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9.0 SURFACE WATER, FLOOD RISK AND WATER RESOURCES

9.1 Introduction

9.1.1 This chapter of the Environmental Statement (ES) identifies the potential impacts and effects of the construction, operation, and decommissioning of the Proposed Development (including both phases 1 and 2 as outlined in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2) on the 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, hydromorphology, flood risk and drainage.

9.1.2 This assessment has been undertaken in accordance with the Chapter 2: Assessment Methodology (ES Volume I, EN070009/APP/6.2).

9.1.3 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.

9.2 Legislation, Planning Policy Context and Other Guidance

9.2.1 This section identifies and describes legislation, planning policy and guidance that is of relevance to the assessment of effects on surface water receptors, flood risk and water resources.

National Legislation

9.2.2 The following United Kingdom (UK) legislation is of relevance to the water environment assessment:

- Levelling-up and Regeneration Act 2023 (HM Government, 2023a): includes provision for the setting of levelling-up missions and reporting on progress in delivering them. Of particular relevance to this chapter are requirements around nutrient pollution standards and wastewater treatment works upgrades;
- Environment Act 2021 (HM Government, 2021): enables improved environmental protections to be included into law, includes new binding targets for water, which when set will need to be considered by new development that may affect the water environment;
- Water Act 2014 (as amended) (HM Government, 2014): mainly deals with regulating the impact of water supply on the water environment and the price of water;
- Flood and Water Management Act 2010 (as amended) (HM Government, 2010): requires flood and coastal erosion risk management authorities, among other requirements, to aim to contribute towards the achievement of sustainable development when exercising their flood and coastal erosion risk management functions. The Act created new roles and responsibilities on local authorities. County and unitary authorities are now classed as Lead Local Flood Authorities (LLFAs). LLFAs have responsibilities for coordinating the

management of flood risk from local sources, and placed a duty on the Environment Agency to develop the national strategy for flood and coastal erosion risk management (FCERM) in England;

- Marine and Coastal Access Act 2009 (HM Government, 2009a): includes requirements for new development to need a Marine Licence from the Marine Management Organisation for works below Mean High Water Spring Tide;
- Land Drainage Act 1991 (HM Government, 1991a): sets out the functions of internal drainage boards (IDBs) and local authorities (as LLFA) in relation to land drainage of ordinary watercourses. New development proposing to do works that are near to or which may affect the flows in ordinary watercourses may require a consent from the relevant authority;
- Water Resources Act 1991 (HM Government, 1991b): serves as a comprehensive legal framework in the UK to ensure the responsible management, use, and protection of water resources, for which new developments may need to take into account;
- Water Industry Act 1991 (HM Government, 1991c): serves as a comprehensive legal framework to ensure the responsible management, use, and protection of water resources, particularly for the uspply of water and provision of sewerage services;
- Environmental Protection Act 1990 (as amended) (HM Government, 1990): brings together pollution prevention and disposal regulations, imposes duty of care on those involved with any waste stream;
- Salmon and Freshwater Fisheries Act 1975 (as amended) (HM Government, 1975a): sets out protection for migration routes of salmon and trout;
- The Water Environment (Water Framework Directive) (England Wales) Regulations 2017 (HM Government, 2017a): these regulations aim to improve and integrate the way water bodies are managed throughout the UK for which new development must be compliant or otherwise be carefully justified and include all necessary mitigation and compensation;
- Environmental Damage (Prevention and Remediation) (England Amendment) Regulations 2017 (as amended) (HM Government, 2017b): aims to prevent and remediate damage to the environment;
- Environmental Permitting (England and Wales) Regulations 2016 (HM Government, 2016): aims to streamline the legislative system for activities in England and Wales including those for construction activities which may pose an alteration of flood risk. New developments that may need to do works to a Main River or discharge unclean water, trade or process effluent into a controlled water may need to apply for a permit;
- Control of Major Accident Hazards (COMAH) Regulations 2015 (COMAH, 2015): aims to prevent and mitigate the effects of major accidents involving dangerous

substances which can cause serious damage / harm to people and / or the environment;

- Environmental Damage (Prevention and Remediation) Regulations 2015 (HM Government, 2015a): aims to prevent and remediate damage to the environment;
- Bathing Water (Amendment) (England) Regulations 2018 (HM Government, 2018): concerns the management of bathing water quality;
- Eels (England and Wales) Regulations 2009 (HM Government, 2009b): gives powers to the regulators to implement recovery measures in all freshwater and estuarine waters in England and Wales and for which new developments that could impact eels should take into account;
- Control of Pollution (Oil Storage) (England) Regulations 2001 (HM Government, 2001): sets out the requirements for the storage of oil for quantities over 200 litres, which is relevant to any development that may involve the storage of oil during construction or operation;
- Control of Substances Hazardous to Human Health (COSHH) Regulations 2002 (HM Government, 2002): requirements to control and manage risks from hazardous substances, such as may be used on construction sites or as part of the operation of new developments;
- Anti-Pollution Works Regulations 1999 (HM Government, 1999): outlines the contents of any-pollution works notices served under the Water Resources Act 1991; and
- Water Framework Directive Standards and Classifications Directions 2015 (as amended) (HM Government, 2015b): includes directions for classification of surface water and groundwater bodies for which new developments must consider as part of any Water Framework Directive Assessment.

Planning Policy Context

National Planning Policy

Overarching National Policy Statement for Energy (EN-1) (2024)

9.2.3 The Overarching National Policy Statement (NPS) for Energy (EN-1) (Department for Energy Security & Net Zero (DESNZ), 2023a) is relevant to this assessment with the main sections being:

- Section 4.12: Pollution control and other environment regulatory regimes, Paragraph 4.12.1 states that “Issues relating to discharges or emissions from a proposed project, and which lead to other direct or indirect impacts on terrestrial, freshwater, marine, onshore, and offshore environments, or which include noise and vibration may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes, for example local planning consent or marine licences”, which is followed by paragraph 4.12.3 which states “Pollution from industrial sources in England and Wales is controlled through the Environmental Permitting (England and Wales)

Regulations 2016. The Environmental Permitting Regulations require industrial facilities to have an Environmental Permit and meet limits on allowable emissions to operate" and finally by line 4.12.4 "Larger industrial facilities undertaking specific types of activity are required to use Best Available Techniques (BAT) to reduce emissions to air, water, and land. Agreement on what sector specific BAT standards are, will now be determined through a new UK-specific BAT process".

- Section 5.88 Flood Risk, Paragraph 5.8.13 states that "A site-specific flood risk assessment should be provided for all energy projects in Flood Zones 2 and 3 in England or Zones B and C in Wales. In Flood Zone 1 in England or Zone A in Wales, an assessment should accompany all proposals involving:
  - *"Sites of 1 hectare or more;*
  - *Land which has been identified by the EA or NRW as having critical drainage problems;*
  - *Land identified (for example in a local authority strategic flood risk assessment) as being at increased flood risk in future;*
  - *Land that may be subject to other sources of flooding (for example surface water); and*
  - *Where the EA or NRW, Lead Local Flood Authority, Internal Drainage Board or other body have indicated that there may be drainage problems".*
- The minimum requirements for an FRA are listed in Paragraph 5.8.15.
- Section 5.16: Water Quality and Resources, under line 5.16.3 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, and how this might change due to the impact of climate change on rainfall patterns and consequently water availability across the water environment, as part of the ES or equivalent."
- Paragraph 5.16.7 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 Abstraction Licensing Strategies) and also demonstrate how proposals minimise the use of water resources and water consumption in the first instance;*

- *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;* m*any impacts of the proposed project on water bodies or protected areas (including shellfish protected areas) under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and source protection zones (SPZs) around potable groundwater abstractions"; how climate change could impact any of the above in the future; and* m*any cumulative effects".*

National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (2024)

9.2.4 The NPS for Natural Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DESNZ, 2023b) was designated in 2024 and is 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. Relevant to this assessment, the main sections include:

- section 2.3: Climate change adaptation, particularly paragraph 2.3.4 which states

  "*As climate change is likely to increase risks to some of this infrastructure, from flooding or rising sea levels for example, applicants should in particular set out how the proposal would be resilient to:*

  - *Increase risk of flooding;*
  - *Effects of rising sea levels and increased risk of storm surge;*
  - *Higher temperatures;*
  - *Increased risk of earth movement, coastal erosion, or subsidence from increased risk of flooding and drought; and*
  - *Any other increased risks identified in the applicant's assessment*".

- section 2.3.5; "*The resilience of the project to climate change should be assessed in the Environmental Statement (ES) accompanying an application. For example, future increased risk of flooding should be covered in the flood risk assessment*".

- section 2.21: Natural Gas and Oil Pipelines: Applicant assessment - Impacts-Water Quality and Resources. In particular, line 2.21.37 states that

  "*Constructing pipelines creates corridors of surface clearance and excavation that can potentially affect watercourses, aquifers, water abstraction and discharge points, areas prone to flooding and ecological receptors. Pipeline impacts include:*

  - *Inadequate or excessive drainage;*
  - *Interference with groundwater flow pathways;*
  - *Mobilisation of contaminants already in the ground;*

- *The introduction of new pollutants;*
- *Flooding;*
- *Disturbance to water ecology;*
- *Pollution due to silt from construction; and*
- *Disturbance to species and their habitats*".

- section 2.23: Natural Gas and Oil Pipelines: Secretary of State decision making - Water Quality and Resources, in particular Paragraph 2.23.5 which states that *"The Secretary of State should liaise with the Environment Agency/ National Resources Wales / Scottish Environment Protection Agency (SEPA) over the potential for the new development to result in loss or reduction of supply to any licensed abstraction or unlicensed groundwater abstraction, or any potential interference with current legitimate uses of groundwater or surface waters, taking account of the terms of any relevant EPs or any negative effect on a groundwater dependent ecosystem"*;

National Policy Statement for Electricity Networks Infrastructure (EN-5) (2024)

9.2.5 The updated NPS for Electricity Networks Infrastructure (EN-5) (Department for Energy Security and Net Zero, 2023c) was designated in 2024 and refers to EN-1 about 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. Relevant to this assessment, the main sections include:

- section 2.3: Climate change adaptation and resilience, particularly paragraph 2.3.2 which states

  "*As climate change is likely to increase risks to the resilience of some of this infrastructure, from flooding for example, or in situations where it is located near the coast or an estuary or is underground, applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to:*

  - *Flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change;*
  - *The effects of wind and storms on overhead lines;*
  - *Higher average temperatures leading to increased transmission losses;*
  - *Earth movement or subsidence caused by flooding or drought (for underground cables); and*
  - *Coastal erosion- for the landfall of offshore transmission cables and their associated substations in the inshore and coastal locations respectively*".

UK Marine Policy Statement

9.2.6 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.

The North East Inshore Plan and North East Offshore Marine Plan

9.2.7 The North East Inshore Plan and North East Offshore Marine Plan (Defra, 2021) 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.

9.2.8 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 (2023)

9.2.9 The National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities (DLUHC), 2023) 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 158);

- 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 159a);
- 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 165);
- 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 166);
- 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 167); 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 180).

National Planning Practice Guidance (2019)

9.2.10 The Planning Practice Guidance (PPG) Water Supply, Wastewater, and Water Quality (last updated July 2019) (DLUHC, 2019), provides guidance for local planning authorities on assessing the significance of water environment effects of proposed developments. The guidance highlights that adequate water and wastewater infrastructure is needed to support sustainable development.

9.2.11 The NPPF (DLUHC, 2023) and the Flood Risk and Coastal Change PPG (DLUHC, 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.

A Green Future: Our 25 Year Plan to Improve the Environment (2018)

9.2.12 In 2018, Defra published the 25 Year Plan to Improve the Environment (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, minimising waste and managing exposure to chemicals; enhancing beauty, heritage and engagement with the natural environment.

9.2.13 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 Environmental Improvement Plan 2023

9.2.14 UK Government's Environmental Improvement Plan (EIP23) (Defra, 2023a) has been published by Defra as a revision of the 25 Year Plan to Improve the Environment (Defra, 2018) (25YEP) (detailed below) and to report on the progress made since 25YEP. One of their goals is to upgrade 160 wastewater treatment works by 2027 and provide 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 approximately 643 km 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 two rounds of Landscape Recovery Schemes. A third round of Landscape Recovery will open in 2024 (data not published at the time of writing) and so details of which river catchments will be part of the scheme is yet to be published. 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).

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

9.2.15 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 (HM Government, 2021) to link the dividends of water company to their environmental performance.

9.2.16 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.

9.2.17 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)

9.2.18 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.

9.2.19 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

9.2.20 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.

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

9.2.22 A review of Schedule 3 of the Flood and Water Management Act 2010 (HM Government, 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.

9.2.23 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 (National Highways, 2021); and
- DMRB CG 501 Design of Highway Drainage Systems (Highways England, 2022).

River Basin Management Plan

9.2.24 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 updated in 2024, they will remain in place until reviewed and updated by 2027. The water bodies within the water environment Study Area fall under the Tees Management Catchment within the Northumbria RBMP (Defra, 2016).

Flood Risk Management Plans 2021 to 2027

9.2.25 Flood Risk Management Plans (FRMPs) for England 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 (environment Agency, 2022a). 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, 2022b).

Local Planning Policy

Local Policy Guidance

Redcar and Cleveland Local Plan (2018)

9.2.26 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 LPA'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.
- Policy SD7 – Flood and Water Management – Flood risk will be taken into account at all stages in the planning process to avoid inappropriate development in areas at current or future risk. All development proposals will be expected to be designed to mitigate and adapt to climate change, taking account of flood risk by ensuring opportunities to contribute to the mitigation of flooding elsewhere are taken; prioritising use of SuDS; ensuring full separation of foul and surface water flows; and ensuring development is in

accordance with the Redcar and Cleveland SFRA. 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)

9.2.27 The elements of the Proposed Development to the north of the River Tees (i.e. the Natural Gas Connection Corridor and CO_2 Export Corridor) are located within the Stockton-on-Tees Borough Council (STBC) administrative area. STBC published a Local Plan in 2019 (STBC, 2019) which outlines the LPA'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 Water Framework Directive (WFD) and Northumbrian River Basin Management Plan. The LPA 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 water bodies (including deculverting and removing barriers to fish migration).

Hartlepool Borough Council Local Plan (2018)

9.2.28 The elements of the Proposed Development to the northwest of the study area (i.e. parts of the Hydrogen Pipeline Corridor) are within the administrative boundary of Hartlepool Borough Council (HBC). HBC published a Local Plan in 2018 (HBC, 2018) which outlines the LPA's strategy up to the year 2031. The following policies of the local plan are of relevance to the water environment:

- Policy CC2- Reducing and Mitigating Flood Risk - All new development proposals will be required to demonstrate how they will minimise flood risk to people, property and infrastructure from all potential sources by:
  - Avoiding inappropriate development in areas at risk of flooding and directing the development away from areas at highest risk, applying the Sequential Test and if necessary the Exceptions Test, in accordance with national policy and the Hartlepool Strategic Flood Risk Assessment;
  - Site Specific Flood Risk Assessments will be required in accordance with national policy;
  - Ensuring that the development will be safe over its lifetime, taking account of climate change, will not increase flood risk in vulnerable locations elsewhere and where possible, will reduce flood risk overall;
  - Assessing the impact of the development proposal on existing sewerage infrastructure and flood risk management infrastructure, including whether there is a need to reinforce such infrastructure or provide new infrastructure;
  - Ensuring that development proposals are resilient to flood risk, in accordance with national policy and the findings and recommendations of the Hartlepool Strategic Flood Risk Assessment;

- Requiring that all development proposals include provision for the full separation of foul and surface water flows;
- Ensuring that development proposals separate, minimise and control surface water run-off, with Sustainable Drainage Systems being the preferred approach.
- Surface water should be managed at source wherever possible, ensuring that there is no net increase in surface water runoff for the lifetime of the development. Surface water should be disposed of in accordance with the following hierarchy for surface water run-off:
  - to a soak away system, unless it can be demonstrated that this is not feasible due to poor infiltration with the underlying ground conditions;
  - to a watercourse, unless there is no alternative or suitable receiving watercourse available;
  - to a surface water sewer;
  - disposal to combined sewers should be the last resort once all other methods have been explored.
- Where Greenfield sites are to be developed, the surface water run-off rates should not exceed, and where possible, should reduce the existing run-off rates. Where previously developed (brownfield) sites are to be developed, surface water run-off rates should seek to achieve greenfield equivalent run off rates or be reduced by a minimum of 50% of the existing site run-off rate.

- Policy NE1- Natural Environment- The Borough Council will protect, manage and enhance Hartlepool's natural environment and will ensure that:
  - The major/principal aquifers underlying Hartlepool along with watercourses and other surface and coastal waters will be protected from over abstraction and contamination from pollutants and saline intrusion resulting from development. Developments will be required to demonstrate that they do not impact on the major/principal aquifer underlying Hartlepool, along with watercourses and other surface and coastal waters and they can achieve access to a sustainable water supply prior to approval.
  - Opportunities are taken to retain, restore and de-culvert watercourses to improve their role and value as wildlife corridors and habitats.
  - Development has regard to coastal change, bathing water quality, and coastal processes over time, and in particular the need to avoid exacerbating coastal squeeze and incorporate measures to mitigate this where appropriate.

Tees Valley Authorities – Local Standards for Sustainable Drainage (2019)

9.2.29 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 'Tees Valley

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.

9.2.30 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.

9.2.31 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 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 (ES Volume I, EN070009/APP/6.2);
- Chapter 5: Construction and Programme Management (ES Volume I, EN070009/APP/6.2);
- Figure 1-1: Site Location (ES Volume II, EN070009/APP/6.3);
- Figure 4-3: CO_2 Export Corridor (ES Volume II, EN070009/APP/6.3);
- Figure 4-4: Hydrogen Pipeline Corridor (ES Volume II, EN070009/APP/6.3);
- Figure 4-5: Natural Gas Connection Corridor (ES Volume II, EN070009/APP/6.3);
- Figure 4-6: Electrical Connection Corridor (ES Volume II, EN070009/APP/6.3);

- Figure 4-7: Water Connections Corridor (ES Volume II, EN070009/APP/6.3);
- Figure 4-8: Other Gases Connection Corridor (O_2 and N_2) (ES Volume II, EN070009/APP/6.3);
- Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3);
- Figure 9-2: Groundwater Features and their Attributes (ES Volume II, EN070009/APP/6.3);
- Figure 9-3: Fluvial Flood Risk (ES Volume II, EN070009/APP/6.3);
- Figure 9-4: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3);
- Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4);
- Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4);
- Nutrient Neutrality Assessment (EN070009/APP/5.13); and
- Water Framework Directive (EN070009/APP/5.14).

Study Area

9.3.3 For the purposes of this assessment, a Study Area of 1 km around the Proposed Development Site has been considered to identify surface water features that could reasonably be affected by the Proposed Development. However, since watercourses 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 water body is considered the furthest downstream water body that could conceivably be impacted.

9.3.4 As flood risk impact can also impact upstream and downstream, Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) 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 Bran Sands Wastewater Treatment Works (WwTW) does not have capacity).

Consultation

9.3.5 An EIA Scoping Opinion was requested from the Inspectorate on 6 April 2023. A response was received on 17 May 2023. For the Scoping Opinion and the Applicant's responses to them, refer to Appendix 1E (ES Volume III, EN070009/APP/6.4).

9.3.6 The PEI Report was published for consultation on 14 September 2023 and the consultation period ended on 26 October 2023. A second statutory consultation was held between 13 December 2023 and 23 January 2024, and additional targeted consultation was held between 9 February 2024 and 10 March 2024. The matters raised have been reviewed and an explanation of how the Applicant has had regard to them is set out in the Consultation Report (EN070009/APP/5.1).

9.3.7 Refer to Table 9-1 for a detailed summary of the Statutory Consultation feedback relevant to this chapter from Statutory Environmental Bodies, and the Applicant's responses.

