H2Teesside Project

Planning Inspectorate Reference: EN070009/APP/5.13

Land within the boroughs of Redcar and Cleveland and Stockton-on-Tees, Teesside and within the borough of Hartlepool, County Durham

Document Reference: 5.13: Nutrient Neutrality Assessment

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 - Regulation 5(2)(q)

Applicant: H2 Teesside Ltd

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TABLE OF CONTENTS

TABLES

PLATES

1.0 INTRODUCTION

1.1 Overview

1.1.1 On 16 March 2022, Natural England published advice (Natural England, 2022a) to a number of Local Planning Authorities (LPAs), including Redcar and Cleveland Borough Council (RCBC), Stockton-on-Tees Borough Council (STBC) and Hartlepool Borough Council (HBC) and the Inspectorate, to indicate that as a Competent Authority under the Habitats Regulations the LPA (or Secretary of State in the case of a Development Consent Order (DCO)), must carefully consider the nutrient impacts of any new plans and projects on habitats sites and whether those impacts may have an adverse effect on the integrity of a habitats site that requires mitigation, including through nutrient neutrality. In the case of RCDB, STBC and HBC, the affected habitats site is the Teesmouth & Cleveland Coast Special Protection Area (SPA) / Ramsar site, for which excessive nitrogen is contributing to unfavourable status.

1.1.2 The H2 Teesside project (hereafter 'The Proposed Development') is located within the catchment of the Teesmouth & Cleveland Coast SPA / Ramsar site. Therefore, this Nutrient Neutrality Assessment (hereafter the 'Assessment') considers the potential nutrient impacts of the Proposed Development, whether the issue of nutrient neutrality is invoked, and assesses whether the Proposed Development is nutrient neutral.

1.1.3 The catchment of the Teesmouth & Cleveland Coast SPA / Ramsar site as defined by Natural England is shown in Plate 1-1 below.

1.1.4 The Report to Inform Habitats Regulations Assessment (EN070009/APP/5.10) that is to be prepared for the Proposed Development, in line with Planning Inspectorate Advice Note 10: Habitats Regulations Assessment relevant to nationally significant infrastructure projects (The Inspectorate, 2022), will take into account the outcomes of this Assessment.

1.2 The Issue of Nutrient Neutrality

1.2.1 In many designated estuarine and freshwater habitats sites, poor water quality due to nutrient enrichment is one of the main reasons for sites being in an unfavourable condition. Excessive levels of nutrients can cause the rapid growth of certain plants and excessive oxygen consumption (this process is called eutrophication). This in turn can lead to reduced biodiversity, and the condition of a site being considered 'unfavourable'. To improve the water quality in these sites, reductions in nutrients are required.

Plate 1-1: Teesmouth & Cleveland Coast SPA / Ramsar Catchment as defined by Natural England

1.2.2 Nutrient neutrality has become an issue in many areas of the country, such as the Solent, Somerset Levels, the Wye catchment in Herefordshire, the Camel catchment in Cornwall, the Stour catchment in Kent, and the Poole Harbour and Chesil and The Fleet catchments in Dorset, amongst others. The issue has reached legislative control by virtue of the ruling of the European Court of Justice (ECJ) in combined cases C-293/17 and C-294/17 (the Dutch Nitrogen case) (Official Journal of the European Union, 2019). That judgment was about atmospheric nitrogen but in the process of making their ruling the judgment refined the definition of plans and projects to include operations such as agriculture, confirming that agricultural inputs of nutrients (either from atmosphere or runoff) need to be covered in the 'in combination' requirements of HRA process.

1.2.3 In addition, the ruling reaffirmed that if a European protected nature conservation site is in a deteriorating condition (such as due to excess nutrient levels that may also be forecast to increase) there are very limited circumstances under which further discharges of nutrients to a site can legally be permitted. This is covered in paragraph 79 of Advocate-General Kokott's opinion (InfoCuria, 2018), written to inform the court: 'Where total damage is reduced, but the integrity of the protected site concerned is nevertheless adversely affected [by which she means where the total nitrogen deposition still exceeds the critical load], Article 6(3) of the Habitats Directive does not in any case permit any additional damage of this kind'.

