been scoped out and so was not visited on the site walkover.
Kettle Beck	Tees Transitional Waterbody	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 no	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. The bed was dominated by fine sediment with some isolated very fine gravel accumulations. Submerged macrophytes were abundant and some sections of the

Name	Tributary of	Watercourse Description	Site Observations
		clear from online mapping north of the A1085 as the watercourse is culverted.	channel were shaded by overhanging vegetation and thick riparian vegetation. 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.
Holme Fleet	Tees Transitional Waterbody	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 but still considered where relevant within the Study Area of the assessment.
Kinkerdale Beck	Tees Transitional Waterbody	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. The bed was dominated by fine sediment. Submerged macrophytes were abundant and some sections of the channel were shaded by overhanging vegetation. 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	Tees Transitional Waterbody	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 alignment 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. Fine sediment accumulations were abundant; the channel was largely overgrown; and this section of the channel largely shaded by overhanging deciduous vegetation. Pollution was evident with red staining on all of the vegetation immediately downstream of the culvert.
Lackenby Channel	Tees Transitional Waterbody	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 with limited hydromorphological interest.
Main's Dike	The Fleet	Main's Dike watercourse rises from a spring in Wilton Wood to the southeast of the Site at NZ 59328 19741. The watercourse then flows north along the eastern boundary of the Wilton International Site, and into the Mill Race at NZ 57893 22824.	Main's Dike was observed along the eastern edge of the Wilton International Site where it was very straight, around 1 m in width and with steep incised banks rising around 4 m from the channel. The watercourse was heavily shaded, and no macrophytes were observed in the channel at this location although marginal vegetation was dense.

Name	Tributary of	Watercourse Description	Site Observations
			The bed was dominated by fine sediment, with some isolated fine gravel patches (e.g. 2-3 cm diameter). Significant sediment accumulations were observed downstream of the Mains Dike Bridge culvert. There was also evidence of some lateral erosion of the banks and the formation of small, alternating fine gravel lateral bars, although the gradient was still shallow and the channel stable.
Mill Race	The Fleet	The course of the Mill Race is unclear as it is largely culverted but appears to emanate from coalescence of ditches and watercourses at NZ 57893 22824, then flows north of the Wilton International Site beneath the A1085. It remerges at NZ 57102 24152 and flows west into The Fleet.	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 wide) leading up to a circular culvert of around 2 m diameter, with artificial concrete banks in places. Banks were step and incised. The bed was dominated by fine sediment. 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, very straight, with a bed dominated by fine sediment. Road runoff appears to discharge into the channel.
Mucky Fleet / Swallow Fleet	Tees Transitional Waterbody	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 Transitional Waterbody.	Not visited during the site visit because they are outside of the Site Boundary but still considered where relevant within the Study Area of the assessment

9.4.13 In addition to the watercourses described in Tables 9-6 and 9-7, 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. These ditches do not have nature conservation designations and due to largely being in culvert are expected to have minimal biodiversity value. In places, the drainage channels are visible above ground and are typically of the order of 0.5-1 m in width, ephemeral (i.e. flowing for only part of the year or only after storms), have artificial engineered and sometimes concrete channels, and thus generally do not support functional flows (i.e. flows with the ability to erode, transport and deposit sediment resulting in the formation of geomorphic bedforms).

9.4.14 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.

9.4.15 Other waterbodies shown in Figure 9-1: Surface Water Features and Their Attributes in PEI Report, Volume II 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.

9.4.16 In total, there are over 250 still waterbodies within 200 m of the Site boundary (see Chapter 13: Aquatic Ecology in PEI Report, Volume I) 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. For instance, the Lazenby Reservoirs are located southeast of the Wilton International Site. 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 includes 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.

Tees Estuary

9.4.17 The present-day Tees Estuary has a largely anthropogenic character due to land reclamation, canalisation and channel deepening that began in the mid-1800s. Originally the estuary was surrounded by expansive wetlands and the tidal ingress extended for approximately 44 km upstream from the mouth. Historical maps indicate a channel width of up to 300 m between Stockton and Middlesbrough prior to 1900, which has reduced to a modern-day width varying between 100 and 200 m. This relatively narrow estuarine channel has marginal intertidal areas, especially where the mouth widens, spanning around 300 ha. This includes an approximately 140 ha area known as Seal Sands, on the north bank, which is separated from other intertidal areas by Seaton Channel (Royal Haskoning, 2016a). In the mid-1990s the Tees Barrage was built. This comprises a river barrage together with a road bridge and a footbridge. Navigation for boats is maintained by a barge lock, whilst there is also a fish pass. Water is held upstream of the barrage at the level of a typical high tide and the water used to supply a white-water course. The barrage has reduced the tidal stretch of the Tees to approximately 14 km from the mouth and reduced tidal volume upstream of South Gare by around 7% (ABPmer, 2002).

9.4.18 The Tees Estuary is not designated as a Bathing Water or Shellfishery. Northumbrian Water’s Brans Sands WwTW discharges to the estuary close to Teesmouth.

9.4.19 The mouth of the Tees Estuary has a breakwater to either side, the North Gare and South Gare breakwaters. The South Gare breakwater is the larger and longer structure (approximately 2 km in length compared to around 850 m for the North Gare breakwater). The South Gare breakwater runs parallel to the main approach channel of the Tees and is built over areas of deposited slag. Within the mouth of the Tees, to the south, is Bran Sands Bay, while Coatham Sands is to the east of the breakwater. North Gare Sands is to the south of the North Gare breakwater, with Seaton Sands to the north.

9.4.20 PD Teesport report that the Tees Approach Channel has a charted depth of 15.4 m, which progressively reduces to 4.5 m east of Billingham Beck, which is 8 nautical miles upstream from the entrance to the estuary (Royal Haskoning, 2016c).

9.4.21 The tide curve at Teesmouth is near sinusoidal in shape with a mean spring range of 4.6 m and a mean neap tide range of 2.3 m (UKHO, 2006). Other tidal statistics are given in Table 9-8.

Table 9-8: Tidal Statistics for the Tees Estuary (ABPmer, 2002)

Tide Statistic	Level (m Chart Datum)
Lowest recorded water level	-0.38
Lowest astronomical tide	0.00
Mean low water spring tide	+0.90
Mean low water neap tide	+2.00
Mean sea level	+3.20
Mean high water neap tide	+4.30
Mean high water spring tide	+5.50
Highest astronomical tide	+6.10
Highest recorded water level	+6.86

9.4.22 The data in Table 9-8 indicate that there is variability between the astronomical tide range and the maximum and minimum recorded water levels, thereby suggesting that meteorological factors (e.g. wind, surge and waves) have an important influence on water levels in the estuary.

9.4.23 The source of the Tees is at Cross Fell in the Pennines, some 160 km from the mouth of the Tees. Freshwater input to the estuary is measured at a gauging station at Low Moor (NGR NZ 364 105). According to the National River Flow Archive (CEH, n.d.) for the period 1969-2018, the Tees at this point has a mean flow of 20.528 m^3/s, with a 10% exceedance (Q10) of 46.5 m^3/s, and a 95 exceedance (Q95) of 3.07 m^3/s.

9.4.24 The Tees Barrage controls freshwater flow into the Tees Estuary and allows partial mixing with saline water. However, the combination of reduced tidal volume, partial mixing and longitudinal salinity gradient drive a density driven gravitational circulation. Ebb flows are strongest at the surface, while flood tide flows are more evenly spread through depth. As such, the tidally average currents tend to be seawards in the surface waters and landwards closer to the estuary bed (Royal Haskoning, 2016a). This effect leads to a net sediment supply into the estuary from offshore areas.

9.4.25 Waves in the Tees Estuary result from a combination of locally generated wind waves, and offshore swell. The majority of offshore swell is from a northerly direction. The most common wind direction observed at South Gare is from the southwest (210-217ºN), although the largest wind events (i.e. of over 40 m/s) tend to be from the north (HR Wallingford, 2006).

9.4.26 Extreme wave heights for defined return periods, as previously reported for the waverider buoy north of the Tees North Buoy, are presented in Table 9-9. The North and South Gare breakwaters limit swell wave energy into the Tees Estuary, where any remaining energy is combined with local wind-driven waves (Royal Haskoning, 2016a).

Table 9-9: Extreme Wave Heights North of Tees North Buoy as Reported by HR Wallingford (2006)

Return Period in Years	Significant Wave Height (Hs (m))
0.1	3.87
1	6.03
10	8.63
50	10.69

9.4.27 Suspended sediment concentrations are generally low in Tees Bay and in the Tees Estuary when compared to some UK estuaries, with values typically below 50 mg/l based on historical (pre-Tees Barrage) measurements held by the Environment Agency. Highest concentrations tend to coincide with spring tides, and inputs tend to be derived from marine influences downstream, freshwater inputs from further up the catchment and industrial inputs. The marine input is washed in with the flood tide, and often causes resuspension of fine bed sediments.

9.4.28 The DCO Application relating to York Potash Harbour Facilities in 2016 (Royal Haskoning, 2016a) demonstrates that historical bed sampling in the vicinity of the Proposed Development has bed sediments comprising 65-70% silt, with some clay (around 20%) and the reminder sand and gravel. Coarser sands tend to settle in the lower estuary, with finer material transported further up the estuary by the tides. It is estimated that the total fine material input to the estuary is 280,000 m^3 to 330,000 m^3 per year (Royal Haskoning, 2016d).

Tees Bay

9.4.29 Tees Bay includes Bathing Waters designated under the Bathing Waters Directive, with 'Redcar Coatham' being located immediately north of the PCC, and 'Seaton Carew North Gare' being situated immediately north of the study area. There are no designated shellfisheries within Tees Bay.

9.4.30 Tees Bay has a tidal regime driven by the North Sea tidal wave, which originates in the north and travels south. The tide is semi-diurnal, repeating every 12.5-13 hours, with a macro-tidal range of 4.6 m for a mean spring tide and meso-tidal range of 2.3 m for a mean neap tide. Tidal velocities are generally low, reaching up to 0.25 m/s to 0.3 m/s. The flood tide direction in the Bay is southeast and the ebb direction northwest (EDF Energy, n.d.).

9.4.31 The sediment regime in the area includes surface seabed sediments, suspended sediments and a variety of sources and sinks. Silts and muds are readily transported as suspended sediment load and can remain in suspension for extended periods through the tidal cycle, while coarser sands and gravels may only be mobilised at times of peak hydrodynamic forcing carried as bedload. Suspended sediment concentrations between 1500 and 4000 mg/l have been measured at exposed locations during peak wave events (EDF Energy, n.d.).

9.4.32 Coatham Sands are protected at the western end by nearshore slag banks exposed at low water and known as the German Charlies. The Redcar seafront then extends as a defended headland for around 1.5 km. The headland results from the outcropping rocks of Coatham Rocks and Redcar Rocks (Royal Haskoning, 2014).

9.4.33 Within this area is the cable landfall of the Teesside Offshore Wind Farm, which is a 27 turbine 62 MW capacity offshore wind farm situated 1.5 km north of Coatham Sands, and which has been operational since 2013. There is also the discharge point from the former Steelworks site within Tees Bay off Coatham Sands.

Navigation

9.4.34 The Tees Estuary and adjacent Tees Bay is subject to significant commercial vessel traffic. The Navigational Risk Assessment for the York Potash Harbour development (Royal Haskoning, 2016c) provided a summary of vessel movements within the Tees Estuary for 2013-2014, which are shown in Table 9-10. Updated figures will be requested from PD Teesport and will be included in the full impact assessment once received. The general pattern from 2013 is of an average of 878 vessel movements per month, peaking in May (1009) and with fewest in December (714).

Table 9-10: Vessel Movements for the Tees Estuary 2013 (Royal Haskoning, 2016c)

Month	No of movements
January	824
February	808
March	981
April	922
May	1009
June	871
July	899
August	867
September	869
October	890
November	886
December	714

9.4.35 Further to the above, commercial fishing vessels are launched from Redcar and Marske-by-the-Sea and give rise to further traffic in the Tees Bay area. In particular, fishing effort in the area is focused on potting for crab and lobster, supplemented by trawling for cod, haddock, sole, whiting, plaice and turbot (EDF Energy, n.d.).

9.4.36 The nearest HM Coastguard moorings (Maritime and Coastguard Agency, n.d.) are to the north of the study area at Hartlepool Marina. There is an RNLI Lifeboat station at Redcar Seafront.

Surface Water Quality

9.4.37 The Tees Coastal WFD waterbody is at Good Chemical Status under the WFD Cycle 2 classifications (2016) with all priority substances, priority hazardous substances, specific pollutants and other pollutants being at Good status or higher.

9.4.38 The Tees Transitional WFD waterbody is also at Good Chemical Status under the WFD Cycle 2 classifications (2016), but does have failures for tributyltin compounds, which have a status of Fail. The Environment Agency believe this is due to diffuse contamination of estuarine sediments (Environment Agency, n.d.a).

9.4.39 The Tees Estuary (South Bank) waterbody is at also Good Chemical Status with no assessment require for priority substances, priority hazardous substances, specific pollutants, and other pollutants do not require assessment (Environment Agency, n.d.a).

9.4.40 Water quality data has been obtained from the Environment Agency's Water Quality Archive (Environment Agency, n.d.c) for the Tees Estuary. Annual average values for the year 2018 are summarised in Table 9-11 for a sampling point close to the mouth of the Tees at the Gares, and at Smiths Dock, Redcar Jetty, Teesport and the confluence with Dabholm Gut moving upstream (these monitoring locations are also shown on Figure 9-1). The parameter values presented Table 9-11 are compared against WFD standards where they apply to transitional waters.

Table 9-11: Summary of Tees Estuary Water Quality Data Based on Monitoring at Multiple Sites Between 2009 - 2019 (Environment Agency, n.d.c)

Parameter	WFD Threshold (for Good)	Tees at the Gares, NGR NZ 55200 28400	Dabholm Gut Confluence, NGR NZ 54822 24858	Teesport, NGR NZ 54400 23700	Redcar Jetty, NGR NZ 54500 25700	Smiths Dock, NGR NZ 52800 22100
Temperature of Water (ºC)	-	10.28	12.01	11.9	10.2	10.6
Ammoniacal Nitrogen as N (mg/l)	21	0.270	-	-	0.545	-
Nitrate as N (mg/l)	-	0.43	-	-	0.88	1.19
Nitrite as N (mg/l)	-	0.011	-	-	0.0205	0.0155
Orthophosphate, reactive as P	-	0.045	-	-	0.0961	0.1185
Oxygen, Dissolved, % Saturation	-	101.95	98.07	94.25	97.41	93.39
Arsenic, Dissolved	25	1.15	-	1.100	-	1
Chromium, Dissolved		-	5.22	0.5	-	0.5
Copper, Dissolved	3.76*	0.630	1.39	-	0.91	0.89
Lead, Dissolved	1.3	0.128	0.574	0.294	0.244	0.59
Nickel, Dissolved		0.891	3.483	-	1.598	0.168
Zinc, Dissolved	6.8**	2.167	8.90	4.30	3.24	3.79
Tributyltin	0.015	0.0002	0.0003	0.0002	0.0002	0.0002
Lindane		-	-	-	0.0004	-
para para DDT	0.01	-	-	-	0.0012	-
Chloroform		-	1.060	0.116	-	-
Carbon tetrachloride	12	-	-	-	-	-
Hexachlorobenzene	0.05	-	-	-	0.0004	-
Hexaclorobutadiene	0.05	-	-	-	0.0004	-

*where DOC is less than or equal to 1 mg **dissolved plus Ambient Background Concentration (µg/l)

9.4.41 There are no failures against any EQS, although there is some evidence of slightly elevated metal concentrations, which is expected given the industrial and urban nature of the area surrounding the estuary mouth and the immediate upstream reaches of the River Tees. Tributyltin concentrations are all below the EQS at all monitoring locations despite its WFD 'Fail' classification and may suggest significant spatial variability in concentrations across the WFD waterbody given the low values at these sampling points.

9.4.42 The Water Quality Archive website (Environment Agency, n.d.c) also provides water quality for other waterbodies and sites in close proximity to the Proposed Development, spanning the period 2009-2019 inclusive. Data tables are provided in Appendix 9C: Background Water Quality Data Tables and Water Resources Data, for Brans Sands at Teesmouth, the Wilton Complex Effluent Composite, Dabholm Gut upstream of the Tees, Greatham Creek and Billingham Beck. A summary is provided in Table 9-12 indicating parameters that were measured and a brief overview of water quality implications.

Table 9-12: Summary of Water Quality Data Waterbodies within the Study Area based On Monitoring between 2009-2019 (Environment Agency, n.d.c)

Monitoring Station	Duration of Sampling	Type of Water Sampled	Parameters	General Quality Comments
COASTAL / ESTUARINE:				
Wilton Complex Main Effluent Composite NGR: NZ 56100 24100	1 year (2019)	Effluent	Sanitary pollutants (e.g. Biochemical Oxygen Demand (BOD)), metals and organics (e.g. chloroform).	This effluent shows high levels of numerous pollutants. BOD is very high and indicative of sanitary waste water containing high concentration of organic material; Chloroform exceeds the EQS stated in the Dangerous Substance Directive; and copper and zinc exceed WFD EQS.
Brans Sands NGR: NZ5570026600	2000-2019	Estuarine water	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate).	Slightly alkaline and well oxygenated. Concentration of nitrates was relatively low, although orthophosphate elevated. Copper and zinc were not measured at this site. Escherichia coli and Intestinal enterococci have been measured once (2014) and were below limits of detection.
Dabholm Gut 100 m upstream from the Tees confluence NGR: NZ5550024500	2000-2019	Estuarine water	Physico-chemical parameters (e.g. pH); Trace metals (copper and zinc).	Circum-neutral pH with average concentrations zinc exceeding the WFD Standards for estuarine water. It should be noted that only six samples were taken at this site.
Greatham Creek 100 m from outfall (adjacent to Able UK) NGR: NZ5249026490	2009-2012	Estuarine Water	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate)*; Trace metals.	Slightly alkaline and well oxygenated. Concentration of nitrates and phosphate were low. Numerous metals were measured at this site, all falling below EQS (as outlined in Table 9-11).
FRESHWATER:				
Billingham Beck 50 m upstream of River Tees confluence NGR: NZ4747020507	2000-2019	River	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate); Intermittent metals monitoring until 2014 following which monitoring was regular.	Circum-neutral and well oxygenated. Concentration of nitrates and phosphate are slightly elevated. Dissolved copper concentrations are above the WFD Standard of 1 µg/l even in the 10th percentile value. However, the standard applies to bioavailable copper, and there is insufficient data to determine bioavailability. The mean concentration of zinc is just below the WFD Standard of 10.9 µg/l (plus ambient)
Billingham Beck at Billingham Bottoms NGR: NZ4549522393	2000-2019	River	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate); Trace metals (copper and zinc).	Circum-neutral and well oxygenated. Concentration of nitrates and phosphate are considerably lower than the downstream sampling site close to the Tees confluence. Dissolved copper concentrations are high and may rise above the WFD Standard of 1 µg/l bioavailable (insufficient data to determine bioavailability).

