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9.0 SURFACE WATER, FLOOD RISK AND WATER RESOURCES

9.1 Introduction

9.1.1 This chapter of the Preliminary Environmental Information (PEI) Report identifies the potential impacts and effects of the Proposed Development on surface water environment (including inland, transitional, and coastal surface waters), flood risk and water resources. The scope of the assessment includes water quality, water resources, hydro-morphology, flood risk and drainage.

9.1.2 This preliminary assessment has been undertaken in accordance with the following stages (as also described in 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.

9.1.3 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.

9.1.4 The chapter is supported by information presented in the following Figures (PEI Report, Volume II) and Appendices (PEI Report, Volume III):

- Figure 9-1: Surface Water Features and their Attributes;
- Figure 9-2: Groundwater Features and their Attributes;
- Figure 9-3: Fluvial Flood Risk;
- Figure 9-4: Surface Water Flood Risk;
- Appendix 9A: Preliminary Flood Risk Assessment (FRA); and
- Appendix 9B: Nutrient Neutrality Screening Assessment.

9.2 Legislation and Planning Policy Context

9.2.1 This section identifies and describes legislation, planning policy and guidance of relevance to the assessment of the potential impacts on flood risk, water quality and water resources. Legislation, policy and other relevant guidance has been considered on a national and local level.

National Legislation

9.2.2 The following UK legislation is of relevance to the water environment assessment:

- Environment Act 2021 (UK Government, 2021);

- Water Act 2014 (as amended) (UK Government, 2014);
- Floods and Water Management Act 2010 (as amended) (UK Government, 2010);
- Marine and Coastal Access Act 2009 (UK Government, 2009a);
- Land Drainage Act 1991 (UK Government, 1991a);
- Water Resources Act 1991 (UK Government, 1991b);
- Water Industry Act 1991 (UK Government, 1991c);
- Environment Protection Act 1990 (as amended) (UK Government, 1990);
- Salmon and Freshwater Fisheries Act 1975 (as amended) (UK Government, 1975);
- The Water Environment (Water Framework Directive) (England Wales) Regulations 2017 (UK Government, 2017a);
- Environmental Permitting (England and Wales) Regulations 2016 (UK Government, 2016);
- Control of Major Accident Hazards (COMAH) Regulations 2015 (UK Government, 2015a);
- Environmental Damage (Prevention and Remediation) Regulations 2015 (UK Government, 2015b);
- Bathing Water (Amendment) (England) Regulations 2018 (UK Government, 2018);
- Eels (England and Wales) Regulations 2009 (UK Government, 2009b);
- Groundwater (England and Wales) Regulations 2009 (UK Government, 2009c);
- Control of Pollution (Oil Storage) (England) Regulations 2001 (UK Government, 2001);
- Control of Substances Hazardous to Human Health (COSHH) Regulations 2002 (UK Government, 2002);
- Anti-Pollution Works Regulations 1999 (UK Government, 1999); and
- Water Framework Directive Standards and Classifications Directions 2015 (as amended) (UK Government, 2015c).

9.2.3 The Levelling-up and Regeneration Bill (UK Government , 2023)is progressing through the House of Lords at the time of writing (August 2023) and includes provisions for reducing water pollution, including a requirement for water companies to upgrade wastewater treatment works in nutrient neutrality impacted areas.

National Policy Guidance

National Policy Statements

The National Policy Statement for Energy (EN-1) (2011)

9.2.4 The Overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change, 2011a) is relevant to this assessment with the main sections being:

- Section 4.10: Pollution control and other environment regulatory regimes;
- Section 5.7 Flood Risk, Paragraph 5.7.6 states that "*Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England or Zone A in Wales and all proposals for energy projects located in Flood Zones 2 and 3 in England or Zones B and C in Wales should be accompanied by a flood risk assessment (FRA)"*. The minimum requirements for an FRA are listed in Paragraph 5.7.5
- Section 5.15: Water Quality and Resources states 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 provides advice on what an Environmental Statement (ES) should describe including:
  - *"the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges;*
  - *existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies);*
  - *existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and*
  - *any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions".*

The National Policy Statement for Energy (EN-4) (2011)

9.2.5 The NPS for Natural Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011b) is also relevant in that it describes the need for assessment of the water environment, particularly with regard to effects on water resources and water quality, and potential mitigation measures.

The National Policy Statement for Energy (EN-5) (2011)

9.2.6 The NPS for Electricity Networks Infrastructure (EN-5) (Department of Energy and Climate Change, 2011c) makes reference to EN-1 with regard to the policies for mitigating climate change. It indicates that there is a need to determine vulnerability of a proposed development to flooding and to ensure sufficient resilience to the potential effects of flooding within the design of the development.

Revised Draft National Policy Statements

9.2.7 The UK Government is currently reviewing and updating the energy NPSs. It is doing this to reflect its policies and strategic approach for the energy system that is set out in the Energy White Paper (Department for Business, Energy and Industrial Strategy, 2020), and to ensure that the planning policy framework enables the delivery of the infrastructure required for the country's transition to net zero carbon emissions. As part of the NPS review process, the government published a suite of revised draft NPSs for new energy infrastructure on 6 September 2021. A further update was published in March 2023 by the Department for Energy Security & Net Zero (DESNZ). Draft NPSs of relevance include:

- Draft Overarching National Policy Statement for Energy (EN-1) (DESNZ, 2023a),
- Draft NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DESNZ, 2023b); and
- Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (DESNZ, 2023c).

9.2.8 The details of these provisions are, however, subject to consultation and thereafter implementation. The timetable for adoption of the updated NPSs is not known, however it is expected that these will be finalised and shall replace the current NPSs by the time the DCO Application for the Proposed Development is submitted.

9.2.9 Given the importance of these NPSs, the EIA approach takes account of these new emerging documents, whilst any subsequent formal adoption of new NSPs for energy infrastructure will be considered where relevant during the production of the ES. The following summary indicates where the relevant Draft NPS contain requirements that differ from the requirements of the existing NPSs:

- Identifying and securing opportunities to reduce the causes and impacts of flooding overall during the construction period should be included as a minimum requirement for FRA as stated in EN-1 Draft 2023 Section 5.8 Flood Risk, Paragraph 5.8.15;
- Inclusion of changes to the assessment of the existing status due to the impact of climate change on rainfall patterns and consequently water availability across the water environment in EN-1 Draft 2023 Section 5.16 Water Quality and Resources, Paragraph 5.16.13;
- Increased emphasis on early engagement with regulators and consideration of climate change and cumulative effects in EN-1 Draft 2023 Section 5.16 Water Quality and Resources Paragraph 5.16.14;

- EN-2 2021 Section 2.8 Water quality and resources Paragraph 2.8.4: statement regarding the decision making of the Secretary of State specific to water quality and resources as described in EN-1 was not included in the EN-2 Draft 2023 Section 2.6.

UK Marine Policy Statement

9.2.10 The Marine Policy Statement (MPS) (Department for Environment, Food & Rural Affairs (DEFRA), 2011a) is the framework for preparing Marine Plans and taking decisions affecting the marine environment. It establishes a vision for the marine environment, which is for clean, healthy, safe, productive, and biologically diverse oceans and seas. The MPS underpins the process of marine planning, which establishes a framework of economic, social and environmental considerations that will deliver these high-level objectives and ensure the sustainable development of the UK marine area.

9.2.11 The North East Inshore Plan and North East Offshore Marine Plan (DEFRA, 2021a) establishes the plan led system for the marine area in which the riverine parts of the Proposed Development are located. It provides a framework that will shape and inform decisions over how the areas' waters are developed, protected and improved over the next 20 years.

9.2.12 Of particular note is Policy NE-CCUS-2 which indicates that carbon capture, usage and storage proposals incorporating the re-use of existing oil and gas infrastructure will be supported; and Policy NE-WQ-1 which states that proposals that protect, enhance and restore water quality will be supported, and that proposals that cause deterioration of water quality must demonstrate that they will i) avoid, ii) minimise or iii) mitigate (in that order) deterioration of water quality in the marine environment.

The National Planning Policy Framework (2021)

9.2.13 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government (MHCLG), 2012a) was updated in July 2021, 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 "*improving 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 and flood risk - 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, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure (paragraph 153);

- new development should be planned for in ways that: (a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure (paragraph 154);
- inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere (paragraph 159);
- strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards (paragraph 160);
- all plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property (paragraph 161); 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 174).

National Planning Practice Guidance (2021)

9.2.14 The Planning Practice Guidance (PPG) Water Supply, Wastewater, and Water Quality (last updated June 2021), 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.

9.2.15 The NPPF (MHCLG, 2021) and the Flood Risk and Coastal Change NPPG (Department for Communities and Local Government, 2022) 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.

The UK Government's Environmental Improvement Plan 2023

9.2.16 UK Government's Environmental Improvement Plan (EIP23) has been published by Defra as a revision of the 25YEP (see below) and to report on the progress made since 25YEP. One of their goals is to upgrade 160 wastewater treatment works by 2027 and increased advice and incentives to support a shift to sustainable agricultural techniques to mitigate nutrient pollution. They have also set out a goal to restore 400 miles of river through the first round of Landscape Recovery projects and establish 3,000 hectares (ha) of new woodlands along England's rivers. The Tees catchment was not included in the first round of Landscape Recovery Schemes (Burford, 2022). A second round of Landscape Recovery opened in spring 2023 and so details of which river catchments will be part of the scheme is yet to be published (Burford, 2023). Water efficiency labelling will also be rolled out across appliances, and it will be ensured that water companies deliver a 50% reduction in leakages by 2050 (DEFRA, 2023a).

Defra's 25 Year Environment Plan (2018)

9.2.17 In 2018, Defra published the 25 Year Environment Plan (Defra, 2018) (25YEP) 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.

9.2.18 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 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.

The UK Government's Plan for Water: Our Integrated Plan for Delivering Clean and Plentiful Water (2023)

9.2.19 In the plan (DEFRA, 2023b), more investments, tighter regulation and effective enforcement are being made to transform and integrate the water system, address sources of pollution and boost water supply. A few of the key actions include giving the Environment Agency the power to issue bigger penalties for when water

companies pollute, and authorising Ofwat under the new powers in the Environment Act 2021 to link the dividends of water company to their environmental performance.

9.2.20 Besides setting new legally binding targets to significantly reduce pollution from farming, wastewater, and abandoned metal mines, the UK Government have also initiated a significant investment in water infrastructure improvements. Monitoring of storm overflows has also been substantially increased from only 10% in 2015 to over 90% today (DEFRA, 2023b). Further actions are listed within the plan to address multiple sources of pollution impacting water bodies.

9.2.21 With almost £500 million of additional investment in new large-scale water infrastructure, water companies are required to develop plans to meet water demands in a changing climate. Key actions to reduce drought impacts on water reliant business and farmers has also been addressed.

Future Water, The Government's Water Strategy for England (2011)

9.2.22 The Government's Future Water Strategy (Defra, 2011b) 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 (GHG) emissions.

9.2.23 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

9.2.24 Overall, national and local planning policy currently encourages developers to include sustainable 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 to avoid increasing flood risk, but they are also important in reducing the quantities and concentration of diffuse urban pollutants found in the runoff.

9.2.25 Defra published guidance on the use, design and construction of SuDS in 'Non-statutory Technical Standards for SuDS (Defra, 2015).

9.2.26 A review of Schedule 3 of the Flood and Water Management Act 2010 was published by the UK Government in January 2023 and recommended that implementation of Schedule 3 in England. Schedule 3 requires developers to seek approval from a SuDS Approval Body (SAB), who must determine whether the application meets the National Standards. Defra is currently carrying out further work to draft these standards which each SAB will refer to, and these are expected to be published in 2024.

9.2.27 Industry good practice guidance on the planning for and design of SuDS is provided by a range of publications, notably:

- C753 The SuDS Manual (CIRIA, 2015a);
- Design Manual for Roads and Bridges (DMRB) CD532 Vegetated Drainage Systems for Highways Runoff (Highways England, 2020); and
- DMRB CG 501 Design of Highway Drainage Systems (Highways England, 2020).

River Basin Management Plan

9.2.28 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 2022 (the third cycle) and will remain in place until reviewed and updated by 2027. The waterbodies within the water environment Study Area fall under the Tees Management Catchment within the Northumbrian RBMP (Defra, 2022).

Flood Risk Management Plan

9.2.29 Flood Risk Management Plans (FRMPs) are prepared by the Environment Agency for six-year cycles and set out how organisations, stakeholders and communities will work together to achieve the objectives and measures (actions) needed to manage flood risk at a national and local level. The most recent plans were published in 2022 and will remain in place until after 2027. The water environment Study Area is located within the Northumbria River Basin District Flood Risk Management Plan (Environment Agency, 2022).

Local Policy Guidance

Redcar and Cleveland Local Plan (2018)

9.2.30 The Proposed Development Site is located predominantly within the administrative boundary 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's 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.
- 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 FRA. 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 (2019)

9.2.31 The elements of the Proposed Development to the north of the Tees Estuary (i.e. the Natural Gas Connection and CO_2 Gathering Network) are located within the Stockton-on-Tees Borough Council (STBC) administrative area. STBC published a Local Plan in 2019 (STBC, 2019) which outlines the council's 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 FRA 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 proposals 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 run-off 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 run-off 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.
- 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, proposals 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 Northumbrian 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

9.2.32 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 'Sustainable Drainage Systems (SuDS) Guidance: Design Guide and Local Standards' in 2019 (The Tees Valley Authorities, 2019). Volume 1 provides an overview into SuDS techniques and policy requirements. Volume 2 highlights the Tees Valley specific local standards intended to provide clarity to the national standards.

9.2.33 The document strongly promotes the use of SuDS to help manage increased surface water runoff from new developments and help mitigate flood risk. It outlines the minimum standards to ensure a satisfactory scheme is constructed but are not intended to preclude any requirement for a higher standard that may be deemed necessary.

9.2.34 It is stated that when designing and using SuDS, consideration should be given to ensuring that they reduce damage from flooding, improve water quality, protect and improve the environment, protect health and safety and ensure stability and durability of drainage.

9.3 Assessment Methodology and Significance Criteria

9.3.1 This section presents the following:

- the basis of the assessment and the application of the Rochdale Envelope in accordance with the Planning Inspectorate's ('the Inspectorate') Advice Note 9 (The Planning Inspectorate, 2018);
- identification of the information sources that have been used for the assessment;
- summary of consultations;
- assessment methodology;

- an explanation as to how the identification and assessment of water resources and flooding effects has been determined; 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: Proposed Development Site Location Plan (PEI Report, Volume II);
- Appendix 9A: Preliminary Flood Risk Assessment (PEI Report, Volume III).

Study Area

9.3.3 For the purposes of the water quality assessment, a Study Area of approximately 1 km around the Proposed Development Site has been considered 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. The Tees Coastal waterbody is considered the furthest downstream waterbody that could conceivably be impacted.

9.3.4 As flood risk impact can also impact upstream and downstream, the FRA considers 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 Wastewater Treatment Works (WwTW) does not have capacity).

Consultation

9.3.5 The Environment Agency have been contacted for pre-application planning advice, and a response was received on 17th March 2023. A summary of the planning advice relevant to this discipline are outlined in Table 9-1, along with a summary of how the various points will be addressed by the water environment assessment.

9.3.6 An EIA Scoping Opinion was requested from the Inspectorate in April 2023. A response was received on 17th May 2023. The opinions received from the inspectorate, the Environment Agency and Natural England which are relevant to this chapter are summarised in Table 9-1.

9.3.7 A joint workshop with the Environment Agency and Natural England was held on 12th June 2023 within which details of the Proposed Development and the water environment baseline were described, mitigation as defined at this PEI stage was presented, and the approach to the WFD assessment and nutrient neutrality assessments outlined.

Table 9-1: Summary of Environment Agency Pre-application Advice and the Scoping Opinion

CONSULTEE	DATE AND METHOD OF CONSULTATION	CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
Environment Agency	Pre-Application Advice March 2023	Flood Risk: The red line boundary for the full development is located within Flood Zone 3, 2 and 1. The majority of the development site for the Main Site is situated within Flood zone 1. However, small portions of the Main Site are situated within Flood Zone 2 and 3. Parts of the Hydrogen Pipeline Corridor are also within Flood Zone 2 and 3.	Noted. Refer to Figure: 9-3 (PEI Report, Volume II) for fluvial flood risk mapping. The Main Site is wholly within Flood Zone 1. Parts of the Hydrogen Pipeline Corridor are also within Flood Zones 2 and 3.
Environment Agency	Pre-Application Advice March 2023	Flood Risk Vulnerability Classification: No information has been provided on the flood risk vulnerability classification within the provided information. Therefore, we are unable to advise on our policy position in relation to flood risk until the vulnerability of the development has been confirmed by the applicant and/or the local planning authority. It should be noted that 'highly vulnerable' uses, requiring a Hazardous Substance Consent, would not be appropriate within flood zones 3. In accordance with Table 2 of the flood risk and coastal change section of the Planning Practice Guidance (PPG), 'highly vulnerable' developments are not appropriate in flood zone 3 and should not be permitted.	Noted. Flood risk vulnerability is outlined in Appendix 9A: Flood Risk Assessment (PEI Report, Volume III). The Proposed Development comprises an approximately 1.2 GWth Carbon Capture Usage & Storage (CCUS) enabled Hydrogen Production Facility and supporting associated connections. According to NPPF Annex 3 Flood Risk Vulnerability Classification, the Proposed Development is classified as 'Essential Infrastructure'. Essential Infrastructure is defined as 'Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including

CONSULTEE	DATE AND METHOD OF CONSULTATION	CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
			electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood'. The Main Site is wholly in Flood Zone 1.
Environment Agency	Pre-Application Advice March 2023	Sources of Flooding: The main source of potential flooding in the area is from the tidal stretch of the River Tees, but there could be other local sources of flooding such as groundwater and surface water. We have published a suite of interactive maps that indicate where possible flooding from different sources could occur Check the long term flood risk for an area in England - GOV.UK (www.gov.uk). Our maps are not suitable for a detailed Flood Risk Assessment (FRA), but they can indicate where further assessment may be needed.	Noted. These sources have been interrogated during the preparation of the Preliminary FRA (Appendix 9A, PEI Report, Volume III). Further flood risk data and information has also been requested from the Environment Agency and was received in May 2023.
Environment Agency	Pre-Application Advice March 2023	Flood Risk Assessment: We would expect a FRA to be submitted in support of your DCO application. The FRA must assess flood risk from all sources of flooding and recommend the mitigation measures that will be implemented to ensure a safe development in a 1 in 200-year (tidal) flood event, taking account of climate change. It must also demonstrate that flood risk will not be increased elsewhere. Flood risk mitigations will need to be included within the development to ensure it can remain safe for its' lifetime. This includes raising the finished floor levels to the 1 in 200 year plus climate change plus a freeboard of 600mm.	A Preliminary FRA is presented in Appendix 9A (PEI Report, Volume III). This will be updated during the EIA as more information becomes available from the Environment Agency to account for these requirements. Further consultation with the Environment Agency will also be sought as the Proposed Development design progresses.
Environment Agency	Pre-Application Advice March 2023	Flood Risk Information the Environment Agency (EA) holds: We have an outline for a 1 in 200-year level undefended model that can be requested. The modelling we have for this location does not include climate change allowances and therefore	Noted. A request for information was sent to the Environment Agency in March 2023 and a response was

CONSULTEE	DATE AND METHOD OF CONSULTATION	CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		this will need to be calculated in accordance with the 'Flood risk assessments: climate change allowances'. As the development location is at risk from tidal flooding, sea level allowances will need to be applied to the 1 in 200-year level for the lifetime of the development using both higher central and upper end allowances. This applies to both the temporary and permanent works. The extent, speed and depth of flooding shown in the assessment should be used to determine the flood level for flood risk mitigation measures. Where assessment shows flood risk increases steadily and to shallow depths, it is likely to be more appropriate to choose a flood level lower in the range. Where assessment shows flood risk increases sharply due to a 'cliff edge' effect caused by, for example, sudden changes in topography or defences failing or overtopping, it is likely to be more appropriate to choose a flood level higher in the range.	received in May 2023. This has been incorporated into this chapter and its appendices where relevant.
Environment Agency	Pre-Application Advice March 2023	Flood Alleviation Schemes: The Environment Agency are currently in the process of developing flood alleviation schemes which may have an interface with the proposed development. Attached to this letter is the scheme overview for the Greatham North East Flood Alleviation scheme.	Noted, and interfaces with the Greatham North East Flood Alleviation scheme have been considered during the design of the Hydrogen Pipeline Corridor for the Proposed Development.
Environment Agency	Pre-Application Advice March 2023	Flood Risk Consents and Permits: The River Tees is a designated ‘main river’ and under the Environmental Permitting Regulations certain works within 16m of a tidal main river, or within 16m of any flood defence structure on a tidal main river, require a Flood Risk Activity Permit from the Environment Agency. This includes works such as directional drilling under the River Tees. You can find more information on permit requirements using the following link: Flood risk activities: environmental permits - GOV.UK (www.gov.uk). If a permit is required, it must be obtained prior to beginning the works.	Noted. Permits and consents that are expected to be required by the Proposed Development are outlined in Section 9.5 of this Chapter of the PEI Report. The need for an MMO licence is not expected given that there is no requirement for physical works within

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		You may also need a Marine Management Organisation (MMO) license depending on if any works will be undertaken below the mean high water springs (MHWS).	the marine environment (i.e. below MHWST) with trenchless approaches to be used for crossings (e.g. of the Tees estuary and Greatham Creek). If Case 2A and 2B for the Proposed Development are taken forward. then process water effluent may be discharged to Tees Bay but using existing infrastructure and Environmental Permit associated with the NZT development. No new licences would therefore be required. Consultation with the MMO will be undertaken to confirm this during the preparation of the DCO application.
Environment Agency	Pre-Application Advice March 2023	Water Framework Directive (WFD) Assessment: Your development proposal should have regard to the objectives the Water Environment (Water Framework Directive) Regulations 2017, and the Northumbria River Basin Management Plan, which requires the restoration and enhancement of water bodies to prevent deterioration and promote recovery of water bodies. We would expect a WFD assessment to be submitted in support of your DCO application. Your WFD assessment should consider the impact of the proposed development on the WFD status of the receiving water body Tees estuary (GB510302509900) and ensure that there is no deterioration resulting from their activities. Information about the status of the waterbody is available at TEES | Catchment Data Explorer. As well as water quality impacts, your WFD assessment consider impacts to fisheries, ecology, and the marine environment, both from the proposed activity	A WFD Screening and Scoping Assessment will be undertaken and will be issued to the Environment Agency for consultation as to the scope of assessment to be presented in the final WFD Assessment, that will be appended to the ES.

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		once operational and during the construction phase. Any impacts identified need to be minimised and/or mitigated against. These mitigation measures should go above and beyond simply preventing deterioration and should work to create a better environment.	
Environment Agency	Pre-Application Advice March 2023	Construction Environmental Management Plan: A Construction Environmental Management Plan (CEMP) should be submitted in support of your DCO application. With respect to water quality, the CEMP should address the following points: • Treatment and removal of suspended solids from surface water run-off during construction works; • Management of fuel and chemical spills during construction and operation, including the process in place to ensure the environment is not detrimentally impacted in the event of a spill; and • Construction runoff could contain hazardous chemicals and elements due to the site's location. Contaminated land is likely to be present on site, and a scheme would be required to manage the associated risks, and minimise mobilisation of hydrocarbons, heavy metals, and any other hazardous pollutants into the water environment during construction and site operation.	A Framework CEMP will be included in the ES. This will outline mitigation measures based on best practice, to prevent pollution of surface water or groundwater. Further details are given in Section 9.5 of this chapter. The Framework CEMP will be submitted as part of the ES whilst a Final CEMP will be produced and implemented by the appointed contractor post-consent.
Environment Agency	Pre-Application Advice March 2023	Drainage Strategy: In order to determine the water quality impacts, the following information should be submitted as part of your drainage strategy: • How rainwater will be handled and discharged from the site; and • How foul water will be handled and discharged from the site. This should include if the site will be connecting to Northumbrian water's public sewer network.	Noted. Drainage principles for the Proposed Development are outlined in Section 9.5 of this chapter. Further drainage details will accompany the DCO Application, and suitability assessed during the EIA process and reported in the ES.
Environment Agency	Pre-Application Advice March 2023	Reclaimed Water Supply: The applicant seeks to utilise reclaimed water to supply water for the proposed development. However, limited information has been provided on this matter. We recognise that reusing water will provide a substitute	Water supply will be from the River Tees via a connection to the existing

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		for either a new abstraction or increase the utilisation of existing abstractions. This will limit the environmental impact of the proposal and protect the flow regime of sources of supply. We are unable to provide further comments on the opportunities or constraints that could be associated with effluent reuse, as it is assumed that these sources of water are regulated discharges and are therefore controlled under a separate regulatory regime.	Northumbrian Water Limited (NWL) raw water feed.
Environment Agency	Pre-Application Advice March 2023	Discharge of Trade Effluent Effluent discharged from any premises carrying on a trade or industry, and effluent generated by a commercial enterprise where the effluent is different to that which would arise from domestic activities in a normal home is considered to be trade effluent. If you are not able to discharge effluent, it will be classed as waste, and you must then comply with your duty of care responsibilities. Any effluent discharging into the Tees estuary or the adjacent coastal waterbody will need to be assessed as part of the DCO application. This may involve a standalone water quality assessment along with hydrodynamic modelling. Depending on the nature of the discharge, additional chemical or thermal plume modelling may be required. If proposing to discharge to non-mains: If you wish to discharge effluent, after appropriately treating it, to groundwater or surface water a permit under the Environmental Permit Regulations will be required. Full characterisation of the effluent will be required, and modelling may be required at the planning stage to determine the impact of the effluent on the receiving watercourse. A trade effluent consent or a trade effluent agreement with your water and sewerage company (in this case likely to be Northumbrian Water) must be obtained before you discharge trade effluent to a public foul sewer or a private sewer that connects to a public foul sewer.	A provisional and qualitative assessment of effluent discharge is included within this chapter. Further quantitative hydrodynamic dispersion modelling of the effluent discharge to Tees Bay (for Case 2A and Case 2B) is being undertaken and will be reported within the ES. The Environment Agency and Natural England will be consulted further to confirm the modelling scope and review outputs as the modelling work develops. The modelling and associated consultation will be reported within the ES, including a standalone appendix to describe the modelling process and outcomes (for Case 2A and Case 2B).