Table 9-1: Responses to the Statutory Consultation Feedback

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
Environment Agency	26/10/23	Flood Risk Flood Zones The proposed Hydrogen Pipeline Corridor route is located within flood zones 3, 2 and 1 and is located across some EA assets. Flood Risk Assessment (FRA) An FRA should be submitted in support of your DCO application. The FRA must assess flood risk from all sources of flooding and recommend mitigation measures that will be implemented to ensure a safe development for the design flood event (1 in 200 year including climate change). It must also demonstrate that flood risk will not be increased elsewhere. The applicant within the preliminary FRA has classified the development as Essential Infrastructure and has applied the H++ sea level rise for climate change for 75 years (the lifetime of the development in accordance with the Planning Practice Guidance (PPG)). We consider this is an acceptable approach for a development of this scale and nature.	Flood Risk The Applicant confirms that a Flood Risk Assessment FRA) is included as part of the DCO Application at Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). The Main Site is located in Flood Zone 1 (low risk of tidal/fluvial flooding) and following remediation of the site, the development platform will remain above the estimated H++ tidal flood level with a freeboard allowance of 600 mm and therefore remains in Flood Zone 1. Delivery of the final platform elevation is secured through the DCO. Any mitigation beyond setting the level of the development platform has been outlined in Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). Hydrogen Pipeline Corridor The siting of the Connection Corridors takes account of the location of existing and future

		Main Site Design Flood risk mitigation will need to be included within the development to ensure it can remain safe for its' lifetime. This includes having the finished floor levels above the design flood event plus a freeboard allowance of 600 mm. Hydrogen Pipeline Corridor The proposed hydrogen pipeline corridor route could have impacts on our existing flood defences, our land and our future flood schemes. These are discussed below: Pipeline Routes The proposed Hydrogen Pipeline Corridor, heading north towards the Venator Plant, could affect our flood defence assets along Greatham Creek. 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 its completion. The EA's Greatham North East Flood Alleviation Scheme aims to improve the defences to the south of the Potential Venator Plant. We expect to submit an application for planning permission in spring 2024 and have construction programmed to start in spring 2025. We recognise that more information will be provided in the next stages of the DCO and most of our previous comments to the scoping consultation have been incorporated into the submitted	Environment Agency (EA) flood defence assets. Any works required in close proximity to EA flood defences will be undertaken in line and with agreement from the EA, pursuant to protective provisions for their benefit in the draft DCO. Through these protections, the Proposed Scheme will not prevent the EA from being able to carry out the Greatham North East Flood Alleviation Scheme. Pipeline Design The Applicant notes this comment. Chapter 5: Construction and Programme Management (ES Volume I, EN070009/APP/6.2) and Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2) describes the details of pipeline crossing. Design detail will be further developed alongside the provision of additional details as part of the relevant permit applications, discussed in Chapter 9 (ES Volume I, EN070009/APP/6.2). These details are secured within protective provisions where appropriate. The proposed pipeline crosses existing watercourses at several locations in the existing Linkline corridor. In these cases the watercourses are currently routed in culverts below the existing Linkline corridor. Currently there are no plans to modify these structures. If however, condition

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		preliminary FRA. We would like to repeat our comments on the pipeline design and construction with the inclusion of a few additional comments. Please note the following comments are needed for your DCO application and any future Flood Risk Activity Permit to ensure there is no loss in performance of our assets. Pipeline Design 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. Where ground levels near a flood defence are to be disturbed, on either a permanent or temporary basis, the DCO designs must not allow additional water to pond at the toe of the flood defence. The applicant should seek to ensure that any works in the vicinity of our flood defences do not create any open drainage or seepage pathways.	surveys of these structures identify issues during detailed design then maintenance/repair works may be necessary as part of the works. The detailed design will demonstrate that excavations do not unduly compromise existing assets including but not limited to flood defences. Contractors method statements will set out appropriate controls to ensure the protection of existing assets during construction. Where required these can be shared with the relevant authority. Pipeline construction Flood defence crossings are currently planned to be carried out using trenchless techniques, and therefore the pipeline /crossing will be located at a suitable depth below any surface level flood defence structure. Details of the type of crossing proposed at each location is set out in Chapter 5: Construction and Programme Management (ES Volume I, EN070009/APP/6.2) The measures set out in the Framework CEMP (EN070009/APP/5.12), alongside method approvals in the Protective Provisions will ensure

		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. Any requirements placed upon "drilling operations" includes horizontal directional drilling, micro tunnelling or other equivalent trenchless installation. It also includes any of their associated enabling works including excavations or other temporary works as well as launch, reception and joining pits. 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. • 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. Pipeline maintenance Repairs or future improvement works on the pipeline will be subject to an Environmental Permit if taking place within 16m of a flood defence.	that excavations do not unduly compromise existing assets including but not limited to flood defences. The measures set out in the Framework CEMP (EN070009/APP/5.12), alongside method approvals in the Protective Provisions will ensure that trenchless crossings do not unduly compromise existing assets including but not limited to flood defences. Pipeline maintenance The need for such a permit is disapplied in the DCO. Approvals will be sought from the EA pursuant to their Protective Provisions instead. Flood defence maintenance The Applicant fully appreciates the need for the EA to be able to access its flood defence assets and has put provision into the Framework CEMP (EN070009/APP/5.12). requiring that this must be provided for by the Contractor at all times. This will also be discussed with the EA as part of discussions on Protective Provisions for their benefit.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		Flood defence maintenance The EA requires continued access for routine maintenance of the existing and planned defences in order to continue the standard of protection. Any permissions or legal agreements to allow these works to go ahead must be agreed in advance of pipeline construction. Please be aware the EA have statutory powers to carry out works on our assets. Other associated infrastructure For completeness, the same requirements within Appendix 9A: Preliminary FRA Section 9A.9.36 (considerations to ensure no impacts to EA flood defence assets) shall also apply to any other construction over waterways, for example those detailed in sections 9A.9.19 to 29. Mitigation or Compensation Opportunities PEIR Chapter 9 paragraph 9.9.2 discusses that further mitigation or compensation measures relating to a potential open-cut crossing of Belasis Beck for the installation of the pipeline corridor will be considered and re-assessed during the EIA. These compensation measures may be deliverable within the Holme Fleet area near the Belasis Beck catchment. The applicant may wish to make contact with the RSPB on this matter.	Mitigation or Compensation Opportunities Thank you for this suggestion. Liaison with RSPB is ongoing regarding effects and mitigation within and surrounding Saltholm RSPB Reserve. Water Framework Directive The WFD Assessment (EN070009/APP/5.16) has considered impacts to the Tees transitional water body and Tees Coastal water body, including all potential risks to the receptors listed. The WFD Assessment provides information on how adverse impacts will be avoided and/or mitigated, to achieve no deterioration to the two water bodies and receptors. River and groundwater WFD waterbodies have also been considered. The Proposed Development also ensures, in keeping with Natural England's nutrient neutrality requirements, that there would be no addition of nitrogen to the Tees Estuary. Full details are provided at Appendix 9C: Nutrient Neutrality Assessment (ES Volume III, EN070009/APP/6.4).

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		Water Framework Directive We welcome that our previous comments regarding WFD have been acknowledged within this PEIR and that a WFD assessment will be presented in the ES. From a marine ecology and fisheries perspective, the forthcoming WFD Assessment should: • Consider the impact of the proposal on the WFD status of the Tees Transitional water body (GB510302509900), Tees Coastal water body (GB650301500005) and any linked water bodies • Identify all potential risks to the following receptors: hydromorphology, biology – habitats, biology – fish, water quality, WFD protected areas and invasive non-native species (INNS) • Ensure that there is no deterioration resulting from the proposed activities • Demonstrate how the development/activity will avoid adverse impacts • Describe how any identified impacts will be mitigated for or suggest compensation for loss. Guidance on how to assess the impact to WFD is available at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters The applicant should note that although the dissolved inorganic nitrogen (DIN) element for the estuary is reported as at Moderate	Geomorphology The Applicant notes this response. Full details with regard to watercourse crossings have been included within Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2), Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2) and WFD assessments (EN070009/APP/5.16). The WFD assessment follows PINS Advice Note 18 (WFD Assessment) and Environment Agency guidance with regard to undertaking WFD assessment. Mitigation for watercourse crossings is outlined within both Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2) and the WFD assessment (EN070009/APP/5.16). Water Quality Assessment and Hydrodynamic Modelling The Applicant notes this response. The scope of the hydrodynamic modelling was outlined to the Environment Agency at a meeting on 13 November 2023. This is presented at Appendix

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		status, monitoring has identified with 100% certainty that the DIN element falls into the Bad classification status. It is a rule of the WFD classification system that only biological elements can drive overall status below moderate. The WFD objective to prevent deterioration in the status of each body of water applies. Where an element is already at its lowest class, any further deterioration should be prevented, if necessary, through mitigation of all those effects and not limited to significant effects. Geomorphology The WFD assessment should follow industry guidance, consider all relevant information sources, and present option appraisals for watercourse crossings to help demonstrate favourable outcomes. Water Quality Assessment and Hydrodynamic Modelling The proposed further quantitative hydrodynamic dispersion modelling of the effluent discharge to the Tees Bay seems appropriate. The EA will be involved in reviewing the modelling calibration/validation report and the model outputs which are to be provided within the ES. Foul drainage There are inconsistencies within the PEIR regarding where foul drainage will be treated. PEIR Chapter 4: Section 4.3.42 states that	9D: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4). Foul drainage Foul water will connect to the STDC sewage network for appropriate treatment and discharge. This is likely to be via Bran Sands WwTW but may also be via Marske-by-the-Sea WwTW. Further details are provided in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2). Water Availability The Applicant notes this response. An assessment of water availability is included in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2). This includes consideration of the impact of climate change over the lifetime of the development. Predicted quantities of water used by different aspects of the Proposed Development are also outlined in Chapter 9 and taken into account in the assessment of water availability.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		foul water will be treated at either Bran Sands or Marske-by-the-Sea sewage treatment works (STW). Whereas PEIR Chapter 9: Sections 9.3.44 and 9.5.76 state that foul water will be treated at Marske-by-the-sea STW. Following the guidance provided in our response to the scoping opinion, we require confirmation of which STW the foul water from this development will be going to for treatment. This should include details to show that the sewage network and STW have capacity to carry and treat the increase in flows. Water Availability An assessment of water availability should be provided, including but not limited to, a consideration of prolonged droughts as a result of climate change and an overall assessment of the impact of climate change on the lifetime of the project. Predicted quantities of potable water, raw water, demineralised water, cooling water use etc during construction phases and operational phases would be useful information for the water providers and abstraction teams. The EA's Environmental Constraints Report issued March 2023, describes the current and future water availability and wastewater quality in the Tees Industrial Cluster area. The information within this report, describing the possible shortages of raw process water, will be useful to review for this application.	Flood Risk Consents and Permits The Applicant notes this response. Any work that would otherwise require a FRAP will be undertaken in line with EA requirements. Works will be approved pursuant to agreed protective provisions (if included in the draft DCO (EN070009/APP/2.1)). For details on the Other Consents and Licences being pursued for the Proposed Development, please refer to Other Consents and Licenses Statement (EN070009/APP/5.7).

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		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 EA. Assessments are required for both the temporary and permanent works. This includes works such as but not limited to; directional drilling under the River Tees, construction of outfalls, ground raising and works to construct and maintain the pipeline. 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.	
Environment Agency	23/01/24	Flood Defences The changes to the Project Site Boundary in the area at the Venator Site, outlined by Change 1 within the December Update Brochure, may have an impact on our flood defense improvement works. The Environment Agency's Greatham North East Flood Alleviation Scheme aims to improve the defences to the south of the Venator Plant. As part of our improvement works, we will be creating a site compound to support construction on Venator's land for the duration of the works. Our site compound location has been agreed with Venator and is located in the hashed yellow area	Flood Defences The yellow shaded area for Change 1 will be for the construction of a connection from Venator to the Greatham branch of the Hydrogen Pipeline Network which may overlap with the EA's proposed construction compound. The routeing of the hydrogen pipeline in the Greatham area is designed to avoid impacts on the SPA/Ramsar. When selecting the routeing early engagement with the Environment agency identified the need to avoid impacts on flood alleviation schemes.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
		shown here in the increased red line boundary for H2 Teesside. We expect to submit an application for planning permission in summer 2024 and have construction programmed to start in spring 2025. The additional area added to the H2 Teesside Project Site Boundary may have an impact on our Scheme if works at this location are to begin before our Flood Alleviation Scheme has been completed. To ensure the two projects do not coincide and impact each other, we ask for confirmation of the dates when construction for your project is expected to commence in this area. We also request clarity on what works are proposed in this area to ensure there will be no impacts on our flood defense improvement works.	Consequently, HDD techniques will be used to cross the creek to avoid the flood alleviation scheme The exact timing of works in the Venator area is yet to be defined but the Applicant and Venator will work with the EA to avoid conflicts in this area and will provide further information in due course to allow Protective Provisions to be agreed.

9.3.8 Furthermore, engagement meetings have been undertaken on the topic of Water Environment with Natural England on 13 June 2023 and 13 November 2023. The proposed nutrient neutrality methodology and the preliminary screening outcomes were presented.

9.3.9 Engagement meetings with the Environment Agency were held on 13 June 2023 and 24 November 2023. The proposed assessment approach to the surface water, flood risk and water resources ES chapter, as well as the proposed approach to the WFD assessment were presented. An update on flood risk, WFD screening, nutrient neutrality screening and hydrodynamic modelling scope were also presented and discussed. Feedback received from the engagement meetings has been incorporated into the development of this chapter and the associated appendices.

Impact Assessment Methodology

Desk Study

9.3.10 Desk based research has been undertaken to identify the water features 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.

9.3.11 In summary, the key background reports, websites and data used include the following

- RCBC's Local Plan (2018) (RCBC, 2018);
- STBC's Local Plan (2019) (STBC, 2019);
- HBC's Local Plan (2018) (HBC, 2018)
- British Geological Survey Geological Mapping Viewer, 'GeoIndex' (British Geological Society (BGS), (BGS, n.d.);
- Environment Agency Catchment Data Explorer (Environment Agency, n.d.(a));
- Environment Agency Flood Risk Maps for Planning (Environment Agency, n.d.(b));
- Environment Agency Bathing Water Quality website (Environment Agency, n.d.(c));
- Environment Agency Ecology and Fish Data Explorer (Environment Agency, n.d.(d));
- Environment Agency Guidance on discharges to surface water and groundwater: environmental permits (Environment Agency, 2016a);
- Defra Hydrology Data Explorer website (Defra, n.d.(a));
- Defra Multi-Agency Geographic Information for the Countryside (MAGiC) website (Defra, n.d.(b));

- Environment Agency Water Quality Archive website (Environment Agency, 2024);
- 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, n.d.(b));
- Ordnance Survey (OS) maps and aerial photography (Bing, n.d.);
- Data requested from the Environment Agency with regard to water quality of receptors in the Study Area, water resources (licensed abstractions and discharge consents), pollution incidents, fisheries and aquatic ecology data and WFD information and data;
- 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;
- Data requested from STBC and RCBC with regard to Private Water Supplies in the Study Area; and
- Information available in previous planning applications relating to River Tees and Tees Bay – Net Zero Teesside (EN010103, 2020); Improvement of the Inter Terminals (MLA/2019/00151, 2019), Teesside Offshore Windfarm (32421/040319/14, 2014), Able Seaton Berth Dredging (MLA/2015/00334/4, 2015), York Potash Harbour Facilities Order (TR 030002, 2016).

Site Surveys

9.3.12 A walkover survey was undertaken on 15 February 2023 by a surface water quality specialist and hydromorphologist in cold, dry and overcast conditions. A follow up walkover was undertaken on 2 October 2023 in fair weather 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.

9.3.13 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 baseline monitoring undertaken for the Net Zero Teeside (NZT) project, as previously outlined in Appendix 1A: Scoping Report (ES Volume III, EN070009/APP/6.4). 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 (Section 9.4). The results of this monitoring are summarised in Section 9.4 of this

Chapter with more detail provided in Water Framework Directive Assessment (EN070009/APP/5.14).

Source-Pathway-Receptor Model

9.3.14 The assessment is based on the Source-Pathway-Receptor model. 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 pathway or pathways which links the source to the receptor;
- 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.

9.3.15 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.

9.3.16 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.

9.3.17 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).

9.3.18 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.

9.3.19 The assessment of cumulative effects has been undertaken and is detailed within Chapter 23: Cumulative and Combined effects (ES Volume I, EN070009/APP/6.2).

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

Assessment of Surface Water Runoff for the Operational Phase

9.3.21 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. Although the Proposed Development is not considered to pose appreciably greater risk of such pollution in comparison to the existing site, it is necessary to conduct an assessment 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.

9.3.22 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 Assessment method follows three steps:

1. Determine suitable pollution hazard indices for the land use(s);
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
3. If the discharge is to a water body protected for drinking water, consider a more precautionary approach.

9.3.23 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.

9.3.24 At this stage, an Indicative Surface Water Drainage Plan (EN070009/APP/2.12) has been prepared for the Proposed Development and forms the basis of a qualitative assessment of potential impacts on water quality. A Detailed Surface Water Drainage Strategy will be developed, in substantial accordance with that plan, as secured through the DCO.

Water Framework Directive Assessment (WFD)

9.3.25 Developments that have 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).

9.3.26 The following guidance on how to undertake WFD assessments has been used and informs Water Framework Directive Assessment (EN070009/APP/5.14):

- Environment Agency Advice Note - Water Framework Directive Risk Assessment: How to Assess the Risk of Your Activity (Environment Agency, 2016b);
- Environment Agency Guidance - Water Framework Directive Assessment: Estuarine and Coastal Waters (Environment Agency, 2023a) and
- The Inspectorate Advice Note 18: The Water Framework Directive (The Inspectorate, 2017).

9.3.27 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 the assessment of the risk is determined. 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 (HM Government, 2017a).

9.3.28 Refer to Water Framework Directive Assessment for further details regarding the assessment approach (EN070009/APP/5.14).

Nutrient Neutrality Assessment

9.3.29 Natural England has identified the Teesmouth and Cleveland Coast Ramsar / 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.

9.3.30 The Nutrient Neutrality Assessment (EN070009/APP/5.13) 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.

Discharge Modelling: Assessment of Process Water Discharge

9.3.31 Case 2B of the Proposed Development (described further in the sub-section 'Use of the Rochdale Envelope') would discharge treated process water effluent to Tees Bay. Hydrodynamic dispersal modelling of discharges to Tees Bay has been undertaken 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 River Tees e.g. by tidal effects.

9.3.32 Due to the Teesmouth and Cleveland Coast SPA/Ramsar being affected by nutrient neutrality with regards to nitrogen, and the fact that River Tees 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.

9.3.33 Full details regarding the water quality modelling are presented in Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4).

Flood Risk Assessment

9.3.34 A Site-wide FRA is provided in Appendix 9A (ES Volume III, EN070009/APP/6.4), 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 FRA includes a full description of the flood risk baseline, which is also summarised in Section 9.4.

Classification of Effects and Significance Criteria for EIA Assessment

9.3.35 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.

9.3.36 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, 2020) 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.

9.3.37 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.

9.3.38 Following the DMRB LA 113 Road Drainage and the Water Environment (Highways England, 2020) 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 Identified, 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.

9.3.39 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. international or UK legislation (SAC, SPA, SSSI, Ramsar, salmonid water) / Species protected by European Commission legislation Ecology and Nature Conservation.	Source Protection Zone (SPZ) 1; Principal aquifer providing a regionally important resource and/or supporting a site under international 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.
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 international or UK legislation Ecology and Nature Conservation.	Principal Aquifer providing locally important source supporting river ecosystem; SPZ2; Groundwater supports GWDTE; Water abstraction: 500 to 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.

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 to 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.
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 ≤0.001 m^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 protection, and probable strategic need for	Water compatible development.

IMPORTANCE	GENERAL CRITERIA	SURFACE WATER	GROUNDWATER	MORPHOLOGY[2]	FLOOD RISK
				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 (HM Government, 2016) and the Water Resources Act 1991 (as amended) (HM Government, 1991b), 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 and developed from Environment Agency conservation status guidance (Environment Agency 1998a, Environment Agency, 1998b) as DMRB guidance does not currently provide any importance criteria for morphology.

9.3.40 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 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 (>100 mm). 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. Contribution to reduction in water body WFD classification.

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		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 (>10 mm). 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. Groundwater: Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding. Flood Risk:

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		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 water body 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. Improvement in water body WFD classification. Flood Risk: Creation of flood storage and decrease in peak flood level (>100 mm).

IMPACT	CRITERIA	DESCRIPTION AND EXAMPLES
		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

9.3.41 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 the matrix shown in Table 9-4. Effects classed as moderate or greater are considered significant (see shaded cells). Where there is a range of effects (e.g. slight/moderate) 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

9.3.42 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.

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

9.3.44 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. In this case, the final receiving waterbody likely to be affected is the Tees Coastal WFD waterbody which is within 1km of the Proposed Development. As such, all effects would be 'local.

Use of the Rochdale Envelope

9.3.45 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 ('the Inspectorate') Advice Note 9 (The Inspectorate, 2018). This involves assessing the maximum (or where relevant, minimum) / realistic worst-case parameters for the elements where flexibility needs to be retained (building dimensions or operational modes for example).

9.3.46 In line with the Inspectorate's guidance, the following assumptions have been made with regard to the construction phase of the Proposed Development:

- It is assumed that during Proposed Development construction the EPC Contractor(s) will as a minimum conform to all permit / consent / licence requirements and good practice measures to avoid, reduce and minimise the risk of water pollution or unacceptable physical impacts (without mitigation) on water features. Details of this mitigation and good practice standards are described in Section 9.5.

9.3.47 The following assumptions have been made for the operational phase of the Proposed Development:

- Water is to be supplied to the Proposed Development via the existing NWL raw water pipeline feed from the River Tees to the South Tees Development Corporation (STDC) site, or alternatively a new connection to the existing NWL supply either via tie in to NZT infrastructure or the installation of a new connection. With either approach the source water would be from the River Tees. The abstraction flow rate would be 227 m^3/hr for Case 1B or 297 m^3/hr for Case 2B (both cases are described below and in more detail later). Treatment to the supplied water is required to produce the desired water quality for utility water / cooling water make-up, fire-water and for producing demineralised water.
- It is assumed for the purposes of the assessment, that there is no need for the Applicant to obtain a license for abstraction. It is understood based on discussions with NWL that there is sufficient supply of water to accommodate the Proposed Development project water demands.
- Case 1B for the Proposed Development is 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 4 m^3/hr. This will be transported off-site and treated in a manner consistent with nutrient neutrality requirements by either a) denitrification and discharge of resultant effluent by a third party approved and licensed facility within the habitats site catchment area or b) discharging outside of the habitats site catchment by a third party approved and licensed facility .

- Case 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 75.0 m^3/hr for Case 2B. At the time of writing, it has not been decided whether Case 1B or Case 2B will be taken forward. However, a combined discharge under Case 2B to Tees Bay via the NZT outfall is the preferred option as the Applicant is seeking to optimise the water management through a synergised approach across the bp led Teesside projects.
- 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 (European Commission, 2016). The discharge would also be required to meet the standards outlined within the water activity environmental permit for the discharge. Hydrodynamic modelling of the potential discharge has been undertaken and is presented with Appendix 9B Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4) and summarised within this Chapter.
- This assessment assumes that should the Tees Bay outfall associated with the NZT project be utilised by the Proposed Development, then the impacts will be as per the assessment of morphological impact set out in the NZT project assessment, as it does not form part of the Proposed Development. Further detail regarding the outfall are provided in Appendix 9B Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4). No assessment has been included herein regarding installation of the outfall.
- Areas where amines are used, transferred or stored 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 in accordance with the prevailing waste management requirements.
- Clean surface water drainage (predominantly runoff from rainfall) will discharge either: 1) to the Tees River Estuary via an existing or a new South Tees Development Corporation (STDC) outfall; or 2) to Tees Bay via the proposed NZT outfall. Both options are considered by the assessment.
- All liquid chemicals stored within the operational Proposed Development Site will be kept in bunded areas with a volume of 110% of storage capacity.
- Foul water will connect to the STDC sewage network for appropriate disposal. This is likely to be at Bran Sands STW. 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 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 and creek bed to ensure that there is no risk of exposure. For the purposes of assessment this is assumed to be 10 m below the creek bed as a worst case. For the Tees Crossing this is expected to be more in the range of 40-50 m depth, but will be determined following the ground investigation (GI) at the detailed design phase.
- It is assumed that the maximum excavation dimensions for launch and reception pits will be 5 m width x 10 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 drilling fluids used within the drilling machine will be water based and materials like naturally occurring bentonite clay.