9.4.43 The data presented in Table 9-12 indicates that there remains substantial pollution pressure on the Tees Estuary from existing effluent and pollution discharges (e.g. several failures against EQS in the Wilton Complex effluent), although as noted above the Tees has a large capacity to absorb these pollutants with concentrations of most pollutants being below EQS in the monitored data from the Teesmouth area.

9.4.44 The freshwater streams in the Study Area draining to the River Tees are generally not routinely monitored by the Environment Agency. There is data for Billingham Beck, which is outside of the 1 km Study Area and is upstream of the Site, and so has been scoped out of the assessment as it will not be impacted. However, the watercourse is likely to exhibit similar water quality traits to those in the study area given the similar surrounding urban land with heavy industry, low gradients and tide locking affect if the Tees Estuary. The data for this watercourse indicates that certain dissolved metals, including copper and zinc, exceed WFD standards, although the standard for copper is 'bioavailable', which would typically be lower than any measured dissolved copper result. Nitrates and phosphates are also slightly elevated.

9.4.45 Further water quality data for the Study Area is available for Bathing Water areas as designated under the Bathing Waters Directive. In the northeast of the Study Area, Coatham Sands is a designated bathing water (as 'Redcar Coatham'). Water quality at designated bathing water sites in England is assessed by the Environment Agency. From May to September each year, weekly assessments measure current water quality, and at a number of sites daily pollution risk forecasts are issued. Annual ratings classify each site as excellent, good, sufficient or poor based on measurements of *Intestinal enterococci* and *Escherichia coli* taken over a period of up to four years. Redcar Coatham had a 2019 classification of Excellent (Environment Agency n.d.d).

9.4.46 The Environment Agency's Bathing Water Quality website (Environment Agency n.d.d) notes that the Redcar Coatham bathing water is subject to short term pollution caused when heavy rainfall or high tides wash faecal material to the sea from livestock, sewage and urban drainage via rivers and streams, with water quality typically returning to normal after a few days.

9.4.47 The southern extent of the Seaton Carew North Gare Bathing Water is also within the 2 km of the Site and also has a classification of Excellent for 2019 (Environment Agency n.d.d).

Sediment Quality

9.4.48 Numerous investigations of sediment quality have recently been undertaken to support various recent dredging proposals and developments around the Tees Estuary, with samples compared to Cefas[3] Action Levels for the disposal of dredged material. These give an indication of sediment quality in the Tees Estuary and Teesmouth areas. In general, contaminant levels in dredged material below Action Level 1 are of no concern and are unlikely to influence marine licensing decisions and is suitable for sea disposal.

[3] Centre for Environment, Fisheries and Aquaculture Science

However, dredged material with contaminant levels above Action Level 2 is generally considered unsuitable for sea disposal.

9.4.49 Samples were collected in 2017 and 2018 to support dredging at Seaton Port (Able UK, 2018), adjacent to the Seaton Port Dry Dock facility on the north bank of the River Tees, centred approximately on NGR NZ 52416 26658. This is approximately 2.4 km west of the abstraction point for the Proposed Development. Sampling consisted of four surface samples in the vicinity of the dry dock in 2017 and a further five in 2018. A summary of results is shown against Cefas Action Levels in Table 9-13. It is clear that several metals are present in concentrations over Action Level 1, which triggered additional sampling, but none were found to exceed Action Level 2.

Table 9-13: Assessment of Sediment Samples Against Cefas Action Levels for Samples Collected in 2017/18 from Seaton Port (Adapted From Able UK (2018))

Parameter	Action Level 1	Action Level 2	Maximum 2017 Result	Maximum 2018 Results	Comment
Arsenic	20	100	36.28	26.2	Above Level 1; Significantly below Level 2.
Mercury	0.3	3	0.72	0.35	Above Level 1; Significantly below Level 2.
Cadmium	0.4	5	0.47	Below AL1	2017 result above Level 1; Significantly below Level 2.
Chromium	40	400	105.84	92.8	Above Level 1; Significantly below Level 2.
Copper	40	400	66.4	40	Above/equal to Level 1; Significantly below Level 2.
Nickel	20	200	42.88	40.2	Above Level 1; Significantly below Level 2.
Lead	50	500	151.32	108	Above Level 1; Significantly below Level 2.
Zinc	130	800	244.5	199	Above Level 1; Significantly below Level 2.

Note: all value as mg/kg Dry weight (ppm)

9.4.50 The DCO Application relating to York Potash Harbour Facilities in 2016 (Royal Haskoning, 2016a) also included sediment sampling in the main Tees Estuary downstream of Dabholm Gut. The sampling was undertaken in 2014 and full results are available in Royal Haskoning (2016b).

9.4.51 Surface sediment samples were collected as well as sediment from a range of depths down to 4.87 m below the surface. In summary, the sediments contained relatively high levels of contamination, including elevated metals and polycyclic aromatic hydrocarbon (PAH) concentrations. Metals and PAHs exceeded Cefas Action Level 1 at the majority of sampling stations and depths. In some cases, Cefas Action Level 2 was also exceeded, notably for chromium, copper and mercury. As such these sediments were not considered suitable for disposal at sea. The concentration of metals in dredged samples from the Tees Approach Channel were generally less than those sampled closer to the east bank, with no exceedances of Cefas Action Level 1 in the samples from the approach channel. On the whole, there were fewer exceedances of Polychlorinated biphenyls (PCBs) against the Cefas Action Levels than metals and PAHs, although there were instances of exceedances against both Action Level 1 and 2. Concentrations of contaminants are greater at depth than in surface samples, reflecting the historical impact of heavy industry in this area around the waterbody, which in the past received a large amount of waste discharge.

9.4.52 Two earlier impact assessments of sediment quality were undertaken to support the EIA of the Northern Gateway Container Terminal (NGCT) and QE II berth redevelopment project.

9.4.53 The QE II berth sediment assessment consisted of two samples immediately west of Tees Dock, taken in 2008. Two vibrocores were used for sampling sediment to a depth of 4 m below ordnance datum. Results indicated that all metals exceeded Cefas Action Level 1 levels of contamination. Concentrations of dibutyl tin and organotins were present below Action Level 1. Concentrations of cadmium, chromium, copper, lead, mercury and zinc also exceeded Cefas Action Level 2 (Royal Haskoning, 2016a) and were not considered suitable for disposal at sea.

9.4.54 The NGCT sediment samples were collected in 2006 from several locations throughout the Tees Estuary, including the main channel between Tees Dock and Dabholm Gut, Seal Sands, Bran Sands and the Tees Approach Channel. In summary, there was some level of contamination recorded in the samples, particularly with regard to heavy metals. However, levels were not deemed high enough to prevent material being disposed of at sea (Royal Haskoning, 2016a).

9.4.55 These past sampling campaigns indicate significant historical contamination in the Tees Estuary, which is more concentrated at the margins of the channel and at depth than in surface sediments. In some locations, concentrations of contaminants exceeded Cefas Action Level 2 and so disposal at sea is not considered suitable in these cases.

Marine Ecology Overview

9.4.56 Full details regarding marine ecology within the study area are provided in Chapter 14: Marine Ecology and Nature Conservation (PEI Report, Volume I). A brief summary is provided below.

9.4.57 In terms of fisheries, the Tees river and estuary is an important water body for diadromous fish species which make seasonal migrations between the sea and riverine environment. Salmon (*Salmo salar*), sea trout (*Salmo trutta*), European eel (*Anguilla anguilla*), river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*) are all known to be present and have been identified as Local Priority Species within the Tees Valley BAP. Salmon, river lamprey and sea lamprey are also protected species under Annex II of the Habitats Directive. The River Tees is designated as one of the 64 main salmon rivers in England and Wales.

9.4.58 Estuarine and marine fish communities within the vicinity of the Proposed Development represent a mixed demersal and pelagic fish assemblage typical of the central North Sea. Data on the Environment Agency website indicates that the total number of the monthly combined upstream counts for salmon and sea trout at the Environment Agency fish counter at the Tees Barrage on the Lower Tees has steadily declined in recent years, with total fish counted being 498 (2016), 297 (2017), 217 (2018) and 204 (2019) (Environment Agency, 2019).

9.4.59 Common shellfish species within inshore waters include edible crab (*Cancer pagurus*), European lobster (*Homarus gammarus*) and velvet swimming crab (*Necora puber*). There are no designated shellfish waters within the vicinity of the Site.

9.4.60 The North Sea and coastal waters around the Site are known to be important for harbour porpoise (*Phocoena phocoena*), which is an Annex II species under the Habitats Directive.

9.4.61 No protected phytoplankton species or invasive non-native species (INNS) were identified during the Environment Agency surveys in the Tees Estuary. However, there is evidence of some forms of taxa being present that cause harmful algal blooms in UK coastal waters or fish mortality.

9.4.62 No formal monitoring of harmful algal blooms is carried out within the lower Tees estuary or coastal water bodies although the Tees WFD water body which covers the lower reaches of the estuary is classified as having 'Good' phytoplankton status despite Seal Sands being recognised as a sensitive eutrophic area.

9.4.63 With regard to zooplankton, several INNS are known to have been introduced to the North Sea due to human activities and have responded to favourable conditions, but no protected species have been identified.

9.4.64 Results of the Phase I and macrofaunal sampling is reported in Chapter 14: Marine Ecology and Nature Conservation (PEI Report, Volume I). Overall, benthic communities were characterised by relatively low abundance, biomass, species richness and diversity. No protected species were identified during the intertidal survey. Similarly, the only INNS recorded was the seaweed wakame (*Undaria pinnatifida*). Further surveys are planned and the results will be updated during the full impact assessment stage.

Freshwater Ecology Overview

9.4.65 Full details regarding marine ecology within the study area are provided in Chapter 13: Aquatic Ecology (PEI Report, Volume I). A brief summary is provided below.

9.4.66 There is only one riverine WFD waterbody within the red line boundary of the Proposed Development and this is the Tees Estuary South Bank (GB103025072320). Routine WFD monitoring is therefore limited in the area and there is limited availability of aquatic datasets. Those that are available were requested from the Environmental Records and Information Centre (ERIC). Given the limited data availability, further aquatic baseline surveys are to be undertaken to gather more robust data for the full impact assessment.

9.4.67 The rivers and streams within the Tees Valley are classified as UK BAP priority habitats and salmon, brown/sea trout, European eel, brook lamprey, sea lamprey and river lamprey are classified as UK BAP priority species.

There were no notable fish species recorded within 2 km of the Site boundary within the past three years based on the ERIC data.

9.4.68 In the past 5 years there are records of designated aquatic invertebrates being present in ponds associates with Coatham Dunes near Coatham Sands, in Saltholme Nature Reserve, and Cowpen Marsh (See Chapter 13: Aquatic Ecology, PEI Report, Volume I, for details of species). Data requests returned no records for designated aquatic macroinvertebrates species within a 2 km radius from the Site within the past 3 years. Further surveys are to be undertaken to inform the full impact assessment (see Chapter 13: Aquatic Ecology, PEI Report, Volume I).

9.4.69 The WFD macroinvertebrate monitoring data provided by the Environment Agency from 2016 for Dabholm Gut (part of the 'Tees Estuary South Bank' WFD waterbody) at NZ 56570 23772 indicates that the waterbody has very poor quality (Whalley Hawkes Paisley Trigg score of 17.6 to 19.5, Average Score Per Taxa of 3.3 to 3.5, very low diversity) and no species of conservation interest were recorded.

9.4.70 On the basis of available data, there are no notable or protected macrophyte species recorded within the study area. However, given the lack of monitoring sites there will be more extensive macrophyte surveys at the full impact assessment stage.

9.4.71 A range of INNS species listed on Schedule 9 of the Wildlife & Countryside Act are recorded in the study area, based on data provided by the ERIC. Only one was in the Proposed Development area, which was Nuttall's Waterweed (*Elodea nuttalii*). A range of historical aquatic INNS records were returned for the study area by ERIC including water fern (*Azolla filiculoides*), New Zealand pigmyweed (*Crassula helmsii*), parrot's feather (*Myriophyllum aquaticum*), floating pennywort (*Hydrocotyle ranunculoides*) and Canadian waterweed (*Elodea canadensis*).

Sites of Ecological Importance

9.4.72 Designations within and in close proximity to the Study Area are shown on Figure 9-3: Ecological Designations (PEI Report, Volume II). The Water Connection Corridors and the CO_2 Gathering Network and Natural Gas Connection Corridor (where it crosses the Tees Estuary) of the Proposed Development cross the Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI). The Teesmouth and Cleveland Coast SSSI is notified under Section 28C of the Wildlife and Countryside Act 1981 and is of special interest for many nationally important features that occur within and are supported by the wider mosaic of coastal and freshwater habitats. Habitats in the SSSI include sand dunes, saltmarshes, mudflats, rocky and sandy shores, saline lagoons, grazing marshes, reedbeds and freshwater wetlands. The site stretches from Crimdon Dene Mouth in the north, to Marske-by-the-Sea in the south, and inland to Billingham including the entire Tees Estuary upstream to the Tees Barrage.

9.4.73 The coast either side of Teesmouth is also designated as being of international importance as the Teesmouth and Cleveland Coast Special

Protection Area (SPA) which is designated under the EU Birds Directive, and the Teesmouth and Cleveland Coast Ramsar site, which is a wetland designated as being of international importance under the Ramsar Convention. The designation is for its important bird populations, and the SPA is a complex of discrete coastal and wetland habitats. These include sandflats, mudflats, rocky foreshore, saltmarsh, sand dunes, wet grassland and freshwater lagoons. The SPA is classified for its breeding Little Tern, passage Sandwich Tern and Redshank, wintering Red Knot and an assemblage of over 20,000 wintering birds. The SPA and Ramsar site both fall cross the Proposed Development boundary at its northern extent for the water connection corridor.

9.4.74 Seaton Dunes and Common Local Nature Reserve (LNR) (part of the Teesmouth and Cleveland Coast SSSI) is located just over 2km from the Proposed Development boundary. The area is of considerable importance for its invertebrate fauna, flora and bird life. The range of habitats include sandy, muddy, and rocky foreshore, dunes, dune slacks and dune grassland, as well as relict saltmarsh, grazed freshwater marsh with dykes, pools and swells (Natural England, n.d.).

9.4.75 Chalton's Pond LNR is located approximately 1 km west of the eastern extent of the Site boundary. This is an 8 ha site, consisting of wetlands, amenity grassland and woodland. The site is upslope and upstream of the Site and so is scoped out of further assessment.

9.4.76 There are no other statutory, local non-statutory or other non-statutory designated sites whose reason for designation is due to aquatic habitats, species or their assemblage up to 1 km from the Site.

Groundwater and Geological Features

9.4.77 Full details of geology and groundwater are provided in Chapter 10: Geology and Hydrogeology (PEI Report, Volume I) and are shown in Figures 10.1 to 10.3. In summary, the British Geological Society Geoindex viewer (British Geological Society, n.d.) indicates that the solid geology beneath the study site consists of strata of Jurassic and Triassic age.

9.4.78 Immediately around the River Tees and to the south of Teesmouth the bedrock is Triassic Mercia Mudstone including the northern section of the PCC which is also underlain the Penarth Group. The southern half of the PCC is underlain by Jurassic Redcar Mudstone, which also stretches south to beyond the Wilton International Site and underlies the majority of the town of Redcar.

9.4.79 To the north of the Tees Estuary, Mercia Mudstone underlies the Seal Sands Industrial Estate, which overlies the Triassic Sherwood Sandstone Group, which is present beneath Seal Sands, Cowpen Marsh, Saltholme and the town of Billingham.

9.4.80 Bedrock is overlain by superficial deposits consisting 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 and the southern extent of the Wilton International Site are underlain by Devensian Till (diamicton). The northwest of the study area towards Cowpen Bewley is underlain by glaciolacustrine deposits. Finally, there are marine beach deposits on the coastline north of Teesmouth.

9.4.81 DEFRA's Multi-agency geographical information for the countryside (MAGIC) website (DEFRA, n.d.) indicates that the Sherwood Sandstone to the north of the Tees is classified a Principal Aquifer. These 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.

9.4.82 The Mercia Mudstone bedrock deposits surrounding the Tees are classified as a Secondary B aquifer. These are lower permeability strata which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. The Redcar Mudstone to the south of this is Secondary (undifferentiated) aquifer. This 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.

9.4.83 The superficial deposits beneath the Site are predominantly classified as a Secondary (undifferentiated) aquifer, and in some cases unproductive (i.e. drift deposits with low permeability that have negligible significance for water supply or river base flow). However, there is an area of Secondary A superficial aquifer beneath the PCC and immediately south towards the A1085 and Dormanstown. Secondary A aquifers are 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.

9.4.84 The study area to the east and south of the Tees estuary is wholly within the Tees Mercia Mudstone & Redcar Mudstone WFD groundwater body (GB40302G701300) (Environment Agency, n.d.a). The waterbody is at Poor Overall Status, with Good Quantitative Status but Poor Chemical Status. The latter is a consequence of Poor Chemical Dependent Surface Water Body Status, due to point source pollution from mining and quarrying sources. The waterbody has an area of 494.57 km^2.

9.4.85 The study area to the west and north of the Tees Estuary is mainly within the Tees Sherwood Sandstone WFD groundwater body (GB40301G702000), with the exception of an isolated point around Port Clarence, which remains in the Tees Mercia Mudstone & Redcar Mudstone WFD groundwater body. The Tees Sherwood Sandstone groundwater body is at Good Overall Status, with Good Quantitative and Chemical Elements. The waterbody has an area of 293.01 km^2.