1.2.4 As a result, in the absence of any empirically derived threshold by which additional aquatic inputs of nitrogen and phosphorus can be deemed nugatory or *de minimis*, it must be concluded that all new development within the affected habitats site catchment has the potential to increase nitrogen and phosphate deposition into the protected sites above consented levels and thus interfere with the ability of a site to achieve its conservation objectives and the integrity of the European protected nature conservation site. Also, under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended) (HM Government, 2017) an LPA or Secretary of State (competent authority) cannot legally consent a plan or project that will have an adverse effect on the integrity of any European protected nature conservation site without imperative reasons of overriding public interest being proved and sufficient compensatory measures being provided. As such, all development proposals should consider whether this will be the case.

1.2.5 One way that the potential impact of new development can be determined is by using nutrient neutrality calculations to create a nutrient budget. A calculation methodology covering both nitrogen and phosphorus (where applicable) has been developed by Natural England using the most up-to-date scientific evidence base at the time of publication. This methodology was originally developed in 2020 and has since been updated and published as the 'Nutrient Neutrality Generic Methodology' (Natural England, 2022b).

1.2.6 In March 2022, Natural England identified further habitats sites that are in unfavourable status due to excess nutrients and to which the nutrient neutrality process will now apply. This now includes over 70 local authority areas including RCBC, STBC and HBC (only nitrogen is a concern in these three local authority areas).

Natural England also published locally amended nutrient calculators alongside their guidance.

1.2.7 Should a derived nutrient budget for a development demonstrate that there will be a nutrient surplus (i.e. is not nutrient neutral) then in the absence of any strategic solution or local credit scheme, developers must identify suitable mitigation that allows neutrality to be achieved. There are a range of nutrient mitigation approaches that can be adopted.

1.2.8 Improvements to wastewater treatment works (WwTWs) are one of the mitigation approaches, to achieve nutrient neutrality, for instance, by incorporating tertiary treatment phosphate stripping. However, this approach is largely outside of developers' control and can take years to implement, and so does not generally enable nutrient neutrality to be achieved in the short term. The Levelling-Up and Regeneration Act 2023 (HM Government, 2023a) outlines new nutrient effluent targets to be achieved by WwTWs by 2030 based on Technically Achievable Limits (TAL), and new development connecting to the WwTWs that are affected by nutrient neutrality requirements are expected to provide additional treatment to reduce the future burden on developers . The greater nutrient treatment required through TAL upgrades apply only to WwTWs serving 2,000 or more people and in areas currently affected by nutrient neutrality requirements. For WwTWs that serve between 250 and 2,000 people, upgrades may be needed at the discretion or direction of the Secretary of State. There will also be improvements to WwTWs relating to Water Company PR24 Business Plans.

1.2.9 Strategic scale mitigation solutions, such as large wetlands, are under development by various LPAs and Natural England to enable developers to buy nutrient credits to offset development. Such solutions can have multiple benefits including Natural Flood Management (NFM), biodiversity improvements and potential for recreation. A notable example of a strategic solution is the Solent Nutrient Market Pilot scheme (Partnership for South Hampshire, 2023). However, for most LPA areas, strategic scale mitigation solutions are not yet in place and mitigation approaches often involve changing land use, for instance from agricultural land to woodland or greenspace (that is not treated with fertilisers) to reduce nutrient uptake, although this may be unfeasible for developments with a substantial nutrient load. Wetland creation for nutrient treatment of foul water or abstracted river water and use of sustainable drainage systems (SuDS) to treat surface water runoff is another commonly applied mitigation approach. Overall, a key consideration with regard to mitigation is that it must be in place from the point of operation of a development and must be maintained for the lifetime of that development.

1.2.10 In the UK Government's Spring 2023 budget (HM Government, 2023b) it was announced that the Department for Levelling Up, Housing and Communities would launch "a call for evidence for locally led nutrient neutrality credit schemes" and provide "funding to support clearer routes for housing developers to deliver 'nutrient neutral' sites, in line with their environmental obligations".