9.3.48 Given the above, this assessment presents a reasonable 'worst-case' approach.

Assumptions and Limitations

9.3.49 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.

Assumptions

9.3.50 The Proposed Development will be constructed in two phases as outlined in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2). Phase 1 will consist of a single hydrogen production unit, on-site hydrogen storage and supporting utilities. Phase 2 will consist of a further hydrogen production unit, on-site hydrogen storage and supporting utilities constructed thereafter. The majority of the Hydrogen Pipeline Corridors to facilitate the transportation of hydrogen to offtakers will be constructed and completed in Phase 1 except for short additional spurs within of the Hydrogen Pipeline Corridors, to be completed in Phase 2.

9.3.51 Permitted preliminary works for Phase 1 are expected to start in the third quarter (Q3) of 2025 (subject to the granting of the DCO), with the main civil works to start in Q4 of 2025. Construction of Phase 1 is anticipated to last approximately 32 to 36 months and is expected to be complete in Q2 2028.

9.3.52 The early enabling works for Phase 2 may overlap with commissioning for Phase 1 in Q2 2028. It is expected that the main civils works for Phase 2 will begin in Q3 of 2028 (after Phase 1 is commissioned) and be completed by the end of 2030. It is proposed that there will be no overlap between the main construction phases of Phases 1 and 2.

9.3.53 If the duration of the construction of Phase 2 is extended (when compared to that for Phase 1 due to potential overlaps in Phase 1's operation and Phase 2's construction activities), ongoing management of the simultaneous operation and construction activities and minimisation of the associated risks and impacts would be required. However, this is not considered to affect the assessment presented herein, which considers construction, operational and decommissioning phases separately for the whole development. Provided that the outlined mitigation measures (see Section 9.5) are implemented there would be no anticipated additional impacts or effects should there be overlap between the operation of Phase 1 and construction of Phase 2.

9.3.54 A reasonable assumption has been made that all works will take place using good practice, as set out and secured in the Framework CEMP (EN070009/APP/5.12). A Decommissioning Environmental Management Plan (DEMP) would be produced pursuant to a Requirement of the Draft DCO (EN070009/APP/4.1). The DEMP would consider in detail all potential environmental risks on the Proposed Development Site and contain guidance on how risks can be removed or mitigated. This will include details of how surface water drainage should be managed during decommissioning and demolition. The delivery of a DEMP is secured by a Requirement on the draft DCO.

Limitations

9.3.55 The assessment has been undertaken using available data and Proposed Development design details when the ES was produced as outlined in Section 9.3. It is also based on understanding of flow pathways as observed during the site walkover. However, many of the watercourses in the Study Area are in culvert and underground for significant sections, and so assumptions have been made regarding flow pathways for these culverted sections, based on Ordnance Survey (OS) mapping. Understanding of flow pathways is described for each watercourse in the baseline (Section 9.4).

9.3.56 Aside, from Pond 14 (the only open water pond remaining within the Teesmouth and Cleveland Coast 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 feature importance (which adopts a holistic approach and considered a wide range of attributes in addition to water quality) 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 deposition of N_2 to this open water pond.

9.3.57 The understanding of drainage arrangements assessed herein is based on the Indicative Surface Water Drainage Plan (EN070009/APP/2.12). The drainage strategy will be subject to further development at detailed design in consultation with the Environment Agency and LLFA. This is secured under a requirement in the DCO. The development of the Detailed Drainage Strategy will need to be supported by appropriate water quality risk assessments.

9.3.58 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.

9.3.59 This assessment has been undertaken using available data and Proposed Development design details when the ES was produced. However, at this stage some details of the Proposed Development remain subject to optionality, as outlined above with regard to the Rochdale Envelope. As such, the assessment is a worst-case scenario, and actual effects may be less than those presented herein.

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, Figure 9-2: Groundwater Features and their Attributes, Figure 9-3: Fluvial Flood Risk and Figure 9-4: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3) throughout.

Land Use, Topography and Rainfall

9.4.2 The Production Facility is located on part of the former Redcar Steelworks site to the east of Redcar Bulk Terminal (referred to as 'the Foundry') and west of the proposed Net Zero Teesside site. The site is coastal, being located immediately south-west of Teesmouth, at approximately 6 to 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 (ES Volume II, EN070009/APP/6.3)). 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 River Tees at the southern extent of Bran Sands and continues west towards Billingham (Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3). The crossing of the River Tees is included to incorporate the Hydrogen Pipeline Corridor infrastructure required by the Proposed Development. To the north and west of the River Tees the Hydrogen Pipeline Corridor 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 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 River Tees 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).

9.4.4 South and east of the River Tees, the Proposed Development Site extends south to Grangetown to accommodate the Electrical Connection Corridor, Water

Connections Corridor, Natural Gas Connection Corridor, Other Gases Connection Corridor, and the Hydrogen Pipeline Corridor. This whole area is below 20 m AOD, rising gradually to the east. It is predominantly industrial but with some residential land use at the margins of the study area at Dormanstown and Grangetown.

9.4.5 The nearest weather station with historical data is located at Stockton-on-Tees (Met Office, n.d.), approximately 5 km south-west of the eastern extent of the Proposed Development Site (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.

9.4.6 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.

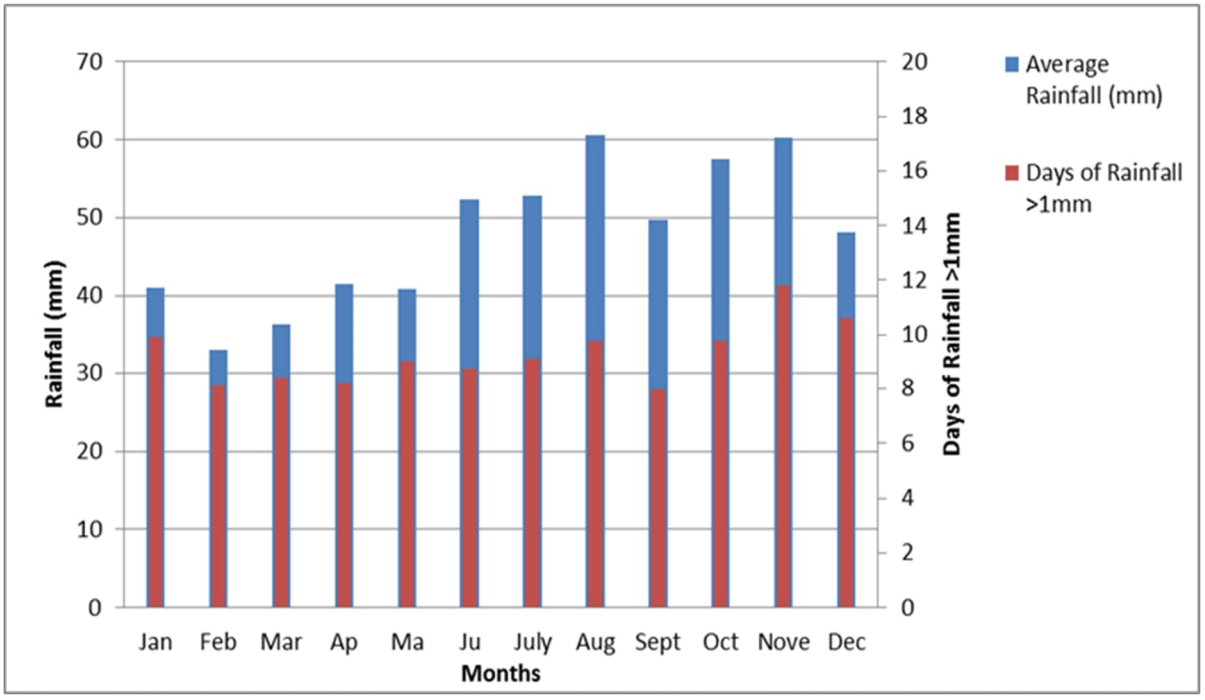

Plate 9-1: Stockton-on-Tees Weather Station (Met Office, n.d.) – Average Rainfall per Month (1981-2010) and Average Days per Month with >1 mm of Rainfall (1981-2010)

Water Features

9.4.7 A site walkover was undertaken of water features north of the River Tees on 15 February 2023 in cold, dry but overcast conditions. Using observations taken on these visits, data from OS mapping (Bing, n.d.) and the Environment Agency Catchment Data Explorer website (Environment Agency, n.d.(a)), a summary list of the surface water features (and where relevant to the assessment, groundwater

water features) were identified within the Study Area. These are listed in Table 9-5 and also presented in Figure 9-1: Surface Water Features and their Attributes and Figure 9-2: Groundwater Features and their Attributes (ES Volume II, EN070009/APP/6.3). Further details on these water features are presented in Table 9-5 to Table 9-7.

9.4.8 The Environment Agency's Catchment Data Explorer website (Environment Agency, n.d.(a)) confirms that the WFD estuarine and coastal water bodies in the Study Area are contained within the Northumbria River Basin District, the Northumbria Transitional and Coastal (TraC) Management Catchment, and the Tees Lower and Estuary TraC Operational Catchment. The fluvial water bodies are contained within the Northumbria River Basin District, Tees Management Catchment and Tees Lower and Estuary Operational Catchment.

9.4.9 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 (ES Volume II, EN070009/APP/6.3)). Although these are the WFD reporting reaches, WFD principles and objectives apply to all tributaries of these watercourses. The WFD water bodies include one coastal water body (Tees Coastal Water), one estuarine water body (Tees transitional water body) and three rivers (The Fleet – designated as River Tees (S Bank), Cowbridge Beck, and North Burn from Source to Claxton Beck.

9.4.10 Within the catchments of the WFD water bodies outlined in Table 9-6, there are also a number of named watercourses shown on OS mapping (Bing, n.d.) – these are described in Table 9-7 (also refer to Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3)).

9.4.11 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 have minimal biodiversity value as they are largely in culvert. In places, the drainage channels are visible above ground and are typically of the order of 0.5 to 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

WATER FEATURE	WATER FEATURE TYPE	WFD DESIGNATION OR ASSOCIATED WFD WATER BODY (WHERE APPLICABLE)
Tees Bay	Coastal	Tees Coastal Water (GB650301500005)

WATER FEATURE	WATER FEATURE TYPE	WFD DESIGNATION OR ASSOCIATED WFD WATER BODY (WHERE APPLICABLE)
River Tees	Watercourse (Main River)	TEES Transitional Water body (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 Water body (GB510302509900), and so is considered further in the context of the WFD water body
The Fleet	Watercourse (Ordinary)	River Tees (S Bank) (GB1030250723320)
Main's Dike	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Mill Race	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Dabholm Gut	Watercourse (Ordinary)	Designated under the TEES Transitional Water body (GB510302509900)
Dabholm Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Kettle Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Kinkerdale Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Knitting Wife Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Castle Gill	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Ash Gill	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Holme Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Belasis Beck	Watercourse (Ordinary)	Tributary of Holme Fleet and therefore

WATER FEATURE	WATER FEATURE TYPE	WFD DESIGNATION OR ASSOCIATED WFD WATER BODY (WHERE APPLICABLE)
		associated with the Tees Transitional WFD Water body
Cross Beck	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Mucky Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Swallow Fleet	Watercourse (Ordinary)	Tributary of the Tees Transitional WFD Water body
Saltholme Nature Reserve Ponds, Brine Reservoirs, Brine Field, and refinery ponds	Stillwaters and watercourses	Catchment of Tees Transitional WFD Water body
Cowpen Marsh ponds located adjacent to landfill site off Landfill Rd, Brine Field, small ponds	Stillwaters and watercourses	Catchment of Tees Transitional WFD Water body
Lake at Charlton's Pond Nature Reserve	Stillwater	Catchment of Tees Transitional WFD Water body
Ponds at Billingham Technology Park	Stillwater	Catchment of Tees Transitional WFD Water body
Ponds within Coatham Dunes and Bran Sands	Stillwater	Catchment of Tees Transitional WFD Water body
Ponds at Coatham Marsh	Stillwater	Catchment of Tees Transitional WFD Water body
Numerous industrial ponds and artificial water bodies across the area including Lazenby Reservoirs, Salthome Brine Reservoirs and Venator reservoirs	Stillwater	Catchment of Tees Transitional WFD Water body
Tees Sherwood Sandstone	Groundwater	WFD designation (GB40301G702000)
Tees Mercia Mudstone and Redcar Mudstone	Groundwater	WFD designation (GB40302G701300)

Table 9-6: WFD Surface Water Bodies in the Study Area

WATER BODY	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 water body 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 water body was observed from Coatham Sands between Redcar and Teesmouth. The water body 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. Mitigation Measures: Details of mitigation measures for this water body were requested from the Environment Agency but none were provided. Associated Protected Areas: Teesmouth and Cleveland Coast SPA and Ramsar. 18 designated Bathing Waters including Redcar Coatham, Redcar Granville, Marske Sands, Seaton Carew North Gare, Seaton Carew Centre, Seaton Carew North, Redcar Stray and Redcar Lifeboat Centre. Notable Issues: 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 River Tees. 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.					

WATER BODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
Tees Transitional Water body (GB510302509900)	Moderate Ecological Potential	Fail	Moderate (2015)	Heavily Modified	The Tees Transitional Water body 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 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 River Tees.
Site observations: The Tees water body 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 water body 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 and is around 3 to 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					

WATER BODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
and Their Attributes (ES Volume II, EN070009/APP/6.3). 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 water body 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 River Tees. 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 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. Mitigation Measures: Details of mitigation measures for this water body were requested from the Environment Agency but none were provided. Associated Protected Areas: Teesmouth and Cleveland Coast SPA and Ramsar. Seal Sands (River Tees) Urban Waste Water Treatment Directive (UKENCA98).					
River Tees (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					

WATER BODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
approximately 8 to 9 m wide but increases to approximately 25 to 30 m wide immediately downstream where the channel looks like it may have been artificially constructed for access. There is good connectivity with the floodplain upstream of the culvert but less so downstream. Flows upstream of the culvert may on occasion spill onto the surrounding marsh. Various service crossings were noted over the watercourse near this location. Flow is sluggish 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 to 2 m abruptly from the channel bed. Mitigation Measures: The Environment Agency have outlined mitigation measures to improve this water body. These include re-opening of culverts, restoring in channel morphological diversity, water level management, implementing appropriate vegetation control, removing obsolete structures, installing fish passes and enhancing structures to improve ecology. None of the mitigation measures are currently in place, except for water level management. Protected Areas: Teesmouth and Cleveland Coast SPA and Ramsar.					
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 an easterly direction to its confluence with North Burn at Cowpen Bewley Woodland Park where it is then designated as the Tees transitional water body (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. Mitigation Measures: Not required as upstream of the development and so can be scoped out of assessment.					

WATER BODY	ECOLOGICAL STATUS / POTENTIAL	CHEMICAL STATUS	OVERALL TARGET OBJECTIVE	HYDROMORPHOLOGICAL DESIGNATION	DESIGNATED REACH
Protected Areas: None associated with water body.					
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 Woodland Park where it is then designated as the Tees transitional water body (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. Mitigation Measures: Not required as upstream of the development and so can be scoped out of assessment. Protected Areas: None associated with water body.					

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 Water body 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 to 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 Water body	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 Water body description above.

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
Kettle Beck	Tees Transitional Water body	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 to 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 Water body	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 water bodies and reedbeds.	Holme Fleet was observed at NZ 4941 2396, just off the A1185 under which it is culverted. The watercourse was observed to be linear and modified with imperceptible flow. There was dense in-channel vegetation in the form of reed beds. The channel was around 2 m wide and 0.3 m deep. It is not expected that Holme Fleet will be impacted as part of the Proposed Development.
Kinkerdale Beck	Tees Transitional Water body	This watercourse is mapped as a surface water body 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 to 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 Water body	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 culverted, is straightened and heavily modified with a width of approximately 2 to 3 m.
Knitting Wife Beck	Tees Transitional Water body	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 pipe culvert to the north of the A66 at NZ 5505 2135. Restoration measures have recently been implemented on Knitting Wife Beck. The channel sits within a defined low channel, with steep embankments on either side. A sinuous planform has been designed for the channel, with coarse and fine gravels provided with the intention that the channel reworks these sediments to create hydraulically diverse flow conditions. The channel has no riparian vegetation and so there will be no watercourse shading, no delivery of woody material, and no filtration of fine sediment runoff.
Lackenby Channel	Tees Transitional Water body	The Lackenby Channel is a drainage cut between the Lackenby steelworks (NZ 55305 22207) and the eastern bank of the River Tees (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 observed north of the A1053 within the Teeside Works, Cleveland. The channel width varied between 10 to 15 m with steep incised banks rising 2 m above the observed water level. The channel was longitudinally disconnected with short, culverted lengths to make way for site access. Bed sediment was obscured due to high turbidity. There was very little in the way of flow diversity or geomorphological value due to the linear and modified nature of the channel. It was noted on site that the watercourse appeared polluted by an oil-based contaminant and gave

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
			off an odour. It was noted that the channel is bordered by extensive industrial works with heavy plant and excavators, which may have resulted pollution of the watercourse.
Main's Dike	The Fleet – River Tees (S Bank WFD Water body)	Main's Dike watercourse rises from a spring in Wilton Wood to the south-east of the Site at NZ 59328 19741. The watercourse then flows north along the eastern boundary of the Wilton International Site, and into the Mill Race at NZ 57893 22824.	Main's Dike was observed along the eastern edge of the Wilton International Site where it was very straight, around 1 m in width and with steep incised banks rising around 4 m from the channel. The watercourse was heavily shaded, and no macrophytes were observed in the channel at this location although marginal vegetation was dense. The bed was dominated by fine sediment, with some isolated fine gravel patches (e.g., 2 to 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 – River Tees (S Bank WFD Water body)	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 to 3m wide. It is culverted beneath Dormanstown and road crossings of the A108 and railway line.
Mill Race	The Fleet – River Tees (S Bank WFD Water body)	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	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 to 4 m wide) leading up to a circular culvert of around 2 m diameter, with artificial concrete banks in places. Banks were steep and incised. The bed was dominated by fine sediment. There are numerous service crossings of the watercourse at this location.

NAME	TRIBUTARY OF	WATERCOURSE DESCRIPTION	SITE OBSERVATIONS
		International Site beneath the A1085. It remerges at NZ 57102 24152 and flows west into The Fleet.	The Mill Race was also observed downstream of the A1085 adjacent to the Trunk Road roundabout where it was 2 to 3 m wide, very straight, with a bed dominated by fine sediment. Road runoff appears to discharge into the channel. The Fleet, which is hydraulically connected to the Mill Race was observed north of the A1085 within Coatham Marsh. The channel was steeply embanked and largely obscured due to the density of riparian vegetation. Channel width was estimated at 1.5 to 2 m. Sections of the watercourse have been diverted through underground culverts and the watercourse is crossed by numerous pipes. Habitat and geomorphology value are low.
Mucky Fleet/ Swallow Fleet	Tees Transitional Water body	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 Water body.	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.

9.4.12 There is also a network of small watercourse channels throughout the saltmarsh and wetland area to the west and south-west of Seal Sands (around Greatham Creek, Holme Fleet and Belasis Beck). Some of these channels were observed on site from the Saltholme RSPB Reserve, and they are small (1 to 2 m wide) low gradient, single thread, meandering water features that are well connected to their floodplains.

9.4.13 Other water features shown in Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3) outside of the Study Area and upstream of any proposed works are not considered any further as there will not have any pathways through which to be impacted. This includes Greatham Beck, Skelton Beck, Cross Beck, Claxton Beck, Spencer Beck, Normanby Beck, Ormesby Beck, Middle Beck, Marton West Beck, Lustrum Beck and Old River Tees.

9.4.14 There are a large number of still water features within the study area, most of which are small ponds or artificial standing water features. The majority of these on the south-east bank of the Tees are small artificial water features and ponds related to the surrounding industrial land use. To the north-east of the Tees there are further artificial and industrial water features, such as the large brine reservoirs immediately north of the Proposed Development Site at Saltholme. The surrounding wetlands here also include several large, interconnecting water features 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 water features within the South Gare and Coatham Dunes.

9.4.15 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 described in the NZT ES (bp, 2021a), 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. Further details regarding the dune ponds and water quality data relating to Pond 14 are provided within Water Framework Directive Assessment (EN070009/APP/5.14).

River Tees

9.4.16 Land reclamation, canalisation, and channel deepening carried out in the mid-19th century result in the present-day River Tees'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).

9.4.17 The River Tees is not designated as a Bathing Water or Shellfishery. Northumbrian Water's Bran Sands WwTW discharges to the estuary close to Teesmouth.

9.4.18 The mouth of the River Tees 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 approximately 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.

9.4.19 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).

9.4.20 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 River Tees (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

9.4.21 Freshwater input to the estuary is measured at a gauging station at Low Moor (NGR NZ 364105). 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.

9.4.22 The Tees Barrage controls freshwater flow into the River Tees 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.

9.4.23 A combination of locally created wind waves and offshore swell generates the waves in the River Tees. 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).

9.4.24 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 River Tees (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

9.4.25 Suspended sediment concentrations are generally low in Tees Bay and in the River Tees when compared to some UK estuaries, with values typically below 50 mg/l on average 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.