9.4.86 Cranfield University's Soilscapes website (Cranfield University, n.d.) indicates that the majority of the study area either side of the Tees Estuary is underlain by loamy and clayey soils of coastal flats with naturally high groundwater. Beyond this, the southern section of the Lackenby Steelworks and all of the Wilton International Site is underlain by slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soil. The latter is also found in the northern extent of the study area north of Haverton Hill and toward Billingham. However, due to past development soil type and structure is likely to have been altered and large areas of Made Ground exist. Finally, sand dune soils are found along the coastal areas to the north of the study area.

Water Resources

9.4.87 The study area is not within a Drinking Water Protected Area, Drinking Water Safeguard Zone or near any Source Protected Zones.

9.4.88 The following provides information on water activity permits (i.e. discharges), water abstractions and past pollution incidents.

Water Activity Permits

9.4.89 The Envirocheck report (Landmark Information Group, 2019) for the Proposed Development indicates that there are 45 active water permits (i.e. formerly discharge consents) within 250 m of the Proposed Development. Details are provided in Appendix 9C: Background Water Quality Data Tables and Water Resources Data (PEI Report, Volume III) Table G and locations are shown in Figure 9-1: Surface Water Features and Their Attributes. A request was made to the Environment Agency for data up to 1 km from the Site, but this data has not been provided.

9.4.90 The majority of consented discharges are of treated/untreated sewage effluent from storm tanks, pumping stations, and combined sewer overflows (both private and water company). There are also a significant number of trade effluent, process/chemical and cooling water discharges in the study area, reflecting the industrial land uses. Finally, there are two active discharges for raised mine/groundwater where past activity is still having present day water quality impacts.

Abstractions

9.4.91 Data provided by the Environment Agency indicates that there are 18 licensed water abstractions within 2 km of the Site, which are presented in Appendix 9C: Background Water Quality data tables and Water Resources Data (PEI Report, Volume III) Table 9C-8 and the water attributes plan (presented in Figure 9-1: Surface Water Features and Their Attributes).

9.4.92 Twelve abstractions are for groundwater from the underlying Triassic Sherwood Sandstone to the north and west of the Tees Estuary. They are predominantly for industrial, commercial and public service use. There are also groundwater abstractions for water supply.

9.4.93 There are six surface water abstractions, from both the Tees and Holme Fleet. Again, the predominant use is the industrial, commercial and public service sector, with one abstraction also for power generation.

9.4.94 Details on private water supplies have been requested from the local authorities and will be presented and assessed as part of the full impact assessment stage.

Water Pollution Incidents

9.4.95 The Envirocheck report (Landmark Information Group, 2019) for the Proposed Development indicates that there have been four water pollution incidents of Category 3 (minor) or worse within 250 m of the Site within the last 10 years. Details are given in Table 9-14 and locations are shown in Figure 9-1: Surface Water Features and Their Attributes. A request was made to the Environment Agency for data up to 1 km from the scheme boundary, but this data has not been provided at the time of writing.

Table 9-14: Pollution Incidents to Controlled Waters within 250 m of the Site

Fig 9.1 Ref	Notification ID & Date	Category	National Grid Reference	Pollutant	Probable Receiving Waters
P1	969033 10/03/2012	3 (Minor)	NZ 49573 21710	Atmospheric pollutants and effects - smoke	Tees Estuary
P2	1187178 25/12/2013	3 (Minor)	NZ 49573 21710	Contaminated Water – firefighting runoff	Tees Estuary
P3	1256199 15//07/2014	2 (Significant)	NZ 56608 23878	Crude sewage	Dabholm Gut
P4	1405228 22/01/2016	2 (Significant)	NZ 57917 23982	Oils – Diesel (including agricultural)	Tributary of the Fleet

9.4.96 The recorded pollution incidents have impacted the Tees Estuary, Dabholm Gut and a tributary of the Fleet. They have been related to pollution from oils, crude sewage and contaminated water associated with firefighting runoff.
Flood Risk

9.4.97 This section provides a summary of the baseline Flood Risk data available for the Site. Refer to Appendix 9A: FRA in PEI Report, Volume III for a more detailed description of the baseline environment in relation to flood risk.

9.4.98 The Environment Agency's 'Flood Map for Planning' (Environment Agency, n.d.b) 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. These have been illustrated on Figure 9-4: Environment Agency Fluvial Flood Zones (PEI Report, Volume II) and should be referred to throughout.

9.4.99 The Flood Zone definitions for the flood zones used on the Flood Map for Planning, are defined in Table 9-15 below.

Table 9-15: Flood Zone Definitions (source Table 1 of the PPG; Department of Communities and Local Government, 2012b)

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

Tidal Sources

9.4.100 The River Tees is classified as a Main River and is tidal as it passes through the study area, with the normal tidal limit approximately 14 km upstream (at the Tees Barrage).

9.4.101 Greatham Creek, a Main River, is a tidal watercourse which flows in an easterly direction, following the Stockton on Tees Borough Council boundary, and discharges into the Tees at Seal Sands. Its tidal limit extends to a weir, which is approximately 300 m upstream of the confluence with Cowbridge Beck, outside of Stockton Borough. Greatham 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.

9.4.102 The online Flood Map for Planning (Environment Agency, n.d.b) illustrates that the entirety of the PCC and the connection corridors on the south bank of the River Tees are located within Flood Zone 1 (i.e. a low risk of flooding from tidal sources). The exceptions to this are the connection corridors that cross Coatham Dunes and Coatham Sands down to MLWS, a small area of connection corridor around the existing intakes that extends west to Bran Sands, and where the corridor route crosses the River Tees, which all extend into Flood Zone 3 (i.e. a high risk of flooding from tidal sources).

9.4.103 Flood risk is more extensive to the north of the River Tees including large areas of the very low-lying Seal Sands, Cowpen Marsh, Saltholme and Port Clarence, with flooding predominantly associated with the River Tees and Greatham Creek. The connection corridor that extends out towards Billingham crossing land between the two tidal watercourses is located across Flood Zone 1 (low risk), Flood Zone 2 (medium risk) and Flood Zone 3 (high risk) with the main area at risk located to the north of Port Clarence.

9.4.104 The Environment Agency 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. 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.

9.4.105 The tidal defences in proximity to the Site consist of a combination of high ground and raised defences, including floodwalls and flood banks. According to information provided by the Environment Agency 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 Environment Agency inspects these defences routinely to ensure potential defects are identified.

9.4.106 Based on the information provided by the Environment Agency, it has been determined that the PCC and the majority of the connection corridors are at a low risk of flooding from tidal sources. However, the section of the Natural Gas Connection Corridor and the CO_2 Gathering Network crossing the River Tees and the section of corridor route to the east of Billingham, located between the tidal River Tees and Greatham Creek is at high risk of tidal flooding.

Fluvial Sources

9.4.107 The nearest fluvial watercourses to the PCC are The Fleet (otherwise known under the WFD as ‘Tees Estuary (S Bank)’), located approximately 275 m to the south east of the PCC (but flowing through the Site Boundary), and Dabholm Gut, located approximately 1 km to the south of the PCC and along the Site Boundary.

9.4.108 Numerous other Ordinary Watercourses intersect the connection corridor routes including: Mains Dike, The Mill Race, Kinkerdale Beck, Kettle 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. The position and direction of flow of these watercourses has been described earlier. These watercourses all pose a potential risk of fluvial flooding to the connection corridors.

9.4.109 The Environment Agency’s online Flood Map for Planning (Environment Agency, n.d.b) illustrates that the entirety of the PCC and the connection corridors on the south bank of the River Tees are located within Flood Zone 1 (i.e. a low risk of flooding from fluvial sources). The exception to this is an area of Flood Zone 2 (i.e. a medium risk of flooding) associated with The Fleet, and an area of Flood Zone 2 and Flood Zone 3 (i.e. a high risk of fluvial flooding) associated with the Dabholm Gut.

9.4.110 Although tidal flood risk is the greatest risk to the north of the Tees Estuary, there are Ordinary Watercourses, such as the Mucky Fleet, Swallow Fleet, and Belasis Beck that could pose a fluvial flood risk to small sections of the connection corridor, predominantly where the connection corridor crosses a watercourse/ drain.

Groundwater Flood Risk

9.4.111 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).

9.4.112 The Environment Agency have no groundwater level monitoring sites within 2 km of the study area (the closest groundwater level data held is from a site approximately 8.2 km north-north-west of the Site boundary). However, the bedrock groundwater level is expected to be around the ordnance datum given the proximity to the coast and the prevailing flat, low gradient topography of the study area.

9.4.113 The Tees Catchment Flood Management Plan (CFMP) (Environment Agency, 2009) states "*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 Stockton on Tees Borough Council area 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.

9.4.114 The Environment Agency's Areas Susceptible to Groundwater Flooding map is illustrated in the Redcar and Cleveland Borough Council and Stockton on Tees Borough Council Preliminary Flood Risk Assessment (PFRA) report (Stockton-on-Tees Borough Council, 2011). The Areas Susceptible to Groundwater Flooding map is divided into 1 km^2 grid-squares in which a percentage is given for what proportion of the 1 km^2 is considered to be susceptible to groundwater emergence. Within both the Redcar and Cleveland Borough Council and Stockton on Tees Borough Council areas the map shows the Site lies predominantly in an area where 75% or more of the area is considered to be potentially at risk of groundwater emergence.

9.4.115 Based on this information the risk of flooding from groundwater sources is considered to be a medium risk.

Surface Water Runoff to the Site

Overland Flow of Rainfall Runoff

9.4.116 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 more impermeable surfaces.

9.4.117 Surface water flooding is the main source of flood risk in the Redcar and Cleveland Borough Council area with regular flooding occurring in Eston, Redcar and Guisborough. This flooding is due to insufficient surface water, combined sewer and culverted watercourse capacity to convey the rainfall away. The Redcar and Cleveland Borough Council PFRA (Redcar and Cleveland Borough Council, 2011) 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*".

9.4.118 The Environment Agency's online Risk of Flooding from Surface Water maps (Environment Agency, n.d.b) 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. This is illustrated on Figure 9-5: Flood Risk from Surface Water PEI Report, Volume II). Environment Agency mapping indicates that the PCC and the associated connection corridors are generally at very low risk (<0.1% AEP event) of flooding from surface water. The risk of surface water flooding within the PCC from elsewhere is considered to be low to very low.

9.4.119 However, there are small, isolated areas of high, medium and low flood risk where water is seen to pond during more significant rainfall events. These areas are constrained to be topographical low spots within the Site Boundary. The main locations of identified surface water flooding are:

- Approximately 275 m to the south east of the PCC 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 A1185 and Cowpen Bewley Road, approximately 8 km to the west of the PCC. Land in this area is at low to medium risk of surface water flooding.

9.4.120 Based on the above information, the risk of surface water runoff to the Site is considered to be Low.

Existing Drainage Infrastructure

9.4.121 No information was available regarding the private drainage falling within the Site boundary at the time of preparing this assessment. It is assumed the existing surface water drainage systems within the PCC and along the connection corridors collects runoff from buildings, hardstanding areas and gullies etc., which then discharge into the surrounding sewer network and/ or watercourses. This will be confirmed within the Drainage Strategy at the the ES stage.

9.4.122 The Northumbrian Water Bran Sands Wastewater Treatment Works (WwTW) is immediate to the south of the PCC and discharges into the Dabholm Gut.

9.4.123 According to the local Strategic Flood Risk Assessment (SFRA) (Redcar and Cleveland Borough Council, 2016) there has been in total 234 records of historical sewer flooding incidents in the Redcar and Cleveland Borough Council area. Information provided in their SFRA indicates that no historical sewer flooding has occurred in close proximity to the PCC and connection corridors to the south of the River Tees. Flooding from drainage infrastructure within the Redcar and Cleveland Borough Council area tends to occur in predominantly residential areas, with Eston (located to the south west of the Site), identified as a critical drainage area.

9.4.124 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

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

9.4.126 A review of online Ordnance Survey mapping indicates that there are no canals located in close proximity to the Site.

9.4.127 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 Environment Agency once this comes into effect under the Flood and Water Management Act 2010.

9.4.128 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.

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

9.4.130 The Environment Agency's online Long-Term Flood Risk Mapping (Environment Agency, n.d.b) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds but does not give any information about the depth or speed of the flood waters. 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 (Crookfoot Reservoir, NZ 43115 31173) 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 DCO Application Site at residual risk from reservoir flooding.

9.4.131 Based on the information above the current residual risk of flooding from artificial sources is considered to be low.

Future Baseline

Construction (2022)

9.4.132 As outlined in Chapter 5: Construction and Management (PEI Report, Volume I) the peak of construction is expected to in 2024.

9.4.133 The future baseline has been determined qualitatively by considering the possibility of changes in the attributes that are considered when deciding the importance of water bodies in the Study Area.

9.4.134 Generally, there is an improving trend in water quality and the environmental health of waterways in the UK since the commencement of significant investment in sewage treatment in the 1990s, the adoption of the WFD from 2003, and the application of ever more stringent planning policies. In terms of water quality impacts, the future baseline assumes that all WFD water bodies achieve their planned target status by 2027.

9.4.135 It is likely that through the action of new legislative requirements and ever more stringent planning policy and regulation, that the health of the water environment will continue to improve post-2027, although there are significant challenges such as adapting to a changing climate and pressures of population growth that could have a retarding impact. It is also difficult to forecast these changes with any certainty.

9.4.136 Under the WFD, The Tees Coastal waterbody has an objective of achieving Good Ecological Potential by 2027, the Tees transitional waterbody has an objective of achieving Moderate Ecological Potential by 2015, and the Tees S Bank (Estuary) WFD waterbody has an objective of achieving Good Ecological Potential by 2027. As all waterbodies are currently at this overall status there must be no deterioration from this, and there are also objectives for individual elements of the WFD classification that are to be achieved (e.g. biological quality elements, physico-chemical parameters). It is assumed that these objectives are achieved following the completion of the Proposed Development.

9.4.137 There are additional significant challenges such as adapting to a changing climate (i.e. in general drier summers, wetter winters, and an increased frequency of significant storms are forecast for the UK) and the pressures of population / economic growth that could have a retarding effect on the water environment if it is not managed carefully through the design of projects, mitigation, and the maintenance of those mitigating solutions. However, again it is difficult to forecast these changes with any certainty.

9.4.138 The assessment of the importance of water bodies takes into account a large range of attributes and does not focus solely on water quality. This assessment takes into account other attributes such as scale, nature conservation designations, fish habitat type, the presence of protected species, social and economic uses. For some of these attributes, it is unlikely that they will change in the future (e.g. water body size, whether a river is likely to support cyprinid or salmonid fish populations, the presence of a designated nature conservation site or bathing water).

Operation (2026)

9.4.139 The same future baseline conditions expected during construction will apply to the operation phase (i.e. all WFD targets are met, improving water quality, no change in the presence and status of designated sites).

9.4.140 The wider area around the PCC is allocated in the local plan for industrial development, and if the Proposed Development was not progressed, then another form of development would likely take its place or it is assumed that the Site would be left in its current state.

Importance of Receptors

9.4.141 The importance of the local water resource receptors within the study area is described in Table 9-16. Importance is based on the criteria outlined above in Table 9-2.

Table 9-16: Importance of Receptors

Watercourse	Importance Descriptions
Tees Bay	The Tees Coastal waterbody is considered a **Very High importance** receptor on the basis of being WFD designated and including sites protected / designated under EU (e.g. Teesmouth and Cleveland Coast Special Protection Area, bathing waters) and UK legislation (Teesmouth and Cleveland Coast SSSI).
Tees Estuary	The Tees Estuary is considered a Very High importance receptor for water quality on the basis of its scale, being WFD designated and supporting and range of internationally, nationally and locally protected nature conservation sites (Teesmouth and Cleveland Coast SSSI). This is despite significant modifications to the channel and flow regime, and the presence of contamination within fine sediments. It is also important for the dilution and dispersion of treated/untreated sewerage/trade/process waste water, which at the same time influence water quality and present a risk of chemical spillages. Water is also abstracted from the estuary for industrial use (e.g. cooling water supply). However, the morphology is considered Low importance due to significant modifications of the channel, particularly along the banks, and flow and tidal conditions being influenced by the Tees Barrage and breakwaters. The channel is also important for navigation and commercial activities (which also require maintenance dredging).
The Fleet (Tees Estuary (S Bank) WFD waterbody)	The Fleet (freshwater reach) is considered a High importance receptor for water quality on the basis of being WFD designated (as Tees Estuary S Bank), and having an estimated Q95 <1.0 m^3/s. Although the upper reaches flow through the Teesmouth and Cleveland Coast SPA/SSSI sites, these are upstream of the Proposed Development. It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. The Fleet is considered a Low importance receptor for morphology on the basis of being substantially modified by past land use, having an artificial cross section and being culverting over significant lengths.
Main's Dike	Main's Dike is considered a Medium importance receptor for water quality on the basis of not being designated under the WFD in its own right, its size and scale, and with estimated Q95 >0.001m^3/s. It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. It is considered a Low importance receptor for morphology on the basis of being largely artificial in character as a straightened channel and deficient in bedforms.
Mill Race	The Mill Race is considered a Medium importance receptor for water quality on the basis of its relatively small size and scale, not being designated under the WFD as its own waterbody and having an estimated It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. Q95 >0.001 m^3/s. It is considered a Low importance receptor for morphology on the basis of being largely artificial in character with deficiency of bedforms, with significant stretches of culvert.
Dabholm Gut	Dabholm Gut is connected to and designated as part of the Tees transitional waterbody. As such, it is considered a Very High importance receptor for water quality as per the Tees Estuary above. The morphology is considered Low importance due to being an artificial channelised watercourse, over-widened in places and with artificial banks.
Lackenby Channel	Lackenby Channel is considered a Medium importance receptor for water quality on the basis of not being designated under the WFD as its own waterbody, its relatively small size and scale, and an estimated Q95 >0.001 m^3/s. Unlike Dabholm Gut, its final reach is believed to be culverted beneath PD Teesport and thus it does not have an open connection to the Tees Estuary. The morphology is considered Low importance due to being an artificial, straight, channelised watercourse with artificial banks.