1.2.11 In a further development in August 2023, the UK Government announced proposed amendments to the then draft Levelling-Up and Regeneration Bill to the effect that

urban wastewater developments would no longer need to consider nutrient flows as part of HRA for planning decision making and plan-making in nutrient neutrality catchments. However, the proposed amendments were overturned in the House of Lords, and as such, were not included in the Levelling-Up and Regeneration Act that received Royal assent in October 2023. No further legislation was brought forward in the King's Speech in November 2023. In any case, the proposed amendments would only have applied to urban wastewater, and developments which generate nutrient loads outside of urban wastewater, such as agricultural and certain industrial developments (including the Proposed Development) would have been unchanged.

1.3 Teesmouth & Cleveland Coast Special Protection Area/Ramsar Site

1.3.1 The Teesmouth & Cleveland Coast SPA / Ramsar is a 12,211 ha estuarine and coastal site located on the north-eastern coast of England as shown in the Figure 12-1 (ES Volume I, EN070009/APP/6.2).

1.3.2 The designated sites comprise a range of coastal habitats, such as sandflats and mudflats, rocky shore, saltmarsh, freshwater marsh and sand dunes. The SPA / Ramsar site lies along a stretch of coast that has been significantly modified by human activity. The site provides feeding and roosting opportunities for a significant number of waterfowl in winter and the passage period.

SPA Qualifying Features

1.3.3 The site qualifies as a SPA under Article 4.1 of the Birds Directive (79/409/EEC) (European Commission, 1979) by supporting populations of the following features, as per the conservation objectives for the SPA updated in May 2020 (Natural England, 2014):

- *Recurvirostra avosetta*; Pied avocet (Breeding);
- *Calidris canutus*; Red knot (Non-breeding);
- *Calidris pugnax*; Ruff (Non-breeding);
- *Tringa totanus*; Common redshank (Non-breeding);
- *Sterna sandvicensis*; Sandwich tern (Non-breeding);
- *Sterna hirundo*; Common tern (Breeding);
- *Sterna albifrons*; Little tern (Breeding); and
- Waterbird assemblage.

1.3.4 An extension to the Teesmouth & Cleveland Coast SPA / Ramsar was made in 2020 to improve seabird protection within the SPA network (Defra, 2020).

Ramsar Qualifying Features:

1.3.5 The site qualifies as a Ramsar under the following features (Ramsar Sites Information Service, 2000):

- criterion 5 – Assemblages of international importance; species with peak counts in winter are 26,786 waterfowl (5-year peak mean 2011/12 to 2015/16); and
- criterion 6 – Species / populations occurring at levels of international importance; qualifying species / populations (as identified at designation); species with peak counts in spring / autumn – common redshank *Tringa totanus*; 1,648 individuals representing an average of 1.1% of the East Atlantic population (1987 to 91); Species with peak counts in winter – red knot Calidris *Canutus islandica*; 5,509 individuals representing an average of 1.6% of the Canada/Greenland/Iceland/ UK population (5 year peak mean 1991/92 to 1995/96), and Sandwich tern *Thalasseus sandvicensis* – 1,900 individuals representing an average of 4.3% of the GB population (1988 to 1992).

1.3.6 The following threats / pressures to the site integrity of the Teesmouth & Cleveland Coast SPA have been identified in Natural England's Site Improvement Plan (Natural England, 2014):

- physical modification;
- public access / disturbance;
- direct land take from development;
- water pollution;
- fisheries: Commercial marine and estuarine;
- fisheries: Recreational marine and estuarine;
- undergrazing;
- inappropriate water levels;
- predation;
- coastal squeeze;
- change to site conditions; and
- air pollution: Impact of atmospheric nitrogen deposition.

2.0 ENGAGEMENT

2.1.1 A pre-application consultation meeting was held on the subjects of nutrient neutrality screening and Water Framework Directive (WFD) Screening with Natural England and the Environment Agency on 12 June 2023. At this meeting an overview of the Proposed Development was provided, with preliminary details presented regarding possible raw water supply, management principles for surface water runoff, options for foul discharge and process water discharge rates and nitrogen concentration.

2.1.2 During the statutory consultation process, no specific responses or feedback were received with regard to Nutrient Neutrality.

2.1.3 The outcomes of the Nutrient Neutrality Screening Report were presented to Natural England at a consultation meeting on 24 November 2023. No concerns were raised with regard to the screening process at that time.