9.4.26 The DCO application relating to York Potash Harbour Facilities in 2016 (Royal Haskoning, 2016a) states that historical bed sampling in the vicinity of the Proposed Development Site determined bed sediments comprising 65 to 70% silt, with some clay (around 20%) and the remainder 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% to 35% (Royal Haskoning, 2016d).

9.4.27 There are some notable enhancement schemes relating to the River Tees. The Tees Tidelands Programme is led by the Environment Agency and STBC and consists of a

number of projects that aim to restore intertidal habitats and ecologically reconnect the River Tees to tributaries.

9.4.28 The Tees Tidelands programme includes the Environment Agency Seal Sands SSSI restoration project. This is initially focusing on building a River Tees baseline hydraulic model, but in the future also seeks to identify the prioritised physical interventions to manage excess growth of macroalgae.

9.4.29 The Tees Rivers Trust (TRT) are undertaking a River Tees Edges project to install a suite of bio-engineered designs that enhance ecology in the highly modified Tees navigation channel. 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 River Tees Edges project focused on areas along the River Tees (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).

9.4.30 TRT are also undertaking species (i.e. oyster, seagrass, mussel) reintroduction projects at locations within Tees Bay and the estuary.

9.4.31 The Canal and River Trust (CRT) are developing designs to secure enhanced fish passage across the Tees Barrage and so throughout the Tees catchment.

Tees Bay

9.4.32 Tees Bay includes Bathing Waters designated under the Bathing Waters Regulations 2013 (as amended) (HM Government, 2013), with 'Redcar Coatham' being located immediately north of the Proposed Development Site within the study area, and 'Seaton Carew North Gare' being situated approximately 1.5 km north of the Study Area (north of the North Gare breakwater). There are no designated shellfisheries within Tees Bay.

9.4.33 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 to 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.).

9.4.34 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.).

9.4.35 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).

9.4.36 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

9.4.37 The River Tees 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 River Tees (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

9.4.38 In addition to the above, commercial fishing vessels launched 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.).

9.4.39 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 Royal National Lifeboat Institute (RNLI) Lifeboat station at Redcar Seafront.

Surface Water Quality

9.4.40 The Tees Coastal WFD water body is currently at 'does not require assessment' for chemical status under Cycle 3 (2022) data (Environment Agency, n.d.(a)). However, under the Cycle 3 2019 data the chemical status was Fail, due to failures for polybrominated diphenyl ethers (PBDE) and mercury and its compounds. The status of all other priority substances, priority hazardous substances, specific pollutants and other pollutants was either Good, High, or had not been assessed.

9.4.41 The Tees Transitional WFD water body is currently at 'does not require assessment' for chemical status under Cycle 3 (2022) data (Environment Agency, n.d.(a))). However, under the Cycle 3 2019 data the chemical status was Fail, due to failed status for PBDEs, benzo(g-h-i)perylene, tributyltin compounds, and cypermethrin (Priority substances). The failure for tributyltin compounds were attributed to diffuse pollution from contaminated water body bed sediments.

9.4.42 The River Tees (South Bank) water body is currently at 'does not require assessment' for chemical status under Cycle 3 (2022) data. However, under the Cycle 3 2019 data the chemical status was Fail, due to failures for PBDEs and mercury as well as its compounds (Environment Agency, 2024). Priority substances were all at Good Status and Other Pollutants did not require assessment.

9.4.43 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.

9.4.44 Water quality data has been obtained from the Environment Agency's Water Quality Archive (Environment Agency, 2024) for the River Tees. 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 (ES Volume II, EN070009/APP/ 6.3)). 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 River Tees Water Quality Data Based on Monitoring at Multiple Sites Between 2009 – 2022. (EA, 2024)

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	-
para-DDT	0.01	-	-	-	0.001	-

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
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). Cells that include '-', indicate no available data.

9.4.45 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 water body.

9.4.46 The Water Quality Archive website (Environment Agency, 2024) also provides water quality for other water bodies and sites in proximity to the Proposed Development Site, spanning the period 2019 to 2023 inclusive. A summary is provided in Table 9-12 indicating parameters that were measured and a brief overview of water quality implications. Full data tables are provided in Water Framework Directive Assessment (EN070009/APP/5.14).

Table 9-12: Summary of Water Quality Data Water bodies within the Study Area Based on Monitoring Between the Range of 2000-2023 (Environment Agency, 2024)

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 to 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 WFD EQS. While chloroform exceeds the EQS in the Dangerous Substance Directive.
Bran Sands NGR: NZ 55700 26600	2000 to 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*

MONITORING STATION	DURATION OF SAMPLING	TYPE OF WATER SAMPLED	PARAMETERS TESTED	GENERAL QUALITY COMMENTS
				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 to 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 (adjacent to Able UK) NGR: NZ 52490 26490	2009 to 2019	Estuarine water	Physico-chemical parameters (e.g. pH, temp, dissolved oxygen); Nutrients and sanitary products (e.g. nitrate, ammoniacal nitrogen, orthophosphate); Trace metals.	Slightly alkaline and well oxygenated. Concentration of nitrates and phosphate were low. Numerous metals were measured at this site, all falling below EQS (as outlined in Table 9-11).
Billingham Beck 50 m upstream of River Tees confluence NGR: NZ 47470 20507	2019 to 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)

MONITORING STATION	DURATION OF SAMPLING	TYPE OF WATER SAMPLED	PARAMETERS TESTED	GENERAL QUALITY COMMENTS
Freshwater				
Billingham Beck at Billingham Bottoms NGR: NZ 45495 22393	2019 to 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.

9.4.47 The data summary presented in Table 9-11 indicates that there remains substantial pollution pressure on the River Tees 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.

9.4.48 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 water body), 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 River Tees. The data for this watercourse indicates that certain dissolved metals exceed WFD standards, while nitrates and phosphates are also slightly elevated.

9.4.49 Further water quality data for the Study Area is available for Bathing Water areas as designated under the Bathing Water Regulations 2013 (as amended) (HM Government, 2013). 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 2023 classification of Good, which was reduced from Excellent in 2022 (Environment Agency, 2024).

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

9.4.51 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 Excellent for 2023 (Environment Agency, 2024).

9.4.52 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.

9.4.53 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.

9.4.54 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.

9.4.55 Previous sampling (2020 to 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 are included in Water Framework Directive Assessment (EN070009/APP/5.14).

Sediment Quality

9.4.56 Numerous investigations of sediment quality have recently been undertaken to support various recent dredging proposals and developments around the River Tees, with samples compared to Cefas Action Levels for the disposal of dredged material. These give an indication of sediment quality in the River Tees 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.

9.4.57 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. 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 (HM Government, 2023b) 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.
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)

9.4.58 The DCO application relating to York Potash Harbour Facilities in 2016 (Royal Haskoning, 2016a) also included sediment sampling in the main River Tees 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).

9.4.59 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 (HM Government, 2023b) at most of sampling stations and depths. In some cases, Cefas Action Level 2 (HM Government, 2023b) 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 water body, which in the past received a large amount of waste discharge.

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

9.4.61 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 (HM Government, 2023b) 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.

9.4.62 The NGCT sediment samples were collected in 2006 from several locations throughout the River Tees, 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).

9.4.63 These past sampling campaigns indicate significant historical contamination in the River Tees, 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 (HM Government, 2023b) and so disposal at sea was not considered suitable in these cases.

Marine Ecology Overview

9.4.64 Full details regarding marine ecology within the Study Area are provided in Chapter 14: Marine Ecology (ES Volume I, EN070009/APP/6.2). A summary is provided below.

9.4.65 In terms of fisheries, the Tees Transitional WFD water body 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) (Tees Valley Nature Partnership, 2012). Salmon, river lamprey and sea lamprey are also protected species under Annex II of the Habitats Directive (European Nature Information System (EUNIS), 2019). The River Tees is designated as one of the 64 main salmon rivers in England and Wales.

9.4.66 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 from the Environment Agency (Environment Agency, 2022) 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, 2022). Data was not available when the ES was produced for the entirety of 2023.

9.4.67 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 study area.

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

9.4.69 No protected phytoplankton species or invasive non-native species (INNS) were identified during the Environment Agency surveys in the River Tees. 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).

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

9.4.71 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.

9.4.72 The most recent Phase I and Phase II intertidal benthic survey was undertaken in October 2019 as part of the NZT project surveys (bp, 2021b). 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 (European Environment Agency (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 (HM Government, 2006) and belong to the UK BAP (Joint Nature Conservation Committee (JNCC), 2019) 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. Following a review of available data, with consideration of the potential impact pathways associated with the Proposed Development, no project specific marine ecology surveys have been proposed (see Chapter 14: Marine Ecology (ES Volume I, EN070009/APP/6.2) for further details).

9.4.73 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 (involving the chemical pyridine), and dredging in the Tees area, including River Tees. 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.

9.4.74 Further details regarding marine ecology within the Study Area are provided in Chapter 14: Marine Ecology (ES Volume I, EN070009/APP/6.2).

Freshwater Ecology Overview

9.4.75 Full details regarding freshwater ecology within the Study Area are provided in Chapter 12: Ecology and Nature Conservation (including Aquatic Ecology) (ES Volume I, EN070009/APP/6.2). A summary is provided below.

9.4.76 There is one riverine WFD water body within the boundary of the Proposed Development Site that is considered to be potentially impacted – this is the River Tees 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.

9.4.77 Several notable fish species were recorded within 2 km of the Proposed Development Site using Environment Agency data (Environment Agency, 2022), NBN Atlas data (NBN Trust, n.d.), survey results for other developments in the area. These include Annex II species bullhead *Cottus gobio*, species of principal importance brown/sea trout *Salmo trutta*, in addition to the European eel *Anguilla anguilla*, which is classified as 'Critically Endangered' in the International Union for Conservation of Nature (IUCN) (IUCN, 2023) and afforded further protection under the Eel Regulations 2009 (HM Government, 2009b) (see Chapter 12: Ecology and Nature Conservation (ES Volume I, EN070009/APP/6.2)).

9.4.78 There were no specific records of protected macroinvertebrate species identified in the aquatic ecology desk study data. However, some notable taxa were identified in this study, 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.

9.4.79 Previous surveys and those undertaken for the Proposed Development within the Study Area only identified locally notable species. None of the species identified are listed under statutory or non-statutory designations.

9.4.80 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 (Tees Valley Nature Partnership, 2012). 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 crayfish being present. White-clawed crayfish is therefore considered absent from the Study Area.

9.4.81 The WFD macroinvertebrate monitoring data provided by the Environment Agency from 2016 for Dabholm Gut (part of the 'River Tees South Bank' WFD water body) at NZ 56570 23772 indicates that the water body 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.

9.4.82 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).

9.4.83 Several INNS species were identified in the desk study, from Environment Agency data and data from previous NZT project surveys (bp, 2021a). Species identified on the Wildlife and Countryside Act 1981 (HM Government, 1981) (Schedule 9) include Floating Pennywort (*Hydrocotyle ranunculoides*), New Zealand pigmyweed (*Crassula helmsii*), Parrot feather (*Myriophyllum aquaticum*) and Himalayan balsam (*Impatiens glandulifera*). Nuttall's waterweed (*Elodea nuttallii*) was also recorded, which is listed in the Invasive Alien Species (Enforcement and Permitting) Order 2019 (HM Government, 2019). Most of these species are outside the Study Area

but floating pennywort has been found in The Fleet. During the summer macrophyte field surveys, Himalayan balsam was recorded along the margins of Kinkerdale Beck, and giant hogweed was observed along the banks of Dabholm Gut.

Sites of Ecological Importance

9.4.84 Full details regarding Sites of Ecological Importance within the Study Area are provided in Chapter 12: Ecology and Nature Conservation (including Aquatic Ecology) (ES Volume I, EN070009/APP/6.2). A summary is provided below.

9.4.85 Designations within and in proximity to the Study Area are shown on Figure 10-10: Ecological Designations (ES Volume II, EN070009/APP/6.3). The Hydrogen Pipeline Corridor (where it crosses the River Tees) 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 (HM Government, 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 River Tees upstream to the Tees Barrage.

9.4.86 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) (HM Government, 2017c), 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 across the Proposed Development Site at its northern extent for the Water Connections Corridor.

9.4.87 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 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.).

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

9.4.89 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 within the Study Area.

Groundwater and Geological Features

9.4.90 Full details of geology and groundwater are provided in Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, EN070009/APP/6.2). 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.

9.4.91 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.

9.4.92 To the north of the River Tees, 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.

9.4.93 Bedrock is overlain by superficial deposits consisting of Tidal Flat Deposits (sand, silt and clay). These are found beneath the River Tees, 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.

9.4.94 Defra's MAGiC website (Defra, n.d.(b)) 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.

9.4.95 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.

9.4.96 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.

9.4.97 The Study Area to the east and south of the River Tees is within the Tees Mercia Mudstone & Redcar Mudstone WFD groundwater body (GB40302G701300) (Environment Agency, 2023a) (see Figure 9-2 (ES Volume II, EN070009/APP/6.3)). The water body 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 water body has an area of 494.57 km^2.

9.4.98 The Study Area to the west and north of the River Tees 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 (see Figure 9-2 (ES Volume II, EN070009/APP/6.3)). The Tees Sherwood Sandstone groundwater body is at Good Overall Status, with Good Quantitative and Chemical Elements. The water body has an area of 293.01 km^2.

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

9.4.100 Soilscapes (Cranfield University, n.d.) indicates that the majority of the Study Area either side of the River Tees 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

9.4.101 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).

9.4.102 This section contains information on water activity permits (e.g. discharges), water abstractions, and past water pollution incidents based on information provided by the Environment Agency or publicly available online data.

Water Activity Permits

9.4.103 There are 70 water activity permits (i.e., discharge consents) within the Study Area (Defra, 2023d). Locations are shown in Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3).

9.4.104 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. The table of consented discharges relevant to the Proposed Development are provided within Water Framework Directive Assessment (EN070009/APP/5.14).

Abstractions

9.4.105 Data provided by the Environment Agency for the Proposed Development indicates that there are 27 licensed water abstractions within the Study Area (Defra, 2023d). Locations shown in Figure 9-1: Surface Water Features and their Attributes (ES Volume II, EN070009/APP/6.3).

9.4.106 Of these, 24 abstractions are for groundwater from the underlying Triassic Sherwood Sandstone to the north and west of the River Tees. They are predominantly for industrial, commercial, and public service use. There are also groundwater abstractions for water supply.

9.4.107 There is one surface water abstraction (A25), and two from tidal waters (A23 and A26). The full list of licensed abstractions are shown below in Table 9-14.

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

Table 9-14: Licensed Abstractions Located within the Study Area

ID	ABSTRACTION NUMBER	PURPOSE	SOURCE	X	Y
A1	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	450700	522950
A2	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	450830	523400
A3	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	451030	523380
A4	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	451180	524100
A5	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	451200	524370

ID	ABSTRACTION NUMBER	PURPOSE	SOURCE	X	Y
A6	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	451230	524700
A7	1/25/04/134	Industrial, Commercial and Public Services	Groundwater	451280	525000
A8	1/25/04/134	Water Supply	Groundwater	450700	522950
A9	1/25/04/134	Water Supply	Groundwater	450830	523400
A10	1/25/04/134	Water Supply	Groundwater	451030	523380
A11	1/25/04/134	Water Supply	Groundwater	451180	524100
A12	1/25/04/134	Water Supply	Groundwater	451200	524370
A13	1/25/04/134	Water Supply	Groundwater	451230	524700
A14	1/25/04/134	Water Supply	Groundwater	451280	525000
A15	1/25/04/134	Environmental	Groundwater	450700	522950
A16	1/25/04/134	Environmental	Groundwater	450830	523400
A17	1/25/04/134	Environmental	Groundwater	451030	523380
A18	1/25/04/134	Environmental	Groundwater	451180	524100
A19	1/25/04/134	Environmental	Groundwater	451200	524370
A20	1/25/04/134	Environmental	Groundwater	451230	524700
A21	1/25/04/134	Environmental	Groundwater	451280	525000
A22	1/25/04/142	Industrial, Commercial and Public Services	Groundwater	447500	524100
A23	1/25/04/161	Industrial, Commercial and Public Services	Tidal Waters (River Tees)	448105	521942
A24	1/25/04/164	Environmental	Groundwater	452310	523190
A25	NE/025/0001/008	Environmental	Surface Waters (Holme Fleet)	449732	522992
A26	NE/025/0001/018	Industrial, Commercial and Public Services	Tidal Waters (River Tees)	452188	526949
A27	NE/025/0001/024	Industrial, Commercial and Public Services	Groundwater	458132	522714

Water Pollution Incidents

9.4.109 There were 12 water pollution incidents of Category 3 (minor) were identified within the Study Area within the last 5 years. No Category 2 or Category 1 incidents were recorded. Details are given in Table 9-15 and locations are shown in Figure 9-1: Surface Water Features and Their Attributes (ES Volume II, EN070009/APP/6.3).

Table 9-15: Pollution Incidents to Controlled Waters within the Study Area within the last 5 years

ID	INCIDENT NUMBER	NOTIFICATION DATE/TIME	CATEGORY	POLLUTANT TYPE	WATER BODY	X	Y
P1	1604608	10/04/18 16:36	Category 3 (Minor)	Oils and Fuel	River Tees	454040	523170
P2	1627835	01/07/18 14:43	Category 3 (Minor)	Contaminated Water	Billingham Beck	446344	521681
P3	1654441	28/09/18 17:20	Category 3 (Minor)	Sewage Materials	Belasis Beck	447394	523244
P4	1659617	23/10/18 10:24	Category 3 (Minor)	General Biodegradable Materials and Wastes	River Tees	453900	523870
P5	1663756	13/11/18 15:20	Category 3 (Minor)	General Biodegradable Materials and Wastes	River Tees	453900	523870
P6	1667924	06/12/18 17:34	Category 3 (Minor)	Oils and Fuel	River Tees	454000	524070
P7	1707375	04/06/19 11:06	Category 3 (Minor)	Pollutant Not Identified	Greatham Creek	451003	522254
P8	1814296	04/06/20 14:06	Category 3 (Minor)	Sewage Materials	Tees Bay	447923	525756
P9	1927695	24/04/21 08:07	Category 3 (Minor)	Pollutant Not Identified	Cowbridge Beck	447994	525687
P10	2087233	09/08/22 12:15	Category 3 (Minor)	Pollutant Not Identified	River Tees	454387	525101
P11	2098122	08/09/22 11:36	Category 3 (Minor)	Oils and Fuel	Marton Beck	452866	522166
P12	2147632	02/05/23 13:02	Category 3 (Minor)	Oils and Fuel	Lackenby channel	454110	523316

9.4.110 The recorded pollution incidents have impacted the River Tees (including Greatham Creek), Billingham Beck, Belasis Beck, Cowbridge Beck, Marton Beck and Lackenby Channel. They have been related to pollution from oils, crude sewage and contaminated water associated with fire-fighting runoff.

Flood Risk

9.4.111 This section provides a summary of the baseline flood risk data available for the Proposed Development Site. Refer to Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) for a more detailed description of the baseline environment in relation to flood risk.

9.4.112 The Environment Agency's 'Flood Risk Map for Planning' (Environment Agency, n.d.(b)) identifies areas subject to fluvial/tidal flood risk for the present day but does not include the benefits or impacts of any existing flood defences. Flood zones are illustrated on Figure 9-3: Fluvial Flood Risk (ES Volume II, EN070009/APP/6.3) and should be referred to throughout.

9.4.113 The flood zone definitions for the flood zones used on the Flood Map for Planning, are defined in Table 9-16.

Table 9-16: Flood Zone Definitions (source Table 1 of the PPG (DLUHC, 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	Very High

FLOOD ZONE	DEFINITION	PROBABILITY OF FLOODING
	• 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).	

Tidal Sources

9.4.114 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).

9.4.115 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 approximately 300 m upstream of the confluence with Cowbridge Beck, outside of Stockton Borough. Greatham Creek is crossed by bridges which carry the A178 and the emergency access road to Seal Sands. There is a history of tidal flooding and breach of the defences at Greatham Creek.

9.4.116 The online Flood Map for Planning (Environment Agency, n.d.(b)) illustrates that the Main Site and immediate surrounding area is located entirely in Flood Zone 1. However, a significant amount of the Hydrogen Pipeline Corridor is located within Flood Zones 2 and 3 on the left bank where it extends to, and passed, the A178. Here, Flood Zone 3 encompasses majority of the Hydrogen Pipeline Corridor in this region. Small areas of the Electrical Connection Corridor and the Oxygen and Nitrogen Connections Corridor are also located within Flood Zones 2 and 3.

9.4.117 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 (ES Volume II, EN070009/APP/6.3) for the spatial extent of these Flood Zones.

9.4.118 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 Hydrogen Pipeline 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).

9.4.119 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.

9.4.120 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.

9.4.121 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 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). The model demonstrated that during a 0.1% AEP (1 in 1,000 chance) event based upon the existing (2019) scenario, tidal levels in the River Tees could rise by 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.

9.4.122 The Main Site is considered to be at 'low risk' of flooding from tidal sources, together with the Connection Corridors that are located within Flood Zone 1 on the south bank of the River Tees (CO_2 Export Corridor and Electrical Connection Corridor, as described in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2)). 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 Connections Corridor and Electrical Connection Corridor are at 'high risk' of tidal flooding.

Fluvial Sources

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

9.4.124 Numerous other Ordinary Watercourses intersect the Connection Corridors 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.

9.4.125 The Environment Agency's online Flood Map for Planning (Environment Agency, n.d.(b)) 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 are 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. Refer to Figure 9-3: Fluvial Flood Risk (ES Volume II, EN070009/APP/6.3) for the spatial extent of these Flood Zones.

9.4.126 Although tidal flood risk is the greatest risk to the north of the River Tees, 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 Hydrogen Pipeline Corridor crosses a watercourse / drain.

9.4.127 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

9.4.128 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.

9.4.129 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.

9.4.130 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.

9.4.131 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.

9.4.132 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.

9.4.133 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

Overland Flow of Rainfall Runoff

9.4.134 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.