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Environment Agency	Pre-Application Advice March 2023	Discharge of Clean Water: Clean surface water (i.e., clean, uncontaminated rainwater from hard standing areas such as roads and car parks) can be discharged to a watercourse without a permit if the discharge passes through a maintained oil interceptor or Sustainable Urban Drainage System. If a water attenuation system is proposed it would be beneficial to see the details, methods, and maintenance of the system to ensure longevity and effectiveness.	Noted. Drainage principles for the Proposed Development are outlined in Section 9.5 of this chapter. Further drainage details will accompany the DCO Application, and suitability assessed during the EIA process and reported in the ES.
Environment Agency	Pre-Application Advice March 2023	Construction Dewatering (Discharge): Discharge from temporary excavations can occur if the discharge can meet all of the conditions of the Regulator Position Statement "Temporary dewatering from excavations to surface water". This is available at https://www.gov.uk/government/publications/temporary-dewatering-from-excavations-to-surface-water/temporary-dewatering-from-excavations-to-surface-water). If any discharge cannot meet all the conditions, a Bespoke Environmental Permit would be required, this would follow the same timeline as other water quality permits stated under the discharge of trade effluent section of this response.	Noted. Permits and consents that are expected to be required by the Proposed Development are outlined in Section 9.5 of this chapter.
Environment Agency	Pre-Application Advice March 2023	Water Resources (Abstraction and Impoundment): The proposals may require Water Resource Licences in respect of the construction activities required and the eventual operation of the site. Water Resource (Impoundment and Abstraction) Licences are issued by the Environment Agency under the terms of the Water Resources Act 1991, and the provisions of the Water Resources (Abstraction and Impounding) Regulations 2006. The current estimated time to receive a water resources licence permit is between 6 and 9 months. Therefore, applications should be made at the earliest opportunity.	Noted. Permits and consents that are expected to be required by the Proposed Development are outlined in Section 9.5 of this chapter.
Environment Agency	Pre-Application Advice March 2023	Impounding licence: If you intend to impound a watercourse then you are likely to need an impounding licence from the Environment Agency. An impoundment is any dam, weir or other structure that can raise the water level of a water body	Noted. Permits and consents that are expected to be required by the

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		above its natural level. 'On-line' impoundments hold back water in rivers, stream, wetlands and estuaries, and consequently affect downstream flows, sediment transport and migration of fish. Impoundments could be created through works to modify or change existing watercourses. An Impoundment Licence could also be required if you amend, modify or remove existing in channel structures.	Proposed Development are outlined in Section 9.5 of this chapter.
Environment Agency	Pre-Application Advice March 2023	Construction Dewatering (Abstraction): Dewatering is the removal/abstraction of water (predominantly, but not confined to, groundwater) in order to locally lower water levels near the excavation. This can allow operations to take place, such as mining, quarrying, building, engineering works or other operations, whether underground or on the surface. The dewatering activities on-site could have an impact upon local wells, water supplies and/or nearby watercourses and environmental interests. This activity was previously exempt from requiring an abstraction licence. Since 1 January 2018, most cases of new planned dewatering operations above 20 cubic metres a day will require a water abstraction licence from us prior to the commencement of dewatering activities at the site.	Noted. Permits and consents that are expected to be required by the Proposed Development are outlined in Section 9.5 of this chapter.
Environment Agency	Pre-Application Advice March 2023	Nutrient Neutrality: Nutrient Neutrality applies to developments and discharges in this area. Please ensure liaison with Natural England is undertaken as this issue may have implications on your WFD assessment and technical assessments.	Noted. A Nutrient Neutrality Screening Report is included in Appendix 9B (PEI Report, Volume III). Consultation is being undertaken with Natural England as the Proposed Development design is progressed to ensure that nutrient neutrality is suitably assessed.
The Inspectorate	Scoping Opinion May 2023	Flood Zones. The Scoping Report identifies Flood Zones across the Study Area however does not include sub-categories, such as an area of high probability (Flood Zone 3a) or functional floodplain (Flood Zone 3b). The ES should provide an	Noted. Refer to Figure 9-3: Evaluating Magnitude for Surface Water, Flood Risk and Water Resources, (PEI

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		accurate and consistent description of the baseline flood risk for each element of the Proposed Development and the description should clearly distinguish between Flood Zones, including Flood Zones 3a and 3b where relevant. The Applicant's attention is drawn to the EA's comments in Appendix 2 regarding Flood Zones; the Inspectorate notes that there is a discrepancy between information in the Scoping Report, which identifies that Main Site B is entirely within Flood Zone 1, and the EA's information, which states it is primarily within Flood Zone 1 but partially within Flood Zones 2 and 3. The Flood Zone should be confirmed within the ES and mitigation identified as required.	Report, Volume II) for fluvial flood risk mapping. A further description is provided in the Preliminary FRA (Appendix 9A, PEI Report, Volume III) and summarised in this chapter.
The Inspectorate	Scoping Opinion May 2023	Pollution of surface water courses during operation. The Scoping Report scopes in assessment for this matter during construction and decommissioning. Consideration of the potential for accidental spillages during operation is proposed to be assessed as part of Geology, Hydrogeology and Contaminated Land (paragraph 6.4.88 of the Scoping Report). Cross-reference should be made to the outcome of that assessment in the Surface Water Resources chapter of the ES.	Assessment of pollution to surface watercourses is addressed in this chapter. Refer to Section 9.5 for Development Design and Impact Avoidance and Section 9.6 Likely Impacts and Effects for the impact assessment. Cross-references are made to other chapters where appropriate.
The Inspectorate	Scoping Opinion May 2023	Additional assessments. The Inspectorate notes that a Flood Risk Assessment (FRA), Water Framework Directive (WFD) assessment and nutrient neutrality assessment will be prepared. Information from these assessments should be used to inform preparation of the ES. The Scoping Report describes surface water bodies and groundwater bodies designated under the WFD, which are located close to the Proposed Development. The ES should include an assessment of the likely significant effects to both types of WFD water body. The Applicant's attention is drawn to the EA's comments in regarding scope of the WFD and nutrient neutrality assessments.	Noted. A preliminary impact assessment is presented in this chapter taking into account Appendix 9A: Preliminary FRA, (PEI Report, Volume III) and Nutrient Neutrality Screening Appendix 9B (PEI Report, Volume III). The assessment will be updated as appropriate for the ES when further Proposed Development design details are available.

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The Inspectorate	Scoping Opinion May 2023	Scope of assessment – FRA. The FRA underpinning the ES assessment should additionally cover matters including the effect that temporary mounds of soil in the floodplain could have on flood risk, the volumes of water displacement involved and mitigation measures where necessary. The Applicant's attention is drawn to the EA's comments in Appendix 2 regarding scope of the FRA and climate change allowances.	Noted. Refer to the Appendix 9A: Preliminary FRA (PEI Report, Volume III).
The Inspectorate	Scoping Opinion May 2023	Impacts from frac-out. The ES should include an assessment of likely significant effects arising from frac-out i.e. fracking fluid breakout during HDD works, on aquatic environment receptors and water resource receptors, including consideration of any impacts arising from clean-up works.	Noted. Impacts from frac-out have been considered. Refer to Section 9.5 for Development Design and Impact Avoidance and Section 9.6 Likely Impacts and Effects for the impact assessment.
The Inspectorate	Scoping Opinion May 2023	Scope of assessment. The ES should assess the potential for an increase in offsite flood risk arising from any proposed ground raising within the development boundary, including the pipeline corridors. Effort should be made to agree the scope of the assessment, including the requirement for flood modelling, with the EA. The ES should identify any mitigation required to address likely significant effects.	Noted, refer to Appendix 9A: Preliminary FRA (PEI Report, Volume III). Flood risk effects (including offsite flood risk) are summarised in this chapter.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Offsite Flood Risk. If ground raising is occurring within part of the development boundary, and the existing ground levels are below the design flood event, then an assessment will be required to confirm no increase in offsite flood risk. Given current topographical levels of the Main Site and if ground raising is significant which is below the design flood event, then flood modelling should be undertaken. If the pipeline is causing any ground raising or is above ground which could impact local flood mechanisms, an assessment will be required to understand any increase in offsite flood risk and provide mitigation measures, this assessment could include modelling.	Noted – refer to Appendix 9A: Preliminary FRA (PEI Report, Volume III). Flood risk effects (including offsite flood risk) are summarised in this chapter. Continued consultation with the Environment Agency will be maintained should modelling be required during the EIA.

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Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Hydrogen Pipeline Corridor. The proposed hydrogen pipeline corridor heading north towards the Venator Plant, could affect our flood defence assets along Greatham Creek and the EA's land holding at Marsh House Farm. In addition, all three routes (labelled R1, R2 and R3 on a document previously supplied to the EA ('All Utility Connection Corridor, Figure 1') could have a significant impact on Greatham Creek and its associated saltmarsh habitat – the last remaining natural area of the original Tees Estuary. In particular, R2 and R3 in particular are of significant concern to the EA. R2 runs along the line of one of our major flood defences at Cowpen Marsh. The defence lies between the Cowpen Bewley Landfill (to the West) and the Teesmouth and Cleveland Coast Special Protection Area (SPA) (to the East). As such, any work along this corridor could impact one the three current land uses. To the north of Greatham Creek, R2 then runs through Saltern Wetlands (an area of saltmarsh owned by the EA) and under the EA's flood embankment to the south of the ConocoPhillips tank farm. The EA has concerns that this route will have an impact on the wetland area, which lies within the SPA, and flood defences. R1 crosses the no. 4 brinefield (owned by Sabic and used for hydrocarbon storage), and under the flood embankment on the south bank of Greatham Creek (Sabic Embankment). It also lies under the flood embankment on the north bank of Greatham Creek, which is to be significantly repaired as part of EA's Greatham North East Flood Alleviation Scheme (FAS). This route also crosses the redundant no. 5 brinefield (owned by Inovyn Chlorvinyl Ltd) and the ConocoPhillips oil pipeline corridor and Seal Sands Emergency Access Road. R3 crosses our land at Marsh House Farm to be used for the extraction of clay in 2024-2026 for our Greatham NE FAS. The EA is also developing a scheme (Greatham North East FAS) to improve the defences to the south of the Venator Plant. We expect to submit an application for planning permission in Spring 2024 and hope to start construction of the scheme in summer 2024. We are currently	Noted, interfaces with the Greatham Creek flood alleviation scheme have been taken into account during determining the route of the Hydrogen Pipeline Corridor. Impacts on flood defences are considered in Appendix 9A: Preliminary FRA (PEI Report, Volume III). Continued consultation with the Environment Agency will be maintained to ensure there are no impacts to flood defence assets. Potential impacts and effects to habitats are considered in Chapter 12: Ecology and Nature Conservation (including Aquatic Ecology) (PEI Report, Volume I). Impacts on surface waterbodies and groundwater bodies related to the pipelines are considered in this chapter.

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		seeking contributions from beneficiaries of the scheme. As the proposed pipeline could benefit from our works, we would welcome discussions with the applicant on the potential for financial contributions from DCO, if R1 is chosen as the preferred route.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Pipelines. The EA would require the existing flood standard of protection, provided by the defences to be maintained both during the construction of the pipeline, and after completion of the scheme, whichever route is chosen. In order minimise the impact of the DCO on our flood defences, consideration should be given to the following comments: Pipeline Design • Where the pipeline crosses a flood defence structure below ground, designs for the pipeline must include a load case for the top water level. This may be different at each location. The pipeline must also be at a suitable depth to ensure the stability of the flood defence structure, this is to be demonstrated in submitted designs; • The scoping report states the pipeline will not cross our flood defence structure above ground. If this is to change, loading to our asset will need to be considered and the design must not impede access for routine maintenance and inspections of the flood defence structure; • If the pipeline crosses a watercourse above ground, it must be appropriately designed and positioned to prevent accumulation of debris and localised increases in water levels; • Where the pipeline is to utilise existing pipework that crosses watercourses, it is expected that modifications to the structure will be made where possible for improved conveyance and reduce debris accumulation; and	Noted. These considerations will be taken into account during Proposed Development design development. Full details regarding pipeline design are being developed, and so worst-case assumptions have been considered in this chapter.

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		• Where ground levels near a flood defence are to be disturbed on either a permanent or temporary basis, designs must not allow additional water to pond at the toe of the flood defence.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Pipeline Construction. • Open trench methodology is not permitted when crossing a flood defence. Excavations near the footprint of a flood defence must remain a safe distance away from the toe of the defence to ensure stability of the defence. This must be demonstrated in submitted designs; and • Directional drilling would be permitted when crossing a flood defence provided: - The drilling operation does not affect the stability of the flood defence structure by inducing a geotechnical failure, including when it is retaining flood water; and - The drilling or permanent works do not provide a conduit for water seepage underneath the flood defence structure, including when it is retaining flood water.	Noted. These considerations will be taken into account during ongoing Proposed Development design.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Pipeline Maintenance. • Repairs or future improvement works will be subject to an Environmental Permit from the EA if taking place within 16 m of a flood defence; and • Routine maintenance activities on the pipeline should be detailed within the DCO application.	Noted. Information regarding maintenance activities pertaining to pipelines will be included during the EIA and reported in the ES.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice	Flood Defence Maintenance. In order to maintain the standard of protection, the EA requires continued access to continue routine maintenance of the existing and planned defences. Any permissions or legal agreements to allow these works to go	Noted. Environment Agency access will be incorporated as necessary.

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	responses outlined above)	ahead, must be agreed in advance of pipeline construction. It should be noted that the EA have statutory powers to carry out works on our assets.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Drinking Water Protected Areas. The scoping report states there are no drinking water protected areas within 1 km (or in Section 6.3.8, 15km) of the proposed development area. In terms of groundwater, all groundwater bodies in England are designated as drinking water protected areas. As such, the development area sits upon a groundwater drinking protected area.	Noted. Clarified within this chapter that this refers to drinking protected areas for surface water.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Drainage. In terms of SUDs, we would recommend that there is no increase in infiltration within the development area. This is to avoid the risk of contaminant mobilisation given the industrial heritage of the area. This ties into section 6.4.88 where the scope of assessment includes 'disturbance of contaminated soils and perched groundwater, and the creation of new pathways to sensitive receptors (including construction workers and controlled waters) during construction.	Surface water drainage is proposed to be discharged to Tees Bay following treatment and so there would be no increase in infiltration. Drainage principles for the Proposed Development are outlined in Section 9.5 of this chapter. Further drainage details will accompany the DCO Application, and suitability assessed during the EIA and reported in the ES.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	The Water Environment (Water Framework Directive) (WFD) Regulations. The applicant should provide an assessment of the impact of the proposal on water quality in respect to the following waterbodies: • Tees (GB510302509900) • Tees Coastal (GB650301500005) • Tees Estuary (South Bank) GB103025072320)	A WFD Assessment will be presented in the ES. This will include potential for impacts relating to pipeline corridors.

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		The WFD assessment will need to have regard to the Water Environment Regulations (WER) / WFD, and the Northumbria River Basin Management Plan (NRBMP). The applicant should ensure that: • The pipeline corridors do not add to the physical modification of the water environment unless equivalent appropriate mitigation measures are put in place; and • Pipeline corridor routes and excavations should as far as practicably minimise or avoid the crossing of watercourses, and not run proximate and parallel to watercourses. In particular, pipeline corridors should not be situated so as to jeopardise the potential for restoration of intertidal and riverine habitats that support the recovery of the Teesmouth and Cleveland Coast SPA. Preferably pipeline corridors should follow existing physical modifications such as road infrastructure or existing pipeline corridors.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Nutrient Neutrality. For clarification of the statement at 6.3.9, the Teesmouth and Cleveland Coast SPA is within the Tees catchment where future development must be nutrient neutral to ensure no deterioration in WER (WFD) Dissolved Inorganic Nitrogen (DIN) element status. Reductions below the current baseline are required to achieve the protected area objectives. Similarly, the undertaking at 6.3.36 to carry out a Nutrient Neutrality Screening Assessment to assess likely impact on achievement of the targets for the WFD DIN element is acknowledged and supported. This should include the potential impact from emissions to air.	Noted. A Nutrient Neutrality Screening Report is included in Appendix 9B (PEI Report, Volume III). Consultation will continue with Natural England as the Proposed Development design is progressed to ensure that nutrient neutrality is suitably assessed.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-	Baseline conditions. The Scoping Report identifies in section 2.2 that large areas of the proposed development site was historically intertidal habitat within the Tees estuary. The progressive infilling of the estuary, port development and subsequent flood protection modifications have contributed to the Tees estuary waterbody	A freedom of information request has been sent to the Environment Agency to obtain additional information regarding WFD mitigation measures.

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	application advice responses outlined above)	being designated as a Heavily Modified Waterbody (HMWB) under WFD. In order to achieve the overarching WFD objective of Good Ecological Potential (GEP) in HMWBs, mitigation measures must be taken to address the ongoing ecological impacts of such modifications and prevent deterioration on this baseline. A Mitigation Measures Assessment has been undertaken and various information on appropriate mitigation measures is available. However, the limitations of the Catchment Data Explorer portal are such that this information cannot currently be provided through that platform.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Future baseline. The Tees estuary is undergoing a period of ecological recovery after decades of industrial and sewage pollution. The future ecological baseline conditions are likely to be an improvement on the current conditions because of interventions already completed. Future baseline conditions will also be influenced by imminent legislation (Levelling Up Bill) and regulatory requirements (Water Company Price Review) that are likely to require significant reductions in the level of nutrients within the Tees estuary and within the timeframe of the proposed development. The area is also already subject to nutrient neutrality advice that aims to ensure no deterioration of current environmental conditions. The WFD assessment should therefore take account of such future baseline conditions.	The assessment presented in this chapter. A WFD Assessment will be provided in the ES.
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	Foul drainage. We would expect to see the following points to be addressed within the DCO application: • Confirmation of which sewage treatment works will receive the foul flows. • Confirmation that there is sufficient capacity in the receiving Northumbrian Water network to accept the flows without increasing storm overflow spills. • Confirmation that there is sufficient capacity at the receiving sewage treatment works (STW) to accept the flows while still operating within the permitted flow and quality limits.	Noted. Foul drainage will be discharged to Marske-by-the-Sea WwTW. Further engagement will be undertaken with NWL to confirm this arrangement and that there is sufficient capacity.

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		• The applicant will need to produce their own WFD assessment to demonstrate the impact of the proposed development on the receiving watercourse. • If there is insufficient capacity within the network or at the STW, details of an appropriate phasing approach for the development to enable the necessary upgrades to the sewage network before connecting the development should be provided.	
Environment Agency	Scoping Opinion May 2023 (only included where different or additional to the pre-application advice responses outlined above)	EA and Partner Projects. The EA and partners are bringing forward a programme of projects designed to mitigate the ongoing ecological impact of historical physical modifications on the Tees estuary and tributaries. The current Programme is scheduled to be completed by the commissioning date of the proposed development. The DCO should not jeopardise attainment of these WFD mitigation measures. Therefore, the developer may wish to support these projects so as to demonstrate appropriate mitigation of any impacts, or to secure betterment of the local environment: • The Tees Tidelands Programme is led by the EA and Stockton-on-Tees Borough Council, and consists of a number of projects that aim to restore intertidal habitats and ecologically reconnect the Tees estuary to tributaries. • The EA Seal Sands SSSI restoration project is initially focusing on building a Tees estuary baseline hydraulic model, but in the future also seeks to identify the prioritised physical interventions to manage excess growth of macroalgae. • The Tees Rivers Trust (TRT) are undertaking a Tees Estuary Edges project to install a suite of bio-engineered designs that enhance ecology in the highly modified Tees navigation channel. • TRT are also undertaking species (oyster, seagrass, mussel) reintroduction projects at locations within Tees Bay and the estuary. • The Canal and River Trust (CRT) are developing designs to secure enhanced fish passage across the Tees Barrage and so throughout the Tees catchment.	Noted. These projects are incorporated into the baseline presented in this chapter and any potential impacts on these considered where necessary in the assessment in this chapter.

CONSULTEE	DATE AND METHOD OF CONSULTATION	CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
Natural England	Scoping Opinion May 2023	Nutrient Neutrality. Natural England's Nutrient Neutrality advice is that new developments should not result in additional nitrogen entering the catchment of the River Tees upstream of the Teesmouth & Cleveland Coast SPA and Ramsar site (i.e. they are nutrient neutral). This advice applies primarily to development involving overnight accommodation i.e. it focuses on additional volumes of treated wastewater arising as a result of new house building. However in order to restore the SPA to favourable condition the wider effects of nutrient inputs into the Tees hydrological catchment are also relevant. As a result we note and welcome the applicant's recognition of the nutrient pollution theme (paragraphs 6.3.35-37). The Habitats Regulations Assessment (HRA) process provides the means to assess the proposal and we acknowledge paragraphs 6.6.27-31 accordingly. Natural England looks forward to continued dialogue with the applicant to progress this element of the proposal.	Noted. A Nutrient Neutrality Screening Report is included in Appendix 9B (PEI Report, Volume III). Consultation will continue with Natural England as the Proposed Development design is progressed to ensure that nutrient neutrality is suitably assessed.

9.3.8 A freedom of information request was issued to the Environment Agency in March 2023 to receive the latest baseline information relating to water resources, flood risk and WFD waterbodies. A response had not been received at the time of writing in May 2023. Any data subsequently received will be included in the baseline in the ES.

Impact Assessment Methodology

Desk Study

9.3.9 Desk based research has been undertaken to identify the waterbodies within and adjacent to the Proposed Development Site and defined Study Area, 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.

9.3.10 In summary, the key background reports, websites and data used include the following (all web sources last accessed in January 2023):

- RCBC's Local Plan (2018) (RCBC, 2018);
- STBC's Local Plan (2019) (STBC, 2019);
- British Geological Survey Geological Mapping Viewer, 'GeoIndex' (British Geological Society (BGS), (British Geological Survey , 2023);
- Environment Agency Catchment Data Explorer (Environment Agency, 2023a);
- Environment Agency Flood Risk Maps (Environment Agency, 2023b);
- Environment Agency Bathing Water Quality website (Environment Agency, 2023c);
- Environment Agency Ecology and Fish Data Explorer (Environment Agency, 2021);
- Environment Agency Guidance on discharges to surface water and groundwater: environmental permits (Environment Agency, 2016);
- DEFRA Hydrology Data Explorer website (DEFRA, 2021b);
- Environment Agency Water Quality Archive website (Environment Agency, 2023d);
- Centre for Ecology and Hydrology (CEH)'s National River Flow Archive (CEH, 2021);
- Cranfield University 'Soilscapes' (Cranfield University, n.d.);
- Met Office Climate averages data (Met Office, n.d.);
- Defra Multi-Agency Geographic Information for the Countryside (MAGiC) website (Defra, 2023);
- Ordnance Survey (OS) maps and aerial photography (Bing, 2023);
- 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;

- Data requested from the Environment Agency with regard to fluvial and tidal flood risk, flood defences, flood water levels derived from hydraulic modelling studies and climate change allowances; and
- Information available in previous planning applications relating to Tees Estuary and Tees Bay – Net Zero Teesside (EN010103); 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

9.3.11 A walkover survey was undertaken on 15th February 2023 by a surface water quality specialist and hydromorphologist in cold, dry and fair conditions. The walkover focused on surface water features 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.

9.3.12 A programme of water quality monitoring was undertaken of a single pond (known as 'Pond 14' within Coatham Dunes) between January 2023 and March 2023, to provide an update to previous monitoring undertaken for the Net Zero Teeside (NZT) project, as previously outlined in the Scoping Report. Monitoring was required for this pond as this is the only permanently open water pond in the adjacent sand dunes and was previously identified as being potentially susceptible to adverse water quality impacts related to atmospheric nitrogen deposition. More detail is provided later in this chapter. The results of this monitoring are summarised in Section 9.4.

Source-Pathway-Receptor Approach

9.3.13 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 feature);
- a receptor that is sensitive to that impact (i.e. water feature and the services they support); and
- a pathway or pathways by which the two are linked.

9.3.14 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 of impact have been identified through a review of the details of the Proposed Development as currently known, including the size and nature of the development, potential construction methodologies and timescales.

9.3.15 The next step in the model is to undertake a review of the potential receptors, that is, the water environment receptors in the Study Area that have the potential to be

affected. Water features including their attributes have been identified through desk study and site surveys.

9.3.16 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).

9.3.17 The assessment of the likely significant effects is qualitative, and considers construction, operational and decommissioning phases of the Proposed Development, as well as cumulative effects with other developments. This assessment considers the risk of pollution to surface water features directly and indirectly from construction, operational and decommissioning activities, particularly in relation to those water features which are within or close to the Proposed Development 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 Proposed Development design, as applicable. Where other elements of the Proposed Development may be subject to consent under separate planning applications (e.g., any new pipework or outfalls that may be required for surface water discharge to Dabholm Gut), these would also be considered within the cumulative assessment.

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

Assessment of Surface Water Runoff for the Operational Phase

9.3.19 Surface water runoff from development sites of this type may contain pollutants derived from urban surfaces (e.g., inert particulates, litter, hydrocarbons, metals, nutrients and de-icing salts). This 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. There is not considered to be an appreciably greater risk of such pollution from the Proposed Development in comparison to the existing site, nonetheless, an assessment is needed to determine the potential risk to receiving watercourses and to inform the development of suitable treatment measures. There is an opportunity to provide betterment over the existing scenario using SuDS for water quality treatment.

9.3.20 The appropriateness of the surface water drainage measures in terms of providing adequate treatment of diffuse urban pollutants will be 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.

9.3.21 The SuDS Manual (CIRIA, 2015a) only provides a limited number of land use types and so those chosen will be land uses that best reflect 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. For areas where site specific industrial activities may take place or there is a greater risk of a chemical spillage, a process specific risk qualitative assessment will need to be undertaken.

9.3.22 At this stage, a Vent and Drain Philosophy and Surface Water Drainage Plan has been prepared for the Proposed Development and forms the basis of a high-level qualitative assessment for the purposes of the preliminary assessment. SuDS treatment trains remain under development and so the full runoff assessment that utilises the SuDS Manual Simple Index Approach will be included in the ES.

Water Framework Directive Screening and Scoping Assessment

9.3.23 Proposed developments having the potential to impact current or predicted WFD status are required to assess their compliance against the objectives defined for potentially affected water bodies. As part of its role, the Environment Agency must consider whether proposals for new developments have the potential to:

- cause a deterioration of a water body from its current status or potential; and/or
- prevent future attainment of Good status (or potential where not already achieved).

9.3.24 The following guidance on how to undertake WFD assessments has been used and will inform a Water Framework Directive Screening Assessment that will be included in the ES:

- Environment Agency Advice Note – Water Framework Directive Risk Assessment: How to Assess the Risk of Your Activity (Environment Agency, 2016);
- Environment Agency Guidance - Water Framework Directive Assessment: Estuarine and Coastal Waters (Clearing the Waters for All) (Environment Agency, 2017); and
- The Planning Inspectorate Advice Note 18: The Water Framework Directive (The Inspectorate, 2017).

9.3.25 WFD assessments should be undertaken in three stages. The first stage is ‘screening’, the aim of which is to identify the Proposed Development components that could affect WFD status and ‘screen out’ aspects of the project that do not require any further consideration. The second stage is ‘scoping’, whereby WFD receptors that are potentially at risk are identified and it is determined how the risk will be assessed.

Finally, and if required, the third stage involves a full impact assessment, including consideration of the criteria for derogation (if one is expected to be required) as outlined in Regulation 19 of The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

9.3.26 A WFD Screening and Scoping assessment for the Proposed Development will be undertaken and will be issued to the Environment Agency for consultation. Where required, further impact assessment stages will also be undertaken and included within the ES as appropriate.