Watercourse	Importance Descriptions
Kettle Beck	Kettle Beck is considered a Medium importance receptor for water quality on the basis of not having a WFD classification but is estimated to have a Q95 >0.001 m^3/s. It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. It is considered a Low importance receptor for morphology on the basis of being largely artificial in character (i.e. straight ditchcourse with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Kinkerdale Beck	Kinkerdale Beck is considered a Medium importance receptor for water quality on the basis of not having a WFD classification but is estimated to have a Q95 >0.001 m^3/s. It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. It is considered a Low importance receptor for morphology on the basis of being largely artificial in character (i.e. straight ditchcourse with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Knitting Wife Beck	Knitting Wife Beck is considered a Medium importance receptor for water quality on the basis of not having a WFD classification but is estimated to have a Q95 >0.001 m^3/s. It is also possible that fine sediments are contaminated and that these may be leaching into the water depending on the prevailing conditions. It is considered a Low importance receptor for morphology on the basis of being largely artificial in character (i.e. ditchcourse with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Holme Fleet	Holme Fleet is considered Very High importance for water quality on the basis of flowing through the Teesmouth and Cleveland Coast SSSI, although it does not have a specific WFD classification. Whilst not visited on site, aerial imagery suggests that morphologically Holme Fleet is a High importance receptor as it exhibits diverse geomorphic forms and bank side vegetation but deviates from natural conditions due to various floodplain and catchment pressures.
Belasis Beck	Belasis Beck is considered a Very High importance for water quality on the basis of flowing through the Teesmouth and Cleveland Coast SSSI, although it does not have a specific WFD classification. Morphologically, it is considered a High importance receptor as it exhibits a variety geomorphic forms and bank side vegetation but deviates from natural conditions due to various floodplain and catchment pressures.
Greatham Creek	The tidal lower reaches of Greatham Creek are designated under the Tees transitional waterbody. As such, it is considered a Very High importance receptor for water quality as per the Tees Estuary above. No morphological importance has been provided as this waterbody will not be physically impacted.
Mucky Fleet / Swallow Fleet	Mucky Fleet and Swallow Fleet within Cowpen Marsh are considered Very High importance for water quality on the basis of flowing through the Teesmouth and Cleveland Coast SSSI, although they do not have specific WFD classifications. No morphological importance has been provided as this waterbody will not be physically impacted.
Lake at Charlton's Pond Nature Reserve	The pond is considered High Importance for water quality due to having a local designation as a nature reserve, but Low importance for morphology as an artificial waterbody originally constructed for clay extraction for the adjoining brickworks.
Ponds within Coatham Dunes, Coatham Marsh, Saltholme Nature Reserve and Bran Sands	These are considered Very High importance receptors for water quality as they are within the Teesmouth and Cleveland Coast SSSI and several fall under the Teesmouth and Cleveland Coast SPA designation, thereby supporting bird populations. They are considered High Importance for morphology as they have a natural form and bank side vegetation but deviate from natural conditions due to various floodplain and catchment pressures.
Numerous industrial ponds and artificial waterbodies across the area including Lazenby Reservoirs, Salthouse Brine Reservoirs and Ponds at Billingham Technology Park	As industrial, artificial waterbodies lacking any protected species (as far as is currently known) or designations, these are considered Low Importance waterbodies for water quality and morphology.

Note: The importance of water bodies to be reviewed when site specific ecological survey data is available

Floodplain Sensitivity for Impact Assessment

9.4.142 For the construction assessment, the key receptor in terms of all forms of flood risk are the construction workers present on Site, who are considered to be of Very High sensitivity. It is considered that the risk to surrounding residential, commercial and ecological receptors is no greater than in the baseline scenario for the construction phase.

9.4.143 For the operation assessment, the importance is based on understanding of the receptors present within areas at risk of flooding and the existing risk of flooding from all sources. The floodplain around the Tees in the study area and within the majority of the Site boundary is predominantly in Flood Zone 1, where sensitivity of the floodplain for impact assessment purposes is considered Low. The entirety of the PCC is within Flood Zone 1, but there are patches of Flood Zone 2 and 3 associated with the connection corridors, and which relate to tidal and fluvial flooding. To the south of the Tees these areas are notably around the connection corridor across Coatham Dunes and Coatham Sands, and also around Dabholm Gut, The Mill Race and The Fleet. To the north of the Tees, there are similarly areas of Flood Zone 2 and 3 to the south of Seal Sands, around Haverton Hill and from Port Clarence north through Saltholme and Cowpen Marsh. Overall, it has been determined that the PCC and the majority of the connection corridors are at a 'low' risk of flooding from tidal sources. However, the section of the connection corridor crossing the River Tees and the section of the CO_2 Gathering Network route to the east of Billingham, located between the tidal River Tees and Greatham Creek is at 'high' risk of tidal flooding. In EIA terms these areas are of Very High sensitivity to tidal and fluvial flooding due to proximity of essential infrastructure (see Table 9-2).

9.4.144 The criteria described in Table 9-2 do not provide examples of sensitivity for other forms of flood risk and so the sensitivity is based on the existing baseline risk described earlier in this chapter. For the purpose of this impact assessment the sensitivity of non-fluvial forms of flood risk is as follows:

- flooding from surface water – mainly Low Sensitivity, with localised areas of Medium to Very High Sensitivity, mainly associated with watercourses and ponds (refer to Figure 9-5: Flood Risk from surface Water, PEI Report, Volume II);
- flooding from artificial sources – Low Sensitivity;
- flooding from groundwater – Medium Sensitivity; and
- flooding from existing drainage infrastructure – Low to Medium Sensitivity.

9.4.145 Floodplain sensitivity will be reviewed and confirmed in the full impact assessment presented in the Environmental Statement in support of the DCO application.

9.5 Development Design and Impact Avoidance

9.5.1 The following impact avoidance measures have either been incorporated into the design (i.e. embedded mitigation) or are standard construction or operational practices. These measures have, therefore, been taken into account during the impact assessment.

Construction

Surface Water

9.5.2 During construction water pollution may occur directly from spillages of polluting substances into waterbodies, or indirectly by being conveyed in runoff from hard standing, other sealed surfaces or from construction machinery. Construction works will require the dismantling and removal of existing drainage infrastructure that may also contain liquid chemicals and wastewater. Fine sediment may also be disturbed in waterbodies directly or also wash off working areas and hard standing (including approach roads) into waterbodies indirectly via existing drainage systems or overland. Due to past industrial activity, this sediment may not be inert and may potentially contain contamination that could be harmful to the aquatic environment. However, potential impacts to the water environment during the construction phase would tend to be temporary and short term.

9.5.3 Prior to construction starting on Site, a Construction Environmental Management Plan (CEMP) will be prepared by the Contractor. The CEMP would outline the measures necessary to avoid, prevent and reduce adverse effects where possible upon the local surface water (and groundwater) environment. An Outline CEMP will be provided in the Environmental Statement.

9.5.4 The CEMP will need to be reviewed, revised and updated as the project progresses towards construction to ensure all potential impacts and residual effects are considered and addressed as far as practicable, in keeping with available good practice at that point in time. The principles of the mitigation measures set out below are the minimum standards that the Contractor will implement. However, it is acknowledged that for some issues, there are multiple ways in which they may be addressed. In addition, the methods of dealing with pollutant risk will need to be continually reviewed on Site and adapted as construction works progress in response to different types of work, weather conditions, and locations of work.

9.5.5 The CEMP will be standard procedure for the Proposed Development and will describe the principles for the protection of the water environment during construction. The CEMP will be supported by a Water Management Plan (WMP) that would be included as a technical appendix. The WMP will provide greater detail regarding the mitigation to be implemented to protect the water environment from adverse impacts during construction.

9.5.6 The potential for adverse impacts would be avoided, minimised and reduced by the adoption of the general mitigation measures which are outlined in the following sections, and which will be described in the Water Management Plan and CEMP.

Good Practice Guidance

9.5.7 The construction of the Proposed Development would be in accordance with good practice as described in a variety of guidance documents. As of the 17 December 2015 all Pollution Prevention Guidance (PPG) Documents published by the UK environment agencies were withdrawn. A new series of Guidance for Pollution Prevention (GPP) is in development, which provides updated good practice guidance to the UK. While this is not regulatory guidance in England where the UK government website outlines regulatory requirements, it remains a useful resource for best practice. The following relevant GPPs have been released to date on the NetRegs website (NetRegs, n.d.) and should be identified as good practice:

- GPP 2: Above ground oil storage;
- GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5: Works and maintenance in or near water;
- GPP 8: Safe storage and disposal of used oils;
- GPP 13: Vehicle washing and cleaning;
- GPP 19: Vehicles: Service and Repair;
- GPP 20: Dewatering underground ducts and chambers;
- GPP 21: Pollution Incident Response Plans;
- GPP22: Dealing with spills; and
- GPP26: Safe storage – drums and intermediate bulk containers.

9.5.8 Where new GPPs are yet to be published, previous PPGs still provide useful advice on the management of construction to avoid, minimise and reduce environmental impacts, although they should not be relied upon to provide accurate details of the current legal and regulatory requirements and processes. Construction phase operations would be carried out in accordance with guidance contained within the Environment Agency PPG (Environment Agency, 2001), including:

- PPG1: General guide to the prevention of pollution;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG6: Working at construction and demolition sites;
- PPG7: Safe storage – the safe operation of refuelling facilities;
- PPG18: Managing fire water and major spillages; and
- PPG19: Control of Spillages and Fire Fighting Runoff.

9.5.9 Additional good practice guidance for mitigation to protect the water environment can be found in the following key CIRIA documents and British Standards Institute documents:

- British Standards Institute (2009) BS6031:2009 Code of Practice for Earth Works (British Standards Institute, 2009).
- British Standards Institute (2013) BS8582 Code of Practice for Surface Water Management of Development Sites (British Standards Institute, 2013a).
- C753 (2015) The SuDS Manual (CIRIA, 2015a);
- C744 (2015) Coastal and marine environmental site guide (second edition) (CIRIA, 2015b);
- C741 (2015) Environmental good practice on site guide (fourth edition) (CIRIA, 2015c);
- C648 (2006) Control of water pollution from linear construction projects, technical guidance (CIRIA, 2006);
- C609 (2004) Sustainable Drainage Systems, hydraulic, structural and water quality advice (CIRIA, 2004); and
- C532 (2001) Control of water pollution from construction sites – Guidance for consultants and contractors (CIRIA, 2001).

Management of Construction Site Runoff

9.5.10 The measures outlined below, which will be included in the WMP and CEMP, will be required for the management of fine sediment in surface water runoff as a result of the construction activities:

- Reasonably practicable measures will be taken to prevent the deposition of fine sediment or other material in, and the pollution by sediment of, any existing waterbody, arising from construction activities. The measures will accord with the principles set out in industry guidelines including the CIRIA report 'C532: Control of water pollution from construction sites' (CIRIA, 2001). Measures may include use and maintenance of temporary lagoons, tanks, seeding / covering of earth stockpiles, earth bunds, straw bales and sand bag walls, proprietary measures (e.g. lamella clarifiers or contained chemical treatment) and fabric silt fences or silt screens as well as consideration of the type of plant used.
- A temporary drainage system will be developed to prevent runoff contaminated with fine particulates from entering surface water drains without treatment. This will include identifying all land drains and water bodies on the Site and ensuring that they are adequately protected using drain covers, sandbags, earth bunds, geotextile silt fences, straw bales, or proprietary treatment (e.g. lamella clarifiers). Discharge to such water bodies (directly or indirectly) will only be made with the permission of the Environment Agency (or Northumbrian Water if to the public foul sewer) and with the necessary treatment measures implemented.
- Where possible, earthworks will be undertaken during the drier months of the year. When undertaking earth moving works periods of wet weather will be avoided, if possible, to minimise the risk of generating runoff contaminated with fine particulates. However, it is likely that some working during wet weather periods will be unavoidable, in which case

mitigation measures will be implemented to control fine sediment laden runoff.

- To protect waterbodies from fine sediment runoff, topsoil/subsoil will be stored a minimum of 20 m from watercourses on flat lying land (and further if the ground is sloping, subject to ono site risk assessment on observational monitoring). Where this is not possible, and it is to be stockpiled for longer than a two-week period, the material will either be covered with geotextile mats, seeded to promote vegetation growth. In all situation, runoff from the stockpile will be prevented from draining to a watercourse without prior treatment.
- Appropriately sized runoff storage areas for the settlement of excessive fine particulates in runoff will be provided. It is likely that treated water will then be pumped under a temporary Water Activity Permit from the Environment Agency or agreed with Northumbrian Water to an existing Treatment Works (assumed to be treated at the Brans Sands WwTW).
- Mud deposits will be controlled at entry and exit points to the Site using wheel washing facilities and / or road sweepers operating during earthworks activities or other times as considered necessary.
- Equipment and plant are to be washed out and cleaned in designated areas within the Site compound where runoff can be isolated for treatment before discharge to surface water drainage under appropriate consent and / or agreement with Environment Agency and / or Northumbrian Water, or otherwise removed from site for appropriate disposal at a licensed waste facility.
- Debris and other material will be prevented from entering surface water drainage, through maintenance of a clean and tidy site, provision of clearly labelled waste receptacles, grid covers and the presence of site security fencing.
- The Water Management Plan will include details of pre, during and post-construction water quality monitoring. This will be based on a combination of visual observations, frequent in situ testing using water quality probes, and periodic sampling for laboratory analysis.

Management of Spillage Risk

9.5.11 The measures outlined below will be implemented to manage the risk of accidental spillages on site and potential conveyance to nearby waterbodies via surface runoff or land drains. The measures relating to the control of spillages and leaks will be included in the WMP and CEMP and adopted during the construction works:

- Fuel will be stored and used in accordance with the Control of Substances Hazardous to Health Regulations 2002, and the Control of Pollution (Oil Storage) (England) Regulations 2001. Particular care will be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline.
- Fuel and other potentially polluting chemicals will either be in self bunded leak proof containers or stored in a secure impermeable and

bunded area (minimum capacity of 110% of the capacity of the containers).

- Any plant, machinery or vehicles will be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place off site if possible or only at designated areas within the Site compound. Only construction equipment and vehicles free of all oil/fuel leaks will be permitted on site. Drip trays will be placed below static mechanical plant.
- All washing down of vehicles and equipment will take place in designated areas and wash water will be prevented from passing untreated into watercourses.
- All refuelling, oiling and greasing will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses, and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling.
- As far as reasonably practicable, only biodegradable hydraulic oils will be used in equipment working in or over watercourses.
- All fixed plant used on the Site will be self-bunded.
- Mobile plant is to be in good working order, kept clean and fitted with plant 'nappies' at all times.
- A Pollution Prevention Plan will be prepared and included alongside the CEMP. Spill kits and oil absorbent material will be carried by mobile plant and located at high risk locations across the Site and regularly topped up. All construction workers will receive spill response training and tool box talks.
- The Site will be secure to prevent any vandalism that could lead to a pollution incident.
- Construction waste / debris are to be prevented from entering any surface water drainage or water body.
- Surface water drains on roads or within the construction compound will be identified and, where there is a risk that fine particulates or spillages could enter them, the drains will be protected (e.g. using covers or sand bags).
- Suitable facilities for concrete wash water (e.g. geotextile wrapped sealed skip, container or earth bunded area) will be adequately contained, prevented from entering any drain, and removed from the Site for appropriate disposal at a suitably permitted waste facility.
- Water quality monitoring of potentially impacted watercourses will be undertaken to ensure that pollution events can be detected against baseline conditions and can be dealt with effectively.

9.5.12 In addition, any site welfare facilities will be appropriately managed, and all foul waste disposed of by a licensed contractor to a suitably permitted facility.

Use of Coffer Dams at the Abstraction Point

9.5.13 At this stage, the requirement to use the abstraction point within the Tees Estuary for industrial water supply has not been confirmed, although it is believed to be the most likely arrangement for the future development. As a reasonable worst-case scenario, it has therefore been assumed that the former steelworks abstraction point from the Tees Estuary is to be used.

9.5.14 Under this scenario, the current intake may be suitable for re-use with minimal modification, although precise details of what works are required remains to be confirmed. Alternatively, the intake may require more extensive refurbishment and/or replacement. Where this is required, it is assumed that there would be the installation of a coffer dam to create a dry working area. This is unlikely to need a preparatory dredge but this cannot be ruled out at this stage. Installation of the coffer dam (and any dredging in advance, or excavation of sediments afterwards, would be undertaken in accordance with a deemed Marine Licence and following chemical testing of the sediments to determine how they should be disposed of). Maintaining a dry channel bed in the areas of in-channel working using a coffer dam will reduce the overall channel disturbance and potential for mobilising fine sediment (and any contamination) into the water column and estuary. It is assumed for the purposes of this PEI Report that more extensive refurbishment of the intake is required.

9.5.15 The works would be undertaken with due regard to the Eels (England and Wales) Regulations 2009, which may require installation of an eel screen. Furthermore, a fish rescue would be required from the coffer dam.

9.5.16 A cofferdam of approximately 100 - 150 m length would be installed around the abstraction point on the eastern bank of the Tees Estuary, enclosing an area of approximately 1,250 m^3 and projecting up to approximately only 30 m into the channel. Cofferdam installation or removal during the main salmonid fish migratory period would be avoided to minimise ecological impacts from the structure. The cofferdam would be designed to minimise changes to the estuary bed and bank erosion and toe scour.

9.5.17 Dewatering within the cofferdam area will be done only once any fine sediment has significantly settled out and following any necessary fish rescue. The rate and location of the discharge will be controlled and carefully chosen to avoid further erosion of any nearby soft sediments. The works to install, dewater and remove the coffer dam will be subject to a deemed Marine Licence from the MMO.

9.5.18 Whilst in-situ, the cofferdam will be regularly inspected and maintenance undertaken, where required, and any water entering the cofferdam area via seepage will be disposed of appropriately (i.e. by pumping back into the estuary).