9.4.135 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*".

9.4.136 The Environment Agency's online Risk of Flooding from Surface Water maps (Environment Agency, n.d.(b)) indicate areas at risk from surface water flooding, when rainwater does not drain away through the normal drainage systems or soak into the ground, but instead lies on or flows over the ground. This is illustrated on Figure 9-4: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3). 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.

9.4.137 There are, however, small, isolated areas of high, medium and low flood risk where water is seen to pond during more significant rainfall events (see Figure 9-4: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3). 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.

9.4.138 Based on the above information, the risk of surface water runoff to the Proposed Development Site and surrounding study area is considered to be generally low.

Existing Drainage Infrastructure

9.4.139 No information was available regarding the private drainage falling within the Proposed Development Site when the ES was produced. 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.

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

9.4.141 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 the 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).

9.4.142 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 Water Bodies

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

9.4.144 A review of online OS mapping (bing, n.d.) indicates that there are no canals located in close proximity to the Proposed Development Site.

9.4.145 The Reservoir Act 1975 (HM Government, 1975b) defines a large raised 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 (HM Government, 2010). However, the plans to reduce the threshold appear to be on hold at this time.

9.4.146 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.

9.4.147 The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England (HM Government, 1975b). All large raised 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.

9.4.148 Environment Agency Long-Term Flood Risk Mapping (Environment Agency, n.d.(b)) 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 Connection Corridors would cross the reservoir flood extents. Environment Agency mapping (Environment Agency, n.d.(b)) 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.

9.4.149 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

9.4.150 As outlined in Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2), the construction of the Proposed Development is expected to commence with Permitted Preliminary Works for Phase 1 in Quarter 3 (Q3 2025, and so this year has been adopted as the future baseline for construction as a worst-case scenario. Full operation (for both Phases 1 and 2) is scheduled to commence in 2030.

9.4.151 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

9.4.152 All WFD surface water bodies identified within the Study Area (Tees Coastal, River Tees (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). While this is the published position, the Environment Agency have confirmed that they wish to see significantly reduced dissolved inorganic nitrogen (DIN) in the estuary.

9.4.153 The River Tees is considered to be undergoing a period of ecological recovery after several decades of industrial and sewage pollution. Numerous restoration schemes such as the Tees Tidelands programme are in place. 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 further deterioration, and ultimately improvement, with regard to nutrient status.

9.4.154 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 (HM Government, 2021), the Levelling-Up and Regeneration Act 2023 (HM Government, 2023a) and regulatory requirements (Water Company Price Review) include measures to tackle storm sewage discharges and set new requirements on nutrient 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.

9.4.155 The current receptor importance criteria presented in Table 9-17 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 assessment within this chapter is undertaken against existing baseline conditions.

9.4.156 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

9.4.157 The Tees Mercia Mudstone and Redcar Mudstone WFD groundwater body is at its objective of Poor Status by 2015, while the Tees Sherwood Sandstone WFD groundwater body WFD water body is at its objective of Good Status by 2015.

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

Flood Risk

9.4.159 Climate change is predicted to alter both future tidal and fluvial flood risk and this has been taken into account by Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). 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.

9.4.160 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 Main Site affected by flooding from this source during a 1% (1 in 100 chance) event.

9.4.161 The Environment Agency climate change guidance was recently updated (Environment Agency 2022d) 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 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4), 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 this.

9.4.162 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.

9.4.163 However, to ensure a robust approach, for assessment purposes, it is assumed that the Proposed Development could operate for longer than a 25-year design life. As such for flood risk the lifetime of the Proposed Development is assumed to be 75 years for the purpose of the FRA, which is in line with the lifetime of non-residential uses in the NPPF (DLUHC, 2023) and Flood Risk and Coastal Change PPG (DLUHC, 2022).

9.4.164 The Environment Agency Long Term Flood Risk map (Environment Agency n.d.(b)), 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, n.d.(b)). 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: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3).

9.4.165 The new updated climate change allowances published by the Environment Agency (Environment Agency, 2022d) have been used for guidance in Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). This includes the tidal sea level allowance (Table 9A-9) and H++ Sea Level Rise Allowance (Table 9A-10), the fluvial climate change allowance (Table 9A-11), the peak river flow allowance (Table 9A-12), the peak rainfall intensity allowance for 3.3% annual exceedance rainfall event (Table 9A-13) and the 1% annual exceedance rainfall event (Table 9A-14).

Decommissioning

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

9.4.167 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 31 years (assumed Proposed Development decommissioning date), and so the assessment within this chapter is undertaken against existing baseline conditions.

Importance of Receptors

9.4.168 The importance of the local water resource receptors within the Study Area is described in Table 9-17. Importance is based on the criteria outlined above in Table 9-4.

Table 9-17: Importance of Water Resource Receptors

WATER FEATURE	IMPORTANCE DESCRIPTIONS
Tees Bay	Water Quality: The Tees Coastal water body is considered a Very High importance receptor on the basis of being WFD designated and including sites protected/designated under international (e.g. Teesmouth and Cleveland Coast SPA, bathing waters) and UK legislation (Teesmouth and Cleveland Coast SSSI). Morphology: Low importance as a WFD Heavily Modified Water body, dominated in this area by breakwaters.
River Tees	Water Quality: The River Tees 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), and the channel is also important for navigation and commercial activities (which also require maintenance dredging). Morphology: The River Tees is considered of Medium importance for the assessment, taking into account interventions that are underway in the catchment. Its current status is of lower

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	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 River Tees 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 (River Tees (S Bank) WFD water body)	Water Quality: The Fleet (freshwater reach) is considered a High importance receptor for water quality on the basis of being WFD designated (as River Tees (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 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 water body 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

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	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 water body. As such, it is considered a Very High importance receptor for water quality as per the River Tees 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 water body, 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 River Tees. 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. 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.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	Morphology: Medium 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, however recent restoration measures to the channel suggests the channel can recover towards conditions indicative of a higher category.
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.
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: After a site visit, and review of aerial imagery, it is judged that Holme Fleet is a Medium importance receptor but there are significant deviations from natural conditions where the channel has been straightened and embanked.
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: Medium importance receptor as it exhibits a variety geomorphic forms and bank side vegetation in places, but deviates from natural conditions due to significant modifications and historic realignments.
Greatham Creek	Water Quality: The tidal lower reaches of Greatham Creek are designated under the Tees transitional water body. As such, it is considered a Very High importance receptor for water quality as per the River Tees above.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	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 individual WFD designations as water bodies in their own right. 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 water body originally constructed for clay extraction for the adjoining brickworks.
Water bodies 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: Water bodies 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 water bodies 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 water body 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.

WATER FEATURE	IMPORTANCE DESCRIPTIONS
	All other water bodies within Coatham Sands are fully vegetated wetlands and so are not considered to be ponds requiring assessment.
Numerous industrial ponds and artificial water bodies across the area including Lazenby Reservoirs, Salthome Brine Reservoirs and Ponds at Billingham Technology Park	As industrial, artificial water bodies lacking any protected species (as far as is currently known) or designations, these are considered Low Importance water bodies 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, Estuarine Alluvium and Glacial Till (superficial deposits are 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 a Principal Aquifer, supporting numerous abstractions. It is overlain in the Study Area by Tidal Flat Deposits, Glaciolacustrine deposits, and Glacial Till which are generally Secondary (undifferentiated) aquifers.

Floodplain Sensitivity for Impact Assessment

9.4.169 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. The receptors in the wider study area are generally industrial, including essential infrastructure in some places which is of Very High sensitivity. There are also residential areas to the east of the study area (i.e. Dormanstown and Kirkleatham) and west (Billingham) which are classed as more vulnerable development and are of High sensitivity. There is also extensive marshland which is water compatible and therefore of Low sensitivity in flood risk terms. 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.

9.4.170 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 associated infrastructure) and the existing risk of flooding to the wider study area from all sources. Land 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 areas of Flood Zone 2 and 3a associated with the Connection Corridors, which relate to tidal and fluvial flooding. To the south of the Tees these areas are around the Dabholm Gut, Lackenby Channel, the Mill Race and The Fleet. To the north of the Tees, there are 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 and wider study area 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 9-4).

9.4.171 The criteria described in Table 9-3 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 assessment the sensitivity of non-fluvial forms of flood risk is as follows:

- surface water flood risk – 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 Corridor (refer to Figure 9-4: Surface Water Flood Risk (ES Volume II, EN070009/APP/6.3));
- flooding from artificial sources – Low sensitivity;
- flooding from groundwater – Medium sensitivity; and
- flooding from existing drainage infrastructure – Low to Medium sensitivity.

9.5 Proposed 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 assessment and will be secured through the draft DCO.

Construction Phase

9.5.3 The Framework CEMP (EN070009/APP/5.12) sets out the key embedded 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. The Final CEMP(s) will be prepared by the EPC Contractor(s) in accordance with the Framework CEMP prior to construction. The submission, approval, and implementation of the Final CEMP(s) 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.

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 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 The Final CEMP(s) will describe the principles for the protection of the water environment during construction. A Final Water Management Plan (WMP) will be annexed to the Final CEMP(s) 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. An Outline WMP, on which the Final WMP will need to be in substantial accordance with, is included in the Framework CEMP (EN070009/APP/5.12).

9.5.7 The Final WMP will also 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 (EN070009/APP/5.12) will 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 EPC Contractor(s) 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 applicable, there may be the need for a number of secondary permissions for temporary and potentially some permanent works affecting watercourses or groundwater (e.g. 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 EPC Contractor(s) will comply with any conditions imposed by any relevant permission, or otherwise the matters covered by these secondary consents will be covered by the relevant protective provisions of the DCO.

Good Practice Guidance

9.5.10 The following Guidance for Pollution Prevention (GPPs) (NetRegs, n.d.), whilst not regulatory guidance, remain a useful resource for good practice. The good practice approaches will be secured through the Framework CEMP (EN070009/APP/5.12):

- 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;
- GPP6: Working on construction and demolition sites;
- 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) (Environment Agency, 2001a) 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:

- 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 (BSI) (2009) BS6031:2009 Code of Practice for Earth Works (BSI, 2009);
- British Standards Institute (2013) BS8582 Code of Practice for Surface Water Management of Development Sites (BSI, 2013a);
- C753 (2015) The SuDS Manual (second edition) (CIRIA, 2015a);
- C744 (2015) Coastal and marine environmental site guide (second edition) (CIRIA, 2015b);
- C811 (2023) Environmental good practice on site guide (fifth edition) (CIRIA, 2023);
- C649 (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 are included in the Framework CEMP (EN070009/APP/5.12). There are a wide range of measures that can be adopted by the EPC Contractor(s) 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 EPC Contractor(s) 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 are summarised in the Framework CEMP (EN070009/APP/5.12) and adopted

during the construction works. Measures will be implemented in accordance with prevailing pollution prevention legislation and following good practice guidance summarised in the Good Practice Guidance sub-section above. 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 pollution incident response protocols as secured in the final WMP. 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 EPC Contractor(s) in accordance with a Groundwater Risk Assessment to be developed post consent. The purpose of the Construction Dewatering Strategy will be to:

- review GI 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; and
  - 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 or storage of the water will need to be 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 Plan.

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

9.5.19 The need for a Groundwater Risk Assessment and Construction De-Watering Strategy are secured in the Framework CEMP (EN070009/APP/5.12).

Construction of Hydrogen Pipeline Corridor – Trenchless Crossings of Watercourses

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

9.5.21 The Hydrogen Pipeline is expected to range from 6 to 24 inches (15.24 cm to 60.96 cm) in diameter and while being primarily above ground, it would cross the River Tees 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 (ES Volume II, EN070009/APP/6.3).

9.5.22 The use of trenchless technologies avoids any direct impact to the estuary or creek bed, associated sediment mobilisation and scour. For the purposes of assessment the worst case depth below the bed is assumed to be 10 m. For the Tees Crossing this is expected to be in the range of 40 to 50 m depth but will be determined following the GI at the detailed design phase (maximum depth would be 60 m).

9.5.23 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, as set out in the Framework CEMP (EN070009/APP/5.12). For HDD methods, 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) or that the HDD bore may collapse.

9.5.24 Risk of hydraulic fracture will be minimised by:

- performing appropriate geotechnical investigations along the HDD alignment;
- designing the HDD profile to pass at an appropriate depth below the watercourse (>10 m for Greatham Creek and >25 m for the Tees River). The depth should be sufficient to minimise the risk of failure or collapse based on the expected ground conditions;
- designing the HDD profile to pass through competent soil layers identified in geotechnical investigations;
- detailed design of the launch and exit points of the HDD, taking account of geological layers and the intended drill path;
- performing drilling fluid hydrofracture analyses for each drilling operation and maintaining downhole pressures within recommended limits;
- using appropriate downhole annular pressure monitoring equipment (set by fracture calculations) in real time to warn of over pressurising by drilling fluid;

- designing a drilling fluid appropriate for the anticipated ground conditions;
- appropriate monitoring of drilling fluid parameters during drilling; and
- performing regular monitoring of the ground above the HDD alignment for drilling fluid leaks to the surface.

9.5.25 In addition, for HDD casing pipe to contain drilling fluid may be installed through less competent shallow ground layers at entry or exit points when considered necessary. Similarly, MBT shafts will be lined with concrete rings for stability.

9.5.26 For HDD, 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. This may include ground stabilisation prior to drilling. 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. Lost circulation materials on site can also be used to seal any breakout.

9.5.27 The sections of the Hydrogen Pipeline that will be installed via trenchless techniques will require launch and reception pits for HDD and shafts for MBT to be installed. It is assumed for the purposes of the assessment that 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.

9.5.28 The exact dimensions of the launch and receive pits for HDD 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 10 m long x 5 m wide x 3 m deep. 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.

9.5.29 Furthermore, to reduce the works required adjacent to the Teesmouth and Cleveland Coast SPA, a pipe stringing area would be established a minimum of 30 m away from the SPA. The pipe stringing area would be used to fabricate manageable lengths of pipe string. The sections of pipe string would subsequently be carried into position along the spread and dummy spread to allow the remaining joints to be fabricated and complete the pipeline.

9.5.30 Once the Hydrogen Pipeline is installed beneath the watercourse, the HDD pits, MBT shafts 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 HDD 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. However, refer to Chapter 21 Materials and Waste Management (ES Volume I, EN070009/APP/6.2) for detail regarding disposal of used drilling fluids and any waste arisings from the works.

9.5.31 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.

9.5.32 These mitigation measures are secured within the Framework CEMP (EN070009/APP/5.12).

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

9.5.33 Various route options and construction methodologies have been 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).

9.5.34 Table 9-18 outlines all watercourse crossings required for the Hydrogen Pipeline Corridor, with the exception of trenchless crossings which were discussed in the previous section.

Table 9-18: Above Ground and Open Cut Watercourse Crossings

CROSSING TYPE	PIPELINE SECTION	NGR	WATERCOURSE / WATER FEATURE	Crossing Width
Existing Pipebridge	South Tees Development Corporation (STDC) & Seal Sands	NZ 51075 23583	Unnamed watercourse (west of Seaton Carew Road)	45 m (including crossing of rail and pipeline)
Existing Pipebridge	Billingham	NZ 47676 22853	Unnamed watercourse (assumed to be a tributary of Belasis Beck)	20 m (includes rail crossing)
Existing Culvert	Wilton	NZ 56750 23738	The Fleet (River Tees (S Bank) WFD water body)	16 m

CROSSING TYPE	PIPELINE SECTION	NGR	WATERCOURSE / WATER FEATURE	Crossing Width
Existing Culvert	Wilton	NZ 57276 23711	The Mill Race	19 m
Open Cut (assumed as worst case)	South Tees Development Corporation (STDC) & Seal Sands	NZ 49241 23828	Holme Fleet	10 m
Open Cut (assumed as worst case)	Greatham	NZ 51091 23758	Unnamed watercourse (north of Seal Sands Road)	Not known, estimated 15 m for purposes of the assessment
Open Cut	Greatham	NZ 51110 24822	Unnamed ephemeral watercourse (tributary of Greatham Creek)	15 m
Open Cut (assumed as worst case)	Greatham	NZ 48649 24325	Unnamed watercourse (tributary of Holme Fleet, off A1185)	10 m

9.5.35 Table 9-18 indicates that four of the eight required watercourse crossings (that do not use a trenchless methodology) will use existing infrastructure that will not disturb the watercourse (e.g. pipebridge or existing culvert). In the four cases where open-cut installation of pipelines is required, the following mitigation will be implemented.

9.5.36 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 there is a record against which any remedial action can be determined should there be any unforeseen adverse impacts.

9.5.37 At this stage it is assumed that where open-cut crossings are required, water flow will be maintained by damming and over pumping or fluming[1]. 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

[1] Fluming involves the controlled transportation of water through a constructed channel or chute, designed to efficiently move and direct water flow for purposes, such as drainage.

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 are secured via the Framework CEMP (EN070009/APP/5.12).

Construction of Water Connections

9.5.38 Raw water will be supplied via the existing NWL raw water supply to the South Tees Development Corporation (STDC) site or a new connection to the existing NWL raw water supply either via tie in to NZT infrastructure or the installation of a new connection. There would also be a connection to NZT for use of the discharge outfall (for Case 2B). At this stage in the design development, the Water Connections may be entirely above or below ground or a combination of the two.

9.5.39 Applying the Rochdale Envelope approach, the land required for the Water Connections Corridor options currently proposed for the Main Site has been depicted as a broad corridor, as shown by Figure 4-7: Water Connections Corridor (ES Volume II, EN070009/APP/6.3) to account for all options. One watercourse crossing of the Fleet (River Tees (S Bank) WFD water body) is required at NZ 57977 24723, but would utilise an existing pipe bridge, with no works to the watercourse being required.

Construction of Natural Gas Connection / Other Gases Connection

9.5.40 Gas Connection 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) (ES Volume II, EN070009/APP/6.3). The Other Gases Connection may be entirely above or below ground or a combination of the two. There are no required watercourse crossings associated with this.

9.5.41 As outlined in Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2), CO_2 captured and compressed after metering will be exported from the Proposed Development to the Northern Endurance Pipeline CO_2 gathering network on the adjacent NZT site via a CO_2 Export Corridor. No watercourse crossings are required to facilitate the installation of this.

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

Construction of Electrical Connection

9.5.43 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 around 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.

9.5.44 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 corridor. No watercourse crossings are required to facilitate the installation of this.

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

Piling and Excavations

9.5.46 If piling is required for the Main Site, a piling risk assessment will be carried out to reduce as far as reasonably practicable the risk of development of preferential pathways (e.g. groundwater flow) between the Made Ground present and the underlying Secondary 'A' or 'B' Aquifers. The assessment will be in accordance with the Environment Agency's guidance documents including, piling into contaminated sites and will determine the risk to receptors through potential pollution scenarios considering the scope of STDC remedial works and any remediation measures proposed by the Applicant, this is secured pursuant to a Requirement of the Draft DCO (EN070009/APP/4.1).

9.5.47 If any contamination is found during the construction of the Proposed Development, which has not been previously identified, an appropriate risk assessment will be prepared. Any actions/remedial measures resulting from the risk assessment will be agreed with the Local Planning Authorities (LPAs) and in consultation with the Environment Agency where risks to controlled waters are identified, pursuant to DCO Requirement. The contamination assessment will be conducted in accordance with CIRIA C552 - Contamination Land Risk Assessment, A Guide to Good Practice (CIRIA, 2001) and Land Contamination: Risk Management (Environment Agency, 2023). Any required remedial measures will be adopted as part of the Proposed Development Site.

Water Quality Monitoring

9.5.48 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 Final WMP (also refer to the Framework CEMP for further details and the Outline WMP (EN070009/APP/5.12). The purpose of the monitoring programme will also be to ensure pollution is identified as quickly as possible and appropriate action is taken in line with the Pollution Prevention Plan (to be outlined within the Final WMP).

9.5.49 The water quality monitoring programme will be developed by the EPC Contractor(s) 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

9.5.50 All construction material storage and temporary compounds associated with the construction of the Proposed Development will be located in Flood Zone 1 where possible (with exceptions being the Greatham Satellite Compound and Statera / Cowpen Bewley Satellite Compound). During the construction phase, the EPC Contractor(s) will monitor weather forecasts and plan works accordingly. In addition, the EPC Contractor(s) will sign up to Environment Agency flood warning alerts and describe in the Flood Emergency Response Plan (for further details on the Flood Emergency Response Plan please refer to sub-section 'Management of Hazardous Substances on Site' below) 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 EPC Contractor(s) 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.

9.5.51 The EPC Contractor(s) will be required to produce a Flood Risk Management Action Plan/ Method Statement which will provide details of the response to an impending flood and include:

- a 24-hour availability and ability to mobilise staff in the event of a flood warning;
- the removal of all plant, machinery and material capable of being mobilised in a flood for the duration of any holiday close down period;
- details of the evacuation and site closedown procedures; and
- arrangements for removing any potentially hazardous material and anything capable of becoming entrained in floodwaters, from the temporary works area.

9.5.52 If water is encountered during below ground construction, suitable de-watering methods will be used with reference to a Construction Dewatering Strategy. 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) (HM Government, 1991b) and Environmental Permitting Regulations (2016) (HM Government, 2016).

9.5.53 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: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) for further details of flood resistance and resilience measures.

Works in Proximity to Flood Defences

9.5.54 The Hydrogen Pipeline Corridor will cross the River Tees and Greatham Creek (and adjacent water features at Seal Sands) using trenchless technologies as previously described. Dependent on the final corridor route, construction of the corridor would include sections in proximity to the following Environment Agency flood defences:

- defences along Greatham Creek (running north towards the Potential Offtaker at Greatham's Plant);
- a flood embankment on the north bank of Greatham Creek, which is to be significantly upgraded as part of Environment Agency's Greatham North East Flood Alleviation Scheme;
- Cowpen Marsh (between the Cowpen Bewley Landfill (to the west) and the Teesmouth and Cleveland Coast SPA (to the east);
- a flood embankment to the south of the ConocoPhillips tank farm (north of Greatham Creek); and
- a flood embankment on the south bank of Greatham Creek (Sabic Embankment).