Nutrient Neutrality Assessment

9.3.27 Natural England has identified the Teesmouth and Cleveland Coast SPA as a site that is impacted by excess nutrients. In particular, the Seal Sands area is known to be adversely impacted; excessive growth of algal mats is impacting feeding opportunities for the bird populations that the SPA is designated for. Any development in the catchment of the SPA that may lead to an increase in the nitrogen emissions into the designated site must be supported by a robust nutrient neutrality assessment.

9.3.28 A Nutrient Neutrality Screening Assessment is included in Appendix 9B (PEI Report, Volume III). The screening identifies all possible sources of nitrogen from the Proposed Development (including atmospheric deposition, changes in discharges from local WwTW and direct treated effluent discharges) and considers (1) whether this is a new source or fundamentally already part of the catchments nutrient baseline; and (2) whether there is a pathway to the SPA. Where there is scope to reduce nutrient emissions compared to baseline from the Proposed Development Site, this will also be considered. Natural England will be consulted on the outcome of the assessment during which the scope for further assessment will be agreed and included during the EIA and reported in the ES.

Discharge Modelling: Assessment of Process Water discharge

9.3.29 Case 2A and Case 2B of the Proposed Development (described further later in the chapter) would discharge treated process water effluent to Tees Bay. Hydrodynamic dispersal modelling of discharges to Tees Bay, will be undertaken during the EIA to assess potential impacts on the qualifying features of the Teesmouth and Cleveland Coast SPA/Ramsar and the potential for effluent to disperse into the Tees Estuary e.g., by tidal effects.

9.3.30 Due to the Teesmouth and Cleveland Coast SPA/Ramsar being affected by nutrient neutrality with regards to nitrogen, and the fact that Tees estuary is failing to achieve Good WFD status for dissolved inorganic nitrogen (DIN), there will be a particular focus on modelling dispersal of nitrogen (in all of its forms), and this will inform the nutrient neutrality and WFD assessments described above, as well as the Habitats Regulation Assessment.

9.3.31 Consultation on the scope of the water dispersion modelling with the Environment Agency and Natural England will continue during the EIA. The results of the modelling will be reported in the ES.

Flood Risk Assessment

9.3.32 A Site-wide Preliminary Flood Risk Assessment (FRA) is provided as Appendix 9A (PEI Report, Volume III), which, based on information received to date, assesses the current risk of flooding from all sources including fluvial, surface water, groundwater, tidal, artificial sources and drainage infrastructure. The Preliminary FRA includes a full description of the flood risk baseline, which is also summarised in Section 9.4. This will be reviewed and updated during the EIA once further data has been received from the Environment Agency.

Classification of Effects and Significance Criteria for EIA Assessment

9.3.33 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.

9.3.34 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.

9.3.35 Approaches to mitigating potential impacts during the construction, operational and decommissioning phases of the Proposed Development have been described with reference to good practice guidance and design.

9.3.36 Following the DMRB LA 113 (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.

9.3.37 Whilst other disciplines may consider ‘receptor sensitivity’, ‘receptor importance’ is considered herein. 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 feature. 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[1]

IMPORTANCE	GENERAL CRITERIA	SURFACE WATER	GROUNDWATER	MORPHOLOGY[2]	FLOOD RISK
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.	Watercourse having a WFD classification shown in a RBMP and Q95≥1.0 m^3/s. Sites protected/designated under an EC or UK legislation (SAC, SPA, SSSI, Ramsar, salmonid water) / Species protected by EC legislation Ecology and Nature Conservation.	Source Protection Zone (SPZ) 1; Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation; Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems (GWDTE); Water abstraction: >1,000 m^3/day	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. Very high risk from non-fluvial/non-tidal flood sources.
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.	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.	Principal Aquifer providing locally important source supporting river ecosystem; SPZ2; Groundwater supports GWDTE; Water abstraction: 500–1,000 m^3/day.	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. High risk from non-fluvial/non-tidal flood sources.

IMPORTANCE	GENERAL CRITERIA	SURFACE WATER	GROUNDWATER	MORPHOLOGY[2]	FLOOD RISK
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value or is of regional importance.	Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s.	Secondary Aquifer providing water for agricultural or industrial use with limited connection to surface water SPZ 3; Water abstraction: 50–499 m^3/day.	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. Medium risk from non-fluvial/non-tidal flood sources.
Low	The receptor is tolerant of change without detriment to its character, is low environmental value, or local importance.	Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m^3/s.	Generally Unproductive strata. Water abstraction: <50 m^3/day	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	Water compatible development. Low risk from non-fluvial/non-tidal flood sources

IMPORTANCE	GENERAL CRITERIA	SURFACE WATER	GROUNDWATER	MORPHOLOGY[2]	FLOOD RISK
				protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.	

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 another major infrastructure 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.

9.3.38 The magnitude of impact has been determined based on the criteria in Table 9-3 considering the likelihood of the impact occurring. The likelihood of an impact occurring is based on a scale of certain, likely, or unlikely.

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	Surface Water: 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 Groundwater: Loss of, or extensive change to, an aquifer. Loss of regionally important water supply. Loss of, or extensive change to groundwater dependent terrestrial ecosystem (GWDTE) or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification. Loss or significant damage to major structures through subsidence or similar effects. Flood Risk: Increase in peak flood level (>100mm). Change in flood risk to receptor from low or medium to high; Permanent adverse effect on local drainage system and subsequent capacity implications.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface Water: 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. Groundwater: Partial loss or change to an aquifer. Degradation or regionally important public water supply or loss of significant commercial/industrial/agricultural supplies. Partial loss of the integrity of GWDTE.

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		Contribution to reduction in water body WFD classification. Damage to major structures through subsidence or similar effects or loss of minor structures. Flood Risk: Increase in peak flood level (>50 mm). Change in flood risk to receptor from low to medium; Severe temporary adverse effect on local drainage system and subsequent capacity issues
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability	Surface Water: Minor effects of water supplies. Groundwater: Minor effects on an aquifer, GWDTEs, abstractions and structures. Flood Risk: Increase in peak flood level (>10mm). Change in flood risk to receptor from no risk to low risk; Minor effect on local drainage system and subsequent capacity issues
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	Surface Water / Groundwater: No risk identified to surface water quality or hydro-morphology. The proposed project is unlikely to affect the integrity of the water environment. Flood Risk: Negligible change in peak flood level (≤+/- 10 mm). No change in flood risk to the receptor; Negligible change on local drainage system
Minor Beneficial	Results in some beneficial impact on attribute or a reduced risk of negative effect occurring	Surface Water: Contribution to minor improvement in water quality, but insufficient to raise WFD classification.

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		Groundwater: Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding. Flood Risk: Creation of flood storage and decrease in peak flood level (>10 mm) Change in flood risk to receptor from low risk to no risk; Minor reduction in surface water run-off and subsequently the impact on the local drainage system.
Moderate Beneficial	Results in moderate improvement of attribute quality	Surface Water: Contribution to improvement in waterbody WFD classification. Groundwater: Contribution to improvement in water body WFD classification. Improvement in water body catchment abstraction management strategy (CAMS) (or equivalent) classification. Support to significant improvements in damaged GWDTE. Flood Risk: Creation of flood storage and decrease in peak flood level (>50 mm) Change in flood risk to receptor from medium to low Moderate reduction in surface water run-off and subsequently the impact on the local drainage system.
Major Beneficial	Results in major improvement of attribute quality	Surface Water: Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse. Improvement in water body WFD classification. Groundwater: Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer.

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		Improvement in water body WFD classification. Flood Risk: Creation of flood storage and decrease in peak flood level (>100 mm) Change in flood risk to receptor from high to medium or low Major reduction in surface water run-off and subsequently the impact on the local drainage system.

Classification and Significance of Effect

9.3.39 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. 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 ATTRIBUTES			
	LOW	MEDIUM	HIGH	VERY HIGH
No change	Neutral	Neutral	Neutral	Neutral
Negligible	Neutral / Slight	Neutral / Slight	Slight	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

9.3.40 The following significance categories have been used for both potential and residual effects:

- Negligible: an imperceptible effect or no effect to a water resource receptor;
- Beneficial: a beneficial/positive effect on the quality of a water resource receptor; or
- Adverse: a detrimental/negative effect on the quality of a water resources receptor.

9.3.41 In the context of this assessment, an effect can be temporary or permanent, with effects quantified temporally as being short-term (0–5 years), medium-term (6–10 years) and long-term (>10 years).

9.3.42 At a spatial level, 'local' effects are those affecting the Proposed Development Site and neighbouring receptors, while effects upon receptors beyond the vicinity of the Proposed Development Site are considered to be at a 'regional' level. Effects which affect different parts of the country, or England as a whole, are considered being at a 'national' level.

Rochdale Envelope

9.3.43 In order to ensure a robust assessment of the likely significance of the environmental effects of the Proposed Development, the EIA is being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate in line with The Planning Inspectorate's Advice Note 9 (The Planning Inspectorate, 2018). This involves assessing the maximum (or where relevant, minimum)/worst case parameters for the elements where flexibility needs to be retained (building dimensions or operational modes for example)

9.3.44 The following are the reasonable worst case scenario assumptions (maximum parameters) for the purposes of the water environment assessment:

- It is assumed that during Proposed Development 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 in Section 9.5.
- Water is to be supplied to the Proposed Development via the existing Northumbrian Water Limited's (NWL's) raw water pipeline feed from the River Tees. The abstraction flow rate would be 176 m^3/hr for Case 1A and 2A and 182 m^3/hr for Case 1B and 2B. Treatment is required to the supplied water to produce the desired water quality for utility water/cooling water make-up, firewater and for producing demineralised water.
- It is assumed for the purposes of the assessment, that Northumbrian Water's existing abstraction or discharge licences can be used to accommodate the Proposed Development. It is assumed that any alterations required to the consents would be assessed and applied for by Northumbrian Water as appropriate. However, this will be confirmed in the ES.
- Case 1A and 1B for the Proposed Development are based on Minimalised Liquid Discharge (MLD) from the Effluent Treatment Plant. In this scenario treated wastewater from the Effluent Treatment Plant will be reused as makeup water in the Water Treatment Plant. A liquid waste stream (concentrate sludge / waste) containing salts and nutrients would be taken offsite for further treatment at a rate of 5.2 m^3/hr for Case 1A and 3.3 m^3/hr for Case 1B. The offsite treatment location has yet to be confirmed but will be outside of the Teesmouth and

Cleveland Coast SPA/Ramsar site catchment and thus will avoid any implications in terms of nutrient neutrality.

- Case 2A and 2B would require discharge of treated process water effluent to Tees Bay via the neighbouring NZT project outfall. The process water discharge rate would be 104.6 m^3/hr for Case 2A and 65.1 m^3/hr for Case 2B. At the time of writing (August 2023) it has not been decided which option will be taken forward. However, discharge of process wastewater under Case 2A and Case 2B to Tees Bay via the NZT outfall is considered the worst case, given greater potential for impacts to the water environment than Case 1A and Case 1B.
- Should the option to discharge wastewater to the NZT outfall at Tees Bay be taken forward, then it is assumed that the wastewater discharge will meet the requirements of the Best Available Techniques (BAT) Reference Document (BREF) for Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector 2016 (EC JRC, 2016). The discharge would also be required to meet the standards outlined within the discharge permit. Consultation with the Environment Agency will be undertaken to discuss the scope of hydrodynamic dispersion modelling for the discharge to the Tees Bay outfall. Modelling results will be included in the ES.
- This assessment assumes that should the Tees Bay outfall associated with the NZT project be utilised by the Proposed Development, that it will be unchanged from the design assessed for NZT for which no significant morphological effects to the Tees Bay waterbody were identified (bp, 2021), and thus no assessment has been included herein regarding installation of the outfall.
- Amines will be appropriately bunded and accidental spills will be cleaned and go to a separate closed drainage system. From here, it would be recovered and recycled for use within the process, or otherwise taken off-site by tanker to a specialist treatment plant.
- The surface water drainage strategy for the Proposed Development remains under development at the time of writing (August 2023). However, surface water drainage will discharge to Tees Estuary via Dabholm Gut or Tees Bay. There are three options for this route: 1) direct feed to Dabholm Gut (with any new pipework and outfall to be consented under a subsequent planning application); 2) discharge via the existing Bran Sands discharge pipeline (but not requiring treatment at Brans Sands WwTW as this is surface water runoff); or 3) discharge via the NZT outfall. It is assumed that SuDS or bypass oil separators will be used (as a minimum) to provide treatment for surface water runoff prior to discharge from the Proposed Development Site. It is also assumed that penstocks will be provided to isolate any accidental spillages or fire water on the Proposed Development Site that enter the surface water drainage system or process water system, so that they can be disposed of accordingly.
- It is assumed that all liquid chemicals stored within the operational Proposed Development Site will be kept in bunded, controlled areas with a volume of 110% of storage capacity.

- It is assumed that water discharged from the Proposed Development Site will be limited to the greenfield runoff rate, and that water storage (e.g. within an attenuation pond) is appropriately sized to accommodate the 1% Annual Exceedance Probability (AEP) event with 40% allowance for climate change.
- Foul water will be treated at NWL's Marske-by-the-Sea WwTW. It is assumed given the relatively low volumes of foul effluent anticipated from the Proposed Development that NWL will treat this within their consent limits and in accordance with requirements to not cause deterioration or prevent improvement under the WFD.
- The Tees crossing (northern or southern option) and the crossing of Greatham Creek for the Hydrogen Pipeline Corridor 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 assessment this is assumed to be 10-15m below the bed. It is assumed that the maximum excavation dimensions for launch and reception pits will be 5 m width x 5 m length x 3 m depth. It is assumed that these pits will be at least 10 m from the watercourse edge, as measured from the top of bank. It is assumed that the drill fluids used within the drilling machine will be water based, such as naturally occurring bentonite clay.
- 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 and Greatham Creek. In such cases, it is assumed that flow will be temporarily over-pumped, diverted around or flumed through the working area and the watercourse fully reinstated as before.

Limitations and General Assumptions

9.3.45 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.

9.3.46 The assessment has been undertaken using available data and Proposed Development design details at the time of writing. 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 OS mapping. Understanding of flow pathways is described for each watercourse in the baseline (Section 9.4).

9.3.47 Assumptions and limitations relating to flood risk are outlined in the Preliminary FRA (Appendix 9A, PEI Report, Volume III).

9.3.48 A reasonable assumption has been made that all works will take place using best practice, as set out and secured in a Construction Environmental Management Plan (CEMP), pursuant to the Framework CEMP to be submitted with the ES.

9.3.49 Aside, from Pond 14 (the only open water pond remaining within the Teesmouth and Cleveland Cost Site of Special Scientific Interest (SSSI)), no water quality monitoring has been undertaken. Background water quality has been determined from the nearest Environment Agency monitoring stations. This is considered sufficiently robust for the characterisation of water body importance and the determination of impacts on the surface water environment. Water quality data was collected from Pond 14 to assess the potential risk of atmospheric depositions of nitrogen to this open water pond.

9.3.50 The understanding of drainage arrangements assessed herein is based on provisional information. The drainage strategy will be subject to further development in consultation with the Environment Agency and LLFA.

9.4 Baseline Conditions

9.4.1 This section describes the baseline physical characteristics and water features of the Study Area. Refer to Figure 9-1: Surface Water Features and their Attributes (PEI Report, Volume II) throughout.

Land Use, Topography and Rainfall

9.4.2 The Proposed Development Site is located on part of the former Redcar Steelworks site to the east of Redcar Bulk Terminal (referred to as 'the Foundry'). The site is coastal, being located immediately south-west of Teesmouth, at approximately 6 - 8 m above ordnance datum (AOD). Coatham Sands is immediately to the north and Bran Sands is located to the west (Figure 9-1: Surface Water Features and their Attributes). The Proposed Development Site is currently industrial, comprising former steelworks structures. Dormanstown is located south-east of the Proposed Development Site.

9.4.3 The Proposed Development Site extends west across the Tees Estuary at the southern extent of Bran Sands also further south close to Teesport (Figure 9-1: Surface Water Features and their Attributes, PEI Report, Volume II). These crossings of the Tees Estuary are included to incorporate the Hydrogen Pipeline Corridor infrastructure required by the Proposed Development.

9.4.4 South of the Tees Estuary, the Proposed Development Site extends south to Grangetown to accommodate the Electrical Connection Corridor, Water Connection Corridor, Natural Gas Connection Corridor, Other Gases Connection Corridor and the Hydrogen Pipeline Corridor.

9.4.5 The Proposed Development Site to the north of the Tees Estuary partly follows existing pipeline routes on reclaimed land to the south of the Seal Sands inter-tidal mudflats. The Hydrogen Pipeline Corridor extends west as far as Cowpen Bewley Woodland Country Park, and south into the industrial area at the eastern edge of Billingham. This whole section of the Proposed Development 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 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 are included within local SSSI and Special Protection Area (SPA) designations).

9.4.6 The nearest weather station on the Met Office website (Met Office, n.d.) with historical data is located at Stockton-on-Tees, approximately 5.0 km south-west of the eastern extent of the Proposed Development 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.

9.4.7 Plate 9-1 illustrates 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 rainfall between 1981 and 2010.

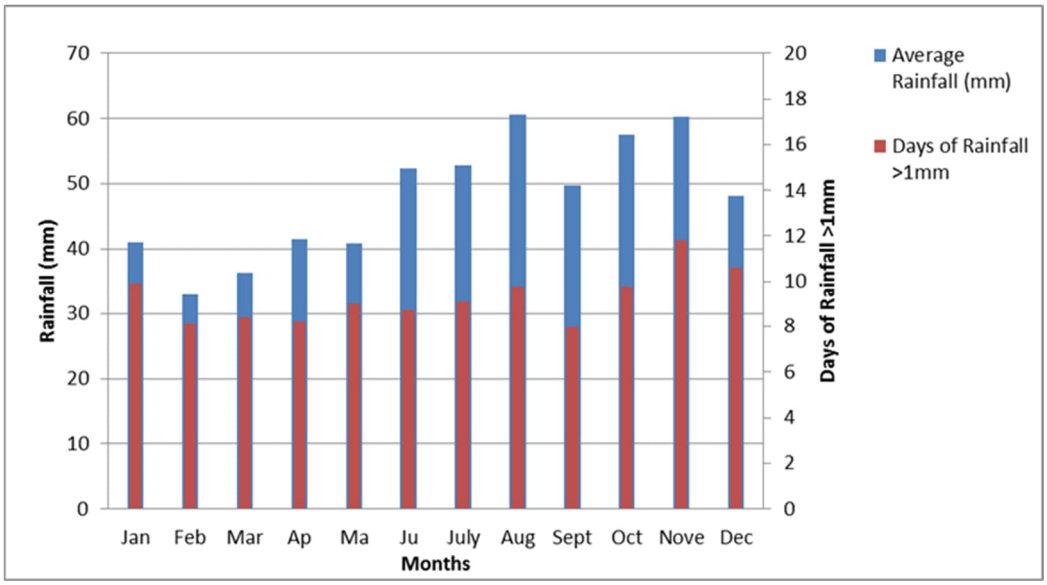

Plate 9-1: Stockton-on-Tees Weather Station – Average Rainfall per Month (1981-2010) and Average Days per Month with >1 mm of Rainfall (1981-2010)

Water Features

9.4.8 A site walkover was undertaken on 15th February 2023 in cold, dry but overcast conditions. Using observations taken on this visit, data from OS mapping and the Environment Agency Catchment Data Explorer website, a summary list of the surface waterbodies and where relevant to the assessment, groundwater water features listed in Table 9-5 were identified within the Study Area and are presented in Figure 9-1: Surface Water Features and their Attributes and 9-2: Groundwater Features and their Attributes (PEI Report, Volume II). Further details on these are presented in Table 9-6 to Table 9-7.

9.4.9 The Environment Agency's Catchment Data Explorer website (Environment Agency, 2023) confirms that the estuarine and coastal waterbodies in the Study Area are

contained within the Northumbrian River Basin District, the Northumbrian Transitional and Coastal (TraC) Management Catchment, and the Tees Lower and Estuary TraC Operational Catchment. The fluvial waterbodies are contained within the Northumbrian River Basin District, Tees Management Catchment and Tees Lower and Estuary Operational Catchment.

9.4.10 There are five WFD designated surface water bodies within the Study Area - these are described briefly in Table 9-6 (see also Figure 9-1: Surface Water Features and their Attributes, 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 three rivers (The Fleet - designated as Tees Estuary (S Bank), Cowbridge Beck, and North Burn from Source to Claxton Beck.

9.4.11 Within the catchments of the WFD waterbodies outlined in Table 9-6, there are also a number of named watercourses shown on OS mapping (Bing, 2023) - these are described in Table 9-7 (also refer to Figure 9-1: Surface Water Features and their Attributes (PEI Report, Volume II)).

9.4.12 In addition to the watercourses described in Table 9-6 and Table 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 for part of their course and so their exact path is unclear. These ditches are not included within any nature conservation designations and due to largely being in culvert 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, intermittent or 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 that result in habitat diversity).

Table 9-5: Surface and Groundwater Water Features Identified within the Study Area

WATERBODY	WATERBODY TYPE	WFD DESIGNATION OR ASSOCIATED WFD WATERBODY (WHERE APPLICABLE)
Tees Bay	Coastal	Tees Coastal Water (GB650301500005)
Tees Estuary	Watercourse (Main River)	TEES Transitional Waterbody (GB510302509900)
Cowbridge Beck	Watercourse (Main River)	Cowbridge Beck from Source to North Burn (GB103025072380)
North Burn	Watercourse (Main River)	North Burn from Source to Claxton Beck (GB103025072540)
Greatham Creek	Watercourse (Main River)	Designated under the Tees Transitional WFD Waterbody (GB510302509900), and so is considered further in the context of the WFD waterbody
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
Castle Gill	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Ash Gill	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Holme Fleet	Watercourse (Ordinary)	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

WATERBODY	WATERBODY TYPE	WFD DESIGNATION OR ASSOCIATED WFD WATERBODY (WHERE APPLICABLE)
Mucky Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Swallow Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Waterbody
Saltholme Nature Reservoir Ponds, Brine Reservoirs, Brine Field, and refinery ponds	Stillwaters and watercourses	Catchment of Tees Transitional WFD Waterbody
Cowpen Marsh ponds located adjacent to landfill site off Landfill Rd, Brine Field, small ponds	Stillwaters and watercourses	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 Transitional WFD Waterbody
Ponds at Coatham Marsh	Stillwater	Catchment of Tees Transitional WFD Waterbody
Numerous industrial ponds and artificial waterbodies across the area including Lazenby Reservoirs, Salthouse Brine Reservoirs and the Venator reservoirs	Stillwater	Catchment of Tees Transitional WFD Waterbody
Tees Sherwood Sandstone	Groundwater	WFD designation (GB40301G702000)
Tees Mercia Mudstone & Redcar Mudstone	Groundwater	WFD designation (GB40302G701300)

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	Fail	Good (2027)	Heavily Modified	The Tees Coastal waterbody stretches from approximately 20 km south-east of Redcar at Boulby, to approximately 13 km north-west of Redcar at Crimdon. It includes a total area of 88.442 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 11.41 km^2. The designation includes the mud and sand flats at Seal Sands, Tees Dock, Greatham Creek, Dabholm Gut and the lower reaches of Billingham Beck. 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

WATERBODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
					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 1 km 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 (PEI Report, Volume II) 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 SSSI. This WFD waterbody also includes Greatham Creek up to the National Tidal Limit (NTL). Greatham Creek was observed during the site visit at Greatham Creek Bridge (A178 road crossing). Here, historic modifications are evident, particularly downstream of the road crossing, with raised stone banks and embankments containing this tidal river maintaining a straightened length through to the Tees Estuary. There are three existing structures downstream of the A178 road crossing, comprising two other bridge crossings and a series of in-channel piers that formed part of a redundant crossing. The watercourse is sinuous upstream of the A178 and forms part of a dynamic system of intertidal channels and marsh. Bed and bank sediment comprised					

WATERBODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
fine material which is likely reworked with each tide. The watercourse has an approximate Mean High Water width of 60 m, although width varies considerably through the more natural length upstream of the road crossing.					
Tees Estuary (South Bank) (GB1030250723320)	Moderate Ecological Potential	Fail	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 2 m 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 was 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.					
Cowbridge Beck from Source to North Burn (GB103025072380)	Moderate Ecological Status	Fail	Good (2027)	Not designated artificial or heavily modified	The watercourse is designated from the junction of Thames Road and Wolviston Road in Wolviston (NGR NZ 45225 24805) and flows in

WATERBODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
					an easterly direction to its confluence with North Burn at Cowpen Bewley Country Park where it is then designated as the Tees transitional waterbody (NGR NZ 48477 25835). It is 4.64 km in length and has a catchment of 13.4 km^2.
Site observations: This watercourse was not observed during the initial site visit as it is upstream of any direct works required for the Proposed Development.					
North Burn from Source to Claxton Beck (GB103025072540)	Bad Ecological Status	Fail	Good (2027)	Not designated artificial or heavily modified	The WFD designated watercourse consists of three tributaries that rise close to Hurworth Burn. These flow generally south to converge at Embleton (NGR NZ 42148 29919), before flowing south-east as a single stem to Cowpen Bewley Country Park where it is then designated as the Tees transitional waterbody (NGR NZ 48384 25916). The designated watercourse has an overall length of 25.7 km and catchment areas of 30.1 km^2.
Site observations: This watercourse was not observed during the initial site visit as it is upstream of any direct works required for the Proposed Development.					

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 (Within Tees Transitional WFD Waterbody catchment)	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 Saltholme 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 Gut.	Refer to the Dabholm Gut description under the Tees Transitional Waterbody description above.

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
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 clear from online mapping north of the A1085 as the watercourse is culverted.	Kettle Beck was observed at the western edge of the Wilton International Site. Here the channel was between 2 and 3 m wide, with an artificial, straightened character. The bed was dominated by fine sediment with some isolated very fine gravel accumulations. Submerged macrophytes were abundant and some sections of the 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.	This watercourse was not observed during the initial site visit as it would not be directly impacted by the Proposed Development (does not cross into the Proposed Development Site).
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.

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
			Further downstream the watercourse is largely culverted beneath the Wilton International Site.
Castle Gill	Tees Transitional Waterbody	Castle Gill is a short watercourse, which flows for approximately 1.5 km in a south-westerly direction within the southern extent of the Wilton International Site, from NZ 57760 20577 to NZ 56121 20500,	This watercourse was not observed during the initial site visit as it would not be expected to be directly impacted by the Proposed Development. Based on aerial photography, it is partly in culvert, is straightened and heavily modified with a width of approximately 2 - 3 m.
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 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 - Tees Estuary (S Bank	Main's Dike watercourse rises from a spring in Wilton Wood to the south-east of the Site	Main's Dike was observed along the eastern edge of the Wilton International Site where it was very straight, around 1 m in width

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
	WFD Waterbody)	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.	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. 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.
Ash Gill	The Fleet - Tees Estuary (S Bank WFD Waterbody)	Ash Gill flows parallel to Main's Dike to the north of the Proposed Development Site. It rises in Kirkleatham and flows northwest through arable agricultural land and the outskirts of Dormanstown before meeting the Fleet at NGR NZ 57587 24388	This watercourse was not observed during the initial site visit as it is upstream of any direct works required for the Proposed Development. However, aerial imagery indicates that the watercourse is straightened with a modified character and is approximately 2 - 3m wide. It is culverted beneath Dormanstown and road crossings of the A108 and railway line.
Mill Race	The Fleet - Tees Estuary (S Bank WFD Waterbody)	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,

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
			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.	Swallow Fleet was observed from the viewing platform on the A178. The watercourse was approximately 30 m wide at its widest point, although this varied. A network of interconnected marshland channels join Swallow fleet, along with several linear, artificial drainage channels. Fine sediment dominates in this intertidal habitat and is likely reworked with each tide.