Works to the Treated Water Outfall

9.5.19 The condition of the existing discharge tunnel from the former steelworks has not yet been confirmed; if it is possible to re-use the existing tunnel, any maintenance activities are likely to be very minor and limited to inspection and hand-based maintenance. Should the Cooling Water System require the construction of a new outfall head, several additional construction activities would be required. These would include:

- a preparatory dredge to create a pocket for the construction of an outfall head;
- final assembly, float and positioning of a replacement head;
- a flood and sink exercise (or similar);
- works to position the outfall head within the dredge pocket;
- a short campaign of either piling or pin drilling to secure the outfall head;
- backfill of the dredged pocket around the outfall head;
- the positioning of rock armouring / scour protection around the outfall head;
- final assembly, pipeline jointing, connections, fabrication and ancillary commissioning works to install a safe and fit-for-purpose discharge pipeline; and
- the presence of vessels such as work boat(s) and/or barge(s) to support the refurbishment process.

9.5.20 For the purposes of the assessment it is assumed that the refurbishment of the outfall head would take 6 months.

9.5.21 If the outfall tunnel required replacement then there would be a preference for a full trenchless technologies approach. This would minimise direct impact to the sea bed and associated sediment mobilisation and scour but would require presence of a jacking rig seaward of the South Gare dune complex, a punch-hole / break-out through the seabed at the intended discharge point and connection into an outfall head (if design required it), and the presence of vessels such as dredger(s), work boat(s) and/or barge(s) to support the refurbishment process.

9.5.22 Were a trenchless technologies-led installation not feasible to achieve the required outfall tunnel length into the Tees Bay or were it deemed not possible on safety grounds (for example due to Unexploded Ordnance risk), a number of other construction activities would be required including:

- The dredging of a pipeline trench;
- The assembly, float and positioning of replacement pipeline tunnel sections;
- A flood and sink exercise;
- Works to position the pipeline within the trench;
- Backfill of the dredged trench.

9.5.23 Appropriate licences and permits will be obtained from the Environment Agency and Marine Management Organisation with regards to dredging, discharges and construction of the outfall tunnel within Tees Bay, and all conditions would be adhered to. Sediment sampling would be required prior to works to the seabed in order to determine presence of any contaminants and enable appropriate mitigation to be identified along with appropriate pathways for disposal / re-use. Best practice construction approaches would be adopted, as at the abstraction point described above.

Construction of CO_2 Gathering Network and Natural Gas Connection

9.5.24 The CO_2 Gathering Network and Natural Gas Network will need to cross the Tees Estuary. New crossings of the Tees will be achieved using trenchless technologies to prevent any disturbance or mobilisation of the estuary bed, sediments, habitats or navigation. The installation of the pipes beneath the Tees Estuary will need to be agreed with the MMO so that there is no risk of it becoming exposed or damaged.

Construction of CO_2 Export Pipeline

9.5.25 Construction of the CO_2 Export Pipeline from the Compressor Site across Coatham Dunes and Coatham Sands to MLWS may be using trenchless technologies techniques or open-cut techniques through the dunes and sands. The latter will assessed in order to allow for an assessment of the potential worst case scenario in line with the overall methodology for the EIA. This will be used to inform the selection of the most appropriate technique that will have the least residual effects on the national and international designations.

9.5.26 If an open-cut method is used to cross the dunes, a trench will be excavated and the pipe laid approximately 1.2 m below ground level. This will involve fencing off the works area, stripping and storing overburden, excavating a trench and storing subsoil, laying and welding pipe sections together at grade level (pipe stringing), laying pipe in the trench, re-instating drainage, and then backfilling subsoil, reinstating overburden and (where necessary) re-planting to the original state as required. Where there is potential to impact pond water levels due to dewatering into the trench then sheet piling or other similar mitigation would be temporarily used around the ponds to prevent this from occurring.

9.5.27 The corridor width required for open cut pipeline construction is 36 m. This is the minimum working width that is required to facilitate construction. This width allows overburden and spoil to be excavated and stored adjacent to the point of generation, stringing and welding of sections of pipe, access along the route, and laying of the pipe within the trench prior to backfilling. At this PEI stage, a wider evaluation corridor (the current Site boundary) has been defined in which further studies are being undertaken in order to optimise the preferred route.

Construction of Electrical Connection Corridor

9.5.28 The construction of the Electrical Connection Corridor is likely to involve above ground and below ground installation works including connections to existing sub-stations. The below ground installations may require open cut methods across the smaller watercourses on site. This includes potential crossings of Belasis Beck, Knitting Wife Beck, Kinkerdale Beck, Mains Dike, Lackenby Channel, The Mill Race and The Fleet (Tees Estuary (S Bank)). In such cases, it is assumed that flow would be temporarily over-pumped or flumed through the works at a suitable rate and with baffles to minimise mobilisation of fine sediments downstream. The cables or pipe will be installed at sufficient depth that there is no risk of ever being exposed in the channel. Once the works have been completed all equipment and materials will be removed and the channel reinstated as found. This will include reinstating bed material in layers as excavated (i.e. it will need to be carefully stored in homogenous stockpiles so it can be replaced). Banks will then be replanted or seeded as required and fine sediment protection measures maintained until they have been adequately stabilised. Watercourses directly impacted by construction would also be monitored before (to record the pre-works condition to inform full reinstatement), during, and following on from construction so that any adverse impacts are identified and remedial action taken where necessary.

Management of Flood Risk

9.5.29 All construction materials and temporary compounds associated with the construction of the Proposed Development will be located in Flood Zone 1 where possible.

9.5.30 During the construction phase, the Contractor will monitor weather forecasts on a monthly, weekly and daily basis, and plan works accordingly. For example, works in the channel of any watercourse will be avoided or halted where there to be a risk of high flows or even flooding. In addition, the Contractor will sign up to Environment Agency flood warning alerts and describe in the Emergency Response Plan the actions it will take in the event of a possible flood event. These actions will be hierarchal meaning that as the risk increases the Contractor will implement more stringent protection measures. This is important to ensure all workers, the construction site and third-party land, property and people are adequately protected from flooding during the construction phase.

9.5.31 If water is encountered during below ground construction, suitable de-watering methods will be used. Any significant groundwater dewatering required will be undertaken in line with the requirements of the Environment Agency (under Water Resources Act 1991 as amended) and Environmental Permitting Regulations (2016).

9.5.32 Safe egress and exits are to be maintained at all times when working in excavations. When working in excavations a banksman is to be present at all times.

Operation

9.5.33 A number of mitigation features would be incorporated into the design of the Proposed Development design in order to avoid, minimise and reduce potential adverse impacts on water features, water resource and flood risk, and these are described in the following sections.

Surface Water Drainage

9.5.34 It is proposed that a suitable surface water drainage network and management system will be provided for the Proposed Development that will provide adequate interception, conveyance and treatment of surface water runoff from buildings and hard standing. As surface water discharge will be to Tees Bay via the Water Discharge Corridor, no attenuation capacity is required. This will focus on the PCC, as this is the area that will result in the greatest increase in impermeable area and built development with foul systems for welfare facilities and process wastewater generated by the site operations. The the connection corridors will not require drainage.

9.5.35 Due to the nature of the Proposed Development it is likely that a range of different diffuse pollutant types may be present, with concentrations of these pollutants varying depending on many factors. However, this risk will be offset by the fact that the Site is a brownfield site that is currently not operating (i.e. surface water from the Site may already contain diffuse pollutants).

9.5.36 The drainage strategy will be defined in consultation with the Environment Agency, the LLFA (RCBC and STBC) and other statutory agencies, taking into account the findings of the FRA and water quality assessment. The proposed drainage system is to include the use of sustainable drainage systems (SuDS) to provide treatment of runoff to ensure potential adverse effects on water quality are avoided. SuDS and the treatment train will be selected with reference to the Simple Index Approach of the SuDS Manual (CIRIA, 2015a), although a more precautionary approach may be taken due to the industrial land use, which may increase the risk.

9.5.37 At this stage the drainage strategy is still being prepared. However, some information is available in the Water Treatment Options Assessment Report (OGCI, 2019a) with regards to what process waste waters may be generated on Site and how these may be treated with the application of Best Available Techniques (BAT). This will be developed by the full drainage strategy, compliant with the requirements of the aforementioned statutory agencies at the full impact assessment stage. Descriptions of some the activities that will generate waste water are listed below:

- **Turbines**– periodically the turbines will be taken off-line and washed with a high concentration detergent solution. Effluent will be collected and disposed of in an appropriate way at an off-site licensed waste facility.
- **Heat Recovery Steam Generator**– this will be subject to chemical cleaning and passivation producing waste of low pH, high suspended solids and total dissolved solids in the form of iron corrosion products. Effluent will be collected and disposed of in an appropriate way at an off-site licensed waste facility.
- **Heat Recovery Steam Generator Blowdown** – effluent from this source consists of demineralised water and additive chemicals in low concentrations, including ammonia, phosphate and di-ethyl hydroxyl amine (DEHA). Although anticipated to be less than the current discharge consent for the Site (which is subject to change), options for treatment are to be explored, such as recycling it to blend with incoming raw water upstream of the clean water treatment plant (described below with reference to clean water provision).
- **Direct Contact Cooler Blowdown** - the water from the direct contact cooler can be taken from downstream of the circulating water cooler at approximately 35°C. This stream will be primarily water containing

dissolved CO_2 from the flue gas and up to 165 mg/l of ammonia. This will require treatment to remove ammonia and nitrogen prior to discharge to the Tees Bay outfall.

- **Degraded Amine** - A side stream of the circulating amine flow is continuously filtered and treated within the reclaimer package to remove heat stable salts and corrosion products. This stream is relatively small and will not be treated on-site but will be collected local to the reclaimer and transported off-site for disposal at a licensed waste facility.
- **Compression and Dehydration Water** - the carbon dioxide (CO_2) product shall be compressed and dehydrated to meet the requirements for discharge to the offshore transport and storage system. The water from the dehydrated CO_2 will be routed to the lowest pressure knock-out drum to flash as much CO_2 as is possible from the water before discharge. The concentration of CO_2 in this water is dependent upon the capture technology selected and the operating pressure of the regenerator column. At the concentrations anticipated the reduction in pH of the solution will be negligible and this stream will not require further treatment to meet existing discharge limits prior to discharge to the outfall. Should discharge limits be altered under an updated permit, then further treatment would be required. This would be outlined at the full impact stage.
- **Cooling Tower Blowdown** - in order to limit the concentration of accumulated mineral, salts, and corrosion product within the cooling water system there is a continuous blowdown. This blowdown will primarily consist of water containing biocide (i.e. a pesticide) and anti-scalants resulting in slightly alkali pH, potential free chlorine and a chemical oxygen demand (COD) as high as 200 mg/l. It is anticipated that under normal operation that the water will remain within acceptable limits for discharge without further treatment. However, to mitigate potentially high COD and free chlorine that will be seen during shock dosing of sodium hypochlorite, to treat biological growth in cooling towers, it is advised that a sodium bisulphate dosing be added to a discharge line that is automatically controlled by a redox probe to neutralise free chlorine and other oxidisers and ensure a neutral pH.
- **Sewage and Sanitary Waste** - will be sent off-site via a pipeline connecting to a local Northumbrian Water WwTW (expecting to be the nearby Bran Sands). This will be confirmed at the full impact stage following consultation with Northumbrian Water to confirm capacity.
- **Surface Water Runoff from Process Areas** - Rain water collected within the process equipment areas shall be discharged to a retention pond via an oil interceptor, with collected oil intermittently removed by vacuum truck and disposed of off-site to a suitable, licensed waste facility. Additional treatment may be provided upstream of the pond using a vortex flow separator (VFS), oil separator or other proprietary measure.

9.5.38 Overall, the current design proposals for Site drainage indicate two routes for disposal of waste water and surface water runoff:

- to the Tees Bay outfall via suitable SuDS or proprietary measures as may be considered necessary; or
- via vacuum truck for off-site disposal at a suitable, licensed waste facility.

9.5.39 Any outfall retention pond would provide a minimum of eight hours residence time to allow equalisation and for operators to take action should water quality deteriorate. Water sampling facilities are to be provided for manual sampling of water prior to discharge. The frequency of testing and parameters to be tested will be agreed with the permitting authority. In situ continuous monitoring of flow, temperature, total organic carbon (TOC) conductivity and pH measurement shall also be undertaken.

9.5.40 The emerging drainage philosophy assumes that drainage will be discharged to Tees Bay and that an effluent treatment plan will be provided for treatment of ammonia from the Direct Contact Cooler blowdown (the current preferred option). Oil water separators shall be provided for runoff and a retention pond situated upstream of the outfall. It is also assumed that penstocks would be provided to isolate any accidental spillages or firewater on site that enter the drainage system.

9.5.41 A Surface Water Maintenance and Management Plan will be provided detailing the requirements of access and frequency for maintaining the different SuDS and surface water features proposed on the Site. It is anticipated that this will be prepared at the detailed assessment stage for inclusion in the DCO application. The maintenance regime must be properly implemented to avoid issues such as blockages which could lead to flooding.

9.5.42 The maintenance required for SuDS and drainage networks will be based on standard guidance and practice. Requirements for maintenance and management of vegetated drainage systems (e.g. ponds) are described in The SuDS Manual (CIRIA, 2015a) and DMRB HD103/06 (Highways Agency, 2006a). Furthermore, it is expected that silt/ oil alarms will be fitted on all interceptors and water storage facilities to alert operators when they require emptying. The drainage strategy should also outline the consequences for the drainage system should the Proposed Development close or be decommissioned.

Decommissioning

9.5.43 At the end of its design life decommissioning of the Proposed Development will see the removal of all above ground equipment down to ground level.

9.5.44 It is assumed that all underground infrastructure will remain in-situ; however, all connection and access points will be sealed or grouted to ensure disconnection. At this stage it is assumed that decommissioning impacts are expected to be limited and will be the same/similar to the construction impacts, as discussed above.

Management of Hazardous Substances on Site

9.5.45 The ongoing operation and management of the Proposed Development will require the use of a range of chemical products (e.g. anti-scalants, water treatment additives, fuels, and oil etc.). If not properly managed and contained there is potential for spillages or leakage, which could enter the surface water drainage system and ultimately receiving waterbodies including the Tees Bay.

9.5.46 To reduce the potential for adverse impacts, the use of the chemical products will follow the product-specific environmental guidelines, as well as the legislative requirements set out in the Control of Substances Hazardous to Health Regulations (COSHH (2002) and Control of Major Accident Hazards (COMAH) Regulations (2015).

9.5.47 A site Emergency Response Plan (prepared for Regulation 9 of the COMAH Regulations) will be in place for dealing with emergency situations involving loss of containment of hazardous substances. This will detail how to contain and control incidents to minimise the effects and limit danger to persons, the environment and property. As described above, it is assumed that penstocks will be included on both the surface and foul water drainage systems to provide final containment of any significant chemical spillage on Site and upstream the site outfall to Tees Bay, and to any discharge upstream of sewers into which site foul waste is discharged.

9.5.48 The Emergency Response Plan will set out the emergency spill control procedure that will include the following key actions adapted from the Health and Safety Executive’s Emergency Response / Spill Control Technical Measures Document (Health and Safety Executive, n.d.):

- spills involving hazardous materials should first be contained to prevent spread of the material to other areas. This may involve the use of temporary diking, sandbags, dry sand, earth or proprietary booms / absorbent pads;
- wherever possible the material should be rendered safe by treating with appropriate chemicals;
- hazardous materials in a fine dusty form should not be cleared up by dry brushing;
- treated material should be absorbed onto inert carrier material to allow the material to be cleared up and removed to a safe place for disposal or further treatment as appropriate;
- waste should not be allowed to accumulate. A regular and frequent waste removal procedure should be adopted; and
- process specific emergency spill kits (acid, alkali, solvent, toxic, etc.) should be readily available with supporting procedures, and maintained on a regular basis, and staff regularly trained in their use.

9.5.49 Once a hazardous spillage has been contained, to prevent spread of the material to other areas, the material should be treated to render it safe. Acids and alkalis may be treated with appropriate neutralising agents. Due to differing properties of various groups of chemical products, an appropriate strategy with suitable treatment agents should be established in each case.

9.5.50 Once the material has been treated the cleared-up area should be washed with large volumes of water. This should not be discharged from the Site outfall but disposed of offsite or sent to the sewers if practical (and agreed with the sewerage undertaker). The washing operation will represent an abnormal loading on the downstream treatment works, and so the treatment plant must be notified in advance so that appropriate measures can be adopted. This will include providing details of approximate quantity of hazardous material, composition of the material, physical properties of the material, and the state of the material (e.g. whether it has been neutralised). It is therefore important that the Site operator liaises closely with Northumbrian Water when developing the Emergency Response Plan.

9.5.51 Further guidance to be consulted in development of the site Emergency Response Plan will include:

- HS(G)191 Emergency planning for major accidents. Control of Major Accident Hazards Regulations 1999 (Health and Safety Executive, 1999);
- HS(G)71 Chemical warehousing: the storage of packaged dangerous substances (Health and Safety Executive, 1992); and
- BS 5908: Fire and explosion precautions at premises handling flammable gases, liquids and dusts. Code of practice for precautions against fire and explosion in chemical plants, chemical storage and similar premises (British Standards Institute, 1990).

9.5.52 All products are to be labelled with their hazard ratings so that the user is aware of any potential risks to the environment. Provided they follow the label instructions, the risks are well controlled. Only well trained, certificated and staff experienced in the use of the various chemical products will be allowed access.

Water Demand

9.5.53 There is a significant clean water requirement for the Proposed Development, with details of the various aspects of the Proposed Development requiring clean water described below:

- **Cooling Water Make-Up** - The PCC is to be provided with an open loop cooling system with mechanical draft evaporative cooling towers to cool the process equipment within the facility. The cooling demand (including main power plant condenser and auxiliaries, carbon capture plant and CO_2 compressor station) is estimated to be a total flow of 41,848 tonnes per hour (te/h) with a total duty of 525.9 MW_{th}, boiler water make-up requirement of 40 te/h, and a temperature range of 10ºC. Note that there are various estimates in the Cooling System Analysis Report (OGCI, 2019b), with this estimate being based on Case X2 (refer to OGCI, 2019b for further detail). Treated water is required for the make-up losses from this system (this is discussed later), which is a function of cooling tower evaporative losses, cooling tower drift losses and cooling tower blowdown. Refer to Water Treatment Options Assessment Report (OGCI, 2019a) for further details.
- **Fire Water** – tanks are to be filled with water to meet the instantaneous demand required for active fire protection.