9.5.55 The Environment Agency requires the existing standard of protection provided by the defences to be maintained both during construction and after completion of the Proposed Development.

9.5.56 Consultation with the Environment Agency will be maintained to ensure no impacts to flood defence assets. In order to minimise the impact of the Proposed Development Site on the flood defences, consideration will be given to the following (with details able to be agreed pursuant to Protective Provisions for the Environment Agency within the DCO):

- 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.
- Should the pipeline cross a flood defence structure above ground, loading to the flood defence 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(s) will be made where possible to improve conveyance and reduce debris accumulation.
- 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.
- 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.

9.5.57 Directional drilling is 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.

9.5.58 In order to maintain the standard of protection, the Environment Agency requires continued access to continue routine maintenance of the existing and planned defences. Any permissions or legal agreements to allow these works to go ahead, would be agreed in advance of pipeline construction.

Operation

9.5.59 The Hydrogen Production Facility will operate under an Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2016 (HM Government, 2016), whilst the operator will implement and maintain an Environment Management System (EMS) which will be attested to International Standards Organisation (ISO) 14001 (International Organisation for Standardization, 2015). The EMS will outline requirements and procedures required to ensure that the Proposed Development Site is operating to the appropriate standard.

9.5.60 The source of water to supply the Proposed Development will be the existing NWL raw water pipeline feed from the River Tees to the South Tees Development Corporation (STDC) site, or alternatively a new connection to the existing NWL supply via tie in to NZT infrastructure.

9.5.61 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 and 9-2b below show flow diagrams summarising the Proposed Development's water balance for both Case 1B and Case 2B of the Proposed Development. As set out in Chapter 4; Proposed Development (ES Volume I, EN070009/APP/6.2), Low Carbon Hydrogen (LCH) technology is used by the Proposed Development, and this applies to Case 1B and 2B.

9.5.62 The difference between the cases is that Case 1B uses 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 transported off-site and treated in a manner consistent with nutrient neutrality requirements by either a) denitrification and discharge of resultant effluent within the habitats site catchment area by a third party or b) discharging outside of the habitats site catchment by a third party. Case 2B is an alternative to MLD and requires discharge of treated process effluent to the NZT project outfall at Tees Bay.

9.5.63 Surface water drainage will discharge either: 1) to the River Tees Estuary via an existing or a new South Tees Development Corporation (STDC) outfall; or 2) to Dabholm Gut (with any new pipework and outfall to be consented under a subsequent planning application). This is described further below.

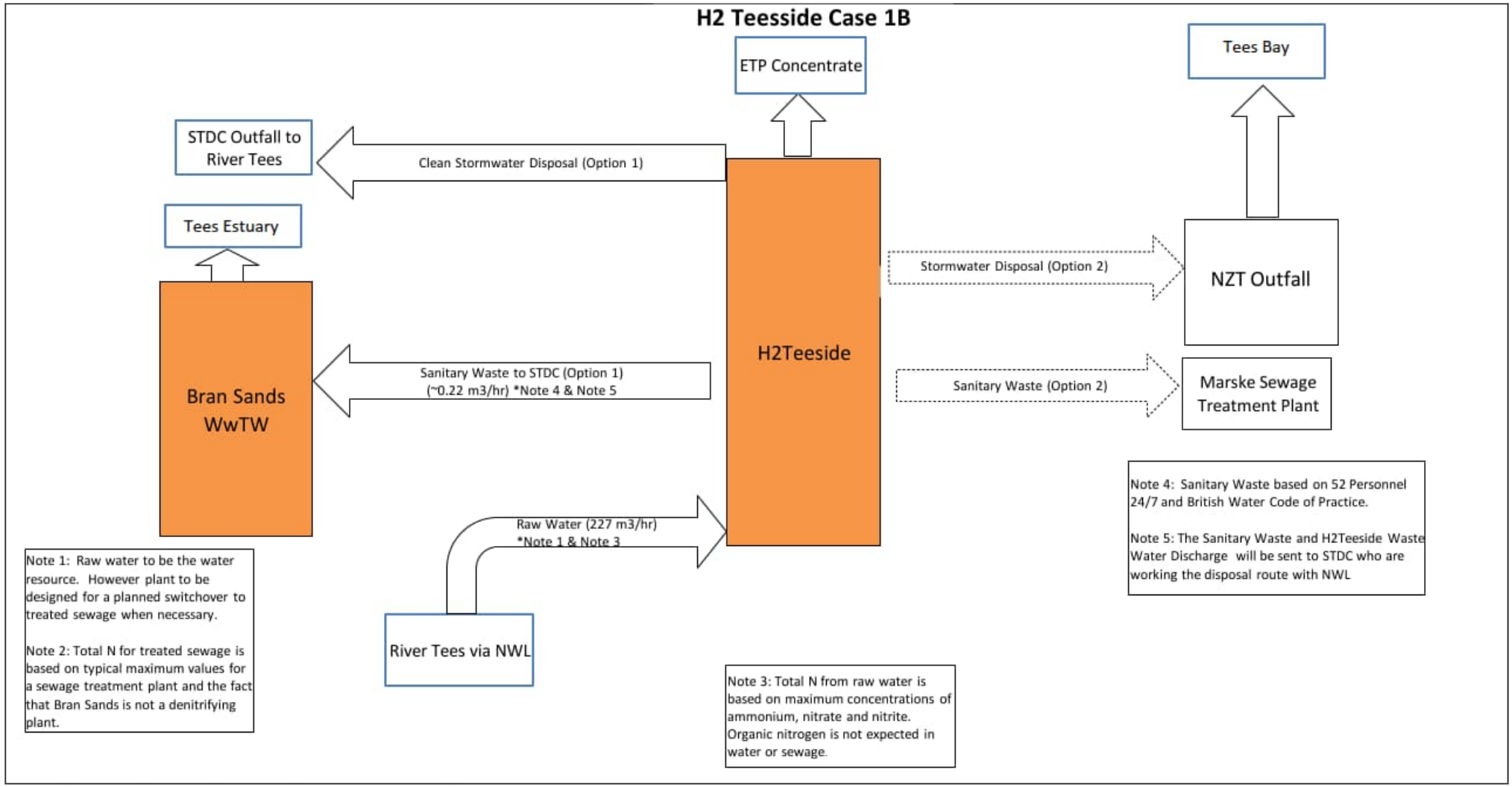

Plate 9-2A: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 1B

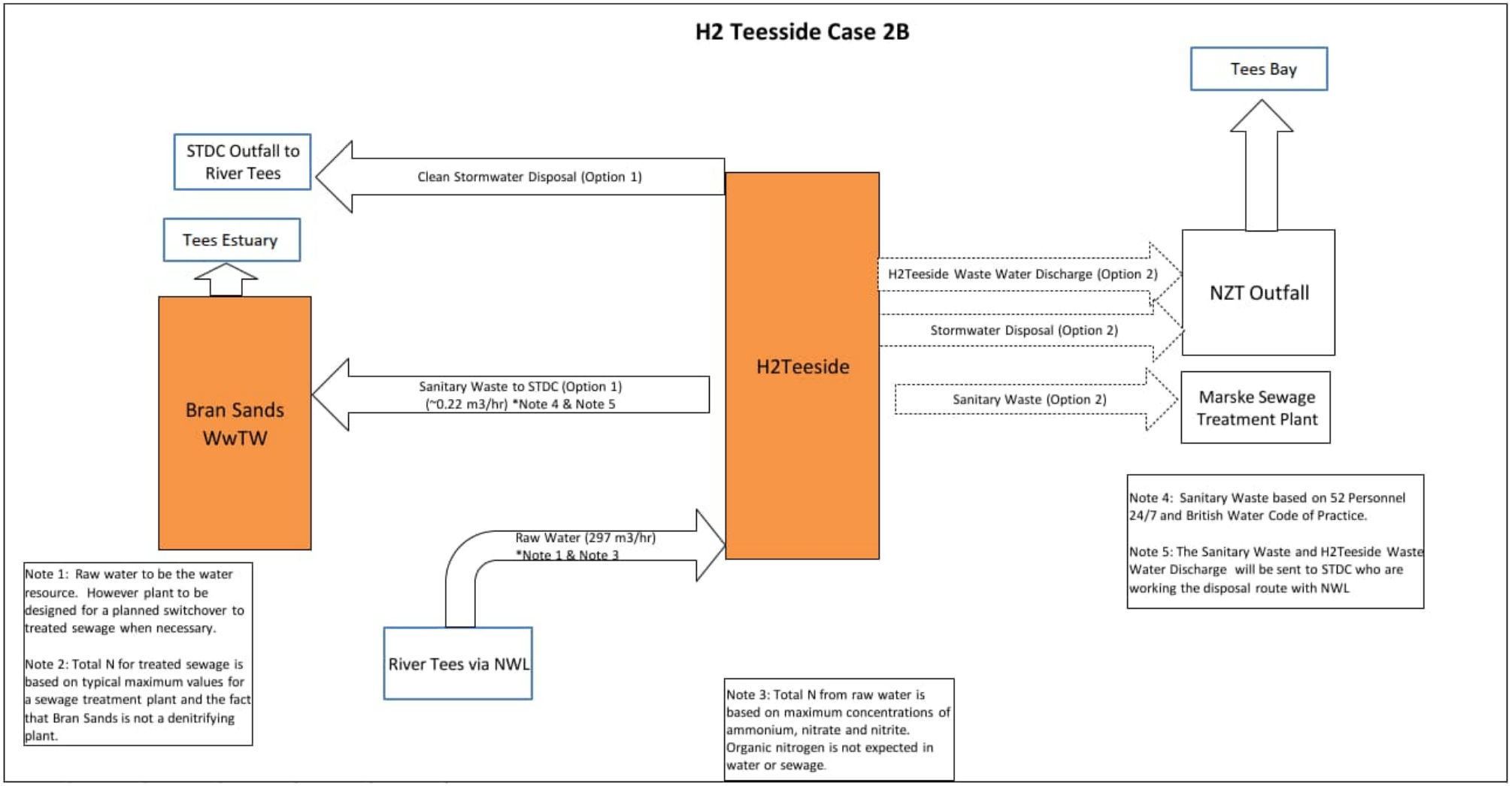

Plate 9-2B: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 2B

9.5.64 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

9.5.65 There is a significant clean water requirement for the Proposed Development comprising the elements listed in Table 9-19.

Table 9-19: Clean Water Requirement for the Proposed Development

WATER REQUIREMENT	CASE 1B & 2B (M^3/hr) (PHASES 1&2)
Cooling water make-up	167
Utility water	10
Fire-water make up	Normally No Flow
Demineralised water for boiler feed water make-up, chemicals, CO_2 absorber and HCl scrubber	104

9.5.66 Water is to be supplied via the existing NWL's raw water pipeline feed from the River Tees. Treatment is required to the supplied water to produce the desired water quality for utility water / cooling water make-up, fire-water and for producing demineralised water.

Surface Water Drainage

9.5.67 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.

9.5.68 Surface water drainage will discharge either: 1) to the River Tees via a South Tees Development Corporation (STDC) outfall; or 2) to Tees Bay via the proposed NZT outfall.

9.5.69 The surface water discharge from the Proposed Development will be limited to the greenfield runoff rate (197 l/s (for Phase 1 and 2 combined), and water storage will be appropriately sized to accommodate the 1% Annual Exceedance Probability (AEP) event with 30% allowance for climate change. The surface water storage requirement for both phases of the Proposed Development is 9,500 m^3.

9.5.70 Due to the nature of the Proposed Development, there is a risk that a range of different diffuse pollutant types may be present in surface water runoff,. However, this risk will be minimised by the fact that any process effluent will be segregated from surface water drainage and handling of chemicals on site will be regulated through the Environmental Permit.

9.5.71 A Detailed Surface Water Drainage Strategy will be defined in consultation with the Environment Agency, the LLFAs (RCBC and STBC) and other statutory agencies and will be secured under a Requirement of the DCO. This will be in substantial accordance with the principles of the Drainage Strategy as outlined in the Indicative Surface Water Drainage Plan (EN070009/APP/2.12).

9.5.72 The main functional requirements of the drainage system are:

- to collect, contain or remove major spills to limit the effects of any fire and/ or its duration;
- to minimise exposure of personnel to harmful substances;
- to recycle or reuse effluents to reduce costs and avoid waste;
- to prevent contamination to ground and surface water systems outside the limits of the process plant;
- to collect and treat fire-water and rainwater; and
- to provide a treatment system that will meet local and national code and legislative requirements.

9.5.73 The Indicative Surface Water Drainage Plan proposes 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. At this stage the following SuDS have been proposed:

- Incorporation of rainwater harvesting across suitable site buildings, with the potential for collected water to be used on-site to meet process needs. Rainwater harvesting will reduce the volume of runoff generated and will contribute to reduced attenuation storage. An initial estimate of 145 m^3/a of rainwater could be collected from roofs. This would translate into a total tank storage volume of 10 m^3.
- Pervious paving will be considered across car park areas, enabling rainwater to infiltrate into the sub-base and discharge in a controlled manner to the site drainage system. Pervious paving will reduce peak runoff through the provision of attenuation storage and offer filtration, adsorption, biodegradation and sedimentation within the sub-surface.
- Where achievable the use of gravel cover will be considered. Pore spaces within the gravel matrix provide attenuation storage, reducing peak runoff rates. In additional the gravel provides a degree of pre-treatment.

- Swales will be considered for conveyance of road run-off.
- An attenuation pond will be present to provide storage but also will provide a degree of water quality treatment.

9.5.74 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 fire-fighting effluent. Clean, uncontaminated storm water will be segregated from potentially contaminated water.

9.5.75 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. An oily water drain will provide for collecting water from plant areas where oil may be present. Rotating equipment with lube oil systems which are located outdoors shall be provided with paving and be kerbed/bunded with controlled discharge to ensure that uncontrolled surface run-off is avoided and that spillage and leakages from equipment are contained. Lube oil spillages in the kerbed/bunded area will be manually cleaned up and disposed of offsite. Transformers and substations shall be located within kerbed areas. Lube-oil and transformer oil change-out shall be drained to portable drums with spillages contained by oil mats and good-practice clean-up. Used oils will be disposed of off-site. Drainage is routed by gravity via the oily water sewer to a below ground Oily Water Separator contained within the Oily Water Treatment Package. The liquids that are transferred to the Oily Water Treatment Package will be settled and filtered to remove hydrocarbons. Treated water discharged from the treatment package flows to the surface water attenuation pond. Oil removed in the treatment package is collected as waste and is disposed off-site by vacuum tankers.

9.5.76 Areas for chemical injection packages and chemical storage tanks (excluding amine solvent) shall be kerbed/bunded to ensure that spillages and leaks from chemical dosing packages and associated intermediate storage tanks are contained. Chemical spills within bunds / kerbed areas should be routed to sumps within the bund area and from which the contents are routed to a neutralisation pit to prevent unwanted reactions. Provision will be provided to allow routing of clean neutralised fluid or storm water from chemical drainage areas to the oily water drain upon testing by the operator to confirm that the water is non contaminated. Contaminated water can be collected via vacuum truck for offsite disposal. To minimise rainwater collection where practicable and safe to do so, these chemical injection packages and intermediate storage tanks shall be located indoors or be provided with a rain shelter if outdoors. The rain shelters shall have open sides for ventilation.

9.5.77 The amine contaminated surface water drain is an independent hazardous segregated drain system. In the Hydrogen Production Facility, where there is equipment that contains amine, there is the potential for rainwater or fire water falling in this area to be contaminated with amine. To ensure that it is not released to the environment, kerbed or bunded areas shall be provided to collect this fluid

which is gravity fed to an Interceptor Pit. Here a sample will be taken to confirm if the contents of the sump meet the site criteria prior to pumping the sump contents to the main non-hazardous open drain. Contaminated fluid is disposed off-site by vacuum tankers.

9.5.78 In addition to the above sources of surface water, under exceptional circumstances fire-water 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 and tested. Should contamination be present, this water will be directed to an oil separator (or pumped out for appropriate off-site disposal at a licensed waste facility depending on the extent of the contamination), or if tested and confirmed to be clean, it will go to the stormwater attenuation pond. 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 Environment Agency, LLFAs and the Fire Service post-DCO consent during detailed design. The capacity of the fire-water catchment will be sufficient to prevent overspill to adjacent catchment areas or systems. Storage across the drainage networks will be sufficient for the 4 hours of fire-water plus leak scenario.

9.5.79 The Detailed Surface Water Drainage Strategy to be developed post-consent under a Requirement in the draft DCO will outline the consequences for the drainage system should the Proposed Development close or be decommissioned. This will also outline the final details of firewater management and drainage. It is also envisaged that a Surface Water Maintenance and Management Plan will 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. Furthermore, the development of the final, Detailed Surface Water Drainage Strategy will include an appropriate water quality risk assessment.

Process Wastewater

9.5.80 Process waste waters will be generated at the Proposed Development as follows:

- boiler blowdown – this will generally be of good quality with some residual total dissolved solids that will need removal for use as demineralisation water;
- process condensate - this has high ammonia (NH_3), methanol (CH_3OH), carbon dioxide (CO_2), methane (CH_4) and H_2 that need removal before it can be discharged; and
- hazardous liquid wastes – to be taken off-site (e.g. amine).

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

9.5.82 Other wastewater streams (cooling tower blowdown and demineralisation plant rejects) will be treated in an Effluent Treatment Plant (ETP). Case 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.

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

9.5.84 The continuous flows of effluent are summarised in Plate 9-2a-b at Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). In Case 1B there would be an overall continuous flow of liquid waste from the ETP for offsite disposal of 4 m^3/hr. 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 of 75 m^3/hr.

9.5.85 As outlined above, at this stage two options remain for disposal of treated process water and liquid waste depending on which of the 'cases' is taken forward. Two options are under consideration in terms of process effluent management. The first option is based on Minimalised Liquid Discharge (MLD) from the Effluent Treatment Plant. In this scenario, treated wastewater from the on-site Effluent Treatment Plant will be reused as makeup water in the Raw Water Pre-Treatment Plant. A concentrated liquid waste stream containing salts and residual nutrients would be transported off-site by tanker to an approved and licensed facility and treated in a manner consistent with nutrient neutrality requirements by either a) denitrification and discharge of resultant effluent within the Teesmouth & Cleveland Coast SPA/Ramsar catchment or b) discharging outside of the designated site catchment by a third party. The second option is an alternative to MLD and requires treatment of processed effluent in the bio-treatment plant and discharge via the NZT outfall to 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 (European Commission, 2016).

9.5.86 Amine contaminated water will be contained and where possible will 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.

9.5.87 Should treated wastewater be discharged to Tees Bay under Case 2B, the indicative effluent quality is currently expected to be as shown in Table 9-20.

Table 9-20: Indicative Effluent Quality Following Treatment

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

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

Foul Wastewater

9.5.89 Foul water will connect to the STDC sewage network for appropriate treatment and discharge. This is likely to be via Bran Sands WwTW but may also be via 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

9.5.90 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 to Health Regulations 2002 (COSHH) (HM

Government, 2002) and Control of Major Accident Hazards (COMAH) Regulations (2015) (HSE, 2015).

9.5.91 An Emergency Response Plan (prepared for Regulation 9 of the COMAH Regulations (HSE, 2015)) 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 (HSE, n.d.).

9.5.92 Further guidance to be consulted in development of the Emergency Response Plan include:

- HS(G)191 Emergency planning for major accidents. Control of Major Accident Hazards Regulations 1999 (HSE, 1999);
- HS(G)71 Chemical warehousing: the storage of packaged dangerous substances (HSE, 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 (BSI, 1990).

Maintenance

9.5.93 The objective of plant maintenance is to ensure the Hydrogen Production Facility and the Connection Corridors operate safely and reliably. Routine maintenance will be planned and scheduled via the maintenance management system with major overhauls occurring approximately once every four years on each unit.

9.5.94 Inspection and maintenance activities are key criteria for determining the footprint and layout of the Hydrogen Production Facility. The maintenance strategy to be adopted will use established methods such as Risk Based Inspection (RBI) and Reliability Centred Maintenance (RCM). Therefore, to support the maintenance strategy for the Hydrogen Production Facility, each major element would have appropriate access areas and temporary construction compounds, whilst the internal road layout for the Main Site would enable free movement for cranes and heavy lifting equipment.

9.5.95 Pipelines will be subject to an Integrity Management Plan that will include, but not be limited to, Inline Inspection, Cathodic Protection surveys, visual inspections, and maintenance of associated equipment at frequencies informed by RBIs.

9.5.96 It is anticipated that an integrated Operations and Maintenance (O&M) team would have the responsibility for daily operations, including troubleshooting and effecting minor repairs on the plant. Major O&M interventions are likely to be outsourced, whilst major equipment items are likely to be serviced by original equipment manufacturers.

9.5.97 All major maintenance activities requiring significant equipment outages will be coordinated to occur during the planned routine turnaround (TAR) and managed pursuant to management plan secured under the DCO. Equipment requiring routine maintenance outside of this timeframe will be spared and fitted with sufficient isolation to facilitate the activity whilst plant production continues.

Flood Risk Mitigation

9.5.98 The following mitigation measures have been considered to protect the Proposed Development at the Main Site in accordance with the legislative and regulatory authority requirements:

- Flood resistance and resilience measures;
- Flood Emergency Response Plans;
- Flood Warnings and Alerts;
- Emergency access and egress; and
- Design capacity exceedance.

Flood Resistance and Resilience Measures

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

- raising external ground levels - a minimum ground level of 6.83m AOD following remediation and earthworks at the Main Site ensures that the Proposed Development 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 1,000 chance) event;
- elevating critical plant equipment and/or internal finished floor levels above the peak flood inundation level. However, as the Main Site will be located on a development platform above the H++ climate change scenarios water level, including 600mm freeboard, critical equipment will remain in Flood Zone 1, at low risk of flooding; and
- flood resistant/resilient design.