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

9.4.14 Other water features shown in Figure 9-1: Surface Water Features and their Attributes (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 will not have any pathways through which to be impacted. This includes Greatham Beck, Skelton Beck, Cross Beck, Spencer Beck, Normanby Beck, Ormesby Beck, Middle Beck, Marton West Beck, Lustrum Beck and Old River Tees.

9.4.15 There are a large number of still water features across the Proposed Development Site, most of which are small ponds or artificial standing waterbodies. The majority of these on the south-east bank of the Tees are small artificial waterbodies and ponds related to the surrounding industrial land use. To the north-east of the Tees there are further artificial and industrial waterbodies, such as the large brine reservoirs immediately north of the Proposed Development Site at Saltholme. The surrounding wetlands here also include several large, interconnecting waterbodies which attract a great deal of biodiversity interest, especially birdlife. The ponds within the Proposed Development Site itself are predominantly very small and generally artificial, with the exception being several waterbodies within the South Gare and Coatham Dunes.

9.4.16 The ponds within Coatham Dunes have been surveyed and appear to have formed in depressions in the relatively impermeable historic slag deposits that lie between the Proposed Development Site and the more natural sand dunes that have evolved adjacent to the Tees Bay shoreline. Based on site visits between December 2022 and February 2023 (as well as previous visits undertaken in connection with the NZT Project), these ponds appear to be predominantly rainwater fed with little influence from tidal variation and groundwater. Except ‘Pond 14’ (as previously described for the NZT Project , and for which the nomenclature is maintained here for consistency), all ponds across the dunes have succeeded to become fully vegetated wetlands covered by *Phragmites australis*. Therefore, only Pond 14 will be considered in this assessment.

Tees Estuary

9.4.17 Land reclamation, canalisation, and channel deepening carried out in the mid-19th century result in the present-day Tees Estuary's largely anthropogenic character. The estuary was originally surrounded by extensive wetlands and 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 hectare (ha) area known as Seal Sands, on the north bank, which is separated from other intertidal areas by Seaton Channel (Royal Haskoning, 2016a). The Tees Barrage

that was built in the mid-1990s comprised of 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; North Gare and South Gare. 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 4.1 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 (UK Hydrographic Office (UKHO), 2006). Other tidal statistics are given in Table 9-8.

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

TIDAL STATISTIC	LEVEL (M CHART DATUM)
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

9.4.22 Freshwater input to the estuary is measured at a gauging station at Low Moor (NGR: NZ364105). According to the National River Flow Archive (CEH, 2021) for the period 1969-2021, the Tees at this point has a mean flow of 20.823 m^3/s, with a 10% exceedance (Q10) of 47.3 m^3/s, and a 95% exceedance (Q95) of 3.1 m^3/s.

9.4.23 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.

9.4.24 A combination of locally created wind waves and offshore swell generates the waves in the Tees Estuary. The majority of offshore swell is from a northerly direction. The most common wind direction at South Gare observed between 1999 to 2005 is from the south-west (210-217°N), although frequent large wind events which are normally over 40 m/s tend to occur from the north (HR Wallingford, 2006).

9.4.25 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. Due to North and South Gare breakwaters, only the remaining swell waves energy and short-period local wind waves (including winds from south-west) penetrates into the Tees Estuary (Royal Haskoning, 2016a).

Table 9-9: Calculated Extreme Wave Heights at Waverider Bouy North of Tees North Buoy (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

9.4.26 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.

9.4.27 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 also estimated that the total fine material input to the estuary is 280,000 m^3 to 330,000 m^3 per annum with the assumptions that the fine silty sand content is between 15% - 35% (Royal Haskoning, 2016d).

9.4.28 There are some notable enhancement schemes relating to the Tees Estuary. Firstly, Tees Estuary Edges Enhancement Study (2018) (University of Hull) - this study aimed to identify a framework of habitat enhancement opportunities to improve biodiversity provision and habitat connectivity within the Tees. There is considered potential for functional provision to be improved for species associated with the

existing and proposed SPA designation (e.g. increased foraging potential for waders using intertidal mudflat habitat and breeding birds such as tern species through improvements to essential fish habitats and associated populations). The study focused on areas along the Tees estuary (from barrage to mouth) where estuary edges improvement techniques could be applied. Identified techniques included re-profiling foreshore levels, vegetated floating pontoons, fish habitat creation and extending intertidal areas (Boyes, Cutts and Thomson, 2018).

9.4.29 The Tees Tideland project is currently assessing the potential for implementing measures to restore habitats in the Holme Fleet/Belasis Beck catchment that would formerly naturally have formed part of the Tees Estuary intertidal area, and to restore ecological connectivity with the Tees Estuary.

Tees Bay

9.4.30 Tees Bay includes Bathing Waters designated under the Bathing Waters Directive, with 'Redcar Coatham' being located immediately north of the Proposed Development Site, and 'Seaton Carew North Gare' being situated immediately north of the Study Area. There are no designated shellfisheries within Tees Bay.

9.4.31 The North Sea tidal wave, which originates in the north and travels south, drives tidal patterns in Tees Bay. The semi-diurnal tide occurs 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. In addition, the flood tide direction in the Bay is south-east and the ebb direction is north-west (EDF Energy, n.d.).

9.4.32 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 are mobilised as bedload during periods of peak hydrodynamic forcing carried. A suspended sediment concentration of between 1,500 to 4,000 mg/l has been measured at exposed locations during peak wave events (EDF Energy, n.d.).

9.4.33 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).

9.4.34 Located approximately 1.5 km north of Coatham Sands is the cable landfall for the Teesside Offshore Wind Farm, which has been operating since 2013, and consists of 27 turbines with a 62 MW capacity. Off Coatham Sands but still within Tees Bay is also the discharge point from the former Steelworks site. It is also proposed that a new outfall from the NZT development will be installed off Coatham Sands.

Navigation

9.4.35 The Tees Estuary and adjacent Tees Bay are subject to significant commercial vessel traffic. Table 9-10 provides a summary of vessel movements for 2013 as part of the York Potash Harbour developments (Royal Haskoning, 2016c). According to the data

from 2013, there were on average 878 vessel movements per month, with the highest number in May (1009) and the lowest in December (714).

Table 9-10: Vessel Tracking System for 2013 at Tees Estuary (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

9.4.36 In addition to the above, commercial fishing vessels launch from Redcar and Marske-by-the-Sea generate further traffic in Tees Bay. Fisheries in this area primarily involve potting for crab and lobster, as well as trawling for cod, haddock, sole, whiting, plaice and turbot (EDF Energy, n.d.).

9.4.37 The nearest HM Coastguard moorings (Maritime and Coastguard Agency, n.d.) are to the north of the Study Area at Hartlepool Marina. There is also a RNLI Lifeboat station at Redcar Seafront.

Surface Water Quality

9.4.38 The Tees Coastal WFD waterbody is currently failing to meet Good Chemical Status based on WFD Cycle 3 2019 data, due to failures for polybrominated diphenyl ethers (PBDE) and mercury as well as its compound. The status of all other priority substances, priority hazardous substances, specific pollutants and other pollutants are either good, higher, or have not been assessed.

9.4.39 The Tees Transitional WFD waterbody is currently failing to meet Good Chemical Status based on WFD Cycle 3 2019 data, due to failed status for PBDEs, benzo(g-h-i)perylene, tributyltin compounds, and cypermethrin (Priority substances). The failure for tributyltin compounds are attributed to diffuse pollution from contaminated waterbody bed sediments.

9.4.40 The Tees Estuary (South Bank) waterbody is currently failing to meet Good Chemical Status based on WFD Cycle 3 2019 data, due to failures for PBDEs and mercury as

well as its compounds (Environment Agency, 2023d). Priority substances were all at Good Status and Other Pollutants did not require assessment.

9.4.41 Despite being in the Study Area, North Burn and Cowbridge Beck are both upstream of the Proposed Development Site and so they are not considered further in this section.

9.4.42 Water quality data has been obtained from the Environment Agency's Water Quality Archive (Environment Agency, 2023d) for the Tees Estuary. Annual average values for the period 2009 - 2022 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 shown on Figure 9-1 (PEI Report, Volume II)). The parameter values presented in Table 9-11 are compared against WFD standards where they apply to transitional waters.

Table 9-11: Summary of Mean Average Tees Estuary Water Quality Data Based on Monitoring at Multiple Sites Between 2009 - 2022 (Environment Agency, 2023)

PARAMETER	WFD THRESHOLD (FOR GOOD)	TEES MOUTH 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)	-	10.42	10.79	9.640	10.58	10.33
Ammoniacal Nitrogen, Filtered as N (mg/l)	21	0.114	0.688	0.480	0.277	0.380
Nitrate, Filtered as N (mg/l)	-	0.396	2.841	1.490	1.111	1.088
Nitrite, Filtered as N (mg/l)	-	0.009	0.117	0.014	0.016	0.014
Orthophosphate, Filtered as P (mg/l)	-	0.049	0.335	0.099	0.097	0.106
Oxygen, Dissolved, % Saturation	-	100.22	93.41	93.29	95.95	94.40
Arsenic, Dissolved (ug/l)	25	1.417	1.650	1.367	1.450	1.200
Chromium, Dissolved (ug/l)	-	0.500	2.073	0.433	0.500	0.518
Copper, Dissolved (ug/l)	3.76*	0.566	1.170	0.805	0.828	0.878
Lead, Dissolved (ug/l)	1.3	0.149	0.520	0.436	0.265	0.465
Nickel, Dissolved (ug/l)	8.6	0.575	1.463	0.765	0.867	0.835
Zinc, Dissolved (ug/l)	6.8**	2.167	6.120	4.320	3.188	3.492
Tributyl tin as Cation (ug/l)	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002
Lindane	-	-	-	-	0.000	-

PARAMETER	WFD THRESHOLD (FOR GOOD)	TEES MOUTH 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
para-DDT	0.01	-	-	-	0.001	-
Chloroform:-{Trichloromethane}	-	-	0.626	0.105	-	-
Hexachlorobenzene	0.05	-	-	-	0.000	-
Hexachlorobutadiene	0.6	-	-	-	0.000	-

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

9.4.43 These data indicate only one failure against WFD Environmental Quality Standards (EQS) for transitional waters, which was for tributyltin in Dabholm Gut, although there is some evidence of slightly elevated metal concentrations across the monitoring sites, 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. Raised tributyltin concentrations are consistent with the WFD 'Fail' classification for this waterbody.

9.4.44 The Water Quality Archive website (Environment Agency, 2023d) also provides water quality for other waterbodies and sites in proximity to the Proposed Development Site, spanning the period 2019 - 2023 inclusive. 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 the Range of 2000-2023 (Environment Agency, 2023d)

MONITORING STATION	DURATION OF SAMPLING	TYPE OF WATER SAMPLED	PARAMETERS TESTED	GENERAL QUALITY COMMENTS
Coastal/Estuarine				
Wilton Complex Main Effluent Composite NGR: NZ 56100 24100	2019-2022	Effluent	Sanitary pollutants (e.g., Biochemical Oxygen Demand (BOD)), metals and organics (e.g., chloroform).	Numerous pollutants are present in this effluent. An extremely high BOD indicates that sanitary wastewater contains high concentration of organic material. As for copper and zinc, they exceed the EQS set forth by the WFD. While chloroform exceeds the EQS in the Dangerous Substance Directive.
Brans Sands NGR: NZ 55700 26600	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:NZ 55500 24500	2019-2023	Estuarine water	Trace metals (copper and zinc).	Average concentrations of zinc and cooper are below the WFD Standards for estuarine water. It should be noted that only ten samples were taken at this site.
Greatham Creek 100 m from outfall	2009-2019	Estuarine water	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients	Slightly alkaline and well oxygenated. Concentration of nitrates and phosphate were low. Numerous metals were

MONITORING STATION	DURATION OF SAMPLING	TYPE OF WATER SAMPLED	PARAMETERS TESTED	GENERAL QUALITY COMMENTS
(adjacent to Able UK) NGR: NZ 52490 26490			and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate)*; Trace metals.	measured at this site, all falling below EQS (as outlined in Table 9-11).
Billingham Beck 50 m upstream of River Tees confluence NGR: NZ 47470 20507	2019-2021	Estuarine Water	Physico-chemical parameters (e.g., pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen orthophosphate); Trace metals.	Circum-neutral and well oxygenated. Concentration of nitrates and phosphate are slightly elevated. Dissolved copper concentrations are below but close to the WFD Standard of 3.76 µg/l. 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 6.8 µg/l (plus ambient)
Freshwater				
Billingham Beck at Billingham Bottoms NGR: NZ 45495 22393	2019-2023	River	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, Ammoniacal nitrogen, Orthophosphate)	Circum-neutral and well oxygenated. Concentration of nitrates and phosphate are considerably lower than the downstream sampling site close to the Tees confluence.

9.4.45 The data summary 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.

9.4.46 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, for both the downstream reach of the watercourse below the NTL (which is located at the south-western extent of the Study Area and is part of the Tees transitional WFD waterbody), and for a location upstream of the NTL at Billingham Bottoms. The freshwater reach of the watercourse is likely to exhibit similar water quality traits to those other freshwater rivers and streams in the Study Area given the similar surrounding urban land with heavy industry, low gradients and tide locking effect of the Tees Estuary. The data for this watercourse indicates that certain dissolved metals exceed WFD standards, while nitrates and phosphates are also slightly elevated.

9.4.47 Further water quality data for the Study Area is available for Bathing Water areas as designated under the Bathing Waters Directive. In the north-east 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 2022 classification of Excellent (Environment Agency, 2023d).

9.4.48 The Environment Agency's Bathing Water Quality website (Environment Agency, 2023c) 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.

9.4.49 The southern extent of the Seaton Carew North Gare Bathing Water is also within the 2 km of the Proposed Development Site and has a classification of Good for 2022 (Environment Agency, 2023d).

9.4.50 The only open water pond within the Coatham Dunes (Pond 14 within the Teesmouth and Cleveland Coast SSSI) has been monitored as part of the assessment to determine the potential for impacts from atmospheric deposition of pollutants from the Proposed Development. Pond 14 was monitored on three occasions between December 2022 and February 2023, to supplement previous monitoring undertaken as part of the NZT development between October 2020 and January 2021. In summary, the latest monitoring data indicated that the water is circum-neutral (mean pH 7.82), and well oxygenated with mean dissolved oxygen (DO) values of 97.2% saturated and 11.94 mg/l.

9.4.51 Mean electrical conductivity was 3,111 µS/cm suggesting brackish water. Average ammoniacal nitrogen was recorded at marginally above the laboratory limit of detection (LoD) at 0.05 mg/l. Furthermore, average nitrate values were low (0.4 mg/l) and nitrite was below the LoD. Total nitrogen had a mean average of 0.5 mg/l.

9.4.52 Certain metals including boron and molybdenum were elevated with recorded mean dissolved values of 750.67 µg/l and 200.00 µg/l respectively, and total values of 717.33 µg/l and 212.67 µg/l respectively. Total iron was also found to be elevated with an average value of 259 µg/l; however dissolved iron was far lower at 59.67 µg/l.

9.4.53 Previous sampling (2020 - 2021) of polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPHs) all fell below LoDs. One sample of polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs) and phenols was taken, all of which fell below the LoDs. Further results and analysis from the Pond 14 sampling will be presented in an appendix with the ES.

Sediment Quality

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

9.4.55 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 from 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 presented against Cefas Action Levels in Table 9-13 which shows 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 RESULT	COMMENT
Arsenic	20	100	36.28	26.2	Above Level 1; Significantly below Level 2.

PARAMETER	ACTION LEVEL 1	ACTION LEVEL 2	MAXIMUM 2017 RESULT	MAXIMUM 2018 RESULT	COMMENT
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 values as mg/kg Dry weight (ppm)

9.4.56 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 the York Potash Harbour Facilities ES (Royal Haskoning, 2016b).

9.4.57 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 PAH concentrations. Metals and PAHs exceeded Cefas Action Level 1 at most 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 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.

9.4.58 Two earlier impact assessments of sediment quality were undertaken to support the EIAs of the Northern Gateway Container Terminal (NGCT) and QE II Berth Redevelopment project.

9.4.59 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.

9.4.60 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 heavy metals. However, levels were not deemed high enough to prevent material being disposed of at sea (Royal Haskoning, 2016a).

9.4.61 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 was not considered suitable in these cases.

Marine Ecology Overview

9.4.62 In terms of fisheries, the Tees Transitional WFD waterbody 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 Biodiversity Action Plan (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.

9.4.63 Estuarine and marine fish communities within the vicinity of the Proposed Development Site represent a mixed demersal and pelagic fish assemblage typical of the central North Sea. Data on the Environment Agency (Environment Agency, 2019) 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 generally declined in recent years, but with a notable increase in

2020, with total fish counted being 498 (2016), 297 (2017), 217 (2018), 204 (2019), 328 (2020), 305 (2021), 266 (2022) (Environment Agency, 2021).

9.4.64 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 Proposed Development Site.

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

9.4.66 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. These included: *Alexandrium* spp., *Karenia mikimotoi*, *Dinophysis acuminata*, *Dinophysis acuta*, and *Pseudonitzschia* spp. which are all known to cause shellfish poisoning (Defra, 2008). In addition, several taxa known to cause mortality in fish due to physical damage were also recorded; these included *Gymnodinium* spp., *Dictyocha speculum, Chaetoceros* spp. and *K. mikimotoi* (Defra, 2008).

9.4.67 No formal monitoring of harmful algal blooms is carried out within the lower Tees Estuary or coastal water bodies although the Tees WFD waterbody 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.

9.4.68 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.

9.4.69 The most recent Phase I and Phase II intertidal benthic survey was undertaken in October 2019 as part of the NZT project surveys (NZT ES, Appendix 14A: Intertidal Benthic Ecology Survey Report). Overall, benthic communities were characterised by relatively low abundance, biomass, species richness and diversity. No protected species were identified during the intertidal survey. However, two biotopes (EUNIS A5.233 and A5.242 (EEA, 2012)) were identified in the subtidal sampling which qualify as habitats of principal importance being listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 and belong to the UK BAP priority habitat type, 'subtidal sands and gravels'. The only INNS recorded during the benthic surveys was the seaweed wakame (*Undaria pinnatifida*), found in the intertidal zone.

9.4.70 There have been incidents of mass mortality reported in crabs and lobsters along the coastline between Hartlepool and Whitby in recent years, notably between October and December 2021, and continuing periodically through 2022. Some crustaceans were observed displaying unusual twitching behaviour. The exact cause of death has been highly disputed. However, several explanations have been proposed, including disease, harmful algal blooms, chemical toxicity resulting from historical industrial activity in Teesside, and dredging in the Tees area, including Tees Estuary. The most likely cause of death is a novel pathogen. However, the mortality event is still largely

unexplained (Defra, 2023c), suggesting similar events could continue to occur into the future without an identifiable cause and therefore focused mitigation..

9.4.71 Details regarding marine ecology within the Study Area are provided in Chapter 14: Marine Ecology (PEI Report, Volume I).

Freshwater Ecology Overview

9.4.72 Full details regarding freshwater ecology within the Study Area are provided in Chapter 12: Ecology and Nature Conservation (including Aquatic Ecology) (PEI Report, Volume I). A summary is provided below.

9.4.73 There is only one riverine WFD waterbody within the boundary of the Proposed Development Site that is considered to be potentially impacted - this is the Tees Estuary South Bank (Water Body ID: GB103025072320). Routine WFD monitoring is 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 have been undertaken to gather more robust data to inform the assessment.

9.4.74 Several notable fish species were recorded within 2 km of the Proposed Development Site using Environment Agency data, NBN Atlas data, survey results for other developments in the area. Site surveys have shown European eel *Anguilla* in Dabholm Gut and Pond 3 (see Chapter 12: Ecology and Nature Conservation, PEI Report, Volume I).

9.4.75 There were no specific records of protected macroinvertebrate species identified in the aquatic ecology desk study data. However, some notable taxa were identified, including the beetle (*Helochares obscurus*) (Vulnerable), the beetle (*Ilybius subaeneus*) (nationally scarce), the beetle (*Noterus crassicornis*) (nationally scarce) and the caddisfly *Oxyethira simplex* (nationally scarce). These were found in and around the Swallow and Mucky Fleet area, which is outside the Proposed Development Site, but within the Study Area.

9.4.76 Previous surveys for other developments within the Study Area found pygmy backswimmer (*Plea minutissima*) and the beetle (*Haliplus obliquus*), to be present in The Mill Race. The pygmy backswimmer was also present in samples collected from The Fleet. Both species have a Conservation Score 4 and are considered 'Occasional' under the CCI index (see Chapter 12: Ecology and Nature Conservation (PEI Report, Volume I) for classification details). Pond 14 from an NZT project survey contained a beetle *Hydroglyphus geminus* which is classified as "Local" or locally important under the CCI index. However, none of the species identified are listed under statutory or non-statutory designations.

9.4.77 The autumn 2022 aquatic macroinvertebrate survey for the Proposed Development recorded the locally notable bladder snail *Aplexa hypnorum* in Holme Fleet (NZ 49387 23931) and the locally notable Dytiscidae beetle (*Hygrotus confluens*) in a ditch at NZ 49735 24400.

9.4.78 There were no records of the white-clawed crayfish (*Austropotamobius pallipes*) within 2 km of the Proposed Development Site within the last ten years, nor within

10 km of the Study Area, and there is no mention of presence within the Tees Valley BAP. However, there are recent records of American signal crayfish (*Pacifastacus leniusculus*) in the Study Area, which being an invasive species, reduces the likelihood of native white-clawed being present. White-clawed crayfish is therefore considered absent from the Study Area.

9.4.79 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.

9.4.80 Based on available data, there are no notable or protected macrophyte species recorded within the Study Area. However, Pond 14 had five uncommon species recorded including sea club-rush (*Bolboschoenus maritimus*), spiked water milfoil (*Myriophyllum spicatum*) and horned pondweed (*Zannichellia palustris*).

9.4.81 Several INNS species were identified in the desk study, from Environment Agency data and data from previous NZT project surveys. Species identified on the Wildlife and Countryside Act 1981 (Schedule 9) include Floating Pennywort (*Hydrocotyle ranunculoides*), Giant Hogweed (*Heracleum mantegazzianum*), New Zealand pigmyweed (*Crassula helmsii*), Parrot feather (*Myriophyllum aquaticum*), Japanese knotweed (*Reynoutria japonica*) and Himalayan balsam (*Impatiens glandulifera*). There are statutory constraints to limit their potential spread, and therefore mitigation will be required during Proposed Development construction to prevent their spread and where possible locally eradicate these species within the construction boundary. Nuttall's waterweed (*Elodea nuttallii*) was also recorded, which is no longer listed in Schedule 9 of the Wildlife and Countryside Act 1981 but is listed in the Invasive Alien Species (Enforcement and Permitting) Order 2019.

Sites of Ecological Importance

9.4.82 Designations within and in proximity to the Study Area are shown on Figure 10-10: Ecological Designations (PEI Report, Volume II). The Hydrogen Pipeline Corridor (where it crosses the Tees Estuary) crosses the Teesmouth and Cleveland Coast 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.

9.4.83 The coast either side of Teesmouth is also designated as being of international importance as the Teesmouth and Cleveland Coast SPA which is designated under the Conservation of Habitats and Species Regulations (2017) (UK Government, 2017b), 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 Site at its northern extent for the water discharge corridor.

9.4.84 Seaton Dunes and Common Local Nature Reserve (LNR) (part of the Teesmouth and Cleveland Coast SSSI) is located approximately 1.8 km from the Proposed Development. 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.).

9.4.85 Cowpen Bewley Woodland Country Park LNR is located partly within the Proposed Development Site at its western extent, with Cowbridge Beck running through it (with the watercourse being north of the Proposed Development Site). Reclaimed from former brickworks, landfill, and ex-agricultural land there are now large variety of habitats and wildlife including woodlands, grassland, a lake, and a series of ponds.

9.4.86 Charlton's Pond LNR is located approximately 0.5 km west of the Proposed Development Site. This is an 8 ha site, consisting of wetlands, amenity grassland and woodland. The site is upslope and upstream of the Proposed Development Site and so is scoped out of further assessment.

9.4.87 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 Proposed Development Site.

Groundwater and Geological Features

9.4.88 Full details of geology and groundwater are provided in Chapter 10: Geology, Hydrogeology and Contaminated Land (PEI Report, Volume I). In summary, the BGS Geoindex viewer (BGS, n.d.) indicates that the solid geology beneath the Proposed Development Site consists of strata of Triassic and Jurassic age.

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

9.4.90 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.

9.4.91 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 north-east of the Proposed Development 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 north-west of the Study Area towards Cowpen Bewley is underlain by glaciolacustrine deposits. Finally, there are marine beach deposits on the coastline north of Teesmouth.

9.4.92 Defra's MAGiC website (Defra, n.d.) indicates that the Sherwood Sandstone to the north of the Tees is classified a Principal Aquifer. Principal aquifers 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.

9.4.93 The Mercia Mudstone bedrock deposits surrounding the Tees are classified as a Secondary B aquifer. Secondary B aquifers 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.

9.4.94 The superficial deposits beneath the Proposed Development 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 Proposed Development Site 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.

9.4.95 The Study Area to the east and south of the Tees estuary is within the Tees Mercia Mudstone & Redcar Mudstone WFD groundwater body (GB40302G701300) (Environment Agency, 2023a). 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.

9.4.96 The Study Area to the west and north of the Tees Estuary is mainly within the Tees Sherwood Sandstone WFD groundwater body (GB40301G702000), except 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.

9.4.97 There are no Groundwater Dependent Terrestrial Ecosystems (GWDTE) which are likely to be affected by activities related to the Proposed Development.

9.4.98 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 Lackenby Steelworks 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

9.4.99 The Study Area is not within a Nitrate Vulnerable Zone, Drinking Water Protected Area (Surface Water), Drinking Water Safeguard Zone or near any Source Protected Zones (SPZs).

9.4.100 This section contains information on water activity permits (e.g. discharges), water abstractions, and past water pollution incidents. The following details are derived from the ES for the proposed NZT development (AECOM, 2021). A request has been made to the Environment Agency to update this information specifically for the Proposed Development, and any additional information will be included in the ES.

Water Activity Permits

9.4.101 There are known to be 45 water activity permits (i.e., formerly discharge consents) within 250 m of the NZT development. Locations are shown in Figure 9-1: Surface Water Features and their Attributes (PEI Report, Volume I). This will be refined to include those relevant to the Proposed Development Site for the ES.