- **Utility Stations** – the Site will include utility connections for washing down and flushing of equipment. This utility water will be supplied with treated water from the mains. These loads will be intermittent and relatively small compared to the cooling water make-up demand. It is assumed that the overall volume consumed by these utility stations will be accounted for within the design margin of the facility.
- **Boiler Feed Water Make-Up** – demineralised water is used within the power island to make-up for losses and blowdown within the steam circuit. The maximum normal operating demineralised water demand for boiler feed water make-up ifs 40 te/h.
- **Amine Solution Make-up** – demineralised water is used within the capture plant to dilute the concentrated amine to the required concentration to make-up for system losses.

9.5.54 If raw water is abstracted from the Tees, a water treatment plant (WTP) will be needed on the PCC to remove dissolved solids present and to provide make-up water to cooling water system, fire water system, and for dilution of make-up solvent within the capture plant. The design of the Proposed Development may include individual WTPs for each power island or a larger, single WTP serving the whole generating station. The clean water treatment plant would have a demand flow of 670 te/h for treated water and 40 te/h for demineralised water (OGCI, 2019a). The ES will assess the worst case scenario option.

9.5.55 The Water Treatment Options Assessment Report (OGCI, 2019a) reviews the potential options for the treatment of clean water at the Proposed Development. It was concluded that utilising third party supplied raw water that is treated off-site may be the most cost effective option over the life of the Proposed Development. At the time of writing, adoption of off-site treatment requires further investigation with the raw water supplier (Northumbrian Water) to evaluate availability and commercial terms. As this remains to be determined, it is assumed for the purposes of the PEI Report that water will be extracted from the Tees estuary given that the infrastructure is in place (subject to any maintenance needs as described above with regards to construction).

9.6 Likely Impacts and Effects

9.6.1 The Proposed Development has the potential to cause adverse effects to the water environment during construction, operation and decommissioning phases. Potential impacts are described below.

Construction Phase Impacts

9.6.2 During the construction phase the following surface water environment impacts may occur if appropriate mitigation is not applied:

- Temporary impacts on surface water quality due to deposition or spillage of soils, sediments, oils, fuels or other construction chemicals, or through mobilisation of contamination following disturbance of contaminants in sediments, ground or groundwater, or through uncontrolled site run off.

- Temporary impacts on sediment dynamics and morphology in the Tees Estuary and Tees Bay as a result of the potential installation of coffer dams, dredging, and other construction works associated with the abstraction and discharge points for the Proposed Development.
- Temporary impacts on sediment dynamics and hydromorphology within watercourses and waterbodies, where new crossings are required due to construction works and installation of the CO_2 Export Pipeline, Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network.
- Potential increase in volume and rate of surface water runoff from new impervious areas, leading to an impact on flood risk.
- Increased risk of groundwater flooding or recharge as a result of the below ground installation of the CO_2 Export Pipeline, Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network.
- Alteration in fluvial and overland flow paths as a result of works associated with the CO_2 Export Pipeline, Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network.

9.6.3 Prior to construction works commencing, a Ground Investigation and testing followed by a Quantitative Risk Assessment and development of a Remediation Strategy will be completed, as described in Chapter 10: Geology and Hydrogeology (PEI Report, Volume I). This will be in accordance with CLR11 Model Procedures for the Management of Contaminated Land (Environment Agency, 2004), BS10175:2011+ A2:2017 Investigation of Potentially Contaminated Sites: Code of Practice (British Standards Institute, 2013b) and the Environment Agency's GPLC1 Guiding Principles for Land Contamination in Assessing Risks to Controlled Waters (Environment Agency, 2010).

9.6.4 Construction activities such as earthworks, excavations, site preparation, levelling and grading operations result in the disturbance of soils. Exposed soil is more vulnerable to erosion during rainfall events due to loosening and removal of vegetation to bind it, compaction and increased runoff rates. Surface runoff from such areas can contain excessive quantities of fine sediment, which may eventually be transported to watercourses where it can result in adverse impacts on water quality, flora and fauna.

9.6.5 Construction works within, along the banks and across watercourses can also be a direct source of fine sediment mobilisation, and this sediment could contain contaminants given the past heavy industrial activities on this Site. Background sediment quality data shows that it is quite likely that marginal sediments within the Tees Estuary could contain contaminants at levels that make them unsuitable for disposal at sea. Other watercourses across the study area may also contain contaminated sediments due to the past industry in this area and the limited erosion and conveyance ability of these watercourses. Installation of a new offshore outfall with a diffuser head could also lead to the disturbance and mobilisation of historical contamination that may be found at depth in sediments within Tees Bay.

9.6.6 Other potential sources of fine sediment during construction works include water runoff from earth stockpiles, dewatering of excavations (surface and groundwater), mud deposited on site and local access roads, and that which is generated by the construction works themselves or from vehicle washing.

9.6.7 Generally, excessive fine sediment in runoff is chemically inert and affects the water environment through smothering riverbeds and plants, temporarily changing water quality (e.g. increased turbidity and reduced photosynthesis) and causing physical and physiological adverse impacts on aquatic organisms (such as abrasion, irritation). However, given the past industrial activity on the PCC and potentially elsewhere across the study area, there may also be the potential for acute and chronic toxic effects to aquatic organisms and possibly a risk to other water uses (e.g. bathing waters).

9.6.8 There is a requirement for works close to and potentially within the Tees Estuary for works to the abstraction inlet, to Tees Bay for the discharge outlet and CO_2 Export pipeline, and to The Fleet (Tees Estuary (S Bank)), The Mill Race, Mains Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck and Belasis Beck for the Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network. There would be the potential for conveyance of fine sediment, debris and any contamination during these construction works to any of these water bodies or downstream waterbodies and receptors.

9.6.9 During construction, fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and / or used on-site.. There may also be substantial volumes of stagnant water or other liquid/chemical substances within existing drainage and other redundant process infrastructure on the Site. Leaks and spillages of these substances could pollute the nearby surface watercourses if their use or removal is not carefully controlled and spillages enter existing flow pathways or waterbodies directly. Like excessive fine sediment in construction site runoff, the risk is greatest where works occur close to and within waterbodies.

9.6.10 To allow such substances to enter a watercourse could be in breach of the Environmental Permitting (England and Wales) Regulations 2016 and the Water Resources Act 1991 (as amended), and therefore measures to control the storage, handling and disposal of such substances will need to be in place prior to and during construction.

9.6.11 Any construction works on the floodplain have the potential to increase the rate and volume of runoff, change surface water flow pathways, and increase the risk of blockages in watercourses that could lead to flow being impeded, and a potential rise in flood risk.

Surface Water Quality – Suspended Fine Sediments

9.6.12 Preparatory dredging may be required at the abstraction intake and outfall if a new diffuser head is required. Dredging and an open excavation may also be required if a new outfall pipeline is required and for the CO_2 Export Pipeline should these not be installed by non-open cut methods (such as use of trenchless technologies).

9.6.13 The construction of a cofferdam in the Tees Estuary for works to the abstraction point would cause some mobilisation of fine sediments during its installation and removal, and this may mobilise some fine sediment into the water column. However, the volume of sediment will be relatively small and would most likely be localised. Once the coffer dam has been installed, any fine sediment that has been mobilised will quickly dissipate through settling or dispersion and is unlikely to create a plume that may propagate into the wider estuary. The purpose of the coffer dam is to allow a dry working area to be created, which in itself is a measure designed partly to reduce adverse impacts on water quality.

9.6.14 Section 9.5 describes the broad range of surface runoff control measures that will be utilised on the Site, which will be described by the Principal Contractor in a WMP accompanying a CEMP, and confirmed with the Environment Agency, MMO and Northumbrian Water as part of future permit applications. All conditions of the permits would be adhered too.

9.6.15 The coffer dam will be designed to minimise changes in riverbed and bank erosion and toe scour, and hence minimise sediment mobilisation. It will follow the line of the shore and will not protrude significantly into the channel (maximum of approximately 30 m; the estuary is >700 m wide at this location).

9.6.16 Before the installation of the coffer dam and any dredging, the sediments will need to be sampled for chemical analysis. This will be required to inform an application for a deemed marine licence for works to the estuary bed as this will require information on the chemical composition of the sediments to be removed so that the suitability of disposal at sea can be determined. Should an observable sediment plume be observed to be forming in the channel then work would be ceased.

9.6.17 The preferred approach for the outfall is to re-use the existing diffuser head or provide a new one, which may require some minor dredging. However, if it is not possible to re-use the existing outfall pipe a new one would need to be installed. A pipeline for CO_2 export will also be required across Coatham Dunes and Coatham Sands and into Tees Bay. Ideally these installations would be done using trenchless technologies or other non-intrusive technique to minimise adverse impacts during construction. These works within Tees Bay would have a greater potential to mobilise larger amounts of fine sediment than the other works due to the scale of excavation of the seabed that would be required. Increased suspended sediment concentrations would result in a temporary increase in the turbidity of the water column and could potentially (subject to sediment properties and chemical composition) cause an oxygen demand within the sediment plume.

9.6.18 The rate of sediment release during any required dredging would depend on the technique employed, with an enclosed grab approach preferred as this is a specialist technique specifically used to limit release of sediment into the water column, particularly when sediments are known to be contaminated. The chosen approach will be considered within the full impact assessment, when the need for dredging has been clarified. However, it is considered that sediment plumes from dredging generally pose a limited risk to water quality as open seas and estuaries have a large capacity to accommodate an increase in oxygen demand, and fish and mammals are able to avoid the plume. In addition, estuaries are naturally more turbid environments, as is the relative shallow nature of the inshore North Sea. The tidal exchange in the Tees would not be impacted during construction and so any peaks in suspended solid concentrations would be temporary in nature. There is, however, potential to have a short-term impact on the 'Redcar Coatham' Bathing Water for works around the discharge point, and so works to the outfall pipe should be timed appropriately outside of the bathing season (May-September).

9.6.19 With the embedded mitigation measures described in Section 9.5 in place, it is considered that there could be short term, localised and minor adverse impact to Tees Estuary in terms of fine sediments due to the temporary use of a coffer dam and preparatory dredging. Similarly, a temporary, localised minor adverse impact to Tees Bay would result from works to the outfall and CO_2 Export Pipeline. With both of these receptors being of very high importance (see Table 9-18), a temporary minor magnitude of impact would give a worst case **Slight adverse effect** (not significant). This assessment is preliminary and will be revisited at the ES stage, when the need (or not) for a coffer dam, preparatory dredging and open cut installation techniques have been finalised. [

9.6.20 With regard to the open-cut crossings of smaller freshwater watercourses, it is assumed that flow would be temporarily over-pumped through the works to minimise mobilisation of sediments downstream and silt fences, geotextile matting or straw bales used initially once the watercourses are reinstated, to capture mobilised sediments until the watercourse has returned to a settled state. It will be a requirement that the watercourses are reinstated as found. Again, water quality monitoring would be undertaken prior to, during, and following on from the construction activity. Regular observations of the watercourses would also be required post-works during vegetation re-establishment of the banks, especially following wet weather, to ensure that no adverse impacts have occurred. As noted above, there would be no works to the bed of the Tees estuary for the CO_2 Gathering Network and Natural Gas Connection crossing which would both be installed using trenchless technologies.

9.6.21 The watercourses that may be affected by open-cut crossings would also be subject to localised and temporary minor adverse impact relating to fine sediment runoff and mobilisation. For the very high importance Belasis Beck this would give a **Moderate effect** (significant). For the high important waterbody 'The Fleet (Tees Estuary (S Bank))' this would give a **Slight effect** (not significant). For the medium importance waterbodies that might be crossed (The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck) a minor magnitude impact would give a **Slight effect** (not significant).

9.6.22 Given the embedded mitigation to deal with fine sediment from runoff and construction there would be no impact to downstream waterbodies, including watercourses and online ponds (e.g. in Cowpen Marsh).

Surface Water Quality – Chemical Spillages

9.6.23 If appropriate mitigation measures are implemented as described in Section 9.5, including water quality monitoring, then there would be only a short-term, minor adverse impact on the very high importance Tees Bay, Tees Estuary, Belasis Beck, given that they may be worked on directly. This worst case would give a **Moderate effect** (significant).

9.6.24 The high importance waterbody The Fleet (Tees Estuary (S Bank)) may be directly worked on for the Natural Gas and Electrical Connection corridors, and here a minor adverse impact would give a **Slight effect** (not significant), given the temporary nature of any effect and the potential for dilution.

9.6.25 The medium importance waterbodies that would be directly impacted by the various connection corridors are The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck and Kettle Beck. Minor adverse impacts may also occur to these watercourses, giving **Slight effect** (not significant).

9.6.26 Given the embedded mitigation to deal with chemical spillages there is expected to be no impact to downstream waterbodies (e.g. Holme Fleet, Swallow Fleet, Mucky Fleet and Greatham Creek), or online ponds (e.g. in Cowpen Marsh) or those artificial ponds within the Site boundary which are not directly impacted.

Morphological Effects to Waterbodies Relating to the Use of a Coffer Dam and Preparatory Dredging

9.6.27 As described above, preparatory dredging may be required at the abstraction and discharge points. As well as the water quality impacts described above, there is potential to have morphological impacts through smothering of adjacent marine habitats once the sediment settles, which is considered in Chapter 14: Marine Ecology (PEI Report, Volume I).

9.6.28 An enclosed grab approach is preferred for dredging as this is a specialist technique specifically used to limit release of sediment into the water column. The chosen approach will be considered within the full impact assessment, but it is considered that sediment plumes from dredging generally pose a limited risk to water quality given the mitigation measures. The area of dredging would be limited in size as described above, meaning that the volume of sediment will be relatively small and any effect would be localised. There is high potential for dispersal of the sediment in the Tees Estuary given the tidal regime and dynamic nature of the environment. Furthermore, should a noticeable plume of sediment be observed to be forming then works would be stopped.

9.6.29 The installation of the coffer dam will unavoidably cause localised loss of habitat on the estuary bed beneath its footprint. However, the coffer dam will be designed to minimise changes in riverbed and bank erosion, and given the dynamic nature of the estuary, the estuary bed would be expected to make a rapid recovery.

9.6.30 Given the proposed mitigation measures, the impacts on morphology would be negligible due to their localised and temporary nature. As such, there is expected to be a **Neutral effect** (not significant) on the low importance receptor (for morphology) Tees Estuary with regard to the coffer dam and preparatory dredging, but a **Slight effect** (not significant) on the very high important Tees Bay, with regard to potential dredging for the installation of the outfall tunnel and diffuser head. This will be reconsidered at the full impact assessment stage when further design details will be available. The impact on the Tees Bay could be avoided if it is confirmed that the existing outfall pipe can be reused or if not, that the new outfall can be installed using a non-open cut method.

Morphological Effects to Waterbodies: Crossings for the CO_2 Gathering Network, Electrical and Natural Gas Connection Corridors and CO_2 Export Pipeline

9.6.31 Crossings of The Fleet (Tees Estuary (S Bank)), The Mill Race, Mains Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck and Belasis Beck may be required for the Natural Gas Connection Corridor, Electrical Connection Corridor and CO_2 Gathering Network. Open-cut methods have been assumed, with the pipe/cables buried at sufficient depth that there is no risk of exposure and the flow over-pumped or flumed during the works to minimise the risk of water pollution being carried downstream. However, there will unavoidably be short term, temporary adverse impacts on the watercourse and riparian habitats, and the hydrological and sediment regimes during construction. These impacts would be very localised and short in duration, with the channels reinstated fully as found, with some enhancement where possible (subject to further survey).

9.6.32 Installation of the CO_2 Export Pipeline across Coatham Dunes and Coatham Sands and into Tees Bay to below MLWS will also be required. Again, open-cut methods are assumed. Following the installation, drainage would be re-instated and vegetation re-planting undertaken to the original state as required. However, as with the above watercourses there will be unavoidable short-term, temporary adverse impacts on the hydrological and sediment regime in Tees Bay. Further mitigation measures to reduce the potential adverse impacts would include following best construction practice as outlined in the CEMP and WMP, including the implementation of a temporary site drainage system, and undertaking the works in the typically drier periods of the year, where possible. A pre-works survey would be undertaken to record waterbody form and condition prior to works commencing. Pump intakes would be appropriately screened to prevent fish being drawn into the pipe/pump. No plant would track through any channel where works are undertaken and would instead work from the banks. Crossings would be perpendicular to the channel where possible. To ensure the bed substrate was reinstated as found, different sediment layers would be kept separate during their temporary storage. It is anticipated that typical habitats and hydromorphological processes would quickly re-establish following the works.

9.6.33 However, mitigation would be provided should a risk of drying out the ponds through dewatering be identified. This might include sheet piles between the ponds and the pipeline for the extent of the construction works to prevent dewatering, albeit that this may temporarily disrupt groundwater flows into the ponds.

9.6.34 Overall, physical works to watercourses would give a localised, temporary minor adverse impact against hydromorphological status. With the exception of Tees Bay and Belasis Beck, these watercourses are all of low morphological importance, due to mainly being heavily modified, artificial channels, often significantly culverted and lacking significant geomorphic and bedform features. This results in a **Neutral effect** (not significant) due to the short-term nature of the work which would have limited impact at the scale of the wider waterbody. For Tees Bay which is of very high importance, the temporary minor adverse impact gives a Moderate effect (significant). For Belasis Beck, which is of high morphological importance, the temporary minor adverse impact gives a **Slight effect** (not significant).

9.6.35 As details of the construction approach for the Natural Gas Connection Corridor, Electrical Connection Corridor, CO_2 Gathering Network and CO_2 Export Pipeline pipelines are not available at this stage, the above assessment is provisional and will be re-evaluated at the ES stage when more details on construction methodology are available.

Potential Flood Risk – Tidal and Fluvial Sources During Construction

9.6.36 The construction phase of the Proposed Development would involve works in areas of Flood Zone 2 and 3, and close to and within the floodplains of the Tees, The Fleet (Tees Estuary (S Bank)), Belasis Beck, the Mill Race, plus small ditches across the Site, particularly in the vicinity of Saltholme. Should a fluvial flood event occur during construction, this could be a potential high risk to construction workers in the immediate vicinity. The baseline risk could be exacerbated during construction works by the temporary increase in the rate and volume of surface water runoff from an increase in impermeable areas such as compacted soils, any on-going works in channels (i.e. pipeline crossings for electrical and CO_2 corridors) that may constrict or alter the flow within it, and the presence of stockpiled materials and equipment temporarily stored on the floodplain. Sediment, construction materials and equipment may also be washed downstream where it may block the channel and lead to or increase the risk of flooding.