9.5.100 Full details of each of these elements is outlined in Section 9A.9 of Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4).

Flood Warnings and Alerts

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

- Flood Alert - flooding is possible and that the operator of the Proposed Development needs to be prepared;

- Flood Warning - flooding is expected and that the operator of the Proposed Development should take immediate action. Action should be taken when a flood warning is issued and not wait for a severe flood warning; and
- Severe Flood Warning - there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

9.5.102 Each stage provides an indication of the expected level of danger. The system is primarily targeted towards professional partners, alerting them to expected flooding of low-lying land and roads.

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

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

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

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

9.5.107 The Connection Corridors at Seal Sands and Saltholme are located within a designated Environment Agency Flood Warning Area (FWA) (short code name 121FWT565 covering industrial properties on Seal Sands, Southern Graythorp and Billingham Fire Station). As the Main Site will operate 24 hours a day, it will be registered with the Environment Agency's Flood Warnings Direct service and monitoring of the warnings is adopted at the Site to mitigate the residual risk of tidal/fluvial flooding in the event of overtopping or defence failure in the vicinity.

Flood Emergency Response Plan

9.5.108 A Flood Emergency Response Plan will be developed for the Proposed Development by the Operator to ensure the residual risk to the site over the lifetime of the Development is sufficiently managed and mitigated. A management system will be

implemented to respond to a variety of emergency situations both during normal hours (24/7) and over holiday periods.

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

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

Emergency Access and Egress to/from the Main Site

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

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

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

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

9.5.114 Surface water flood maps indicate the access road to and from the Main Site is affected by surface water flooding during higher return period events. Mapping shows flooding to a depth of 300 to 900 mm at the A1085/West Coatham Lane roundabout junction. Should flooding occur in this location appropriate access/egress will be required on the access road to and from the Main Site in case flooding occurs. Alternatively, staff could be evacuated from the Main Site, via the

northern gate from the adjacent NZT PCC Site onto South Gare Road and then east to Redcar via Warrenby.

Place of Safe Refuge

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

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

9.5.117 Routine maintenance work and condition assessments required for the Connection Corridors will not be undertaken during periods of inclement weather or when an Environment Agency Flood Warning is in place, therefore areas of safe refuge will not be required within the Connection Corridor areas.

Exceedance Flows

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

9.5.119 To reduce the risks, maintenance of the system will be incorporated in general site management and remains the responsibility of the operator. A manual will be prepared (the Surface Water Maintenance and Management Plan described in section 9.5.75) detailing each drainage feature on site, the maintenance required, timescales for maintenance and who is responsible for undertaking the maintenance. It is expected that the site operator will ultimately be responsible for maintenance of the site drainage system including all pipes, discharge structures and any SuDS implemented on site in accordance with the recommendations in the SuDS Manual (CIRIA, 2015a).

Decommissioning

9.5.120 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.

9.5.121 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.

9.5.122 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 and Consents

9.5.123 Various water-related permissions may be required where it is not agreed with the relevant regulating authority to disapply them through the DCO. These permissions may include:

- Water activity permit(s) from the Environment Agency under the Environmental Permitting Regulations (England and Wales) 2016 (HM Government, 2016) for temporary construction and permanent operational discharges;
- Trade effluent consent under the Water Industry Act 1991 (HM Government, 1991c) 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 (HM Government, 1991b) (if more than 20 m^3/d is to be dewatered / over-pumped and exemptions do not apply) – see further detail below;
- Temporary water impoundment licence under section 25 of the Water Resources Act 1991 (HM Government, 1991b) in connection with the laying of pipelines;

9.5.124 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 launch and receive pits associated with the trenchless 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 if this is not included for in the DCO to discharge the water to ground or a watercourse if the water is considered to be 'unclean'.

9.5.125 If Case 2B for the Proposed Development is taken forward then process water effluent may be discharged to Tees Bay and would require an Environmental Permit. It would also be necessary to ensure that the Proposed Development meets the conditions to be defined and set by the NZT permit to ensure that it is not contravened.

9.6 Impacts and Likely Significant Effects

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

Construction Phase

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 Corridor, Natural Gas Connection Corridor and Electrical Connection Corridor; and
- alteration in fluvial and overland flow paths as a result of works associated with the Hydrogen Pipeline Corridor, Water Connections 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 water bodies 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 Holme Fleet at approximately NGR NZ 49241 23828, and unnamed watercourses west of the River Tees at NZ 51091 23758, NZ 51110 24822 and NZ 49091 24350 (see Figure 9-1 (ES Volume II, EN070009/APP/6.3)). There are no open-cut crossings required for the Water Connections Corridor, Natural Gas Connection Corridor, Other Gases Connection Corridor or Electrical Connection Corridor.

9.6.7 Where the four open cut pipeline installations are 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. This is secured via the Framework CEMP (EN070009/APP/5.12).

9.6.8 There will be works close to the River Tees and Greatham Beck (both of which are part of the Tees transitional WFD water body) for the trenchless installation of the Hydrogen Pipeline Corridor. The minimum depth of the pipeline beneath these water bodies will be 25 m and 10 m respectively. Furthermore, 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. Further measures to minimise the risk of frac-out were outlined in Section 9.6. As with open-cut crossings, water quality monitoring will also be undertaken prior to, during and following on from the construction activity where necessary.

9.6.9 Where there are to be above ground pipelines installed over watercourses using existing pipe bridges or culverts, 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. There are four such crossings for the Hydrogen Pipeline Corridor (see Table 9-19). These are existing culverts over The Fleet (River Tees (S Bank) WFD waterbody) (approximate NGR NZ 56750 23738) and the Mill Race (approximate NGR NZ 57329 23682), and existing pipe bridges of unnamed watercourses at approximate NGRs NZ 51075 23583 and NZ 47676 22853 (see Figure 9-1 (ES Volume II, EN070009/APP/6.3).

9.6.10 All water features that are potentially impacted ultimately discharge to River Tees, 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 surface runoff control measures that will be utilised on the Proposed Development Site. These will be described by the EPC Contractor(s) in the Final WMP that will form part of the Final CEMP(s), and will be confirmed with the Environment Agency as part of future permit applications. All conditions of the permits will be adhered too. An Outline WMP is annexed to the Framework CEMP (EN070009/APP/5.12).

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 (see Table 9-19 for a summary of impacts relating to water quality during construction). For the High importance Holme Fleet, this will result in a temporary Slight Adverse (Not Significant) effect. For the Low importance unnamed watercourses west of River Tees this will result in a Neutral (Not Significant) effect. No long-term effects on any of these water bodies are anticipated once the works have been completed and the channels stabilised.

9.6.13 There will be a Negligible impact to River Tees and Greatham Creek resulting from works to install the Hydrogen Pipeline Corridor using trenchless techniques, given the minimum 10 m buffer of the launch and reception areas from the watercourse, the site-specific hydraulic fracture risk assessment, and implementation of best practice mitigation measures as outlined in the Final CEMP(s) and Final WMP. Both water features are part of the Tees transitional WFD water body, which is of Very High importance, thereby resulting in a Slight Adverse (Not Significant) effect. No long-term effect on the water body is anticipated given the brevity of the impact.

9.6.14 Where works are required close to, and over, watercourses for installation of pipelines to existing pipe bridges or culverts, the impact to water quality will be Negligible given the embedded mitigation as detailed in Section 9.5. For the High importance Fleet (River Tees (S Bank) WFD water body) this will result in a Slight Adverse (Not Significant) effect. For the Medium importance Mill Race this will result in a Slight Adverse (Not Significant) effect. For the Low importance unnamed watercourses this will result in a Neutral (Not Significant) effect.

9.6.15 For the remainder of watercourses that are not directly worked on, the impact on water quality would be Negligible in all cases given the mitigation measures proposed. For the Very High importance Tees Coastal waterbody, Dabholm Gut, Mucky Fleet, Swallow Fleet and waterbodies within Coatham and Saltholme Marshes this would result in a Slight Adverse (Not Significant) effect. For the High importance Belasis Beck this would result in a Slight Adverse (Not Significant) effect. For the medium importance Main's Dike, Lackenby Channel, Kettle Beck, Kinkerdale Beck, Knitting Wife Beck, Ash Gill and Castle Gill this would result in a Slight Adverse (Not Significant) effect. For the low importance and ubiquitous

unnamed watercourses, drainage channels and ditches across the site this would result in a Neutral (Not Significant) effect. Given this outcome, there would therefore be no significant water quality effects to potential downstream receptors including the Teesmouth and Cleveland Coast SSSI, SPA and Ramsar sites.

Table 9-21: Construction Water Quality Assessment - Summary

RECEPTOR	IMPORTANCE FOR WATER QUALITY	SUMMARY OF POTENTIAL IMPACT	MAGNITUDE OF IMPACT (INCL. MITIGATION)	SIGNIFICANCE OF EFFECT
River Tees (Tees Transitional WFD water body)	Very High	Potential for adverse impacts on water quality from construction of trenchless crossings (e.g. run-off from launch/receiving pit, pipe stringing area or frac-out of drilling fluids	Negligible	Slight Adverse (Not Significant)
Greatham (Tees Transitional WFD water body)	Very High		Negligible	Slight Adverse (Not Significant)
Holme Fleet	High	Potential for adverse impacts on water quality from construction of open cut intrusive pipeline crossings leading to potential mobilisation of sediments or spillages	Minor Adverse (Temporary)	Slight Adverse (Not Significant)
Unnamed watercourses (west of River Tees)	Low		Minor Adverse (Temporary)	Neutral (Not Significant)
The Fleet (River Tees (S Bank) WFD water body)	High	Potential for adverse impacts on water quality from works to add pipelines to existing pipe bridges and culverts, thereby requiring construction in close proximity, or over watercourses, leading to potential mobilisation of sediments or spillages	Negligible	Slight Adverse (Not Significant)
The Mill Race	Medium		Negligible	Slight Adverse (Not Significant)
Unnamed watercourses	Low		Negligible	Neutral (Not Significant)
Tees Coastal WFD waterbody, Dabholm Gut, Mucky Fleet, Swallow Fleet and waterbodies	Very High	Although not directly impacted there may be potential for adverse water quality impacts on these watercourses due to general	Negligible	Slight Adverse (Not Significant)

RECEPTOR	IMPORTANCE FOR WATER QUALITY	SUMMARY OF POTENTIAL IMPACT	MAGNITUDE OF IMPACT (INCL. MITIGATION)	SIGNIFICANCE OF EFFECT
within Coatham and Saltholme Marshes		construction site runoff and accidental spillages		
Belasis Beck	High		Negligible	Slight Adverse (Not Significant)
Main's Dike, Lackenby Channel, Kettle Beck, Kinkerdale Beck, Knitting Wife Beck, Ash Gill and Castle Gill	Medium		Negligible	Slight Adverse (Not Significant)
Ubiquitous unnamed watercourses, drainage channels and ditches	Low		Negligible	Neutral (Not Significant)

Morphological Effects to Water bodies

9.6.16 The Hydrogen Pipeline Corridor will require open cut installation of the pipeline across four watercourses. This would impact Holme Fleet at approximately NGR NZ 49241 23828, and unnamed watercourses west of the River Tees at NGRs NZ 51091 23758, NZ 51110 24822 and NZ 48649 24325 (see Figure 9-1 (ES Volume II, EN070009/APP/6.3)). There are no open-cut crossings required for the Water Connections Corridor, Natural Gas Connection Corridor, Other Gases Connection Corridor or Electrical Connection Corridor. The affected unnamed watercourses are all considered Low importance for morphology given that they are generally artificially straight, modified channels lacking significant geomorphic and bedform features. Holme Fleet to the north of the River Tees is considered of Medium importance for morphology. Holme Fleet exhibits some variety of geomorphic forms and bank side vegetation but has been extensively modified and straightened and culverted in the past, in particular at the proposed crossing location.

9.6.17 A Pre-Works Morphological Survey will be undertaken at each crossing point requiring an intrusive open-cut. The pipelines 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. 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 (maximum of five years as a worst case). Despite the initial (and temporary) direct impact, given that mitigation measures are to be implemented to reduce the scale of physical disturbance and that each watercourse would be fully reinstated, it is considered that the overall impact in the longer-term would be no worse than minor adverse.

9.6.18 As such, physical works are considered to give a Minor adverse impact against hydromorphological status for all open cut pipeline installation locations. For the Medium importance (for morphology) Holme Fleet, this will result in a Slight Adverse (Not Significant) effect. The remaining affected watercourses are of Low importance (for morphology), and so will be subject to Slight Adverse (Not Significant) effect in all cases.

9.6.19 Trenchless crossings beneath the River Tees and Greatham Creek would not impact channel morphology and similarly use of existing pipebridges and culverts would not result in any further impacts on channel morphology for the affected watercourses.

Groundwater Flow Impacts

9.6.20 Excavations and foundations have the potential to disrupt shallow groundwater. It is anticipated that the foundations within the Main Site will include bored piles (approximately 20 m deep) for heavily loaded structures that are sensitive to settlement. A Piling Risk Assessment and associated Piling Methodology will be undertaken in accordance with Environment Agency's Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (Environment Agency, 2001b). The results of this assessment will be used in the piling design and this is secured by a requirement in the DCO.

9.6.21 A review of published geological and hydrogeological information and historical borehole records indicates that shallow groundwater levels are approximately 3 m below the development platform which is planned at approximately 7.1 m above Ordnance Datum (AOD)[2]. With the exception of piled foundations, excavation below the existing groundwater level is not anticipated to be necessary as part of the proposed foundation works at the Main Site.

9.6.22 A GI 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, primarily due to the use of bored piles. Groundwater beneath the Main Site is considered a Medium importance receptor, thereby giving a Slight Adverse (Not Significant) effect.

[2] Note that the Phase 1 development platform will be at approximately 7.1m AOD and the final high pavement point will be above 7.4 m AOD. The Phase 2 development platform might be above 7.1 m AOD but it will not exceed 8m AOD.

9.6.23 Depths required for construction of the Hydrogen Pipeline Corridor, Electrical Connection Corridor, Other Gases Connections Corridor and Water Connections Corridor 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 the pipelines are 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. 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

9.6.24 Construction works to install the Hydrogen Pipeline Corridor beneath the River Tees and Greatham Creek using drilling or boring techniques would 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 are assumed to be 10 m width x 5 m length x 3 m depth for the purposes of the assessment.

9.6.25 There is potential for shallow groundwater to be encountered in association 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. Furthermore, a Construction Dewatering Strategy will be prepared by the EPC Contractor(s) in accordance with a Groundwater Risk Assessment to be developed post consent (see Section 9.5). This will outline the dewatering requirements to be adopted in order to ensure no adverse impacts on the receiving water environment.

9.6.26 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' (Environment Agency, 2023b) 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.

9.6.27 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, a Construction Dewatering Strategy and best industry practice outlined in the Framework CEMP (EN070009/APP/5.12), 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.

9.6.28 No impacts to other watercourses, water bodies, groundwater abstractions or PWS are predicted from this temporary and short-term effect.

Potential Flood Risk – Tidal and Fluvial Sources During Construction

9.6.29 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 (River Tees (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.

9.6.30 However, with the implementation of standard construction methods and mitigation as described in Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) and the Final CEMP(s) this risk can be effectively managed. 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

9.6.31 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 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4). 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 Very High importance construction workers is considered to be Negligible, resulting in a Slight Adverse (Not Significant) effect.

Potential Flood Risk – Groundwater Sources During Construction

9.6.32 The Proposed Development Site is considered to be at medium risk of flooding from groundwater sources in Saltholme. Excavation of trenches 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(s), Construction

Dewatering Strategy and Final WMP (refer to Section 9.5), a Negligible magnitude of impact is predicted to Very High importance construction workers, resulting in a Slight Adverse (Not Significant) effect.

Potential Flood Risk – Drainage Infrastructure and Artificial Sources During Construction

9.6.33 The Proposed Development is at low to medium risk of flooding from sewers and other water supply infrastructure. With the implementation of measures that will be outlined in the Final CEMP(s) and Final 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.

9.6.34 Environment Agency mapping and Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) indicates that the Proposed Development Site is not at risk of flooding from reservoirs or artificial water bodies. 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

9.6.35 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.

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

9.6.36 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 (Tees Bay or River Tees). Discharge of a range of pollutants could lead to chronic adverse impacts in terms of the receiving water body physicochemical and ecological status, although it should be noted that there is a large capacity for dilution and dispersal in Tees Bay and River Tees. There is also a risk that a significant

chemical spillage or pollution incident could occur on the Main Site which could be discharged to Tees Bay or River Tees.

9.6.37 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 Main Site.

9.6.38 Discharges to the Surface Water Drainage System will include stormwater from roadways and access area drainage, car park, roof drainage, landscape areas and walkways. At this stage, incorporation of rainwater harvesting is proposed across suitable site buildings, with the potential for collected water to be used on-site to meet process needs. Pervious paving is to be used across car park areas, enabling rainwater to infiltrate into the sub-base and discharge in a controlled manner to the site drainage system. For the remainder of the site drainage system, a gravel matrix is proposed for bioretention (the exact make up of which will be confirmed in the detailed drainage design post consent), swales will also be used and discharged to the attenuation pond prior to outfall to Tees Bay or River Tees.

9.6.39 The SuDS Manual's Simple Index Approach (CIRIA, 2015a) has been applied to provisionally demonstrate the suitability of the SuDS treatment trains within the Pre-FEED surface water drainage design (which will be further developed into a detailed drainage design secured under a requirement in the draft DCO).

9.6.40 The High Pollution Hazard Index has been adopted to assess runoff from the Proposed Development, as this is described in the SuDS Manual (CIRIA, 2015a) as, "*Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways*". It is thus deemed the most appropriate hazard index available for the majority of the Proposed Development Site (and is the most precautionary available).

9.6.41 For the car park areas the Medium Hazard Index has been adopted as this is described as, "*Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways*". This is considered suitably precautionary for car park areas.

9.6.42 Table 9-22 shows the pollutant hazard index score for different pollutants (total suspended solids, metals and hydrocarbons) for the High and Medium Pollution Hazard Level, as outlined in the SuDS Manual (CIRIA, 2015a). It also shows the Mitigation Index for each of the proposed SuDS in the treatment train. To achieve a pass the total Mitigation Index (for all parts of the SuDS treatment train) must meet or surpass the Pollution Hazard Index. Under the Simple Index Approach the

effectivity of the second treatment train is considered to be 50% compared to the first.

9.6.43 The Simple Index Approach analysis in Table 9-22 indicates that the proposed SuDS mitigation provides sufficient treatment for pollutants, and so no adverse effects from surface water runoff would be expected to the water quality of Tees Bay or River Tees as a result of the Proposed Development. Nonetheless, this is a provisional finding, and a repeat assessment would be undertaken as part of the detailed Drainage Strategy (a DCO requirement) once treatment trains have been finalised. Further treatment would be incorporated where necessary depending on the outcome of the further analysis.

Table 9-22: Simple Index Approach Assessment for Surface Water Runoff from Car Park and General Site

RELEVANT ROAD CATCHMENTS	TREATMENT TRAIN		POLLUTANT CATEGORY	POLLUTANT HAZARD INDICES FOR 'HIGH RISK' AND 'MEDIUM RISK' LAND USES	TREATMENT TRAIN (MITIGATION INDICES)				
					1	2	3	OUTCOME	COMMENT
Car Park Area (Medium Pollutant Hazard Risk)	A	Permeable Paving>Attenuation Pond>Outfall	TSS	0.7	0.7	0.35		0.99	According to the SIA method this option would provide adequate treatment for all categories of pollutants. It is important that both SuDS and proprietary measures are well maintained to ensure the most efficient operation for the lifetime of their installation, and this would be achieved through the proposed Surface Water Maintenance and Management Plan.
			Metals	0.6	0.6	0.35		0.99	
			Hydrocarbons	0.7	0.7	0.25		0.99	

RELEVANT ROAD CATCHMENTS	TREATMENT TRAIN		POLLUTANT CATEGORY	POLLUTANT HAZARD INDICES FOR 'HIGH RISK' AND 'MEDIUM RISK' LAND USES	TREATMENT TRAIN (MITIGATION INDICES)				
					1	2	3	OUTCOME	COMMENT
General Site (High Pollutant Hazard Risk)	B	Bioretention>Swale>Attenuation Pond>Outfall	TSS	0.8	0.8	0.25	0.35	0.99	
			Metals	0.8	0.8	0.3	0.35	0.99	
			Hydrocarbons	0.9	0.8	0.3	0.25	0.99	
Note 1 After the first treatment train component the performance of subsequent treatment trains are reduced by 50% as per C753 The SuDS Manual 2nd eds (CIRIA, 2016) guidance.									
Note 2 It is assumed that all SuDS will be designed following best practice guidance contained in the C753 The Suds Manual 2nd eds (CIRIA, 2016) and DMRB (e.g. CG532 and CG501). Where there are limitations to the design of a SuDS feature it may be appropriate to reduce the treatment performance applied. For this reason a treatment 'buffer' should be provided.									
Note 3 The performance of each SuDS type as part of the treatment train will need to be reviewed as the design is further developed. Management and maintenance requirements need to be confirmed to ensure SuDS are maintained fully operational for the lifetime of the proposed development.									

Outcome Legend		
Pollution index	>	Mitigation Index
Pollution index	< by 0.1 or =	Mitigation Index
Pollution index	< by more than 0.1	Mitigation Index

9.6.44 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 be separated from the main 'clean' surface water drainage system using appropriate methods such as kerbs, bunds, sumps. An oily water sewer system will be in place which conveys the potentially contaminated water to an Oily Water Separator for treatment. Oil removed in the treatment package is collected as waste and is disposed off-site by vacuum tankers. Further details are given in Section 9.5.

9.6.45 Amine contaminated water will be contained and contaminated fluid taken off-site by tanker to a specialist treatment plant.