9.4.102 The majority of the consented discharges come from treated/untreated sewage effluent from storm tanks, pumping stations and combined sewer overflows (both private and public water company). There are also a substantial number of discharges coming from trade effluent, process/chemical, and cooling water in the Study Area, reflecting the presence of industrial land use. Furthermore, there are two active discharges for raised mine/groundwater where past activity continues to impact present-day water quality.

Abstractions

9.4.103 Data provided by the Environment Agency for the NZT development indicates that there are 18 licensed water abstractions within 2 km of that site. Locations shown in Figure 9-1: Surface Water Features and their Attributes (PEI Report, Volume II).

9.4.104 Twelve of these 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.

9.4.105 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.

9.4.106 Details on private water supplies (PWS) have been requested from the local authorities. RCBC have confirmed that there is one PWS located at NZ 56914 20433. This is for Barnaby Side Farm and is for 2m^3 per day and is south of the Proposed Development Site. STBC have confirmed that there are no private water supplies in the Study Area in their respective administrative areas.

Water Pollution Incidents

9.4.107 Four water pollution incidents of Category 3 (minor) or worse were identified within 250 m of the NZT development 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 (PEI Report, Volume II).

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

FIG 9.1 REF.	NOTIFICATION ID & DATE	CATEGORY	NATIONAL GRID REFERENCE	POLLUTANT	PORBABLE RECEIVING WATER
P1	969033 10/03/2012	3 (Minor)	NZ 49573 21710	Atmospheric pollutants and - smoke	Tees Estuary effects
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

9.4.108 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

9.4.109 This section provides a summary of the baseline flood risk data available for the Proposed Development Site. Refer to Appendix 9A: Preliminary FRA (PEI Report, Volume III) for a more detailed description of the baseline environment in relation to flood risk.

9.4.110 The Environment Agency's 'Flood Map for Planning' (Environment Agency, 2023b) 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. Flood zones are illustrated on Figure 9-3: Fluvial Flood Risk (PEI Report, Volume II) and should be referred to throughout.

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

Table 9-15: Flood Zone Definitions (source Table 1 of the PPG; Department of Communities and Local Government, 2022)

FLOOD ZONE	DEFINITION	PROBABILITY OF FLOODING
Flood Zone 1	Land that has a low probability of flooding (less than 1 in 1,000 annual probabilities 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)	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map).	Very High

Tidal Sources

9.4.112 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).

9.4.113 Greatham Creek, a Main River, is a tidal watercourse which flows in an easterly direction, following the STBC 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.

9.4.114 The online Flood Map for Planning (Environment Agency, 2023b) illustrates that the Main Site is located entirely in Flood Zone 1 and a significant amount of the Hydrogen Pipeline Corridor is located within Flood Zones 2 and 3. Small areas of the Electrical Connection Corridor and the Water Connections Corridor are also located within Flood Zones 2 and 3.

9.4.115 The Hydrogen Pipeline Corridor crosses Flood Zones 2 and 3 at the delta of Greatham Creek flowing into the Seaton on Tees Channel, between Holme Fleet and Swallow Fleet in the south-west of the Proposed Development Site and around the Dabholm Gut and Knitting Wife Beck in the north-east of the Proposed Development Site. Refer to Figure 9-3: Fluvial Flood Risk (PEI Report, Volume II) for the spatial extent of these Flood Zones.

9.4.116 Flood risk is 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 3a (high risk) with the main area at risk located to the north of Port Clarence. There is no land within the Proposed Development Site within Flood Zone 3b (Functional Floodplain).

9.4.117 The Environment Agency own and maintain a number of flood defence assets along the River Tees near the Proposed Development Site. This includes a series of embankments and walls upstream and downstream of the Transporter Bridge and defences around the Greatham Creek delta flowing into Seaton on Tees Channel. There are also demountable defences (that when erected create a wall with the same standard of protection as the surrounding defences). These are privately owned and maintained by Wilton International Site.

9.4.118 The tidal defences in proximity to the Proposed Development 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.

9.4.119 The Environment Agency provided modelled tidal peak water levels for the tidal Tees area for the NZT development for the 0.5% AEP (1 in 200 year), 0.1% AEP (1 in 1,000 year) and 0.1% AEP with climate change scenario flood events, and this has been used to inform the Preliminary FRA (Appendix 9A, PEI Report, Volume III). The model demonstrated that during a 0.1% AEP (1 in 1000 chance) event based upon the existing (2019) scenario, tidal levels in the Tees Estuary could rise up to 4.33 m AOD at the mouth of the estuary and up to 4.40 m AOD where the A19 crosses the Tees near Portrack.

9.4.120 The Main Site is considered to be at 'low risk' of flooding from tidal sources, together with the connection corridors located within Flood Zone 1 on the south bank of the River Tees (CO_2 Export Corridor and Electrical Connection Corridor). The section of the Hydrogen Pipeline Corridor crossing the River Tees and the section to the east of Billingham (located in Flood Zone 3a on the left bank of the River Tees) is at 'high' risk of tidal flooding. On the right bank of the River Tees and east of the Main Site, sections of the Water Connection Corridor and Electrical Connection Corridor are at 'high risk' of tidal flooding.

Fluvial Sources

9.4.121 The nearest fluvial watercourses to the Main Site are The Fleet (otherwise known under the WFD as 'Tees Estuary (S Bank)'), located approximately 0.8 km east of the Main Site (but crossing through the Water Connections Corridor and Electrical Connection Corridor); Dabholm Gut, located approximately 0.7 km south of the Main Site and within the Hydrogen Pipeline Corridor; and the Mill Race, located approximately 0.9 km south-east of the Main Site.

9.4.122 Numerous other Ordinary Watercourses intersect the connection corridor routes including Mains Dike, The Mill Race, Lackenby Channel, Holme Fleet, 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 in Table 9-7. These watercourses all pose a potential risk of fluvial flooding to the connection corridors.

9.4.123 The Environment Agency's online Flood Map for Planning (Environment Agency, 2023b) illustrates that the entirety of the Main Site is within Flood Zone 1, while about half of the Hydrogen Pipeline Corridor is located in Flood Zones 2 and 3 in areas around the Tees. The majority of the Electrical Connection Corridor and the Water Connections Corridor is located within Flood Zone 1, except a small part of the Electrical Connection Corridor, between the Teesport Estate and the Trunk Road Industrial Estate, which falls within Flood Zones 2 and 3.

9.4.124 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 Hydrogen Pipeline Corridor, predominantly where the connection corridor crosses a watercourse/drain.

9.4.125 It is considered that for the baseline flood risk scenario that the Proposed Development Site and the majority of the connection corridors to the north and

south of the River Tees are at 'low' risk of flooding from fluvial sources. There are areas of higher risk where the connection corridors cross watercourses.

Groundwater Flood Risk

9.4.126 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), i.e. to the north of the Tees.

9.4.127 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 Main Site). 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.

9.4.128 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 STBC 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.

9.4.129 The Environment Agency's Areas Susceptible to Groundwater Flooding map is illustrated in the RCBC and STBC Preliminary Flood Risk Assessment (PFRA) report (STBC, 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 RCBC and STBC areas the map shows the Proposed Development Site lies predominantly in an area where 75% or more of the area is considered to be potentially at risk of groundwater emergence.

9.4.130 The groundwater vulnerability map identifies the Proposed Development Site as Medium-High risk; this means that there are some areas that offer groundwater protection from pollution, whereas other areas may allow pollution to be transmitted to groundwater.

9.4.131 Based on this information the risk of flooding from groundwater sources is considered to be a medium risk for those parts of the Proposed Development Site to the north of the Tees.

Surface Water Runoff to the Site

Overland Flow of Rainfall Runoff

9.4.132 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.

9.4.133 Surface water flooding is the main source of flood risk in the RCBC area with regular flooding occurring in Eston, Redcar and Guisborough. This flooding is due to

insufficient capacity within surface water drainage systems, combined sewer and culverted watercourses to convey the rainfall away. The RCBC PFRA (RCBC, 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*".

9.4.134 The Environment Agency's online Risk of Flooding from Surface Water maps (Environment Agency, 2023b) 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 9-4: Flood Risk from Surface Water (PEI Report, Volume II). Environment Agency mapping indicates that the Proposed Development Site 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 Proposed Development Site from elsewhere is considered to be low to very low.

9.4.135 There are, however, 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 topographical low spots within the Proposed Development Site. The main locations of identified surface water flooding are:

- in the north-east part of the Proposed Development Site where water is seen to flood around the A1085/Broadway East roundabout junction. Land in this area is at low to high risk of surface water flooding in the area of the Hydrogen Pipeline Corridor, Water Connections Corridor and Electrical Connection Corridor; and
- land located to the west between the A1185 and Cowpen Bewley Road, approximately 8 km to the west of the Proposed Development Site. Land in this area is at low to medium risk of surface water flooding.

9.4.136 Based on the above information, the risk of surface water runoff to the Proposed Development Site is considered to be low.

Existing Drainage Infrastructure

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

9.4.138 Northumbrian Water's Bran Sands WwTW is located immediately to the south of the Proposed Development Site and discharges into the Dabholm Gut.

9.4.139 According to the local SFRA (RCBC, 2016) there has been in total 234 records of historical sewer flooding incidents in the RCBC area. Information provided in their SFRA indicates that no historical sewer flooding has occurred in close proximity to the Proposed Development Site and connection corridors to the south of the River Tees. Flooding from drainage infrastructure within the RCBC area tends to occur in predominantly residential areas, with Eston (located to the south-west of the Proposed Development Site), identified as a Critical Drainage Area (CDA).

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

Artificial Waterbodies

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

9.4.142 A review of online OS mapping indicates that there are no canals located in close proximity to the Proposed Development Site.

9.4.143 The Reservoir Act 1975 defines a large reservoir as one that holds over 25,000 m^3 of water, although this was 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. However, the plans to reduce the threshold appear to be on hold at this time.

9.4.144 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.

9.4.145 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.

9.4.146 Environment Agency Long-Term Flood Risk Mapping (Environment Agency, 2023b) shows that a significant portion of the area is at risk of flooding in the unlikely event of a breach or failure of reservoirs. The mapping 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 Environment Agency mapping shows two scenarios, dry-day and wet-day scenario, where the wet-day scenario includes additional extreme fluvial flooding conditions. The reservoir flood extents largely follow the fluvial/tidal floodplains in the area. Even in the wet-day scenario, the Main Site is not shown to be affected, but the proposed pipeline corridors would cross the reservoir flood extents. Environment Agency mapping shows that the risk is associated with several reservoirs including: Hury Subsidiary, Balderhead, Blackton, Cow Green, Crookfoot, Grassholme and Selset. These are owned by NWL with the exception of Crookfoot which is privately owned.

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

Future Baseline

Construction (2025-2029); Operation 2030

9.4.148 As outlined in Chapter 5: Construction Programme and Management (PEI Report, Volume I), the construction of the Proposed Development is expected to commence with early enabling works for Phase 1 in 2025, and so this year has been adopted as

the future baseline for construction as a worst-case scenario. Full operation is scheduled to commence in 2030.

9.4.149 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.

Surface Water

9.4.150 All WFD surface waterbodies identified within the Study Area (Tees Coastal, Tees Estuary (South Bank), Cowbridge Beck and North Burn) have a target of Good by 2027, with the exception of Tees Transitional which has a target of maintaining the existing Moderate Potential (i.e. no deterioration from the present condition). However, these WFD classifications are subject to change during RBMP Cycle 3.

9.4.151 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. The Environment Act 2021, the proposed Levelling-Up and Regeneration Bill and regulatory requirements (Water Company Price Review) include measures to tackle storm sewage discharges and set new requirements on phosphate removal from sewage treatment works. There are, however, 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.

9.4.152 The Tees Estuary is considered to be undergoing a period of ecological recovery after several decades of industrial and sewage pollution. As such, there is likely to be an improvement over current conditions due to interventions that are being implemented or have already been implemented. This includes the introduction of nutrient neutrality requirements that aim to ensure no deterioration with regard to nutrient status.

9.4.153 The current receptor importance criteria presented in Table 9-16 is largely based on the presence or not of various attributes (e.g. water body size, designated nature conservation site, WFD designation, or presence of a Bathing Water). For most of these attributes, it is unlikely that they will change in the future. The application of these criteria is therefore not sensitive to more subtle changes or improvements in water quality as may be experienced over time. Thus, no significant changes to current baseline conditions are predicted for the future baseline in the absence of the Proposed Development, as the principal reasons for differences in water body importance are unlikely to change. For this reason, the impact assessment within this chapter is undertaken against existing baseline conditions.

9.4.154 It is also noteworthy that the wider area around the Proposed Development Site 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 Proposed Development Site would be left in its current state.

Groundwater

9.4.155 The Tees Mercia Mudstone & Redcar Mudstone WFD groundwater body is at its objective of Poor Status (2015), while the Tees Sherwood Sandstone WFD groundwater body WFD waterbody is at its objective of Good Status by 2015. However, these WFD classifications are subject to change during RBMP Cycle 3.

9.4.156 No significant changes to current baseline conditions are predicted for the future baseline for the same reasons as outlined above for surface water. The impact assessment within this chapter is therefore undertaken against existing baseline conditions.

Flood Risk

9.4.157 Climate change is predicted to alter both future tidal and fluvial flood risk and this has been taken into account by the Preliminary FRA (Appendix 9A, PEI Report, Volume III). Climate change resilience is accounted for, accommodating current government climate change projections, including peak river flow allowances, sea level allowances and peak rainfall intensity allowances.

9.4.158 Where the risk of flooding from fluvial sources is currently assessed as high, the risk category of flooding to the site is not likely to increase due to climate change, although flooding is likely to be more frequent and to a greater extent. If a flood event did occur, the impact of climate change would result in an increase in the depth and extent of floodwater across the areas of the site affected by flooding from this source during a 1% (1 in 100 chance) event.

9.4.159 The Environment Agency climate change guidance was recently updated with revised sea level allowances up to the year 2125. Applying these sea level allowances to the existing (2019) scenario indicates water levels along the estuary could increase by 1.32 m. This would result in a rise up to 5.40 m AOD and 5.65 m AOD for the 0.5% AEP and 0.1% AEP respectively at the mouth of the estuary and up to 5.48 m AOD and 5.72 m AOD near Portrack. For details of different modelled scenarios refer to the Preliminary FRA (Appendix 9A, PEI Report, Volume III), as water levels do vary depending on the time horizons used in the analysis. In reality, given the expected lifetime of the Proposed Development, climate change flood water levels will be significantly less than those shown in Table 9A-17 with a decrease of 0.5 m for the Higher Central allowance water levels and a 0.68 m decrease for the Upper End allowance water levels.

9.4.160 The Phase 1 and Phase 2 production facilities will have a design life of 25 years. However, the operational life could be longer subject to market conditions and plant condition. At the end of its operational life, the most likely scenario would be that the Proposed Development would be closed, with all above ground structures on the Main Site removed, and the ground remediated as required by the Environmental Permit to facilitate future re-use.

9.4.161 The PEI Report has assumed that the Proposed Development could operate for longer than a 25 year design life. As such for flood risk the lifetime of the development is assumed to be 75 years for the purpose of the preliminary FRA, which

is in line with the lifetime of non-residential uses in the NPPF and Flood Risk and Coastal Change PPG.

9.4.162 The Environment Agency Long Term Flood Risk map (Environment Agency 2022b), which includes the Risk of Flooding from Surface Water (RoFSW), shows that the Main Site is generally at very low risk (less than 0.1% AEP). There are isolated pockets of low risk (between 0.1% and 1% AEP) throughout which appear to be associated with topographic low points. There are no pluvial flood flow routes crossing the Main Site as per Environment Agency mapping. Environment Agency mapping shows surface water flow routes and areas of ponding associated with watercourses and bodies of water across the Hydrogen Pipeline Corridor - refer to Figure 9-4: Risk of Flooding from Surface Water (PEI Report, Volume III).

9.4.163 The new updated climate change allowances published by the Environment Agency have been used for guidance in the Preliminary FRA (Appendix 9A, PEI Report, Volume III). This includes the tidal sea level allowance (Table 9A-8) and maximum scenario (Table 9A-9), the fluvial climate change allowance (Table 9A-10), the peak river flow allowance (Table 9A-11), the peak rainfall intensity allowance for 3.3% annual exceedance rainfall event (Table 9A-12) and the 1% annual exceedance rainfall event (Table 9A-13).

Decommissioning

9.4.164 It is considered that continued environmental improvements, tighter regulation at both national, regional and local scales, and environmental enhancements will lead to a gradual improvement over current baseline conditions in terms of water quality.

9.4.165 Climate change has the potential to significantly impact on drainage and flood risk, for example through increased storm intensity and changes in future rainfall patterns. However, the design of the Proposed Development will incorporate the climate change projections required by the Environment Agency to ensure that potentially increased surface water flows are accounted for and managed across the lifetime of the Proposed Development. Therefore, it is assumed that there will be no significant adverse changes to current baseline conditions within the next 28 years (assumed Proposed Development decommissioning date), and so the impact assessment within this chapter is undertaken against existing baseline conditions.

Importance of Receptors

9.4.166 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 Water Resource Receptors

WATER FEATURE	IMPORTANCE DESCRIPTIONS
Tees Bay	Water Quality: 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

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	Area, bathing waters) and UK legislation (Teesmouth and Cleveland Coast SSSI). Morphology: Low importance as a WFD Heavily Modified Waterbody, dominated in this area by breakwaters.
Tees Estuary	Water Quality: 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 wastewater, 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). The channel is also important for navigation and commercial activities (which also require maintenance dredging). Morphology: The Tees Estuary is considered of Medium importance for the assessment, taking into account interventions that are underway in the catchment. Its current status is of lower importance but due to significant modifications of the channel, particularly along the banks, and flow and tidal conditions being influenced by the Tees Barrage and breakwaters. Nonetheless, the Environment Agency and partners are delivering a number of projects (e.g. Tees Tideland Programme) designed to mitigate the ongoing ecological impact of historical physical modifications on the Tees estuary and tributaries. The current Programme is scheduled to be completed by the commissioning date of the proposed development, and thus it is considered to raise the importance classification to medium to reflect the ongoing improvements within the catchment.
The Fleet (Tees Estuary (S Bank) WFD waterbody)	Water Quality: 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. Morphology: The Fleet is considered a Low importance receptor for morphology on the basis of being substantially

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	modified by past land use, having an artificial cross section and being culverting over significant lengths.
Main's Dike	Water Quality: 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 >0.001 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. Morphology: 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	Water Quality: 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. Morphology: The Mill Race 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	Water Quality: 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. Morphology: Low importance due to being an artificial channelised watercourse, over-widened in places and with artificial banks.
Lackenby Channel	Water Quality: 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. Morphology: Low importance due to being an artificial, straight, channelised watercourse with artificial banks.
Kettle Beck	Water Quality: 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.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	Morphology: Low importance receptor on the basis of being largely artificial in character (i.e. straight ditch course with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Kinkerdale Beck	Water Quality: 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. Morphology: Low importance on the basis of being largely artificial in character (i.e. straight ditch course with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Knitting Wife Beck	Water Quality: 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. Morphology: Low importance receptor on the basis of being largely artificial in character (i.e. ditch course with steep banks) with deficiency of bedforms and significant stretches of culvert.
Ash Gill	Water Quality: Ash Gill 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. Morphology: Low importance receptor on the basis of being largely artificial in character (i.e. ditch course with steep banks) with deficiency of bedforms, and significant stretches of culvert.
Castle Gill	Water Quality: Castle Gill 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. Morphology: Low importance receptor for morphology on the basis of being largely artificial in character (i.e. ditch course with steep banks) with deficiency of bedforms, and stretches of culvert.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
Holme Fleet	Water Quality: Holme Fleet is considered a 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. Morphology: 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	Water Quality: Belasis Beck is considered a 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. Morphology: 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	Water Quality: 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. Morphology: Greatham Creek is considered a High importance receptor, since it displays a natural form upstream of the A178 road crossing, although modifications to the channel and adjacent land are evident downstream of the road crossing.
Mucky Fleet/ Swallow Fleet	Water Quality: 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. Morphology: High importance since they display a natural form, although historic modifications to connected drainage channels are likely to have altered the function of these watercourses.
Lake at Charlton's Pond Nature Reserve	Water Quality: The pond is considered High Importance for water quality due to having a local designation as a nature reserve. Morphology: The pond is considered to be of Low importance for morphology as an artificial waterbody originally constructed for clay extraction for the adjoining brickworks.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
Waterbodies within Coatham Marsh, Saltholme Nature Reserve and Bran Sands	Water Quality: 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. Morphology: Waterbodies at Coatham Marsh, Saltholme Nature Reserve and Bran Sands 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.
Pond 14 (open water pond) within Coatham Dunes – all other ponds in Coatham Dunes identified by mapping have now succeeded to fully vegetated wetlands and are not open water ponds requiring assessment.	Water Quality: Pond 14 is considered a Very High importance receptor for water quality as it is within the Teesmouth and Cleveland Coast SSSI and the Teesmouth and Cleveland Coast SPA designations. The Coatham Sands waterbodies and dune slacks provide habitat for bird populations, particularly redshank (*Tringa totanus*), who move inland to open water at high tide. Site survey has indicated that Pond 14 is the only waterbody remaining in the Coatham Sands dunes complex that has not succeeded to a fully vegetated wetland state, and therefore has particular importance as the sole area of open water habitat within the dunes. Morphology: Pond 14 is considered of Low Importance for morphology due to its artificial nature, having been formed from slag deposits from the adjacent former steelworks. All other waterbodies within Coatham Sands are fully vegetated wetlands and so are not considered to be ponds requiring assessment.
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.
Mercia Mudstone Group/ Redcar Mudstone Group	This is considered a Medium importance receptor. It is present beneath the Main Site, Water Connection Corridor, Electrical Corridor and parts of the Hydrogen Pipeline Corridor. Mercia Mudstone is a Secondary B aquifer and supports several abstractions for industry. Redcar Mudstone Group is Secondary (undifferentiated) aquifer. The bedrock is overlain by tidal flat deposits, blown sand, glaciolacustrine deposits, marine deposits and till (superficial deposits are

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	secondary A aquifer in the case of blown sand and otherwise Secondary (undifferentiated) aquifer).
Sherwood Sandstone Group	This is considered a Very High importance receptor. It is present beneath the Hydrogen Pipeline Corridor to the west of the Study Area, and is Principal Aquifer, supporting numerous abstractions. It is overlain in the Study Area by tidal flat deposits, glaciolacustrine deposits, and till which are generally Secondary (undifferentiated) aquifer.

Floodplain Sensitivity for Impact Assessment

9.4.167 For the construction assessment, the key receptor in terms of all forms of flood risk are the construction workers present on Proposed Development 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.

9.4.168 For the operational assessment, the importance is based on understanding of the receptors present within areas at risk of flooding (i.e. the Proposed Development and other infrastructure) and the existing risk of flooding from all sources. The floodplain around the Tees in the Study Area and within the majority of the Proposed Development Site is predominantly in Flood Zone 1, where sensitivity of the floodplain for impact assessment purposes is considered Low. The entirety of the Main Site is within Flood Zone 1, but there are notable areas of Flood Zone 2 and 3a associated with the connection corridors, and which relate to tidal and fluvial flooding. To the south of the Tees these areas are notably around Dabholm Gut, Lackenby Channel, the Mill Race and The Fleet. To the north of the Tees, there are similarly areas of Flood Zone 2 and 3a to the south of Seal Sands, around Haverton Hill and from Port Clarence north through Saltholme and Cowpen Marsh. Overall, it has been assessed that the Main Site and the majority of the connection corridors are at a 'low' risk of flooding from tidal sources. However, the section of the Hydrogen Pipeline Corridor crossing the River Tees and around Seal Sands and Cowpen Marsh are at 'high' risk of tidal and fluvial 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).

9.4.169 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, and mainly in connection with the Hydrogen Pipeline Corridor and Electrical Connection (refer to Figure 9-4: Surface Water Flood Risk (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.

9.5 Development Design and Impact Avoidance

9.5.1 The EIA process aims to avoid, prevent, reduce or offset potential environmental effects through design and/or management measures. These are measures that are inherent in the design and construction of the Proposed Development (also known as 'embedded measures').

9.5.2 The following impact avoidance measures have either been incorporated into the design or are standard construction or operational practices. These measures have, therefore, been taken into account during the impact assessment and will be secured through the draft DCO.

Construction

9.5.3 A Framework CEMP will be included within the ES which will accompany the DCO Application which will set out the key measures to be employed during the Proposed Development construction phase in order to control and minimise the impacts on the environment – including the minimisation of water environment effects. A Final CEMP will be prepared by the construction contractor in accordance with the Framework CEMP prior to construction. The submission, approval, and implementation of the Final CEMP will be secured by a Requirement of the draft DCO.

Surface Water

9.5.4 During Proposed Development construction, water pollution may occur directly from spillages of polluting chemical substances into water features, or indirectly by being conveyed in runoff washed off from hard standing, other sealed surfaces or from construction machinery. Site clearance and remedial works on the Main Site and where construction compounds and laydown areas are required (e.g. at the Teesworks site) may require the dismantling and removal of existing drainage infrastructure, removal of compounds and targeted removal of underground obstructions, all of which may contain or interact with liquid chemicals and wastewater. This will be managed by the remediation contractor with contaminated water either treated onsite or removed from site for disposal in accordance with a suitable Remediation Strategy (refer to Chapter 10: Geology, Hydrogeology and Contaminated Land (PEI Report Volume I) for further detail).

9.5.5 Fine sediment may be disturbed in water features directly, wash off working areas and hard standing (including approach roads) into water features indirectly via existing drainage systems or overland or be generated by the need to dewater excavations. Due to past industrial activity, this sediment may not be inert and may potentially contain chemical contaminants that could cause water quality to deteriorate and be harmful to the aquatic environment. However, potential impacts to the water environment during the construction phase will tend to be temporary and short term.

9.5.6 As detailed above, prior to the construction of the Proposed Development beginning, a Final CEMP will be prepared by the construction contractor. The Final CEMP will describe the principles for the protection of the water environment during construction. Within the Final CEMP as a technical appendix will be a Water Management Plan (WMP) which will outline the mitigation measures necessary to avoid, prevent and reduce adverse effects where possible upon the local surface water (and groundwater) environment during construction.

9.5.7 More specifically, the WMP will include an outline of responsibilities with regard to water management, required water quality monitoring, pollution prevention measures, training requirements for construction workers with regard to the water environment, an outline of likely relevant permissions and consents required, and a Pollution Incident and Response Plan.

9.5.8 The Framework CEMP that will form part of the ES 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. 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 and adapted as construction works progress in response to different types of work, weather conditions and locations of work.

9.5.9 Finally, where not disapplied through the DCO, there may be the need for a number of secondary permissions for temporary and potentially some permanent works affecting watercourses or groundwater (e.g. flood risk activity permits, water activity permits, land drainage consents, and abstraction/impoundment licences). At this stage it is reasonable to assume that all temporary works will be carried out under the necessary consents/permits and that the contractor will comply with any conditions imposed by any relevant permission, or otherwise the matters covered by these secondary consents will be covered by the provisions of the DCO.