9.6.37 However, with the implementation of standard construction methods and mitigation as described in the CEMP and WMP, this risk can be effectively managed (for example by monitoring weather forecasts and Environment Agency flood warnings, by undertaking works close to watercourses during periods of dry weather, by ensuring an adequate temporary drainage system is in place and maintained throughout the construction phase and avoiding stockpiling material on floodplains). As such, the magnitude of flooding from these sources during construction, on site and further downstream, is considered to be negligible resulting in a **Slight effect** (not significant).

Potential Flood Risk – Surface Water Sources During Construction

9.6.38 The Site would in general be at a low risk from surface water flooding, although in some areas associated with watercourses there are areas of medium and high risk as outlined in the baseline and the FRA (Appendix 9A: FRA, PEI Report, Volume III). However, during the works, existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare ground and the construction of new embankments and impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures (see Section 9.5), this risk can be effectively managed. As such, the magnitude of flooding from these sources during construction is considered to be Negligible resulting in a **Neutral effect** (not significant).

Potential Flood Risk – Groundwater Sources During Construction

9.6.39 The Site is considered to be at medium risk of flooding from groundwater sources. Excavation of cuttings has the potential to liberate groundwater in some areas, and open excavations in some locations may also be more prone to becoming inundated by groundwater. With the implementation of the measures outlined in the CEMP and WMP (presented in Section 9.5), a Negligible magnitude of impact is predicted resulting in a **Neutral effect** (not significant).

Potential Flood Risk – Drainage Infrastructure and Artificial Sources During Construction

9.6.40 The Proposed Development is at low to medium risk of flooding from sewers and other water supply infrastructure. With the implementation of the measures outlined in the CEMP and WMP and other flood risk mitigation as outlined in section 9.5, flooding from these sources is considered to be Negligible given the implementation of standard good practice construction techniques resulting in a **Neutral effect** (not significant).

9.6.41 Environment Agency mapping and the FRA (Appendix 9A: FRA, PEI Report, Volume III) indicates that the Site is not at risk of flooding from reservoirs or artificial waterbodies. As such, flooding from these sources is considered to have a **Neutral effect** (not significant).

Operation Phase

9.6.42 During the operation phase the following potential water environment impacts may occur if appropriate mitigation is not applied:

- impacts on receiving waterbodies from diffuse urban pollutants in surface water runoff, or as a result of accidental spillages;
- changes in water quality within Tees Bay from operational discharges from the PCC including the discharge of treated process wastewater and water from the cooling system;
- potential increase in volume and rate of surface water runoff from new impervious areas, leading to an impact on flood risk, upstream and downstream of the Proposed Development;
- increased local demand for potable water supply; and
- potential nutrient enrichment of ponds located adjacent to the PCC from atmospheric deposition of nitrogen emitted from the Power and Capture Plant (see Chapter 8, Air Quality and Chapter 12, Terrestrial Ecology, PEI Report, Volume I).
- potential morphological and hydrological impacts to waterbodies.

9.6.43 It is important that the water supply and foul water requirements for the Proposed Development are determined so that these can be managed accordingly by the public water company and sewage undertaker without causing significant adverse effects to the water environment. Unlike other aspects of this assessment, the potential impact from foul water discharges is difficult to assess because the consequences are often indirect and distant from the Proposed Development (e.g. the water supply or the river into which treated final effluent is discharged) and a component of a larger, existing issue. Furthermore, water supply and sewage treatment is a highly regulated industry with existing processes and mechanisms to ensure the supply of services for major developments., Statutory requirements are also placed upon statutory waste water undertakers to upgrade their infrastructure when required, whilst ensuring they operate within requirements of water abstraction licences and water activity permits to discharge to rivers.

Potential Pollution of Surface Watercourses: Surface Water Routine Runoff and Accidental Spillages

9.6.44 The Water Treatment Options Assessment Report (OGCI, 2019a) indicates that rainwater runoff from the Proposed Development shall be discharged to a retention pond, after passing through an oil interceptor (with collected oil intermittently removed by vacuum truck and disposed of off-site). Additional treatment may be provided upstream of the pond using a VFS or equivalent. Water from the retention pond shall then be discharged to the outfall into Tees Bay.

9.6.45 The SuDS Manual's Simple Index Approach (CIRIA, 2015a) has been applied to assess the suitability of the proposed SuDS treatment train for surface water runoff and spillages (from non-process areas). The High Pollution Hazard Index has been adopted to assess runoff from the Proposed Development, as this is described in the SuDS Manual as, "*Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways*". It is thus deemed the most appropriate hazard index available for the Proposed Development.

9.6.46 Table 9-17 shows the pollutant hazard index score for different pollutants for the High Pollution Hazard Level, as outlined in the SuDS Manual (CIRIA, 2015a).

9.6.47 The proposed retention pond would provide storage for potential flood and pollution events, prior to discharging at a controlled rate to the North Sea via Tees Bay. Table 9-17 also shows the treatment potential of the pond when compared against the pollution hazard index. To achieve a pass the total mitigation index must meet or surpass the pollution hazard index. Currently, the mitigation index fails to meet the pollution hazard index in all cases and so additional treatment is required.

Table 9-17: Pollution Hazard Indices and the Total Pollutant Mitigation Index for each Pollutant

Proposed Development land use	SuDS train	Mitigation		
		Total Suspended Solids	Metals	Hydrocarbons
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways	Pond	0.7	0.7	0.5
	Pollution Hazard Index	0.8	0.8	0.9
	Total Mitigation Index	**0.7**	**0.7**	**0.5**

9.6.48 Additional treatment is proposed to be provided upstream of the pond using a vortex grit separator as a minimum, while there is a preference for additional SuDS (e.g. filter drains, swales, wetlands). Proprietary treatment systems such as vortex separators are not considered within the Simple Index Assessment as the performance varies between available products. As such, the appropriateness of the chosen product for providing the additional treatment for runoff will be confirmed through consultation with the Environment Agency and LLFA. It is also assumed that penstocks would be provided to isolate any accidental spillages or firewater on site that may enter the drainage system.

9.6.49 The full Drainage Strategy for the Site is under development and so the Simple Index Assessment is indicative only at this stage. The assessment will be repeated as the strategy develops to ensure that suitable treatment is provided prior to discharge to Tees Bay. This will need to be demonstrated in order to ensure compliance with local policy, as the Redcar and Cleveland Local Plan 2018 states that, "*The drainage system (for a development) should not adversely impact water quality of receiving water bodies, both during construction and operation, and should seek to improve water quality where possible*".

9.6.50 As outlined in Chapter 4: Proposed Development (PEI Report, Volume I), hazardous substances will be used on site, an inventory of which will be development throughout the design process. In each case the product will have a Material Safety Data Sheets providing guidance on safe disposal of waste chemicals. It is assumed that during operation of the facility, the disposal of product containers and chemical waste will adhere to this guidance, and the impact avoidance measures above.

9.6.51 Spillages on Site will be treated as per the Emergency Spill Control procedures described within the impact avoidance measures, and spilt substances collected and disposed of as per their individual requirements. It is assumed that penstocks will be provided to isolate any spills or firewater in the surface water drainage system and prevent its discharge to the outfall at Tees Bay. Should any spillage occur the Environment Agency would immediately be informed, or Northumbrian Water should it impact the foul water system.

9.6.52 Given that the Drainage Strategy will have to meet standards required by the environmental permit and the expected local policy requirements, and that measures are in place for dealing with spillages and firewater then a negligible impact is predicted to the North Sea at Tees Bay. Given that this is a very high importance receptor, this would result in a **Slight effect** (not significant). This provisional assessment will be revisited at the full impact assessment stage in the Environmental Statement.

Potential Impacts on Water Quality of Tees Bay from Operational Discharges

9.6.53 Cooling water from the Power and Capture Plant will discharge to Tees Bay under an environmental permit. If water is not sufficiently cooled it could create a thermal barrier to fish passage, especially salmon and lamprey, and have other environmental consequences on the designated coastal sites in terms of ecosystem dynamics and assemblages.

9.6.54 To better understand the consequences of this discharge of cooling water, thermal discharge modelling and assessment has been undertaken (see Appendix 9B: Coastal Modelling Report, PEI Report, Volume III).

9.6.55 As part of the thermal modelling exercise, a precautionary worst-case 15°C ΔT was assumed between intake and discharge; it is expected that the actual uplift be well within this (i.e. c12°C or below, depending on a number of factors including seasonal variation). In the worst-case scenario for abstraction and discharge, the report concludes that the effects from the discharge are highly localised with effluent rapidly dissipating around the outfall head; notably, this is also based on the precautionary assumption that no diffuser head be fitted to the outfall.

9.6.56 Sea temperature changes are assessed in full detail within Chapter 14: Marine Ecology (PEI Report, Volume I); this includes potential changes to the marine environment surrounding the outfall and associated effects on receptors. It also considers the potential for beneficial effects to harmful Invasive Species.

9.6.57 In summary taking into account the modelling result and the findings of Chapter 14: Marine Ecology (PEI Report, Volume I) it can be assessed at this stage that as that impacts from the thermal discharge are localised tit does not threaten the temperature status on the scale of the whole waterbody. Crucially, they do not present a barrier to migratory routes for fish. In EIA terms the impact is therefore negligible, which gives a **Slight effect** (not significant) to the very high importance Tees Bay in terms of thermal discharge effects.

9.6.58 There is further potential for physico-chemical water quality impacts at the Tees Bay outfall, as discharged water is likely to include that from:

- Heat Recovery Steam Generator Blowdown – effluent from which includes low concentrations of ammonia, phosphate and di-ethyl hydroxyl amine (DEHA);

- Direct Contact Cooler Blowdown – effluent from which may include high concentrations of ammonia and nitrogen;
- Compression and Dehydration Water – effluent from which could have low pH; and
- Cooling Tower Blowdown – effluent from which may have high COD and free chlorine, although treatment is proposed in the form of sodium bisulphate dosing.

9.6.59 The Tees Coastal WFD waterbody is currently at Good Chemical Status and Good Status for Physico-chemical Quality Elements, and the Proposed Development must not lead to deterioration of this status. It will need to be demonstrated that the discharged effluent from the Proposed Development meets the required standards for an arrange of water quality indicators in order to obtain a Water Activity Permit (i.e. a consent from the Environment Agency to discharge).

9.6.60 An onsite effluent treatment plant would be provided following Best Available Techniques (BAT) for treatment of ammonia from the Direct Contact Cooler blowdown.

9.6.61 Once at the retention pond, effluent would have 8 hours residence time for equalisation, and for operators to take action should water quality deteriorate. Water sampling facilities are to be provided for manual sampling of water. The frequency of testing and parameters to be tested will be agreed with the permitting authority. In situ continuous monitoring of flow, temperature, conductivity and pH measurement shall also be undertaken

9.6.62 Given the requirements for the effluent from the Proposed Development to meet conditions of an environmental permit, it is considered that there is limited potential for widespread pollution from the outfall, especially given the large capacity for dilution and dispersal offered by the Tees Coastal waterbody. Furthermore, until 2016 there was a larger cooling water discharge from the Site in relation to the previous use of the Proposed Development site (i.e. the steel works) than is proposed for the Power and Capture Plant (i.e. previously 30,000 te/h was abstracted and now it is estimated that 40 te/h will be needed). As such, a negligible impact is predicted at this stage, with no changes likely to impact on WFD classifications for the larger waterbody. Given that the outfall is to a very high importance receptor this results in a **Slight effect** (not significant). This effect will be re-assessed at the full impact assessment stage, when further details are available regarding water treatment and following consultation with the regulator.

Surface Water Ponds: Water Quality

9.6.63 It is considered that there would be limited potential for adverse impacts resulting from receiving ‘unclean’ water or accidental spillages during operation on any existing ‘natural’ ponds (i.e. excluding new ponds that may be constructed as part of the Proposed Development for drainage purposes). This is based on all routine runoff during operation being directed to the outfall to Tees Bay, and not to the surface water ponds in the area. Overall, the magnitude of impact is expected to be negligible for all ponds within the site boundary, resulting in a potential **Neutral effect** (not significant). There should be no impact to ponds that are outside the Site boundary but within the study area.

9.6.64 Air quality modelling for the Proposed Development has indicated the potential for atmospheric deposition of nitrogen emitted from the Power and Capture Plant to impact adjacent waterbodies, notably ponds in Coatham Dunes. Over time, the deposition of nitrogen can lead to the acidification and enrichment of still waterbodies, especially where there is limited overturn of the water column, a limited buffering capacity, or uptake and removal of excess nutrients. Potential morphological and hydrological impacts to waterbodies. (see Chapter 8, Air Quality and Chapter 12, Terrestrial Ecology, PEI Report, Volume I)

9.6.65 The assessment assumes that the existing Tees Bay outfall is not suitable and that a new outfall consisting of a pipeline and diffuser head weighed down with rock armour will be provided. The route and terminal point of the new pipeline will be similar to the existing. The new pipeline will be buried beneath the sea bed until close to the position of the diffuser head using trenchless technologies which will not result in any temporary morphological impacts to the sea bed.

9.6.66 A large obstruction on the seabed, such as a new diffuser head, has the potential to induce localised scouring of the seabed. This is likely to occur quite rapidly leading to the development of a ‘scour pit,’ which will then be subject to ongoing, smaller-scale erosion/accretion in response to the natural tidal and wave processes. However, the risk will depend on the nature of the shallow bed substrate and whether this consists of sand (which will settle quickly), consolidated clay (which is resistant to erosion), or unconsolidated fine sediments that are easy to erode. This effect would also largely be offset by replacement of the existing outfall diffuser head. This impact will be subject to further modelling to inform the full impact assessment. For the purposes of this assessment it is assumed that due to this effect mainly offsetting the existing situation that a negligible impact will occur. For the very high important Tees Bay this gives a **Minor effect** (not significant).

9.6.67 There will be a new crossing of Coatham Dunes and Coatham Sands into Tees Bay to below MLWS. It is assumed for the purposes of the assessment that this will require open-cut techniques. Furthermore, should a new outfall tunnel need to be installed then this would also potentially also use open-cut techniques between the PCC and discharge point in Tees Bay, then there is the potential for change to the hydrological regime of ponds Coatham Dunes behind Coatham Sands. Those affected ponds are numbers 5, 6, 7, 8, 9, 10, 11, 13, 14 and 15 as numbered in Chapter 13 Aquatic Ecology (PEI Report, Volume I). During initial surveys, out of those affected only ponds 8, 9, 13 and 14 contained water and so have been scoped into further aquatic assessment. Site observation indicates that these ponds are covered with 80-100% *Phragmites australis*, which may mean that they are drying out or have been enriched. It is not currently known how these ponds are fed, and whether the installation of a new pipeline would impact any existing groundwater inflow by altering flow directions or volumes. This will be determined through further hydrological investigation at the full impact assessment stage. At this stage, and given that the hydrology of each pond is likely to be controlled by localised topography immediately around each pond, with limited groundwater flow given the very shallow gradient, it is predicted that the installation of a pipeline would result in a permanent and long term Negligible impact, resulting in a provisional **Slight effect** (significant) to these high importance receptors.

9.6.68 At the time of writing (March 2020) it is not known that any ponds will be directly lost or partly backfilled as a result of the Proposed Development.

Demand for Water

9.6.69 The Proposed Development has a significant demand for water as outlined above, albeit less than for the former steelworks. While the existing abstraction from the Tees Estuary may be used with appropriate treatment provided on Site, utilising third party supplied raw water that is treated off-site may be the most cost-effective option over the life of the Proposed Development. At the time of writing, adoption of an off-site third-party supply requires further investigation with the raw water supplier (Northumbrian Water Ltd) to evaluate availability and commercial terms. The alternative is to abstract and treat water directly from the Tees Estuary, as was done previously for the former SSI Site albeit involving much larger volumes of water.

9.6.70 Northumbrian Water's Water Resources Management Plan 2019 (Northumbrian Water, 2019) indicates that there should be sufficient resources within the network to accommodate this, if required. The plan undertook a supply and demand forecast for each Water Resource Zone (WRZ) in their jurisdiction (with the Industrial WRZ being relevant for the Proposed Development), for a scenario of a worst historical drought and a 1 in 200 year return period drought. Based on licensed quantities from the River Tees there is 170M l/d of water available for the Industrial WRZ under normal operation. In the 1 in 200 design drought year there is only 130 Ml/d of water available for the Industrial WRZ. This means that based on a current demand of 82M l/d the WRZ has a headroom of 48M l/d in the design drought year. Furthermore, given advancements in water efficiency in industry, future demand is expected to decline.

9.6.71 The Plan confirms that a water supply surplus will be maintained up to 2060. Furthermore, the volume of water forecast to be abstracted over the planning period will not lead to deterioration in the status of the waterbodies from which Northumbrian Water abstract.

9.6.72 On the basis that NWL has a supply surplus (although some improvements to transmission infrastructure may be required), or that water will be abstracted from the Tees Estuary in a similar way to the former SSI Site but involving substantially less water, a negligible impact is predicted giving a **Neutral effect** (not significant).

Foul Water Discharge

9.6.73 Sewage and sanitary Waste from the Proposed Development will be sent off-site via pipeline connecting to a local Northumbrian Water treatment plant, probably at Bran Sands. At this stage, it is not known which treatment plant would be used. This will be confirmed at the full impact assessment stage following consultation with Northumbrian Water to confirm capacity.

9.6.74 For the purposes of this assessment it has been assumed that Northumbrian Water will treat foul water prior to discharge to any waterbodies in accordance with requirements to not cause deterioration or prevent improvement under the WFD. Further consultation with Northumbrian Water and development of a suitable detailed foul drainage strategy will be undertaken as the Proposed Development is progressed. At the time of writing, the impact of foul water discharges is considered to be a **Neutral effect** (not significant).

Flooding from Tidal and Fluvial Sources during Operation

9.6.75 The FRA (Appendix 9A, PEI Report, Volume III) indicates that the PCC 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.

9.6.76 During a future scenario resulting from climate change up to 2125 the PCC 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.

9.6.77 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.