3.0 THE PROPOSED DEVELOPMENT

3.1 Overview

3.1.1 The Proposed Development comprises the construction, operation (including maintenance where relevant) and decommissioning of an up to 1.2-Gigawatt Thermal (GWth) Lower Heating Value (LHV) Carbon Capture and Storage (CCS) enabled Hydrogen Production Facility ('the Hydrogen Production Facility') located in Teesside. For further details on the Proposed Development, refer to Chapter 4: Proposed Development (ES Volume I, EN070009/APP/6.2).

3.1.2 For further details specifically regarding the Water Environment or the Rochdale Envelope parameters, please refer to Chapter 9 Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

3.2 Water Cycle Overview

3.2.1 The source of water to supply the Proposed Development will be the existing Northumbrian Water Limited (NWL) raw water pipeline feed from 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 Net Zero Teesside (NZT) infrastructure or the installation of a new connection.

3.2.2 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.

3.2.3 How these streams are dealt with is the subject of two 'cases' being considered by the Applicant. The first case (Case 1B) 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 habitats site catchment or b) discharging outside of the habitats site catchment. Case 2B represents an alternative to MLD, whereby the nutrients are treated using conventional biological treatment. In this case, treated wastewater would be discharged via the NZT outfall to Tees Bay..

3.2.4 Surface water drainage will discharge either: 1) to the Tees Estuary via an existing South Tees Development Corporation (STDC) outfall; or 2) to Tees Bay via the proposed NZT outfall. This is described further below.

3.2.5 Plates 3-1 and 3-2 show flow diagrams summarising the Proposed Development's water balance for both Case 1B and Case 2B of the Proposed Development.