Good Practice Guidance

9.5.10 The following relevant Guidance for Pollution Prevention (GPPs) have been released to date on the NetRegs website (NetRegs, n.d.) and are listed below. While these are not regulatory guidance in England where the UK government website outlines regulatory requirements, it remains a useful resource for best practice. The best practice approaches will be secured through the CEMP:

- GPP 1: Understanding your environmental responsibilities – good environmental practices;
- GPP 2: Above ground oil storage;
- GPP 3: Use and design of oil separators in surface water drainage systems;
- 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;
- GPP26: Safe storage – drums and intermediate bulk containers; and
- GPP 27: Installation, decommissioning and removal of underground storage tanks.

9.5.11 Where new GPPs are yet to be published, previous Environment Agency Pollution Prevention Guidance (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 will be carried out in accordance with guidance contained within the following PPG:

- PPG6: Working at construction and demolition sites (Environment Agency, 2012);
- PPG7: Safe storage – the safe operation of refuelling facilities (Environment Agency, 2011); and
- PPG18: Managing fire water and major spillages (Environment Agency, 2000).

9.5.12 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 (second edition) (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);

- C532 (2001) Control of water pollution from construction sites – Guidance for consultants and contractors (CIRIA, 2001); and
- C736F Containment systems for prevention of pollution (CIRIA, 2014).

Management of Construction Site Run-off

9.5.13 Measures to manage fine sediment in surface water runoff as a result of construction activities will be included in the Framework CEMP and will be developed with further detail in the WMP (to be included in the Final CEMP). There are a wide range of measures that can be adopted by the contractor to reduce the risk of excessive fine sediment in runoff (e.g. the timing of works, minimising earthworks and seeding or covering them), to intercept runoff to prevent uncontrolled runoff from the Proposed Development Site (e.g. by using cut off drains, fabric silt fences and matts (in channel), bunds and straw bales (that may be placed in small channels), designated areas for cleaning plant and equipment, wheel washes and road sweepers), and to treat runoff to remove excessive levels of fine sediment (e.g. settlement lagoons, sumps, spraying on to land or proprietary measures such as lamella clarifiers, flocculation etc.). It will be for the contractor to continually monitor the need for measures depending on the nature of the works being undertaken, the weather conditions, and the performance of sustainable drainage systems installed.

Management of Construction Chemical Spillage Risk

9.5.14 Measures will be implemented to manage the risk of accidental spillages on the Proposed Development Site and potential conveyance to nearby water features via surface runoff or land drains. These measures relating to the control of spillages and leaks will be summarised in the Framework CEMP submitted with the ES and will be included in the WMP in the Final CEMP and adopted during the construction works. Measures will be in accordance with prevailing pollution prevention legislation and following best practice guidance summarised earlier. They will include details of how fuel and other chemicals (including cementitious products) will be stored, used on site, and equipment and plant cleaned, as well as how leaks and spillages will be prevented or remediated if needed. This will also include the implementation of a Pollution Prevention Plan and an Emergency Response Plan, which would both be technical appendices to the Final CEMP (and hence secured in the DCO). 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.

Management of Construction Dewatering

9.5.15 To minimise the impact of the dewatering on groundwater and surface water receptors where pipeline construction or deep excavations are required, a Construction Dewatering Strategy will be prepared by the construction contractor in accordance with a Groundwater Risk Assessment to be developed post consent. The purpose of the Construction Dewatering Strategy will be to:

- review ground investigation data and estimate volume of water that may need to be dewatered and the likely quality of that water;

- consider how phasing/sequencing of excavations will influence the amount of water that may need to be managed at any given time;
- undertake a feasibility assessment of options to remove water, including undertaking appropriate ecological and hydromorphological surveys, and hydraulic modelling (if necessary). Disposal options may include, but are not limited to:
  - re-use of water on-site (e.g. for dust suppression);
  - discharge to local watercourses;
  - spraying to nearby fields.

9.5.16 At this stage the preferred option is to discharge any groundwater abstracted from dewatering activities to a watercourse (where it may compensate for any reduction that might occur from localised lowering of the groundwater table temporarily).

9.5.17 When discharging water to a nearby watercourse the rate of discharge will need to be agreed with the Environment Agency to ensure that there is no unacceptable increase in flood risk or risk of scour. Where the required rate of discharge to keep the excavations dry exceeds what may be allowed to a single watercourse, additional locations for discharging the water will need to be provided or storage provided. Any discharge will need to be undertaken with the agreement of the relevant statutory regulator and will need to comply with the pollution prevention requirements set out in the Final CEMP.

9.5.18 If groundwater contains high concentrations of suspended fine sediment, this will be filtered by using storage basins and in combination with other proprietary measures (for example lamella clarifiers).

Construction of Hydrogen Pipeline Corridor – Trenchless Crossings

9.5.19 A gaseous phase hydrogen pipeline network is required to connect various potential industrial off-takers across the Tees Valley to the Production Facility at the Main Site. This will require crossings of numerous watercourses.

9.5.20 The Hydrogen Pipeline is expected to be 24 inches (i.e., 60.96 cm) in diameter and while being primarily above ground, it would cross the Tees Estuary and Greatham Creek (and adjacent water features at Seal Sands) using trenchless technologies (Horizontal Direction Drilling (HDD) or Micro Bored Tunnelling (MBT). The Hydrogen Pipeline Corridor is shown in Figure 4-4: Hydrogen Pipeline Corridor (PEI Report, Volume II).

9.5.21 The use of trenchless technologies avoid any direct impact to the estuary bed, associated sediment mobilisation and scour. The drilling will be approximately 10-15m below the bed to ensure that there is no risk of exposure, and this buffer distance will be agreed with the Marine Management Organisation (MMO).

9.5.22 In addition to the control and management measures for site runoff and spillage risk noted above, the methodology of the drilling, or other trenchless techniques, will include measures to minimise the risk to the environment. There are risks associated

with the use of drilling muds and plant close to the channel. For example, although rare, without due care there is a risk that drilling muds can 'break out' into watercourses leading to pollution (known as 'hydraulic fracture' or 'frac-out' event).

9.5.23 A site-specific Hydraulic Fracture Risk Assessment will be developed prior to construction following further investigation of specific ground conditions at the crossing locations, and appropriate mitigation developed in line with best construction practice. The drilling fluid that returns to the drilling rig is recycled within that drilling rig. Any wastewater/drilling products that are not recycled will be stored and removed by a suitable waste management contractor and disposed of at a licensed wastewater facility.

9.5.24 The sections of the Hydrogen Pipeline Corridor that will be installed via trenchless techniques will require launch, reception and jointing pits to be installed. It is assumed for the purposes of the assessment that the pit excavations for drilling/boring will be located at least 10 m from the watercourse, as measured from the top of bank, under which they will be directional drilled.

9.5.25 The exact dimensions of the launch and receive pits will be determined by site and ground conditions but will be kept to a safe minimum in terms of length, width and depth. Such pits are typically 5 m long x 5 m wide x 3 m deep. Maximum parameters for the pit dimensions will be confirmed for the ES. A shoring system appropriate to the ground conditions will be used as appropriate to minimise water ingress into the pits. This may be timbers, sheet piling, or a modular system and will be chosen based on suitability for the site conditions. The ingress of any groundwater will be carefully managed through design of the launch or reception pit, shoring method, and a pumping and treatment system. Excessive ingress of water will make the pit unsafe and thus it is important that ingress is minimised and that a suitable system of managing that water is implemented.

9.5.26 Once the Hydrogen Pipeline is installed beneath the watercourse, the pits and any trenches will be backfilled to the original ground level and seeded to reduce the risk of runoff and fine sediments entering watercourses. The drill fluids used within the drilling machine will be water based, such as naturally occurring bentonite clay. The fluid component of the drilling mud will be mains water, obtained from a nearby supply and tankered to site when required. There will be some recycling of drilling muds by the drilling plant used.

9.5.27 The bentonite within the drilling fluid is a naturally occurring mineral and enables the fluid to have sufficient viscosity to carry the cutting chips back to the surface machine whilst lubricating and keeping cool the drilling bit. Directional drilling, or other trenchless techniques, will be undertaken by a specialist contractor and the water column above the drill path will be continuously monitored during drilling. It is noted that drill fluid leakage into a watercourse is not a common problem, particularly given the proposed depths. However, where there is an increased perceived risk (i.e. lack of drilling mud returns), the drilling/boring operation will be suspended, remediation action implemented, and subsequently the methodology for that crossing re-evaluated. Measures to avoid Frac-out will be set out in the ES to accompany the DCO application.

Construction of Hydrogen Pipeline Corridor – Above Ground and Open-Cut Crossings

9.5.28 Various route options and construction methodologies are being considered for the remainder of the Hydrogen Pipeline Corridor (aside from the trenchless crossings discussed above). These include an option for below ground open trench (buried), installation on existing above ground pipe racks, and repurposing and reuse of existing pipelines (where possible). However, this is subject to ongoing design work, discussions with landowners and statutory consultees as well as being informed by environmental surveys.

9.5.29 For the majority of the Hydrogen Pipeline Corridor south of the River Tees, it is proposed to route along existing established pipeline corridors (generally above ground) where possible. There may be a need to cross the following watercourses:

- The Mill Race (approximate NGR NZ 57329 23682);
- Mains Dike (approximate NGR NZ 58121 22905 and NZ 57448 23552); and
- The Fleet (Tees Estuary S Bank WFD waterbody) (approximate NGR NZ 56765 23730).

9.5.30 These are all assumed to be above ground crossings utilising existing pipe bridges. Belasis Beck (approximate NGR NZ 48313 23194) to the north of the Tees off Cowpen Bewley Road will also be constructed above ground (NZ 48313 23194).

9.5.31 The following watercourse pipeline crossings to the north of the Tees Estuary are assumed to require open cut methods for installation:

- Belasis Beck (at approximate NGR NZ 49397 23941); and
- Unnamed watercourses at NZ 51111 24826, NZ 49147 24367 and NZ 51221 26296.

9.5.32 The exact number of watercourse crossings and their methodology will be fully assessed during the EIA and reported in the ES. Where open-cut installation of pipelines is required, the following mitigation will be implemented.

9.5.33 A pre-works morphology survey of the channel of each watercourse to be crossed will be undertaken prior to construction. The pre-works survey is to ensure that there is a formal record of the condition of each watercourse prior to commencement of works to install cables beneath the channel. The survey is a precautionary measure so that should there be any unforeseen adverse impacts there is a record against which any remedial action can be determined.

9.5.34 At this stage it is assumed that where open-cut crossings are required that water flow will be maintained by damming and over pumping or fluming. Works will be carried out in the drier months where possible as this will reduce the risk of pollution propagating downstream, particularly in the case of ephemeral watercourses. Once the watercourses are reinstated, silt fences, geotextile matting or straw bales will be used initially 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 and water quality monitoring will be undertaken prior to, during, and following on

from the construction activity. Regular observations of the watercourses will also be required post-works during vegetation re-establishment of the banks, especially following wet weather, to ensure that no adverse impacts have occurred. These requirements will be secured in the WMP, that will form a technical appendix of the Final CEMP.

Construction of Water Connection Corridor

9.5.35 Raw water will be supplied via the existing NWL raw water supply to the Teesworks site. There would also be a connection to NZT for use of the discharge outfall (for Case 2A and Case 2B) and a potential route for a Demineralised Water connection between the Main Site and Wilton International. At this stage in the design development, the water connections may be entirely above or below ground or a combination of the two. Agreements with NWL and the NZT project will be sought through the ongoing DCO process where required.

9.5.36 Applying the Rochdale Envelope approach, the land required for the water connection options currently proposed for the Main Site has been depicted as a broad corridor. There is potential for watercourse crossings within the corridor depending on the final arrangement of infrastructure. The locations are not known at this stage, but affected watercourses may include the Fleet (Tees Estuary S Bank), Mains Dike and Dabholm Beck. At this stage, and applying a precautionary worst-case scenario, it is assumed that all of these watercourses will be crossed using open-cut techniques, following the mitigation outlined above with regard to the Hydrogen Pipeline Corridor.

Construction of Gas Connections

9.5.37 Gas connection pipelines may be required for the transportation of compressed O_2 and N_2 for use at the Production Facility (this is referred to as the 'Other Gases Connection Corridor', shown by Figure 4-8: Other Gases Connection Corridor (O_2 and N_2) (PEI Report, Volume I)). At this stage in the design process, the connections for other gases may be entirely above or below ground or a combination of the two. There is potential for watercourse crossings relating to the Fleet (Tees Estuary S Bank), Mains Dike and Dabholm Beck. At this stage, and applying a precautionary worst-case scenario, it is assumed that all of these watercourses will be crossed using open-cut techniques, following the mitigation outlined above with regard to the Hydrogen Pipeline Corridor.

9.5.38 As outlined in Chapter 4: Proposed Development (PEI Report, Volume I), CO_2 captured and compressed after metering will be exported from H2Teesside to the NEP CO2 gathering network on the adjacent NZT site via a CO_2 export connection pipeline. No watercourse crossings are known to be required to facilitate installation of this connection at this stage, but this will be confirmed for the ES.

9.5.39 Similarly, natural gas will need to be imported to the Production Facility for use in the reforming process. At this stage, it is anticipated that a pipeline will be constructed which will connect the Production Facility at the Main Site to an existing pipeline. Again no watercourse crossings are known to be required to facilitate installation of this connection at this stage, but this will be confirmed for the ES.

Construction of Electrical Connection Corridor

9.5.40 There is existing electrical infrastructure in the area which comprises a combination of overhead and lower voltage underground cables that serve the local area and other industrial users located in proximity to the Proposed Development Site. The final decision on substation choice will be subject to design development and further work based on constructability and electrical network resilience and capacity.

9.5.41 At this stage in the design development, the electrical connection may be entirely above or below ground or a combination of the two. The Electrical Connection Corridor is currently depicted as broad corridors.

9.5.42 There is potential for watercourse crossings within these corridors depending on the final arrangement of infrastructure. The locations are not known at this stage, but affected watercourses may include:

- The Fleet (Tees Estuary S Bank);
- Mains Dike;
- Dabholm Beck;
- Kinkerdale Beck;
- The Mill Race;
- Cross Beck; and
- Knitting Wife Beck.

9.5.43 At this stage, and applying a precautionary worst-case scenario, it is assumed that all of these watercourses will be crossed using open-cut techniques, following the mitigation outlined above with regard to the Hydrogen Pipeline Corridor.

9.5.44 Where there is a need for transformers and switchgear, these will be bunded given that they may contain hydraulic oils.

Water Quality Monitoring

9.5.45 During construction of the Proposed Development, it is proposed to undertake a water quality monitoring programme to ensure that mitigation measures are operating as planned and preventing pollution. This is standard practice for construction works of this type, and full details will be outlined in the WMP accompanying the Final CEMP. The purpose of the monitoring programme will also be to ensure that should pollution occur it is identified as quickly as possible and appropriate action is taken in line with the Pollution Prevention Plan.

9.5.46 The water quality monitoring programme will be developed by the contractor in consultation with the Environment Agency and MMO and will also reflect any requirements of secondary environmental permits/licences for works affecting, or for temporary discharges to, watercourses within the Proposed Development Site.

Management of Flood Risk

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

possible. During the construction phase, the contractor will monitor weather forecasts and plan works accordingly. 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.

9.5.48 If water is encountered during below ground construction, suitable de-watering methods will be used with reference to a Construction Dewatering Strategy (see below). Any significant groundwater dewatering that is required (i.e., more than 20 m^3 per day) will be undertaken in line with the requirements of the Environment Agency (under Water Resources Act 1991 as amended) and Environmental Permitting Regulations (2016).

9.5.49 Safe egress and exits are to be always maintained when working in excavations. When working in excavations a banksman is to be always present. Refer to the Appendix 9A: Preliminary FRA (PEI Report, Volume III) for further details of flood resistance and resilience measures.

Operation

8.1.1 The Production Facility will require an Environmental Permit and will comply with this under the Environmental Permitting (England and Wales) Regulations 2016. In addition, the Proposed Development will be operated in line with appropriate standards, whilst the operator will implement and maintain an Environment Management System (EMS) which will be certified to International Standards Organisation (ISO) 14001. The EMS will outline requirements and procedures required to ensure that the Proposed Development Site is operating to the appropriate standard.

9.5.50 The source of water to supply the Proposed Development will be the existing raw water pipeline feed, which is an existing licensed abstraction from the River Tees formerly used to supply Redcar Steelworks.

9.5.51 The effluent streams from the Proposed Development will include process water (e.g. process condensate from the reforming process, cooling tower blowdown water and demineralisation plant rejects), surface water runoff and foul effluent. Plates 9-2a to 9-2d below show flow diagrams summarising the Proposed Development's water balance for both Case A and Case B of the Proposed Development (for process and foul water, but not including surface water runoff which is described further below). As set out in Chapter 4; Proposed Development (PEI Report, Volume I), the two 'cases' reflect different technology options for blue hydrogen production, autothermal reforming technology (ATR) and low carbon hydrogen (LCH) technology, respectively. Each of the approaches have different water demands and produce different qualities of process returns.

9.5.52 In addition, two further 'cases' are under consideration in terms of process effluent management. Case 1 is based on Minimalised Liquid Discharge (MLD) from the

Proposed Development's Effluent Treatment Plant. In this scenario treated wastewater from the Effluent Treatment Plant will be reused as makeup water in the Proposed Development's Water Treatment Plant. A low-volume liquid waste stream containing salts and nutrients would be taken offsite for disposal (outside of the Teesmouth and Cleveland Coast SPA catchment). Case 2 is an alternative to MLD and requires discharge of process effluent to the NZT project outfall at Tees Bay.

9.5.53 Surface water runoff from the Proposed Development will be partially used to feed the process but will have an alternative disposal route to Dabholm Gut or Tees Bay. This is described further below.

9.5.54 The various 'cases' for the Proposed Development are summarised in Table 9-17. Note that this does not include management of surface water runoff which is discussed further below.

Table 9-17 Summary of the Four Cases Being Considered for the Proposed Development

	CASE 1A	CASE 1B	CASE 2A	CASE 2B
Technology	Autothermal reforming technology	Low carbon hydrogen - Gas Heated Reformer - ATR combination process	Autothermal reforming technology	Low carbon hydrogen - Gas Heated Reformer - ATR combination process
Process Wastewater Disposal	Minimalised Liquid Discharge – treated wastewater from the Effluent Treatment Plant will be reused as makeup water in the Proposed Development's Water Treatment Plant. A low-volume liquid waste stream containing salts and nutrients would be taken offsite for disposal (at a facility outside of the Teesmouth and Cleveland Coast SPA catchment)	Minimalised Liquid Discharge – treated wastewater from the Effluent Treatment Plant will be reused as makeup water in the Proposed Development's Water Treatment Plant. A low-volume liquid waste stream containing salts and nutrients would be taken offsite for disposal (at a facility outside of the Teesmouth and Cleveland Coast SPA catchment)	NZT Outfall to Tees Bay	NZT Outfall to Tees Bay

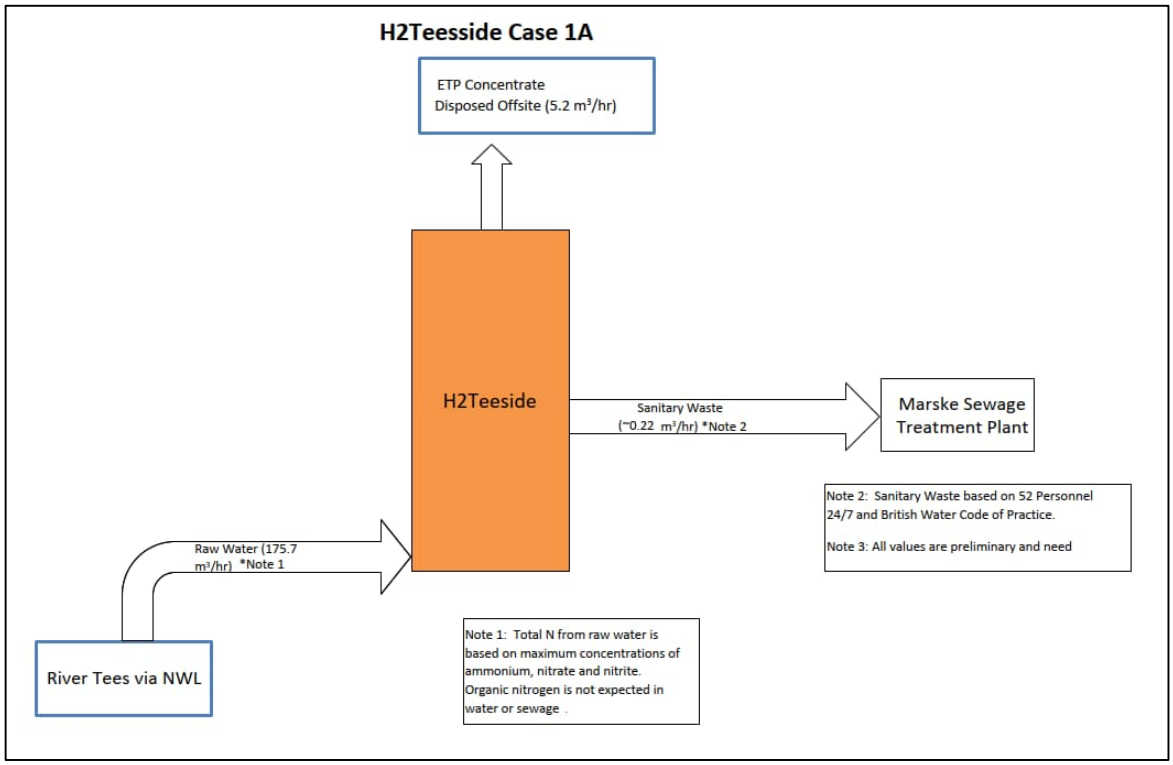

Plate 9-2a: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 1A[1]

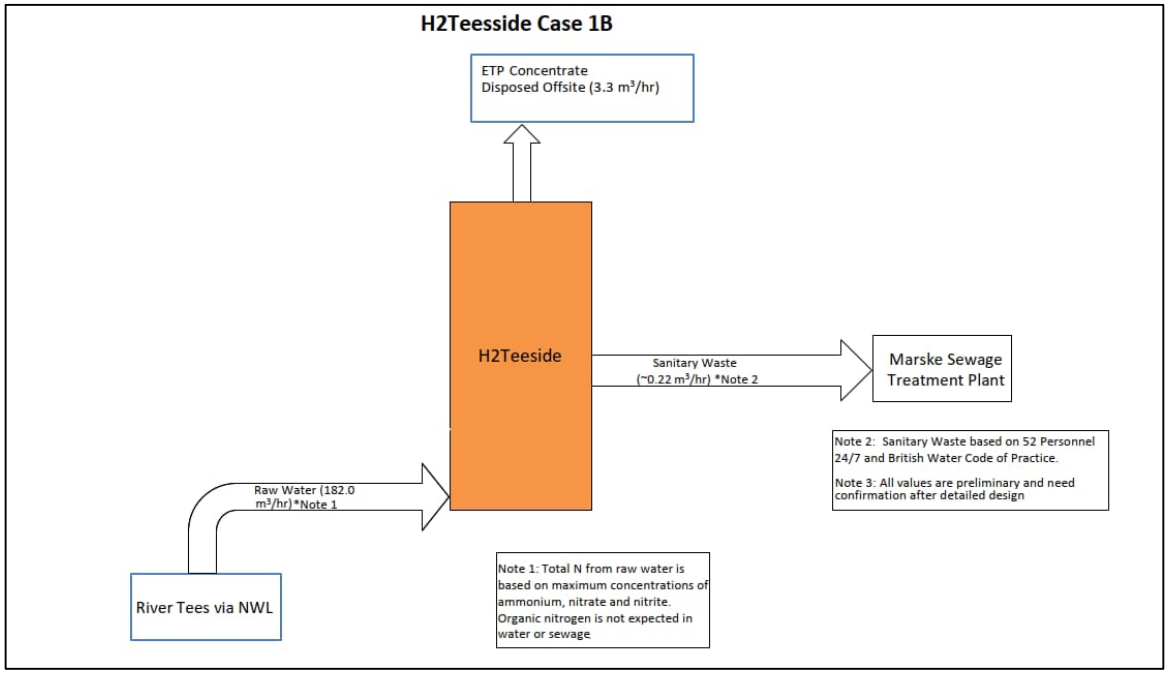

Plate 9-2b: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 1B

[1] Sanitary wastewater volume presented in Plate 9-2a to 9-2d is based on a 52 personnel peak during weekday shifts. However, it should be noted that operations staffing will be on a shift basis to be spread over a 24-hour period and so personnel numbers will vary.