9.6.78 All runoff from the Site is to the proposed outfall discharging to Tees Bay. As such, the risk of flooding should not be exacerbated by the Proposed Development.

9.6.79 In EIA terms, tidal flooding is considered of Very High Importance due to the nature of the development as essential infrastructure (i.e. Power and Capture Plant). Given that the proposed development is expected to have negligible impact on flood levels on or off site, then a **Slight effect** (not significant) is anticipated in terms of tidal and fluvial flooding (based on the classification approach in table 9-4).

9.6.80 However, there are areas where the Proposed Development is at High Risk of being flooded from tidal sources, particularly around the connection corridors north of the Tees. Appropriate mitigation measures are therefore required to be implemented at the Site to mitigate this risk. These are described further in the FRA (Appendix 9A, PEI Report, Volume III) and below in Section 9.7 and would include a Flood Emergency Response Plan.

Flooding from Surface Water Sources during Operation

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

9.6.82 A Drainage Strategy will be prepared for the Proposed Development which covers the use of SuDS, site discharge rates and surface water management/ exceedance flows. Given the implementation of this proposed strategy, surface water from the Proposed Development will be carefully managed, treated and directed to the Tees Bay outfall at controlled rates. Given this increased management of surface water runoff from the development there would likely be a reduction in the surface water flood risk in comparison to existing conditions where the drainage arrangements are dated.

9.6.83 It is considered that the Proposed Development would have a negligible impact, resulting in a **Neutral effect** (not significant) on surface water flood risk.

Flooding from Ground Water Sources during Operation

9.6.84 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 as is best practice. This is described further in the FRA (Appendix 9A, PEI Report, Volume III). Assuming this to be the case, the magnitude of impact from groundwater flooding during operation is considered negligible. As such, the effect is Neutral (not significant).

Flooding from Drainage Infrastructure during Operation

9.6.85 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. However, this is considered very unlikely and so a magnitude of minor adverse is considered appropriate. A **Slight effect** (not significant) is predicted as a worst-case scenario.

9.6.86 Flooding from drains, sewers and surface waters are normally interconnected. Insufficient or reduced drainage capacity within the sewer network can result in drainage capacity being exceeded causing extensive surface water flooding. Likewise, increased volumes of surface water can overload sewers and drains, causing the drainage network to backup and surcharge causing surface water flooding. All new pipes to be installed for the Proposed Development will be appropriately sized to accommodate their calculated capacity requirements. The impact of climate change on expected flows will be accommodated in the design of drainage infrastructure. Given this, the magnitude of impact is considered to be minor adverse, a **Slight effect** (not significant) effect as the worst-case scenario is predicted.

Decommissioning Phase

9.6.87 At the end of its operating life, all above-ground equipment associated with the Proposed Development will be decommissioned and removed from the Site. It is assumed that all underground infrastructure will remain in-situ, however, all connection and access points will be sealed or grouted to ensure disconnection.

9.6.88 On this basis, decommissioning impacts are expected to be limited to waterbodies in close proximity to the PCC (i.e. Tees Estuary, Tees Bay, The Fleet (Tees Estuary (S Bank)), some ponds and potentially waterbodies close to any AGIs along the various connection corridors) and will be similar to the impacts reported for the construction phase, but with fewer earthworks, excavations and tunnel arisings to manage.

9.6.89 A detailed Decommissioning Environmental Management Plan will be prepared to identify required measures to prevent pollution during this phase of the development, based on the detailed decommissioning plan.

9.6.90 There is likely to be a marginal improvement to the water quality of the Tees Coastal waterbody following decommissioning of the Proposed Development, with the discharge of cooling waters and other effluent ceasing.

9.7 Environmental Management and Monitoring

Construction Phase

9.7.1 Mitigation of adverse impacts on the water environment during the construction phase will be achieved principally through embedded measures identified in Section 9.5, notably the adoption of a CEMP and WMP.

9.7.2 A water quality monitoring programme will be set out in brief within the Outline WMP within the Outline CEMP. This will need to be further developed by the Principal Contractor in consultation with the Environment Agency (due to works potentially impacting flow in a Main River and WFD waterbodies), the LLFA (due to works potentially impacting flow in an Ordinary Watercourse), the MMO and potentially Natural England during the process of obtaining Environmental Permits/Consents/Licences for works affecting, or for temporary discharges to, waterbodies during the construction period.

9.7.3 The programme will be expected to include a combination of daily observations and monitoring using a calibrated, handheld water quality probe through the upstream and downstream reaches of water features hydrologically-connected to the Site. It is expected that water quality sampling will be undertaken on a periodic as well as ad-hoc basis, dependent upon circumstances / activities onsite. Monitoring and sampling will be undertaken prior to the commencement of construction as to allow a sufficient baseline data.

9.7.4 Should the above recommendations be implemented there is potential for the significant effects to be down-graded. However, this can only be determined at the full impact assessment stage once further construction details are available. As such, the residual effects remain the same as the effects identified above which take into account the embedded mitigation outlined in Section 9.5.

Operation Phase

9.7.5 The need for a number of additional mitigation strategies will be considered during the design process for the Proposed Development to ensure the operation of Site is maintained in the event of an extreme flood or significant pollution event. These strategies include:

- A Flood Emergency Response Plan - providing flood resistance and resilience measures into the design of the buildings (i.e. minimum floor levels) and designing for failure, maintenance and capacity exceedance of the surface water drainage network. More details are provided in the FRA (see Appendix 9A in PEI Report, Volume III).
- An Emergency Response Plan – setting out how the risk of large emergency and pollution incidents will be managed during the operation of the Proposed Development.

9.7.6 It is assumed that the need for long term water quality monitoring will be set out and agreed with the Environment Agency through the environmental permitting process and thus no details of what this may involve are described here.

9.7.7 Opportunities for environmental enhancement that could be delivered by the Proposed Development are being considered and details will be included in the full impact assessment. However, given the nature of the majority of the watercourses affected being low gradient, slow flowing, and associated with extensive wetland habitat, opportunities for enhancement will be limited after full reinstatement to the pre-works state.

9.8 Limitations or Difficulties

9.8.1 The EIA process enables good decision-making based on the best possible available information about the environmental implications of a proposed development. However, there is often a degree of uncertainty as to the exact scale and nature of the environmental impacts, and in such cases the reasonable worst-case scenario has been considered.

9.8.2 This assessment has been undertaken using available data and Proposed Development design details at the time of writing in March 2020. However, at this stage many details of the Proposed Development remain uncertain or under development, such as the requirement for dredging and the exact nature of the drainage arrangements. The assumptions used are listed in Section 9.3 and have followed the Rochdale Envelope approach. As such the assessment provided herein should be considered provisional, with greater detail to be provided within the Environmental Statement at the full impact assessment stage.

9.9 Residual Effects and Conclusions

9.9.1 A summary of residual effects on water resources and flood risk and their significance is provided in Table 9-18.

9.9.2 At this stage, short term effects have been identified to water quality in the Tees Estuary and Tees Bay due to the potential need for dredging at both locations, and a coffer dam at the abstraction point in the Tees Estuary. These effects would be temporary and would not be expected to cause a failure against WFD classifications or objectives given the large scale of these waterbodies and the temporary nature of the works. This assessment was based on reasonable worst-case assumptions including that preparatory dredging would be required at both locations, and that a coffer dam is needed at the abstraction point. As the design develops it would be preferable to avoid dredging and the use of coffer dams, by finding alternative sources of water supply and using the existing drainage infrastructure, presuming that it is in a suitable condition.

9.9.3 Belasis Beck would be subject to a moderate adverse significant effect should open-cut techniques be used for installation of a pipeline beneath it. This would be avoided by using trenchless technologies which do not disturb the bed or bank habitats or mobilise sediments.

9.9.4 Potential adverse (significant) effects could occur to water quality in Tees Bay, Tees Estuary and Belasis Beck relating to accidental spillages given that they are to be worked on directly. However, it is proposed that water quality monitoring is undertaken in hydrologically-connected downstream water features to ensure that any pollution can quickly be identified, and remedial measures implemented.

9.9.5 All other residual effects are considered to be neutral to slight (not significant), provided that the embedded mitigation measures are implemented as outlined in this PEI Report chapter.

9.9.6 All potential impacts will be re-assessed at the full impact assessment stage when further details are available with regard to the Proposed Development. In particular, further detail is expected with regard to the need for preparatory dredging at the abstraction and outfall points, potential need for a coffer dam at the abstraction point, whether it will be necessary to use open-cut install a replacement discharge tunnel across Coatham Dunes and Coatham Sands, development of the drainage strategy, and consultation input from numerous stakeholders including the MMO, Environment Agency, Natural England and Northumbrian Water.

Table 9-18: Summary of Residual Impacts and Effects

Description of effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and monitoring	Residual Effect Significance in DMRB terms
Construction					
Surface Water Quality – suspended fine sediments	Tees Estuary, Tees Coastal Waterbody (Tees Bay), Belasis Beck: Very High The Fleet (Tees Estuary (S Bank)): High The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Medium Coatham Dunes Ponds: Very High Drain, ditches and ponds on Site: Low	Tees Estuary: Minor (temporary) Tees Coastal Waterbody (Tees Bay): Minor (temporary) Belasis Beck: Minor (temporary) The Fleet (Tees Estuary (S Bank)): Minor (temporary) The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck, ditches, ponds: Minor (temporary) Coatham Dunes Ponds: Minor	Tees Estuary: Moderate (significant) Tees Coastal Waterbody (Tees Bay): Moderate (significant) Belasis Beck: Moderate (significant) The Fleet: Slight (not significant) The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Slight (not significant) Coatham Dunes Ponds: Moderate (significant) Drain, ditches and ponds: Neutral (not significant)	Further to the implementation of the CEMP and WMP (embedded mitigation), water quality monitoring pre-construction and during construction will be undertaken. Use trenchless technologies techniques for pipeline installation across watercourses where possible. Clarify requirement for dredging and use of coffer dam at the abstraction and discharge points for full impact assessment. Undertake hydrological investigation of Coatham dunes ponds to determine dependence on groundwater. Provide mitigation during open-cut works to maintain any groundwater flow should they be dependent on this.	Tees Estuary: Slight (not significant) Tees Coastal Waterbody (Tees Bay): Slight (not significant) Belasis Beck: Slight (not-significant) The Fleet: Slight (not significant) The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Slight (not significant) Drain, ditches and ponds: Neutral (not significant) Coatham Dunes Ponds: Minor (insignificant)
Surface Water Quality – chemical spillages	Tees Estuary, Tees Coastal Waterbody (Tees Bay), Belasis Beck, Greatham Creek, Mucky Fleet, Swallow Fleet, Holme Fleet: Very High The Fleet (Tees Estuary (S Bank)): High The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife	Tees Estuary: Minor (temporary) Tees Coastal Waterbody (Tees Bay): Minor (temporary) Belasis Beck: Minor (temporary) The Fleet (Tees Estuary (S Bank)): Minor (temporary)	Tees Estuary: Moderate (significant) Tees Coastal Waterbody (Tees Bay): Moderate (significant) Belasis Beck: Moderate (significant) The Fleet: Slight (not significant)	Further to the implementation of the CEMP and WMP (embedded mitigation), water quality monitoring pre-construction and during construction will be undertaken.	Tees Estuary: Slight (not significant) Tees Coastal Waterbody (Tees Bay): Slight (not significant)) Belasis Beck: Slight (not significant) The Fleet: Slight (not significant)

Description of effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and monitoring	Residual Effect Significance in DMRB terms
	Beck, Kinkerdale Beck, Kettle Beck: Medium Drain, ditches and ponds on Site: Low	The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck, ditches, ponds: Minor (temporary)	The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Slight (not significant) Greatham Creek, Mucky Fleet, Swallow Fleet, Holme Fleet: No impact		The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Slight (not significant) Greatham Creek, Mucky Fleet, Swallow Fleet, Holme Fleet: No impact
Morphological Effects relating to dredging and installation of a cofferdam and / or diffuser head	Tees Coastal Waterbody (Tees Bay): Very High	Tees Coastal Waterbody (Tees Bay): Negligible	Tees Coastal Waterbody (Tees Bay): Slight (not significant)	Clarify requirement for dredging and diffuser head at the discharge point for full impact assessment.	Tees Coastal Waterbody (Tees Bay): Slight (not significant)
	Tees Estuary: Low	Tees Estuary: Negligible	Tees Estuary: Neutral (not significant)	Clarify requirement for dredging and use of coffer dam at the abstraction points for full impact assessment.	Tees Estuary: Neutral (not significant)
Morphological Effects to Waterbodies: Crossings for the CO_2, Electrical and Natural Gas Connection Corridors, and CO_2 Export Corridor.	Tees Bay: Very High Belasis Beck: High (for morphology) The Fleet (Tees Estuary (S Bank)), The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Low (for morphology) Drain, ditches on Site: Low	Tees Bay: Minor (temporary) Belasis Beck: Minor (temporary) The Fleet (Tees Estuary (S Bank)), The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Minor (temporary) Drain, ditches and ponds on Site: Minor (temporary)	Tees Bay: Moderate (significant) Belasis Beck: Slight (not significant) The Fleet (Tees Estuary (S Bank)), The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Neutral (not significant) Drain, ditches and ponds on Site: Neutral (not significant)	Further to the implementation of the CEMP and WMP (embedded mitigation), water should be over-pumped through the works which should be undertaken in drier periods of the year. Pump intakes should be appropriately screened to prevent fish being drawn into the pipe/pump. Drainage and planting to be reinstated.	Tees Bay: Slight (not significant) Belasis Beck: Slight (not significant) The Fleet (Tees Estuary (S Bank)), The Mill Race, Main's Dike, Lackenby Channel, Knitting Wife Beck, Kinkerdale Beck, Kettle Beck: Neutral (not significant) Drain, ditches and ponds on Site: Neutral (not significant)
Flooding from fluvial sources during construction	Flood Risk: High (construction workers)	Negligible	Slight (not significant)	Implementation of temporary site drainage system as described in future CEMP and WMP (embedded mitigation).	Slight (not significant)

Description of effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and monitoring	Residual Effect Significance in DMRB terms
Flooding from surface water sources during construction	Flood Risk: High (construction workers)	Negligible	Neutral (not significant)	Implementation of temporary site drainage system as described in future CEMP and WMP (embedded mitigation).	Neutral (not significant)
Flooding from groundwater sources during construction	Flood Risk: High (construction workers)	Negligible	Neutral (not significant)	Implementation of temporary site drainage system as described in future CEMP and WMP (embedded mitigation).	Neutral (not significant)
Flooding from drainage artificial sources and drainage infrastructure during construction	Flood Risk: High (construction workers)	Negligible	Neutral (not significant)	None proposed.	Neutral (not significant)
Operation					
Potential Pollution of Surface Watercourses: Routine Runoff and Accidental Spillages	Tees Coastal Waterbody (Tees Bay): Very High	Negligible	Tees Coastal Waterbody (Tees Bay): Slight (not significant)	Implementation of Drainage Strategy which is still to be produced (embedded mitigation).	Tees Coastal Waterbody (Tees Bay): Slight (not significant)
Potential Impacts on water quality of Tees Bay due to thermal discharges	Tees Coastal Waterbody (Tees Bay): Very High	Negligible (TBC)	Slight (not significant)	Implementation of Drainage Strategy which is still to be produced (embedded mitigation).	Slight (not significant)
Potential Impacts on water quality of Tees Bay due to receipt of industrial discharges from the Proposed Development	Tees Coastal Waterbody (Tees Bay): Very High	Negligible	Slight (not significant)	Implementation of Drainage Strategy which is still to be produced (embedded mitigation). Water sampling facilities are to be provided for manual sampling of water. The frequency of testing and parameters to be tested will be agreed with the permitting authority. In situ continuous monitoring of flow, temperature, conductivity and pH	Slight (not significant)

Description of effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and monitoring	Residual Effect Significance in DMRB terms
				measurement shall also be undertaken.	
Potential impacts on morphology from installation of the diffuser head at the outfall point	Tees Coastal Waterbody (Tees Bay): Very High	Negligible	Slight (not significant)	Additional scour protection if modelling suggests this to be required	Slight (not significant)
Potential impacts on hydrology of ponds from installation of the outfall tunnel using open cut techniques	Coatham Dune ponds: Very High	Negligible	Slight (not significant)	Mitigation for groundwater flow disruption, should further investigation suggest that this is required	Slight (not significant)
Surface Water Ponds: Morphology	Ponds on Site: Low to Very High Pond outside Site boundary but within study area: Low to Very High	Ponds on Site: Negligible Ponds outside Site boundary: No impact	Ponds on Site: Neutral to Slight (not significant) Ponds outside Site boundary: No impact (not significant)	None required.	Ponds on Site: Neutral to Slight (not significant) Ponds outside Site boundary: No impact (not significant)
Surface Water Ponds: Water Quality	Ponds on Site: Low Pond outside Site boundary but within study area: Low to Very High	Ponds on Site: Negligible Ponds outside Site boundary: No impact	Ponds on Site: Neutral (not significant) Ponds outside Site boundary: No impact (not significant)	None required.	Ponds on Site: Neutral (not significant) Ponds outside Site boundary: No impact (not significant)
Increase in potable water demand	Potable Water Supply: Very High Importance	Negligible	Neutral (not significant)	Northumbrian Water WRMP indicates sufficient resource available. Ongoing consultation with Northumbrian Water.	Neutral (not significant)
Foul water discharge	Unknown waterbody (depends on treatment works used)	Minor adverse	Neutral (not significant)	Consultation to be undertaken with Northumbrian Water.	Neutral (not significant)
Flooding from fluvial sources during operation	Flood Risk: Low to Very High	Negligible	Slight (not significant)	Implementation of the drainage strategy (embedded mitigation)	Slight (not significant)
Flooding from pluvial sources during operation	Flood Risk: Low to Very High	Negligible	Neutral (not significant)	Implementation of the drainage strategy (embedded mitigation)	Neutral (not significant)
Flooding from groundwater sources during operation	Flood Risk: Low	Negligible	Neutral (not significant)	Implementation of the drainage strategy (embedded mitigation)	Neutral (not significant)
Flooding from drainage infrastructure and artificial waterbodies during operation	Flood Risk: Low	Minor	Slight (not significant)	Implementation of the drainage strategy (embedded mitigation)	Slight (not significant)

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