9.6.46 In the event of fire, 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 and tested. Should contamination be present, this water will be directed to an oil separator (or pumped out for appropriate off-site disposal at a licensed waste facility depending on the extent of the contamination), or if considered clean, it will go to the stormwater attenuation pond. 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 Environment Agency, LLFAs and the Fire Service post-DCO consent during detailed design and secured in the Detailed Surface Water Drainage Strategy.

9.6.47 An inventory of hazardous substances used on the Main Site will be developed throughout the design process. In each case the product will have 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.

9.6.48 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 River Tees or Tees Bay, or otherwise is taken by tanker for off-site disposal at a suitably permitted wastewater facility. A Surface Water Maintenance and Monitoring Plan will also be prepared post consent. 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.

9.6.49 The Surface Water Maintenance and Management Plan will also 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.

9.6.50 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 fire-water (including water quality monitoring), then a Negligible impact is predicted to River Tees or Tees Bay (depending on which option is progressed). Given that these are Very High importance receptors, this will result in a Slight adverse (Not Significant) effect in both cases.

Demand for Water

9.6.51 The Proposed Development requires a flow rate of 227 m^3/hr (5.45 Ml/day) for Case 1B and 297 m^3/hr (7.13 Ml/day) for Case 2B. Water is to be supplied via the existing NWL's raw water pipeline feed from the River Tees. It is understood based on discussions with NWL that there is sufficient supply of water to accommodate the Proposed Development project water demands.

9.6.52 Furthermore, NWL'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/day of water available for the Industrial WRZ under normal operation. In the 1 in 200 design drought year there is only 130 Ml/day of water available for the Industrial WRZ. This means that based on a current demand of 82 Ml/day the WRZ has a headroom of 48 Ml/day in the design drought year. Furthermore, given advancements in water efficiency in industry, future demand is expected to decline.

9.6.53 The Water Resources Management Plan 2019 (Northumbrian Water, 2019) 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 water bodies from which NWL abstract.

9.6.54 NWL'S draft Water Resources Management Plan (Northumbrian Water, 2024) has integrated the Industrial WRZ 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 under a 'dry year annual average' scenario[3] and under a 'dry year critical period' scenario[4].

9.6.55 A supply (to be agreed with NWL) from the existing raw water pipeline from the Tees for the Proposed Development would be undertaken within current allowable limits. The required water demand is 0.40 % of the Tees mean annual flow (20.82 m^3/s) as recorded at Low Moor (see Section 9.4).

[3] The dry year annual average scenario is when demand for water is at its highest before temporary use bans are imposed.
[4] The dry year critical period scenario would represent a period of peak strain on the NWL system (e.g. high seasonal demand such as during a heatwave).

9.6.56 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 (Not Significant) effect.

Potential Impacts on Water Quality of Tees Bay from Operational Discharges

9.6.57 At this stage in the design process, 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 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.

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

9.6.59 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 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 (European Commission, 2016) and its associated BAT Conclusions document. If the project Environmental Risk Assessment (post consent) shows that significant impact could occur with the plant discharging at the BAT-AEL concentrations, tighter emission limits could subsequently be applied.

9.6.60 Given the potential option to use the Tees Bay outfall (Case 2B), hydrodynamic modelling has been undertaken to determine the degree of dispersion from the outfall for constituents of the wastewater, including nitrogen (given nutrient neutrality requirements applicable to the Teesmouth and Cleveland Coast SPA/Ramsar sites). The outcomes are summarised briefly below with full details given in Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4).

9.6.61 The discharged effluent from the Main Site will be comprised of treated process water which is sourced from the River Tees and will contain river water contaminants. These will be concentrated within the process effluent, however the effluent will be treated via a denitrification plant prior to discharge which will reduce DIN concentrations to 15 mg/l. Discharges from the adjacent NZT site will likewise comprise concentrated River Tees water with additional flows generated on-site and treated. There is also a possibility that surface water runoff will be discharged via the NZT outfall, depending which option is taken forward post consent. This has also been taken into account within the modelling scenarios (see Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4).

9.6.62 Water quality data for the River Tees was provided by NWL and combined with information from the Environment Agency and details of water treatment

technology planned on both sites to characterise final discharge effluent flows and loads for the modelling exercise.

9.6.63 Pollutant concentrations determined for the final effluent were compared with EQS standards for Tees Bay under the WFD. The available information shows that effluent concentrations of DIN, benzo(b)-fluoranthene, benzo(g,h,i)-perylene, fluoranthene, PFOS, polyaromatic hydrocarbons, chromium, copper, iron, lead, mercury, zinc and diazinon may exceed EQS values. Effective volume flux calculations[5] have been carried out and show that only DIN, polyaromatic hydrocarbons will be discharged from the Main Site above the allowable volume flux value, although lead is also discharged above the allowable volume flux value when taking account of NZT discharges. Effective volume flux calculations cannot be carried out for benzo(g,h,i)-perylene or PFOS because ambient concentrations of these substances (in the River Tees raw water) already exceed EQS values due to other point source and diffuse pollution sources to Tees Bay and the River Tees.

9.6.64 DIN, polyaromatic hydrocarbons, lead, benzo(g,h,i)-perylene and PFOS were therefore taken forward for modelling. Mixing zones for DIN, polyaromatic hydrocarbons and lead have been defined based on EQS limits and mixing zones for benzo(g,h,i)-perylene and PFOS have been defined using an EQS proxy of 5% above ambient. Thermal impacts were also modelled based on an increase in temperature of 3 °C above ambient.

9.6.65 Near field modelling was carried out for summer and winter conditions at four stages across the tidal cycle – low tide, high tide, maximum current velocity and minimum current velocity. Water level and current data at each stage in the tidal cycle were extracted from a Delft3D hydrodynamic model of Tees Bay and the River Tees constructed and calibrated in 2019 (and included as an appendix within Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4)). The current proposal is to discharge the effluent via a new outfall with a multiport diffuser located in an area with an average water depth of approximately 9 m. Far field modelling has been used to estimate the extent of the mixing zone under minimum current conditions.

9.6.66 The near field and far field modelling show that the impact of the Proposed Development process effluent discharge is small for all polluting substances and temperature at all stages of the tidal cycle. The chemical contaminants are diluted to below the EQS within a very short distance of the outfall and generally before the mixing plume reaches the water surface. The chemical contaminants are rapidly diluted to below the EQS within a very short distance of the outfall by diffusion and mixing with the large volume of ambient water surrounding the discharge point. The largest elevations in pollutant concentrations occur close to the outfall and within the deeper water layers, however the maximum increase in concentration in

[5] The Environment Agency guidance for assessing coastal discharge impacts sets out the procedure for calculating effective volume flux. This test is applied to substances exceeding the EQS and discharge points which are in more than 1 m depth of water and more than 50 m offshore. If the effective volume flux is less than the allowable limit then the impacts on water quality will be minimal due to extensive dilution by ambient water and further assessment (modelling) is not required. The allowable volume flux is determined by water depth up to a depth of 3.5 m and is retained at a value of 3.5 for deeper discharge points. The proposed discharge point will be more than 3.5 m below the water surface at all stages of the tide (Section 3.4) and therefore an allowable volume flux of 3.5 applies to this discharge.

any model cell in any layer is 0.017 mg/l for DIN and 0.022 ng/l for polyaromatic hydrocarbons, neither of which is sufficient to breach EQS values. The maximum modelled increase in benzo(g,h,i)perylene concentration is 0.018 ng/l above ambient concentrations and the maximum increase in PFOS concentration is 0.003 ng/l above ambient concentrations. Both these values are less than 5% above the ambient background. Pre-dilution of the effluent with surface water runoff results in smaller mixing zones for most substances compared to modelling the process effluent discharges only.

9.6.67 Thermal effects are also extremely small, with the temperature of the mixing plume falling below 3 °C above ambient conditions within a very short distance. Surface temperatures are not increased by more than 3°C for any combination of effluent discharge option and tidal stage.

9.6.68 As such, it has been demonstrated that process effluent discharges from the Main Site (in isolation) to Tees Bay via the NZT outfall will not have significant impact on receiving water quality. Refer to Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4) for the detailed modelling results.

9.6.69 It should be noted that the cumulative impact of discharges from the Main Site and NZT sites is larger, with mixing zones more likely to reach the water surface. However, the thermal mixing zones remain extremely small and pollutants are diluted to below the EQS value (or EQS proxy) within a very short distance of the discharge point. Concentrations of DIN are slightly elevated above background concentrations over a wider area but the overall increase in average and maximum pollutant concentrations do not approach EQS values, taking into account the complex tidal currents in this region which can result in pollutants accumulating in shallow water. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative impact of discharges from both sites.

9.6.70 Furthermore, 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 through the Environmental Permit.

9.6.71 Given the modelling outcomes and the fact that the Proposed Development will need to meet the requirements of an Environmental Permit if discharged to Tees Bay, 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 water body.

9.6.72 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 River Tees that are of most concern (notably Seal Sands), and the modelling undertaken for the Proposed Development indicates that discharges from the

proposed NZT outfall would not be carried into the estuary by the tides, and therefore would not contribute nutrients to the designated sites. This is discussed further in Nutrient Neutrality Assessment (EN070009/APP/5.13).

9.6.73 A Negligible impact on water quality in Tees Bay is therefore predicted on the basis of the modelling undertaken for the Proposed Development, with no changes identified that would be considered likely to impact on WFD classifications for the Tees Coastal water body. Given that this is a Very High importance receptor for water quality, this results in a Slight Adverse (Not Significant) effect.

Surface Water Ponds: Water Quality

9.6.74 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 River Tees or Tees Bay, and not to the surface water ponds in the area. Overall, the magnitude of impact is expected to be Negligible for all ponds (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.

9.6.75 There is potential for atmospheric deposition of nitrogen emitted from the Proposed Development to impact adjacent water bodies, 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 water bodies, 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.

9.6.76 An assessment of atmospheric deposition has been undertaken in Chapter 8: Air Quality (ES Volume I, EN070009/APP/6.2). Emissions from the Proposed Development have been assessed using the Environment Agency's Risk Assessment (Defra and Environment Agency, 2016 as updated in 2023). 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.

9.6.77 An assessment of nutrient nitrogen enrichment has been undertaken by applying published deposition velocities to the predicted annual average nitrogen dioxide (NO_2) and 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) (APIS, n.d.), taking into consideration the baseline deposition.

9.6.78 Water quality monitoring of Pond 14 between October 2020 and February 2023 indicates a maximum total nitrogen concentration value of 1.6 mg/l (6 January 2021). This is variable over relatively short time scales with total nitrogen having been below the laboratory limits of detection on five of 11 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 0.05 kg/N/ha/yr as a worst-case scenario would cause an increase in total nitrogen concentration to 1.61 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.

9.6.79 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 (Not Significant) effect for Pond 14.

Foul Water Discharge

9.6.80 Foul water will connect to the STDC sewage network for appropriate treatment and discharge. This is likely to be via Bran Sands WwTW but could alternatively be Marske-by-the-Sea WwTW. NWL will treat foul water from the Main 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. 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 water body 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 activity permits to discharge to surface waters.

9.6.81 However, it is worth noting that peak workforce numbers during operation will be a maximum of approximately 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, operating in a shift pattern of 40 to 50 staff per daytime shift. 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 (PE) of the Bran Sands WwTW was reported as 391,142 and Marske as >93,000 in the Tees Valley Water Cycle Study (2012).

9.6.82 As such, the impact of treated foul water discharge is considered to be Negligible to the River Tees (via Bran Sands WwTW) or Negligible to Tees coastal water body (via Marske-by-the-Sea WwTW), depending on the option taken forward. As both receptors are Very High importance, this results in a Slight Adverse (Not Significant) effect.

Flooding from Tidal Sources During Operation

9.6.83 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) 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.

9.6.84 During a future scenario resulting from climate change up to 2125 or a H++ scenario to 2100, a minimum ground level of 6.83m AOD following remediation and earthworks at the Main Site ensures that the Proposed Development 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 1,000 chance) event.

9.6.85 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. The need to develop the pipelines in this location is essential to connect to existing industrial sources seeking to decarbonise through the proposed CO_2 Export Corridor and export infrastructure.

9.6.86 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.

9.6.87 In EIA terms, tidal flooding is considered of Very High importance due to the nature of the development as essential infrastructure (i.e. Hydrogen Production Facility). Given that the Main Site is expected to have Negligible impact on flood levels on or off site, then a Slight Adverse (Not Significant) effect is anticipated in terms of tidal flooding.

9.6.88 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 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) 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

9.6.89 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) identifies the Main Site to be at 'low' risk of fluvial flooding from Ordinary watercourses located in proximity to the study area.

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

9.6.91 Where the risk of flooding from fluvial sources is currently assessed as high, the risk category of flooding to the Main 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 Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4) for further detail.

9.6.92 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.

9.6.93 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 Proposed 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.

9.6.94 The Main Site will be constructed on a development platform at a level no lower than the highest flood level of 6.83 m AOD (derived from the 6.23 m AOD flood level for a 0.1% AEP H++- plus 600 mm freeboard). 6.83 mAOD would be the minimum level once site clearance and remediation has been undertaken. The operational development therefore remains above the maximum flood level and no further mitigation is required.

9.6.95 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 Facility). 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 (Not Significant) effect is anticipated in terms of flooding from fluvial sources.

Flooding from Surface Water Sources During Operation

9.6.96 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’. Small areas of low to high surface water flood risk have been identified to the south-west of the Main Site around the A1085 / Broadway East roundabout junction and land located to the west between the A1085 and Cowpen Bewley Road.

9.6.97 A Detailed Surface Water Drainage Strategy will be prepared for the Proposed Development (as a Requirement of the draft DCO) which covers the use of SuDS, site discharge rates and surface water management / exceedance flows. These

principles are outlined in Section 9.5. Given the implementation of this proposed strategy, surface water from the Proposed Development Site will be carefully managed, treated and directed to the River Tees or Tees Bay 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.

9.6.98 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

9.6.99 The risk of groundwater flooding across the Proposed Development Site is considered to be medium. However, where the Proposed Development comprises 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: Flood Risk Assessment, (ES Volume III, EN070009/APP/6.4). 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

9.6.100 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. Furthermore, the Proposed Development Site is not located in an area defined as a Critical Drainage Area and there are no historic records of flooding from drainage infrastructure sources for the Study Area in the LLFA SFRAs. Areas associated with flooding from sewerage infrastructure are concentrated in residential areas such as Eston. Given this, the magnitude of impact is considered to be Minor adverse, resulting in a Slight Adverse (Not Significant) effect.

9.6.101 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

9.6.102 The ES does not assume the removal of facilities after 25 years. At the end of its operational life, the most likely scenario would be that the Proposed Development would be decommissioned, with all above ground structures on the Main Site removed, and the ground remediated as required by the Environmental Permit to facilitate future industrial / commercial re-use. The Applicant will assess at that time whether any infrastructure should be retained for future use. The same timescales apply for the Hydrogen Pipeline Corridor and the Connection Corridors. 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.

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

9.6.104 A DEMP would be produced pursuant to a DCO Requirement. This would identify the required measures to prevent pollution during this phase of the development. The DEMP would be agreed with the Environment Agency.

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

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

9.7 Mitigation and Enhancement Measures

Construction

Essential Mitigation

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 the Framework CEMP (EN070009/APP/5.12) and Outline WMP (included as an Annex to the Framework CEMP).

9.7.2 In particular, in terms of the embedded measures a water quality monitoring programme will be set out in the Final WMP within the Final CEMP(s) or, where necessary, during the process of obtaining Environmental Permits / Consents / Licences for works affecting, or for temporary discharges to, water bodies 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

Essential Mitigation

9.7.4 Given that no significant effects have been identified, no additional or essential mitigation is required.

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

Enhancement Measures

9.7.6 No further enhancement measures are required for the operational stage. However, the Proposed Development has the potential to deliver certain benefits to the water environment over the existing situation, for example, through an improved drainage system compared to the existing site, utilising SuDS to improve the water quality of runoff that enters the River Tees water body.

9.7.7 There will also be a reduction in nitrogen entering the sensitive areas of the Teesmouth and Cleveland Coast SPA/Ramsar site which are suffering from eutrophication (notably Seal Sands). The Proposed Development would use raw water (containing nitrogen) from the River Tees and would discharge process water and/or storm water to Tees Bay. Modelling indicates that remaining nitrogen does not disperse back into the River Tees where the sensitive parts of the SPA/Ramsar site are located and will therefore contribute to reduced nutrient pressure on the sensitive area.

Decommissioning

Essential Mitigation

9.7.8 Mitigation of adverse impacts on the water environment during the decommissioning phase will be achieved principally through embedded measures as identified in Section 9.5, notably the adoption of a DEMP. The DEMP will include details of how surface water drainage should be managed at the Proposed Development Site during decommissioning and demolition. Water quality monitoring required during the decommissioning works would be specified in the DEMP and would be expected to be similar to those described previously in relation to the construction phase.

Enhancement Measures

9.7.9 At this stage, no further enhancement measures are expected to be required for the decommissioning stage on the basis that all underground infrastructure would remain in-situ and watercourses are unlikely to be disturbed.

9.8 Residual Effects and Conclusions

Construction

9.8.1 No significant adverse water environment effects have been identified relating to operation of the Proposed Development.

Operation

9.8.2 No significant adverse water environment effects have been identified relating to operation of the Proposed Development.

Decommissioning

9.8.3 No significant adverse water environment effects have been identified relating to decommissioning of the Proposed Development.

9.9 Summary of Significant Effects

9.9.1 Summaries of the potential significant effects associated with the construction (and decommissioning) and operation of the Proposed Development are presented in Table 9-23 and Table 9-24 respectively.

Table 9-23: Summary of Significant Effects During Construction (and Decommissioning)

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
Potential for adverse impacts on water quality from construction of trenchless crossings (e.g. run-off from launch/receiving pit, pipe stringing area or frac-out of drilling fluids)	River Tees (Tees Transitional WFD water body)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Greatham (Tees Transitional WFD water body)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Potential for adverse impacts on water quality from construction of open cut intrusive pipeline crossings leading to potential mobilisation of sediments or spillages	Holme Fleet	High	Minor adverse (temporary)	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Unnamed watercourses (west of River Tees)	Low	Minor adverse (temporary)	Neutral (Not Significant)	No additional measures	Neutral (Not Significant)
Potential for adverse impacts on water quality from works to add pipelines to existing pipe bridges and culverts, thereby requiring construction in close proximity, or over watercourses, leading to potential mobilisation of sediments or spillages	The Fleet (River Tees (S Bank) WFD water body)	High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	The Mill Race	Medium	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Unnamed watercourses	Low	Negligible	Neutral (Not Significant)	No additional measures	Neutral (Not Significant)

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
Potential for adverse water quality impacts on these watercourses due to general construction site runoff and accidental spillages	Tees Coastal WFD waterbody, Dabholm Gut, Mucky Fleet, Swallow Fleet and waterbodies within Coatham and Saltholme Marshes	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Belasis Beck	High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Main's Dike, Lackenby Channel, Kettle Beck, Kinkerdale Beck, Knitting Wife Beck, Ash Gill and Castle Gill	Medium	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Ubiquitous unnamed watercourses, drainage channels and ditches	Low	Negligible	Neutral (Not Significant)	No additional measures	Neutral (Not Significant)
Impact on channel morphology from open-cut	Holme Fleet	Medium (for morphology)	Minor adverse	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
crossing of watercourses for installation of pipelines	Unnamed watercourses	Low (for morphology)	Minor adverse	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Impacts of Main Site construction on groundwater levels and flow	Groundwater beneath Main Site	Medium	Minor adverse	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Impacts of Hydrogen Pipeline Corridor, Electrical Connection Corridor, Other Gases Connections Corridor and Water Connections Corridor construction on groundwater levels and flow	Groundwater - Mercia Mudstone Group / Redcar Mudstone Group	Medium	Negligible	Neutral (Not Significant)	No additional measures	Neutral (Not Significant)
	Groundwater – Sherwood Sandstone Group	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Groundwater dewatering impacts	Groundwater - Mercia Mudstone Group / Redcar Mudstone Group	Medium	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Groundwater – Sherwood Sandstone Group	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from tidal and fluvial sources during construction	Flood Risk (tidal and fluvial)	Very High (construction workers)	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
Flooding from surface water sources during construction	Flood Risk (surface water)	Very High (construction workers)	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from groundwater sources during construction	Flood Risk (groundwater)	Very High (construction workers)	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from drainage artificial sources and drainage infrastructure during construction	Flood Risk (drainage infrastructure and artificial sources)	Very High (construction workers)	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)

Table 9-24: Summary of Significant Effects during Operation

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE AND VALUE/ SENSITIVITY	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
Potential pollution of surface water due to routine runoff and accidental spillages	River Tees (Tees Transitional WFD water body)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Tees Coastal WFD waterbody	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Demand for water	River Tees (Tees Transitional WFD water body)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Impacts on water quality from process water discharges	Tees Coastal WFD waterbody	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Impact on water quality of Pond 14	Pond 14	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
	Other Ponds	Low	Negligible	Neutral (Not Significant)	No additional measures	Neutral (Not Significant)
Impact on water quality from foul water discharge	River Tees (Tees Transitional WFD water body)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)

POTENTIAL IMPACT	RECEPTOR/ RECOURCE	IMPORTANCE AND VALUE/ SENSITIVITY	MAGNITUDE OF IMPACTS	LIKELY SIGNIFICANT EFFECTS	PROPOSED MITIGATION / ENHANCEMENT	RESIDUAL EFFECTS
	Tees Coastal WFD waterbody	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from tidal and fluvial sources during operation	Flood Risk (tidal and fluvial)	Very High	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from surface water sources during operation	Flood Risk (surface water)	Low	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from groundwater sources during operation	Flood Risk (groundwater)	Medium	Negligible	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)
Flooding from drainage artificial sources and drainage infrastructure during operation	Flood Risk (drainage infrastructure and artificial sources)	Medium	Minor adverse	Slight Adverse (Not Significant)	No additional measures	Slight Adverse (Not Significant)

9.10 References

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