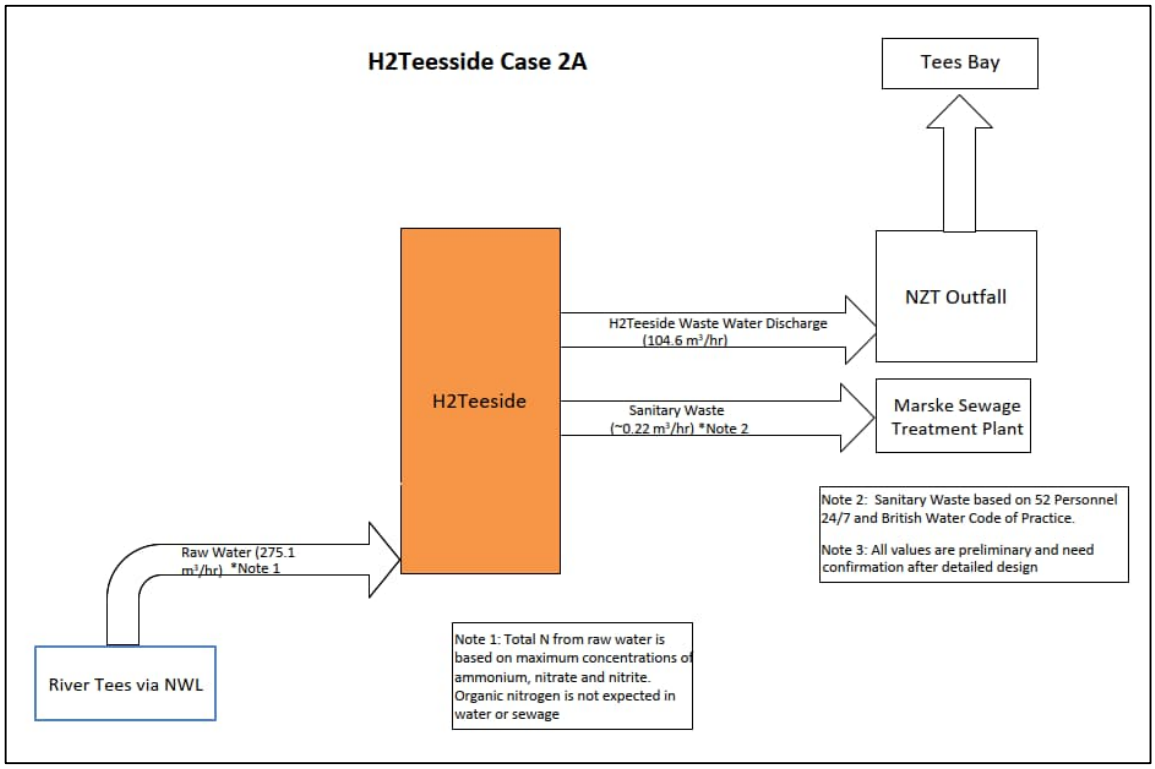

Plate 9-2c: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 2A

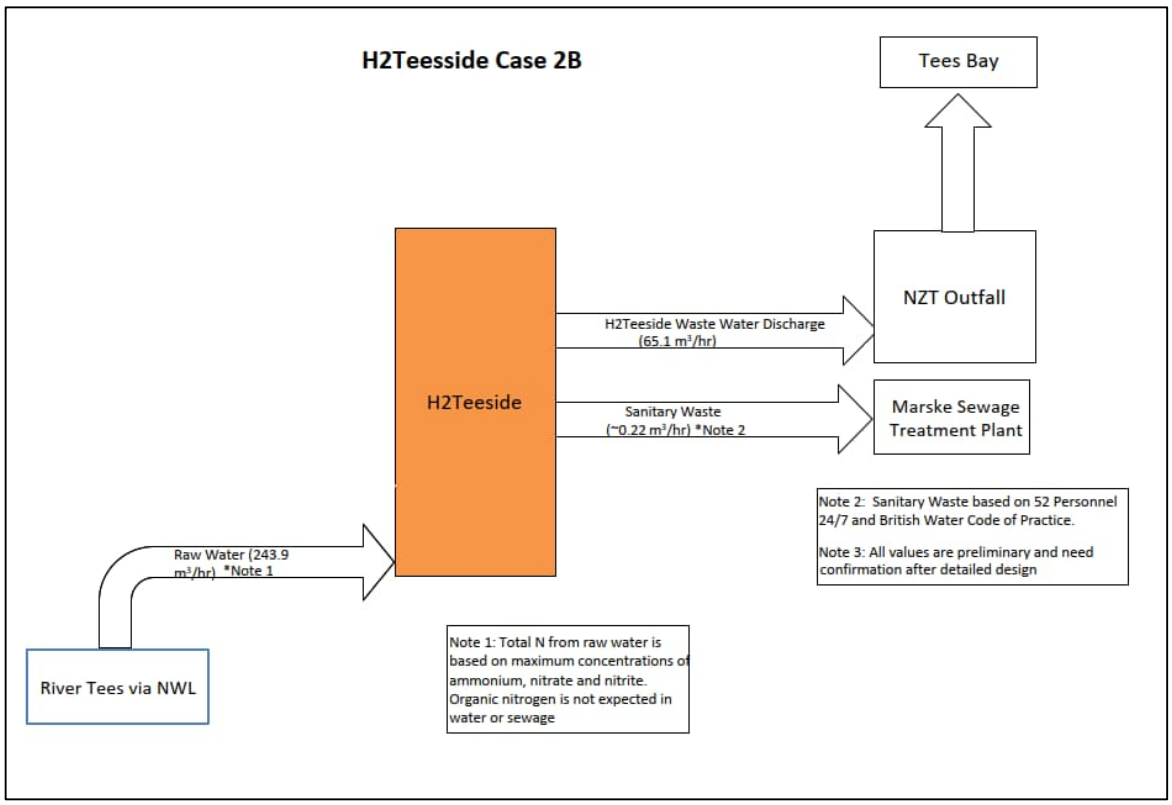

Plate 9-2d: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 2B

9.5.55 Further details regarding water demand, surface water drainage, process wastewater and foul wastewater are described below. A number of mitigation features will be incorporated into the Proposed Development design in order to avoid, minimise and reduce potential adverse impacts on water features, water resource and flood risk - these are also described in the following sections where relevant.

Water Demand

9.5.56 There is a significant clean water requirement for the Proposed Development comprising the elements listed in Table 9-18.

Table 9-17 Clean Water Requirement for the Proposed Development[2]

WATER REQUIREMENT	CASE 1A & 2A (M^3/HR) (PHASE 1&2)	CASE 1B & 2B (M^3/HR) (PHASE 1&2)
Cooling water make-up	144	114
Utility water	10	10
Firewater make up	Normally no flow	
Demineralised water for boiler feed water make-up, chemicals, CO2 absorber and HCl scrubber	220	104

9.5.57 Water is to be supplied via the existing NWL's raw water pipeline feed from the River Tees. However, at the time of writing (August 2023), consultation is ongoing with NWL to confirm this arrangement. Treatment is required to the supplied water to produce the desired water quality for utility water/cooling water make-up, firewater and for producing demineralised water.

Surface Water Drainage

9.5.58 A new surface water drainage network and management system will be provided for the Main Site that will provide adequate interception, conveyance, and treatment of surface water runoff from buildings and hard standing. This will be separate to foul systems for welfare facilities and process wastewater generated by the operation of the Proposed Development Site. The connection corridors will not require additional drainage as they will be using existing pipe racks, pipe bridges, culverts or otherwise installed underground.

9.5.59 Surface water drainage will discharge to Tees Estuary via Dabholm Gut or Tees Bay. There are three options for this route: 1) direct feed to Dabholm Gut (with any new pipework and outfall to be consented under a subsequent planning application); 2) discharge via the existing Brans Sands discharge pipeline (but not requiring treatment at Brans Sands WwTW as this is surface water runoff); or 3) discharge via the NZT outfall.

[2] See Table 9-16 for definition of Cases

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

9.5.61 A Surface Water Drainage Strategy will be defined in consultation with the Environment Agency, the LLFA (RCBC and STBC) and other statutory agencies and will be a Requirement of the DCO. The principles of the Drainage Strategy are outlined in the H2 Teesside PreFEED Vent and Drain Philosophy (Worley, 2023) as follows:

- segregate hazardous and non-hazardous effluent;
- contain leaks and accidental spills via carefully designed collection system;
- establish requirement to segregate collection and to eliminate cross contamination prior to recovery and disposal;
- identify recovery and recycle interfaces for the drained fluids;
- ensure safe design with access for maintenance and inspection; and
- account for normal operations, maintenance draining and drainage during an emergency.

9.5.62 The proposed surface drainage system will include the use of SuDS where possible, to enable attenuation of surface water flows due to increases in the impermeable area as a result of the Proposed Development. SuDS will also provide treatment of surface water runoff to ensure potential adverse effects on water quality in receiving watercourses are avoided. SuDS and the treatment train will be selected with reference to the Simple Index Approach of the SuDS Manual (CIRIA, 2016), although a more precautionary approach may be taken due to the industrial land use, which may increase the risk.

9.5.63 The key objectives of the site surface water drainage system are to provide a drainage system which is inherently safe and protects the local environment and the anticipated outfall from accidental discharges of oil, chemicals or run-off from firefighting effluent. Clean, uncontaminated storm water will be segregated from potentially contaminated water. Gravity drainage will be used wherever practicable. Spillage containment measures such as penstocks will also be included in the drainage design.

9.5.64 Process operations on site will require the storage and use of a range of potentially polluting chemicals. These may be associated with washdown water, tank water draw-offs, pump equipment drips and drains, draw-offs from sample connections, instruments, drain cocks and similar equipment fittings and other routinely contaminated wastewater streams. The surface water drainage system for areas of site drainage that may contain chemical pollutants from minor leaks and spills (i.e., surface water drainage near chemical storage tanks or overlying pipework etc.) will therefore need to be separated from the main ‘clean’ surface water drainage system

using appropriate methods such as kerbs, bunds, sumps. Bunded areas may contain valves that can remain closed until the water stored in the bunded area has been tested. Where water is contaminated, this will be directed to the on-site package treatment plant and will be subject to a requirement of an Environmental Permit.

9.5.65 In addition to the above sources of surface water, under exceptional circumstances firewater may be generated. Fire-fighting water may contain chemicals that can be harmful to the water environment. Therefore, the surface water drainage system will include a retention basin to intercept the first flush of potentially contaminated fire-fighting water and divert it away from the existing surface water SuDS system. The contaminated fire water would then be stored prior to being pumped out for appropriate off-site disposal at a licensed waste facility. The storage requirements and the method by which fire-fighting water is diverted (i.e. an automatic or manual operated system) will be further determined in consultation with the EA, LLFAs and the Fire Service post-DCO consent during detailed design.

9.5.66 A Surface Water Drainage Strategy will be developed (as a Requirement of the DCO) which will outline the consequences for the drainage system should the Proposed Development close or be decommissioned. It is envisaged that a Surface Water Maintenance and Management Plan will also be provided by the future site operator. This will detail the requirements of access and frequency for maintaining all drainage systems proposed on the Proposed Development Site. The maintenance regime must be properly implemented to ensure all treatment measures and processes operate as intended for the lifetime of the Proposed Development. It is anticipated that this will be prepared during the detailed design stage.

Process Wastewater

9.5.67 Process waste waters will be generated on Proposed Development Site as follows:

- boiler blowdown (Case A and B) – this will generally be of good quality with some residual TDS that will need removal for use as demineralisation water;
- process condensate (Case A) - this has residual methanol and ammonia that requires removal to prevent a source of organics and nutrients that can lead to biological growth and biofouling; and
- process condensate (Case B) - this has high ammonia, methanol, carbon dioxide, methane and hydrogen that need removal before it can be discharged; and
- hazardous liquid wastes – to be taken off-site (e.g. amine).

9.5.68 Process condensate will be treated by a dedicated on-site Water Treatment Plant. The treated process condensate will be reused as makeup water in the Water Treatment Plant and so will not be discharged.

9.5.69 Other wastewater streams (cooling tower blowdown and demineralisation plant rejects) will be treated in an Effluent Treatment Plant (ETP). Case 1A and 1B is based on Minimalised Liquid Discharge from the ETP. The treatment configuration in the ETP will be ultrafiltration followed by reverse osmosis (close circuit or staged) to provide > 95% recovery of the wastewater (including chemical rejects during the membrane cleaning process). The non-chemical rejects from the ultrafiltration will

flow to a clarifier and the settled solids dewatered and disposed offsite as a wet cake. The reverse osmosis rejects/concentrate will produce a liquid waste stream containing salts and a quantity of nutrients. This will be transported off-site for further treatment. The treated wastewater from the ETP will be reused as make-up water in the Water Treatment Plant.

9.5.70 Case 2A and 2B represents an alternative to Minimalised Liquid Discharge. In this case, wastewater would be discharged via the NZT outfall to Tees Bay.

9.5.71 The continuous flows of effluent are summarised in Plate 9-2a-d. In Case 1A and 1B there would be an overall continuous flow of liquid waste from the ETP for offsite disposal of 5.2 m^3/hr or 3.3 m^3/hr, respectively. For Case 2A and 2B there would be an overall continuous flow of process water effluent to be discharged to Tees Bay via the NZT outfall (or alternatively to Brans Sands WwTW) of 104.6 m^3/hr or 65.1 m^3/hr, respectively.

9.5.72 As outlined above, at this stage two options remain for disposal of treated process water and liquid waste depending on which of the four 'cases' is taken forward. The first option is transport of liquid waste (concentrate sludge/waste) off-site for further treatment based on Minimalised Liquid Discharge from the ETP. The second is discharge of treated process water to the Tees Bay outfall that will be constructed as part of the NZT project, where it will have to meet the standards required by the discharge permit (in combination with cumulative impacts from NZT discharges). If there is discharge of process wastewater to the outfall at Tees Bay, then it is assumed that the wastewater discharge will meet the requirements of the Best Available Techniques (BAT) Reference Document (BREF) for Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector 2016 (EC JRC, 2016).

9.5.73 Amine contaminated water will be contained and where possible should be recovered and recycled for use within the process, or otherwise will be taken off-site by tanker to a specialist treatment plant. Surface water runoff from uncovered external paved areas of the Proposed Development site containing amine equipment, which during normal operation is expected to result in chemical drips, leaks and minor spill and which could be contaminated, will be located within minimised local kerbed areas and be routed to the amine drain vessel for offsite disposal.

9.5.74 Should treated wastewater be discharged to Tees Bay, the indicative effluent quality is currently expected to be as shown in Table 9-19. This will be reviewed during the EIA and reported in the ES.

Table 9-18: Indicative Effluent Quality Following Treatment

DETERMINAND	CONCENTRATION	EQS
Total Suspended Solids	5-35 mg/l	
Total Organic Carbon (TOC)	10-33 mg/l	

DETERMINAND	CONCENTRATION	EQS
Chemical Oxygen Demand	30-100	
Chromium	5-25 µg/l	0.6 µg/l (long term mean)
Copper	5-50 µg/l	3.76 µg/l (dissolved, where DOC ≤1mg – salt water EQS, long-term mean)
Nickel	5-50 µg/l	8.6 µg/l (annual average)
Zinc	20-300 µg/l	6.8 µg/l (plus ambient background concentration, long-term mean)
Total Nitrogen	15 mg/l (annual mean) 40 mg/l (daily maximum)	
Total Phosphorus	0.5-3.0 mg/l	
Adsorbable Organically Bound Halogens	0.1-0.1 mg/l	

9.5.75 Water sampling facilities are to be provided for manual sampling of water prior any required discharge (dependent of which 'case' is progressed). The frequency of testing and parameters to be tested will be agreed with the permitting authority.

Foul Wastewater

9.5.76 Sanitary wastewater from welfare facilities will be at NWL's Marske-by-the-Sea WwTW. It is assumed given the relatively low volumes of foul effluent anticipated from the Proposed Development that NWL will treat this within their consent limits and in accordance with requirements to not cause deterioration or prevent improvement under the WFD.

Management of Hazardous Substances on Site

9.5.77 The use of the chemical products at the Proposed Development Site 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).

9.5.78 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. The Emergency Response Plan will set out the emergency spill control procedure that will include the actions adapted from the Health and Safety

Executive's Emergency Response/Spill Control Technical Measures Document (Health and Safety Executive, n.d.).

9.5.79 Further guidance to be consulted in development of the site Emergency Response Plan 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).

Decommissioning

9.5.80 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 and the ground remediated to enable future re-use.

9.5.81 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.

9.5.82 A Decommissioning Environmental Management Plan (DEMP) will be produced pursuant to a DCO Requirement. The DEMP will consider in detail all potential environmental risks and contain guidance on how risks can be removed, mitigated or managed. This will include details of how surface water drainage should be managed at the Proposed Development Site during decommissioning and demolition.

Permits, Licences and Consents

9.5.83 Various water-related permissions may be required where it is not agreed with the relevant regulating authority to disapply them through the DCO (although the Applicant is seeking to achieve this for as many consents as possible). These permissions may include:

- land drainage consent(s) under section 23 of the Land Drainage Act 1991for works affecting the flow in ordinary watercourses;
- flood risk activity permit(s) from the Environment Agency under the Environmental Permitting Regulations (England and Wales) 2016 in connection with works to main rivers (e.g. Greatham Creek, River Tees);
- water activity permit(s) from the Environment Agency under the Environmental Permitting Regulations (England and Wales) 2016 for temporary construction and permanent operational discharges;
- trade effluent consent under the Water Industry Act 1991 for the purposes of discharging trade effluent from welfare facilities during construction;

- full or temporary water abstraction licence(s) under section 24 of the Water Resources Act 1991 (if more than 20 m3/d is to be dewatered/over-pumped and exemptions do not apply) – see further detail below; and
- temporary water impoundment licence under section 25 of the Water Resources Act 1991 in connection with the laying of cables.

9.5.84 There is the potential for the need for either full or temporary water abstraction licence(s) from the Environment Agency for the abstraction of water from the send and receive pits associated with the underground watercourse crossings or other excavations where groundwater may be encountered, other than where exemptions apply. A full licence is required when more than 20 m^3 per day of water may need to be abstracted for more than 28 days. A temporary licence is applicable where the abstraction is less than 28 days. Where less than 20 m^3 per day of water needs to be abstracted, no licence is required. However, in all circumstances it may be necessary to obtain a water activity permit(s) from the Environment Agency to discharge the water to ground or a watercourse if the water is considered to be 'unclean'.

9.6 Likely Impacts and Effects

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

Construction and Decommissioning Phase Impacts

9.6.2 During the Proposed Development 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 the hydromorphology of watercourses from open-cut watercourse crossings;
- potential impacts on groundwater resources and local water supplies (licensed and unlicensed abstractions) and potentially the baseflow to watercourses from temporary dewatering of excavations or changes in hydrology;
- 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; and
- alteration in fluvial and overland flow paths as a result of works associated with the Hydrogen Pipeline Corridor, Water Connection Corridor, Other Gases Connection Corridor and Electrical Connection Corridor.

Surface Water Quality

9.6.3 Where construction and decommissioning works are undertaken within or in proximity to water features, close to existing land drains providing a pathway to surface watercourses, groundwater or ponds, or on steeper terrain angled towards a water feature, there is the potential for adverse impacts on water quality due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals spilt on site. There may also be indirect water quality impacts to downstream receptors, as spills or contaminated water can propagate along the initial receiving watercourse. In this case the downstream receptors are the Tees transitional and Tees Coastal WFD waterbodies as all watercourses within the Study Area are tributaries of these.

9.6.4 The construction works in general, but particularly earthworks, dewatering of excavations, the construction of watercourse crossing structures, and drainage and outfall installations (if required) have the potential to cause a reduction in water quality through contaminated construction runoff, and the risk of chemical spillages from plant, equipment and materials.

9.6.5 Construction of open cut intrusive pipeline crossings will require works close to and within the receiving watercourses. There will be potential for conveyance of spills and fine sediment during any works to these outfalls to result in direct impacts on the receiving watercourses.

9.6.6 At this stage, it is assumed as a reasonable worst case that direct works will be required to watercourses where open-cut installation of pipelines is required. For the Hydrogen Pipeline Corridor, open-cut works are expected to impact Belasis Beck at approximately NGR NZ 49397 23941 and unnamed watercourses south of the Tees estuary at NZ 51111 24826, NZ 49147 24367 and NZ 51221 26296.

9.6.7 The nature of watercourse crossing methodology for the Electrical Connection Corridor, Water Connection Corridor and Other Gases Corridor is not yet known, and so it is assumed as a worst case that open-cut crossings will be required for the Fleet (Tees Estuary S Bank), Mains Dike, Dabholm Beck, Kinkerdale Beck, the Mill Race, Cross Beck and Knitting Wife Beck. Exact locations are also not known at this stage. Where this open cut installation is required, flow will be maintained by damming and over pumping to create a dry working area and minimise the risk of polluting the flow. Works should therefore be carried out in the drier months of the year where possible as this will reduce the volume of water to manage and the risk of pollution propagating downstream. Once the watercourse is reinstated, silt fences, geotextile matting, or straw bales should be used initially to capture mobilised sediments until the watercourse has returned to a settled state and thereby reduce risks of downstream water quality impacts. Water quality monitoring will also be undertaken prior to, during, and following on from the construction activity to ensure any spillages or other pollution is identified. These mitigation requirements will be outlined in a WMP that will be produced as part of the Final CEMP.

9.6.8 There will be works relatively close to the River Tees and Greatham Beck (both of which are part of the Tees transitional WFD waterbody) for the trenchless installation

of the Hydrogen Pipeline crossings. However, launch and reception pits will be a minimum of 10 m from the channel in each case to reduce the potential for runoff and spillages to the watercourse. Nonetheless, there will remain some risk of sediment mobilisation in runoff and for chemical spillages to occur that could enter the channel if not managed accordingly. There is also a chance of 'frac-out' events (i.e., hydraulic fluid break out) from drilling to the watercourse if not appropriately mitigated for site specific conditions. A site-specific Hydraulic Fracture Risk Assessment will be produced prior to commencing works to define the mitigation required based on ground conditions. As with open-cut crossings, water quality monitoring will also be undertaken prior to, during and following on from the construction activity.

9.6.9 Where there are to be above ground pipelines over watercourses using pipe bridges, there is potential for runoff of sediments and spillages to impact water quality as works will be required immediately adjacent to, and over, the affected watercourses. At this stage, there are expected to be above ground crossings of Knitting Wife Beck (approximate NGR NZ 54580 23003), the Mill Race (approximate NGR NZ 57329 23682), Mains Dike (approximate NGR NZ 58121 22905), the Fleet (Tees Estuary S Bank WFD waterbody) (approximate NGR NZ 56765 23730) and Belasis Beck (approximate NGR NZ 48313 23194) for the Hydrogen Pipeline Corridor.

9.6.10 All waterbodies that are potentially impacted ultimately discharge to Tees Estuary, where there is potential for a cumulative impact in terms of fine sediment impacts on water quality. Furthermore, any existing drainage assets on the Proposed Development Site that receive runoff laden with fine sediment may eventually discharge to Tees Bay through the existing drainage network.

9.6.11 Section 9.5 describes the broad range of surface runoff control measures that will be utilised on the Proposed Development Site, which will be described by the contractor in a WMP that forms part of the Final CEMP, and which will be confirmed with the Environment Agency and NWL as part of future permit applications. All conditions of the permits will be adhered too.

9.6.12 With the embedded mitigation measures described in Section 9.5 in place, it is considered that those watercourses subject to direct works (i.e. open-cut crossings) will receive temporary Minor adverse impacts to water quality. For the Very High importance Belasis Beck and the Fleet (Tees Estuary S Bank WFD waterbody), this will result in a temporary Slight Adverse (Not Significant) effect. For the Medium importance Mains Dike, Dabholm Beck, Kinkerdale Beck, the Mill Race, Cross Beck and Knitting Wife Beck this will result in a temporary Slight Adverse (Not Significant) effect. For the Low importance unnamed watercourses and ditches this will result in a Neutral (Not Significant) effect. No long-term effects on any of these waterbodies are anticipated once the works have been completed and the channels stabilised.

9.6.13 There will be a Negligible impact to Tees estuary and Greatham Creek resulting from works to install the Hydrogen Pipeline crossings using trenchless techniques, given the minimum 10 m buffer of the launch and reception pits from the watercourse, the site-specific hydraulic fracture risk assessment, and implementation of best practice mitigation measures as outlined in the Final CEMP and WMP. Both water features are

part of the Tees transitional WFD waterbody, which is of Very High importance, thereby resulting in a Slight Adverse (Not Significant) effect. No long-term effect on the waterbody is anticipated given the brevity of the impact.

9.6.14 Where works are required close to, and over, watercourses for pipe bridges, the impact to water quality will be Negligible given the embedded mitigation as detailed in Section 9.5. For the High importance Belasis Beck and the Fleet (Tees Estuary S Bank WFD waterbody) this will result in a Slight Adverse (Not Significant) effect. For the Medium importance Knitting Wife Beck, the Mill Race and Mains Dike this will result in a Slight Adverse (Not Significant) effect.

Morphological Effects to Waterbodies

9.6.15 At this stage, as a worst case there are assumed to be opencut installation of the various connection corridors across Belasis Beck, the Fleet (Tees Estuary S Bank), Mains Dike, Dabholm Beck, Kinkerdale Beck, the Mill Race, Cross Beck, Knitting Wife Beck and three unnamed small watercourse (as described in Section 9.5). The affected watercourses south of the Tees estuary and the unnamed watercourses to the north of the estuary are all considered Low importance for morphology given that they are generally artificially straight, modified channels lacking significant geomorphic and bedform features. However, Belasis Beck to the north of the Tees estuary is considered of High importance for morphology, as it exhibits a variety geomorphic forms and bank side vegetation.

9.6.16 A Pre-Works Morphological Survey will be undertaken at each crossing point requiring an intrusive open-cut. The cables will be buried at sufficient depth to prevent exposure (minimum 1.5 m below the bed) and the flow over-pumped or flumed during the works to create a dry working area and minimise the risk of water pollution being carried downstream. However, there will unavoidably be short term, temporary adverse impacts on the watercourse morphology and loss of riparian habitats, as well as temporary interruption of the hydrological and sediment regimes. However, these impacts will be very localised and short in duration, with the channels reinstated taking into account the pre-works morphological condition. Over time riparian vegetation will re-establish, although it is acknowledged that this may take a few years to completely recover.

9.6.17 Overall, physical works are considered to give a localised and temporary Moderate adverse impact against hydromorphological status for all open cut pipeline installation locations. For the High importance Belasis Beck (for morphology) this will result in a Moderate Adverse (Significant) effect. However, this will be temporary with the channel and riparian habitat expected to recover within five years. The remaining affected watercourses are of Low importance (for morphology), and so will be subject to Slight Adverse (Not Significant) effect in all cases.

Groundwater Flow Impacts

9.6.18 Excavations and foundations have the potential to disrupt shallow groundwater. Full details regarding excavation depths for the Main Site are not known at this stage. A Ground Investigation will be undertaken to inform the design development and to guide appropriate construction methods to minimise impacts on groundwater flow,

which may in turn impact baseflow in rivers or groundwater abstractions. At this stage it is considered that with appropriate construction methodologies a Minor adverse impact on groundwater flow is anticipated in relation to the Main Site. Groundwater beneath the Main Site is considered a Medium importance receptor, thereby giving a Slight Adverse (Not Significant) effect. This will be reviewed during the EIA.

9.6.19 Depths required for construction of the Hydrogen Pipeline, Electrical Connection, Other Gases Connections and Water Connection Corridors are anticipated to be below the water table over part of their routes, and particularly where crossings beneath watercourses are required. The profile of the pipelines is considered to be small compared to the spatial and vertical extent of the secondary superficial aquifers, and therefore is considered to have a Negligible impact on groundwater flow. A Negligible magnitude of impact on groundwater flow on Medium importance groundwater features (Mercia Mudstone Group/Redcar Mudstone Group) results in a Neutral (Not Significant) effect and for the Very High importance groundwater beneath parts of the Hydrogen Pipeline Corridor (Sherwood Sandstone Group) results in a Slight Adverse (Not Significant) effect.

Groundwater Dewatering Impact

9.6.20 Construction works to install the Hydrogen Pipeline Corridor beneath the Tees Estuary and Greatham Creek using drilling or boring techniques may involve a temporary pit either side of the watercourse (>10 m measured from the water's/channel edge under normal flows) as well as regularly spaced jointing pits where longer sections of boring are required. Maximum parameters for the pit dimensions will be outlined in the ES, but for the purposes of this assessment are assumed to be 5 m width x 5 m length x 3 m depth.

9.6.21 There is potential for shallow groundwater associated with the various connection corridors, and so there is potential for groundwater ingress to the pits. This will be managed following standard construction techniques potentially including pumping, damming, or shoring up the pits with sheet piling.

9.6.22 A temporary abstraction licence may be required from the Environment Agency when abstracting more than 20 m^3 of water per day. Any discharge of groundwater to a watercourse may also require a discharge consent from the Environment Agency if it is considered to be 'unclean' and the conditions of the Environment Agency's Regulatory Position Statement 'Temporary dewatering from excavations to surface water' (April 2021) cannot be met. This document states that uncontaminated, clean water, is water that is wholly or mainly clear rainwater or infiltrated groundwater that has collected in the bottom of temporary excavations on an uncontaminated site.

9.6.23 The pits will be backfilled with the original excavated material upon completion and will not affect groundwater base flow in the longer term. While groundwater may be encountered, taking into account that it will be appropriately managed in line with any required permit conditions and best industry practice will be outlined in the Framework CEMP in the ES, there is considered to be a Negligible magnitude of impact on groundwater levels and flow. For the Medium importance Mercia

Mudstone Group/Redcar Mudstone Group groundwater aquifers this is considered to have a Slight Adverse (Not Significant) effect. For the Very High importance Sherwood Sandstone Group groundwater aquifer this is again considered to have a Slight Adverse (Not Significant) effect.

9.6.24 No impacts to other watercourses, waterbodies, groundwater abstractions or PWS are predicted from this temporary and short-term effect at this stage. This will be re-assessed within the ES when further construction design details are available.

Potential Flood Risk – Tidal and Fluvial Sources During Construction

9.6.25 The construction phase of the Proposed Development will involve works in areas of Flood Zone 2 and 3a, and close to and within the floodplains of the Tees, The Fleet (Tees Estuary (S Bank)), Belasis Beck, Dabholm Gut, the Mill Race, plus small ditches across the Proposed Development 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 (very high importance receptors). 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 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.

9.6.26 However, with the implementation of standard construction methods and mitigation as described in Appendix 9A: Preliminary FRA (PEI Report, Volume III), the Final 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 Adverse (Not Significant) effect.

Potential Flood Risk – Surface Water Sources During Construction

9.6.27 The Proposed Development Site will 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 Preliminary FRA (Appendix 9A, 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 impact of flooding from these sources on construction workers is considered to be Negligible, resulting in a Slight Adverse (Not Significant) effect.

Potential Flood Risk – Groundwater Sources During Construction

9.6.28 The Proposed Development 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 Final CEMP and WMP (refer to Section 9.5), a Negligible magnitude of impact is predicted to construction workers, resulting in a Slight Adverse (Not Significant) effect.

Potential Flood Risk – Drainage Infrastructure and Artificial Sources During Construction

9.6.29 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 Final CEMP and WMP and other flood risk mitigation as outlined in Section 9.5, flooding from these sources is considered to be Negligible to construction workers, resulting in a Slight Adverse (Not Significant) effect.

9.6.30 Environment Agency mapping and the Preliminary FRA (Appendix 9A (PEI Report, Volume III)) indicates that the Proposed Development Site is not at risk of flooding from reservoirs or artificial waterbodies. As such, flooding from these sources is considered to have a Negligible impact on construction workers, which gives a Slight Adverse (Not Significant) effect.

Operation Phase

9.6.31 During the operational phase of the Proposed Development, the following potential water environment impacts may occur if appropriate mitigation is not applied:

- impacts on receiving water features from diffuse urban pollutants and sediments in surface water runoff, or as a result of accidental spillages;
- changes in water quality from operational discharges including the discharge of treated process wastewater (this includes increases in nutrients to receiving water features);
- potential nutrient enrichment of ponds located adjacent to the Main Site from atmospheric deposition of nitrogen emitted from the Proposed Development;
- 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 Site;
- increased local demand for potable water supply; and
- water quality impacts on receiving water features (including the sea) from an increase in foul drainage from the Proposed Development.

9.6.32 The water supply and foul water requirements of the Proposed Development will be managed by the public water company and sewage undertaker in line with their own permits and consents, and without causing significant 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 waterbody 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 wastewater 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. It should also be noted that there would be a maximum of approximately 130 personnel for the operational phase of the Proposed Development, operating in a shift pattern of 40-50 staff per daytime shift, whereas Marske-by-the-Sea WwTW has a population equivalent of >93,000 (Stockton-on-Tees Borough Council, 2012). The foul water requirements of the Proposed Development are therefore minimal.

Potential Pollution of Tees Bay due to Surface Water Routine Runoff and Accidental Spillages

9.6.33 The Proposed Development Site is an industrial site with constant use of a range of fuels, oils and other chemicals. There is therefore potential for contaminants to be mobilised by surface water runoff and to discharged into the water environment (assumed to be Dabholm Gut or Tees Bay at this stage). Discharge of a range of pollutants could lead to chronic adverse impacts in terms of the receiving waterbody physicochemical and ecological status, although it should be noted that there is a large capacity for dilution and dispersal in Dabholm Gut/Tees Estuary and Tees Bay. There is also a risk that a significant chemical spillage or pollution incident could occur on the Main Site which could be discharged to Dabholm Gut or Tees Bay.

9.6.34 The provisional drainage arrangements propose to attenuate surface water runoff and contain chemical spillages from the operational Proposed Development Site, whilst minimising flood risk to the Proposed Development Site and surrounding areas. As outlined in Section 9.5, a new surface water drainage network and management system will be provided for the Main Site that will provide interception, conveyance and treatment of surface water runoff from buildings and hard standing. This will be separate to foul systems for welfare facilities and process wastewater generated by the operation of the Proposed Development Site.

9.6.35 Amine contaminated water will be contained and where possible should be recovered and recycled for use within the process, or otherwise taken off-site by tanker to a specialist treatment plant.

9.6.36 The Surface Water Drainage Strategy will require provisions for dealing with chemical spillages and firewater. This includes kerbed/bunded areas, valves (i.e. penstocks), sluices and interception sumps for isolating spillages or contaminated water. The outline principles of the Surface Water Drainage Strategy are outlined in Section 9.5.

9.6.37 The SuDS Manual's Simple Index Approach (CIRIA, 2016) will be applied to demonstrate the suitability of the SuDS treatment trains within the Proposed Development design. At this stage it is assumed that bypass oil separators will be

used (as a minimum) to provide treatment for any oils present in surface water runoff prior to discharge from the Proposed Development Site. It is also assumed that penstocks will be provided so any accidental spillages or fire water can be isolated on site and prevented from entering the surface water drainage system or process water system and disposed of accordingly.

9.6.38 An inventory of hazardous substances used on the Proposed Development Site will be developed throughout the design process. In each case the product will have a Material Safety Data Sheets providing guidance on the safe disposal of waste chemicals, that the operator of the facility will adhere to the guidance stated in Section 9.5 regarding the impact avoidance measures for disposal of product containers and chemical waste.

9.6.39 Water quality monitoring will be regularly undertaken by the site operator to confirm the quality of any water in bunded areas, sumps or tanks to ensure that it is suitable for discharge from the site to the Tees Bay (or other watercourse as later defined), or otherwise is taken by tanker for off-site disposal at a suitably permitted wastewater facility. A Pollution Prevention Plan and an Emergency Response Plan will also be prepared. Should any spillage occur that results in the pollution of controlled waters, the Environment Agency will be immediately informed, or NWL should it impact the foul water system.

9.6.40 A Surface Water Maintenance and Management Plan will be prepared during the detailed design phase to describe the requirements for access and frequency for maintaining drainage infrastructure on the Proposed Development Site. The maintenance regime must be fully implemented throughout the lifetime of the Proposed Development to avoid issues such as blockages which could lead to flooding, or failure of the spillage containment and pollution prevention systems.

9.6.41 Given that the Surface Water Drainage Strategy will have to meet standards required by the environmental permit and the local policy requirements, and that measures will be included for dealing with spillages and firewater (including water quality monitoring), then a Negligible impact is predicted to the Dabholm Gut (part of the Tees estuary WFD waterbody) and Tees Bay (depending on which option is progressed). Given that these are Very High importance receptors, this will result in a Slight adverse effect (Not Significant) in both cases. This will be re-evaluated in the ES.

Demand for Water

9.6.42 The Proposed Development requires a flow rate of 176 m^3/hr (4.2 Ml/day) for Case 1A and 2A and 182 m^3/hr (4.37 Ml/day) for Case 1B and 2B. Water is to be supplied via the existing NWL's raw water pipeline feed from the River Tees. At the time of writing (August 2023), consultation is ongoing with NWL to confirm this arrangement and commercial terms.

9.6.43 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 170 Ml/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 82 Ml/d the WRZ has a headroom of 48 Ml/d in the design drought year. Furthermore, given advancements in water efficiency in industry, future demand is expected to decline.

9.6.44 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 NWL abstract.

9.6.45 It should be noted that NWL are producing a new WRMP for publication in 2024 (Northumbrian Water, 2024). Within the draft document, the Industrial WRZ has been integrated into the Kielder WRZ. This is because NWL demonstrate that the Industrial Supply Zone can be supported by Kielder reservoir and the Tyne–Tees Transfer system and is therefore subject to the same risk to supply as the rest of the Kielder WRZ. The final plan supply demand balance in the draft WRMP for 2024 indicates a supply surplus for the Kielder WRZ across the planning period from 2025 to 2084.

9.6.46 A new supply (to be agreed with NWL) from their raw water pipeline from the Tees for the Proposed Development would be undertaken within current allowable limits. The required water demand is 0.76% of the Tees mean annual flow (20.82 m^3/s) as recorded at Low Moor (see Section 9.4).

9.6.47 On the basis that NWL has a supply surplus (although some improvements to transmission infrastructure may be required), a Negligible impact is predicted giving a Slight Adverse effect (Not Significant). However, this will be re-evaluated within the ES when further details regarding water supply arrangements are available.

Potential Impacts on Water Quality from Operational Discharges

9.6.48 At this stage in the design process, preliminary water supply and wastewater discharge assessments have outlined what process wastewaters may be generated by the Proposed Development and how these may be treated with the application of Best Available Techniques (BAT). These assessments indicate that wastewater contaminants will be generated from water from the boiler blowdown, process condensate and hazardous liquid wastes. Refer to Section 9.5 for further details.

9.6.49 Wastewater treatment will be provided for process effluent, which will either be re-used in the process (Case 1A and 1B, with liquid wastes taken off-site for disposal), or otherwise discharged to the Tees Bay outfall (Case 2A and 2B), where it would meet the standards required by an Environmental Permit.

9.6.50 It is anticipated that the wastewater environmental regulatory emission limit values (ELVs) that apply within the Environmental Permit shall be in-line with the target Best Available Technology (BAT) Associated Emission Levels (AELs) from wastewater treatment plants treating effluent from chemicals sites, or processes as identified

within the BAT Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector (2016) (otherwise known as the CWW BREF) and its associated BAT Conclusions document. If the project Environmental Risk Assessment shows that significant impact could occur with the plant discharging at the BAT-AEL concentrations, tighter emission limits could subsequently be applied.

9.6.51 Given the potential option to use the Tees Bay outfall (Case 2A or 2B), hydrodynamic modelling will be undertaken to determine the degree of dispersion from the outfall for constituents of the wastewater, including total nitrogen (given nutrient neutrality requirements applicable to the Teesmouth and Cleveland Coast SPA/Ramsar sites). Further consultation with the Environment Agency will be undertaken to discuss the scope of works and outcomes of this modelling, and this will be undertaken during the EIA. Water sampling facilities will be provided for manual sampling of water prior to discharge through this outfall. The frequency of testing and parameters to be monitored will be agreed with the permitting authority.

9.6.52 Given that the Proposed Development will need to meet the requirements of an environmental permit if discharged to Tees Bay (with an associated H1 screening assessment plus more detailed assessment if required), it is considered that there is limited potential for widespread pollution from process water discharge, especially given the large capacity for dilution and dispersal offered by the Tees Coastal waterbody.

9.6.53 It is noted that development discharging nitrogen into the Teesmouth and Cleveland Coast SPA/Ramsar is required by Natural England to be nutrient neutral, due to the current unfavourable status of the site as a result of excess nutrients causing eutrophication. The conservation and WFD objectives for the estuary and Teesmouth and Cleveland Coast Ramsar/SPA sites also require nitrogen loading of the estuary to be reduced. In particular, it is the intertidal and terrestrial areas of the Tees estuary that are of most concern (notably Seal Sands), and modelling undertaken for the NZT scheme indicated that discharges from the proposed NZT outfall in Tees Bay could also be carried into the estuary by the tides, and thereby contribute nutrients to the designated sites (BP, 2022).

9.6.54 A Nutrient Neutrality Screening Assessment has been undertaken for the Proposed Development and is provided in Appendix 9B (PEI Report, Volume III). This has screened in further assessment of the nitrogen discharged into Tees Bay for Case 2A and 2B, as there is potential for this nitrogen to be dispersed into the Tees estuary due to tidal movements (and thus reach the sensitive areas of the Teesmouth and Cleveland Coast SPA/Ramsar site). This assessment only applies to new sources of nitrogen (i.e. not just nitrogen that was already in Tees river water that has been abstracted and is returned downstream). The hydrodynamic modelling to be undertaken during the EIA will determine the extent to which the designated site may be affected (if at all) via wastewater discharge from the NZT outfall, and so whether there may be a requirement to offset this load from Case 2A or Case 2B through mitigation. A full nutrient neutrality assessment will be undertaken once the

outcome of the modelling is known. The outcomes of the modelling will be presented in the ES.

9.6.55 At this stage, a Minor impact on water quality is predicted on a precautionary basis as there may be some level of change in water quality, but with no changes considered likely to impact on WFD classifications for the Tees Coastal waterbody. Given that this is a Very High importance receptor for water quality, this results in a Moderate adverse effect (Significant). This effect will be re-assessed during the EIA when further details are available regarding effluent quality and proposed water treatments and following consultation with the regulator regarding additional assessments.

Surface Water Ponds: Water Quality

9.6.56 It is considered that there will be limited potential for adverse impacts resulting from receiving 'unclean' water or accidental spillages during Proposed Development 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 Dabholm Gut, and not to the surface water ponds in the area. Overall, the magnitude of impact is expected to be Negligible for all ponds (Low importance receptors) within the Proposed Development Site, resulting in a potential Neutral effect (Not Significant). There should be no impact to ponds that are outside the Proposed Development Site but within the Study Area.

9.6.57 There is potential for atmospheric deposition of nitrogen emitted from the carbon capture plant to impact adjacent waterbodies, notably open water within Coatham Dunes, where Pond 14 is the only open water pond. Over time, the deposition of nitrogen can lead to the enrichment of still waterbodies, especially where there is limited overturn of the water column and a long residence time, as is the case at Pond 14 where there is little to no groundwater interaction. This in turn has potential consequences for the wider habitat and species that make use of the pond.

9.6.58 An assessment of atmospheric deposition has been undertaken in Chapter 8: Air Quality (PEI Report, Volume I). Emissions from the Proposed Development have been assessed using the Environment Agency's Risk Assessment (Defra and Environment Agency, 2016). Detailed dispersion modelling using the atmospheric dispersion model ADMS (currently ADMS 5.2.2) has been used to calculate the concentrations of pollutants at identified receptors. These concentrations have been compared with the defined Air Quality Assessment Levels (AQALs) for relevant pollutants.

9.6.59 An assessment of nutrient nitrogen enrichment has been undertaken by applying published deposition velocities to the predicted annual average nitrogen dioxide (NO_2) and ammonia (NH_3) concentrations at the Teesmouth and Cleveland Coast SPA, determined through dispersion modelling, to calculate nitrogen deposition rates (expressed as kilograms per ha per year, Kg/ha/yr). These deposition rates have then been compared to the Critical Loads for nitrogen published by UK Air Pollution Information System (APIS) (Centre for Ecology and Hydrology and APIS, 2016), taking into consideration the baseline deposition.

9.6.60 Water quality monitoring of Pond 14 between October 2020 and February 2023 indicates a maximum total nitrogen concentration value of 1.6 mg/l (6th January 2021). This is variable over relatively short time scales with total nitrogen having been below the laboratory limits of detection on five of eleven sampling visits (i.e. <0.5 mg/l). Based on the maximum recorded total nitrogen baseline value of 1.6 mg/l in Pond 14, a predicted deposition of 0.25 kg/N/ha/yr as a worst-case scenario would cause an increase in total nitrogen concentration to 1.72 mg/l after one year, for a hypothetical scenario with no other gains or losses of nitrogen. This is considered to be within the likely range of concentrations that would be observed in the pond over a year and would not be of detriment to the pond ecosystem.

9.6.61 Given the low level of enrichment of Pond 14 a negligible impact is predicted for this very high importance receptor. This results in a Slight adverse effect (not significant) for Pond 14.

Foul Water Discharge

9.6.62 It has been assumed that all foul water from welfare facilities will be directed to the nearby NWL Marske-by-the-Sea WwTW. It is assumed that NWL will treat foul water from the Proposed Development Site within their consent limits and in accordance with requirements to not cause deterioration or prevent improvement under the WFD or will upgrade their facilities if necessary.

9.6.63 Operation workforce peak numbers will be a maximum of 130 staff (if both Phase 1 and Phase 2 of the Proposed Development are progressed). Operations staffing will be on a shift basis to be spread over a 24-hour period. Normally staff levels will be 40-50 peak during the week, however, during 28-day maintenance periods which are likely to occur approximately every four years, there would be up to 400 people. For context, the population equivalent of the proposed WwTW was reported as >93,000 at Marske, in the Tees Valley Water Cycle Study (2012).

9.6.64 As such, the impact of treated foul water discharge is considered to be Negligible to the Tees coastal waterbody (via Marske-by-the-Sea WwTW). As this is a Very High importance receptor, this results in a Slight Adverse (Not Significant) effect.

Flooding from Tidal Sources during Operation

9.6.65 Appendix 9A: Preliminary FRA (PEI Report, Volume III) indicates that the Proposed Development Site and the majority of the Connection Corridors 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. This includes access roads to the east of the Proposed Development Site.

9.6.66 During a future scenario resulting from climate change up to 2125 and a H++ scenario to 2100, the Main Site remains at 'low' risk of flooding during events that exceed a 0.5% AEP (1 in 200 chance) of flooding and the 0.1% AEP (1 in 1000 chance) event when mitigation comprising a minimum site elevation of 6.83 mAOD is included (based on 1 in 200-year event including climate change allowance plus 600 mm freeboard). The level of 6.83 mAOD would be the minimum once site clearance and remediation has been undertaken.

9.6.67 The western extent of the Hydrogen Pipeline 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 Proposed Development Site is also at high residual risk of flooding should a failure or breach of the flood defences occur. However, works in this area comprise either underground pipework or installation of pipelines on existing pipe racking.

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

9.6.69 In EIA terms, tidal flooding is considered of Very High importance due to the nature of the development as essential infrastructure (i.e. Hydrogen Plant). Given that the Main Site is expected to have Negligible impact on flood levels on or off site, then a Slight adverse effect (Not Significant) is anticipated in terms of tidal flooding (based on the classification approach in Table 9-4).

9.6.70 However, the western extent of the Hydrogen Pipeline 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 is also at high residual risk of flooding should a failure or breach of the flood defences occur. Appropriate mitigation measures will therefore be implemented to mitigate this risk. These are described further in the Preliminary FRA (Appendix 9A, PEI Report, Volume III) and include a Flood Emergency Response Plan. Given this mitigation a Negligible impact is considered appropriate for flood levels on and off site, resulting in a Slight Adverse (Not Significant) effect.

Flooding from Fluvial Sources during Operation

9.6.71 Appendix 9A: Preliminary FRA (PEI Report, Volume III) identifies the Main Site to be at 'low' risk of fluvial flooding from Ordinary watercourses located in proximity to the Proposed Development Site.

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

9.6.73 Where the risk of flooding from fluvial sources is currently assessed as high, the risk category of flooding to the Proposed Development Site is not likely to increase due to climate change. If a flood event did occur, the impact of climate change would result in an increase in the depth and extent of floodwater across the areas of the site affected by flooding from this source during a 1% (1 in 100 chance) event. Refer to the Preliminary FRA (PEI Report, Volume III) for further detail.

9.6.74 The Connection Corridors to the south and south-west of the Main Site will generally be located above ground and will remain at low risk of flooding from fluvial sources, including all climate change scenarios. The only exception is the proposed open-trench channels for the Hydrogen Pipeline Corridor, running to the east and alongside Seaton Carew Road.

9.6.75 Flood risk from fluvial sources (ordinary watercourses) on the north bank of the River Tees, between Billingham and Seal Sands, will increase for all climate change scenarios. Therefore, the Hydrogen Pipeline Corridor will be at risk of flooding over the lifetime of the development. However, most of this will be located underground and in an existing unattended service corridor and is therefore considered acceptable development within Flood Zone 3a. Any maintenance work will be undertaken in accordance with the Flood Emergency Response Plan.

9.6.76 The Main Site will be constructed at a level no lower than the highest flood level of 6.83m AOD (6.23m AOD flood level for a 1 in 200-year event including climate change allowance plus 600 mm freeboard). 6.83 mAOD would be the minimum level once site clearance and remediation has been undertaken.

9.6.77 In EIA terms, fluvial flooding is considered of Very High importance due to the nature of the development as essential infrastructure (i.e., Hydrogen Production Plant). Given that the Main Site is expected to have Negligible impact on flood levels on or off site and that the areas at higher risk relate only to pipelines, then a Slight adverse effect (Not Significant) is anticipated in terms of fluvial flooding (based on the classification approach in Table 9-4).

Flooding from Surface Water Sources During Operation

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

9.6.79 An Outline Drainage Strategy will be prepared for the Proposed Development (as a Requirement of the DCO) 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 Site will be carefully managed, treated and directed to Dabholm Gut at controlled rates. Given this increased management of surface water runoff from the development there will likely be a reduction in the surface water flood risk in comparison to existing conditions where the drainage arrangements are dated.

9.6.80 It is considered that the Proposed Development will have a Negligible impact, resulting in a Neutral (Not Significant) effect on surface water flood risk.

Flooding from Ground Water Sources During Operation

9.6.81 The risk of groundwater flooding within the Proposed Development 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. BS8102 includes guidance on waterproofing barrier materials applied to structures, structurally integral watertight construction, and drained cavity construction. This is described further in Appendix 9A: Preliminary FRA, (PEI Report, Volume III). Assuming this to be the case, the magnitude of impact from groundwater flooding during operation is considered Negligible, resulting in a Neutral (Not Significant) effect.

Flooding from Drainage Infrastructure and Artificial Sources during Operation

9.6.82 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 as part of the drainage strategy. Given this, the magnitude of impact is considered to be Minor adverse, resulting in a Slight Adverse (Not Significant) effect.

9.6.83 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 an impact magnitude of Minor Adverse is considered appropriate, resulting in a Slight Adverse (Not Significant) effect.

Decommissioning Phase

9.6.84 At the end of its operating life (25 years for Phase 1 and Phase 2), all above-ground equipment associated with the Proposed Development will be decommissioned and removed from the site. The same timescales apply for the Hydrogen Pipeline and other connections. It is assumed that all underground infrastructure would remain in-situ, however, all connection and access points would be sealed or grouted to ensure disconnection.

9.6.85 On this basis, decommissioning impacts are expected to be limited to waterbodies in proximity to the Proposed Development Site (i.e., Tees Estuary (including Dabholm Gut and Greatham Creek), Tees Bay, The Fleet (Tees Estuary (S Bank)) and will be similar to the impacts reported for the construction phase, but with fewer earthworks, excavations and tunnel arisings to manage.

9.6.86 A detailed Decommissioning Environmental Management Plan (DEMP) would be prepared to identify required measures to prevent pollution during this phase of the development. The DEMP would be agreed with the Environment Agency.

9.6.87 There may be marginal improvement to the water quality of the Tees transitional and Tees Coastal waterbodies following decommissioning of the Proposed Development, with the discharge of process effluent ceasing.

9.6.88 Overall, no significant effects are anticipated during Proposed Development decommissioning provided that the appropriate mitigation measures are implemented.

9.7 Mitigation and Enhancement Measures

Construction

9.7.1 Mitigation of adverse impacts on the water environment during the construction phase will be achieved principally through embedded measures as 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 the WMP within the Final CEMP. This will need to be further developed by the 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 pursuant to DCO Requirements or 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 Proposed Development Site. It is expected that water quality sampling will be undertaken on a periodic as well as ad-hoc basis, dependent upon circumstances/activities on site. Monitoring and sampling will be undertaken prior to the commencement of construction to allow for sufficient baseline data.

Operation

9.7.4 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 facility 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 Preliminary FRA (Appendix 9A: Preliminary FRA (PEI Report, Volume III).

9.7.5 Assessment work is ongoing with regard to the wastewater discharge to Tees Bay for Case 2A and Case 2B of the Proposed Development. See Chapter 4: Proposed Development, (PEI Report, Volume I) for details. Should further nutrient neutrality assessment, WFD assessment and/or associated hydrodynamic modelling indicate that additional mitigation is required to avoid significant effects, then this will be undertaken during the EIA and reported in the ES.

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. This will be set out as a Requirement within the DCO.

Decommissioning

9.7.7 As no significant effects are anticipated during the decommissioning of the Proposed Development, no additional mitigation measures have been identified at this stage (above the embedded mitigation measures). This will be reviewed as the EIA progresses.

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 August 2023. However, at this stage some details of the Proposed Development remain under development, such as the exact location of the water discharge outfall, the volume, rate and source of water, the quality of the treated process effluent, and the location and methodology for connection corridor crossings. The assumptions used are listed in Section 9.3 and have followed the Rochdale Envelope approach. As such, the assessment is a worst-case scenario, and actual effects may be less than those presented herein. Effects will be re-evaluated during the EIA.

9.9 Residual Effects and Conclusions

9.9.1 Having taken into account the emerging design and mitigation, along with additional information described in the preceding sections, this preliminary water environment assessment has identified two potential significant adverse effects.

9.9.2 The first relates to a potential open-cut crossing of Belasis Beck (which is of High importance for morphology) for the installation of the Hydrogen Pipeline Corridor. This will be a temporary Moderate adverse effect, with the watercourse morphology expected to recover over a number of years (approximately five years). It is anticipated that the significance of effect may be scaled down once further details regarding the watercourse crossings is known, and further mitigation or compensation measures considered - this will be re-assessed during the EIA.

9.9.3 The second potential significant effect relates to water quality impacts to the Tees Coastal waterbody from operational discharges. The scale of impact relates to nitrogen as well as other potential pollutants in the operational effluent from the Proposed Development is yet to be fully determined. Where discharged water contains new sources of nitrogen (i.e., not just nitrogen that was already in Tees river water that has been abstracted), then there may be a requirement to offset this load through mitigation. The concentration and redistribution of nitrogen from existing sources is also something that may require further assessment to ensure that the status quo is not perturbed by the Proposed Development.

9.9.4 No other significant adverse water environment effects have been identified relating to construction, operation or decommissioning of the Proposed Development. However, the preliminary assessment is based on a number of assumptions, and a more detailed assessment will be undertaken during the EIA taking into account ongoing design development, and greater clarity on aspects of the Proposed Development such as the process water discharge details and the drainage arrangements. These issues are also relevant to achieving WFD compliance and nutrient neutrality. The Tees Estuary and designated nature conservation sites are sensitive to water quality impacts, but there is also a need to support improvement for which stringent conservation objectives have been proposed. Further, more detailed nutrient neutrality and WFD assessment will be required to ascertain likelihood for significant effects relating to the Tees Estuary and Tees Coastal waterbodies. This will be undertaken in consultation with the Environment Agency and Natural England, and will include water quality modelling, which will be undertaken during the EIA and reported in the ES.

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