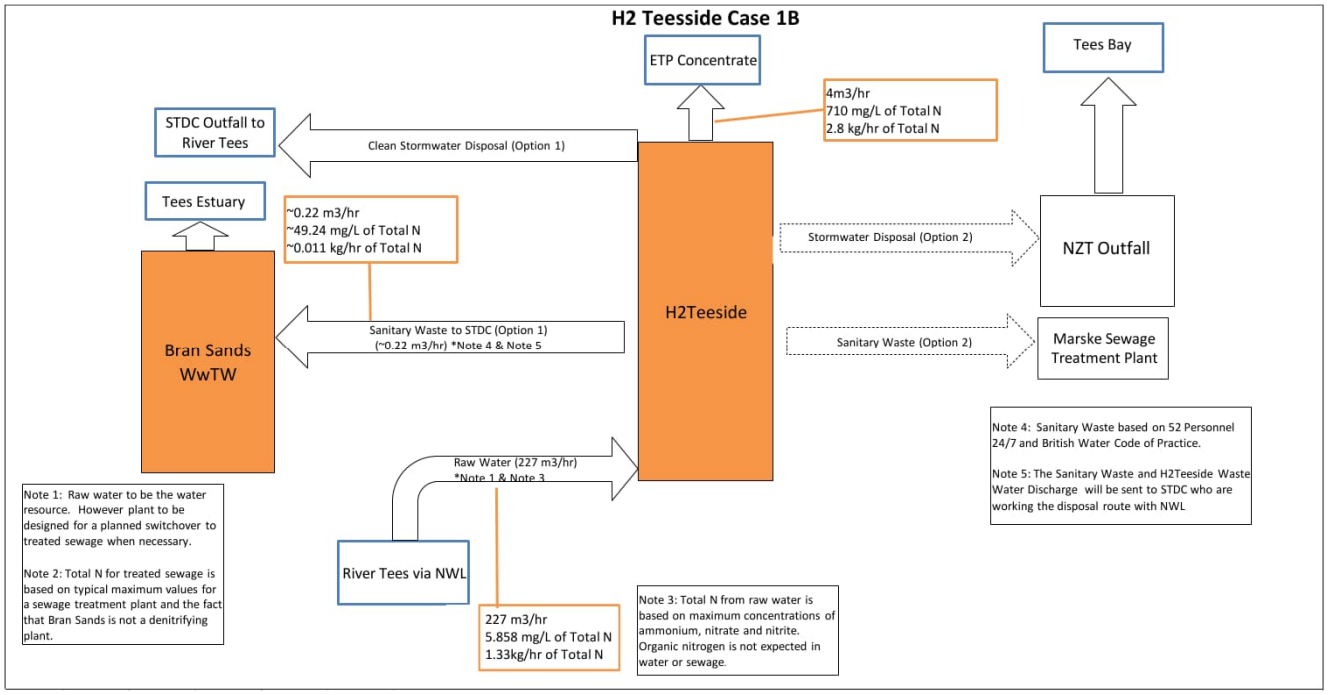

Plate 3-1: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 1B

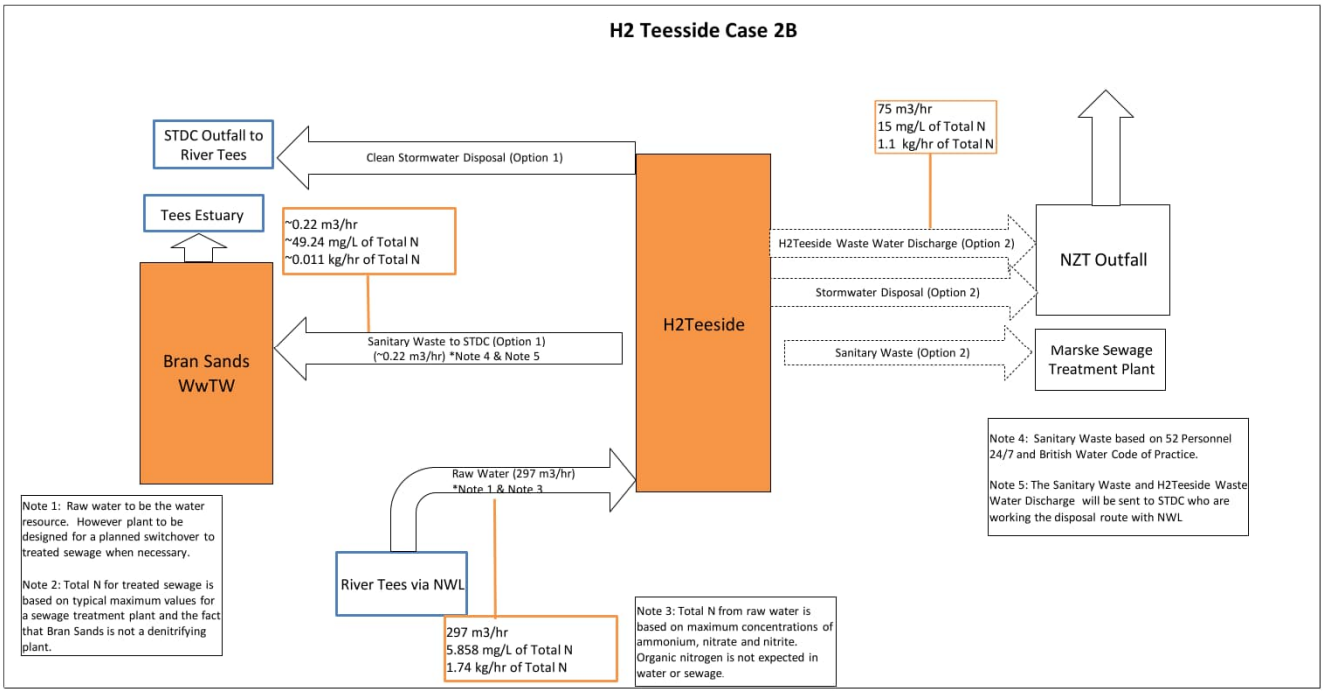

Plate 3-2: Flow Diagram to Summarise the Water Cycle for the Proposed Development for Case 2B

3.3 Water Demand

3.3.1 The raw water requirement for the Proposed Development comprises the elements listed in Table 3-1.

Table 3-1: Raw water requirement for the Proposed Development

WATER REQUIREMENT	CASE 1B & 2B (^{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

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

3.3.3 The abstraction of water from River Tees would remove a certain amount of nitrogen from the estuary, and so when returned 'downstream' there is no net additional nitrogen load, except for that generated by the hydrogen production process itself. The additional nutrient load from the process would result in the water discharged from the site having a maximum concentration of 15 mg/l of total nitrogen.

3.4 Surface Water Drainage

3.4.1 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 effluent generated by the operation of the Main Site. The Connection Corridors will not require additional drainage as they will be using existing pipe racks, pipe bridges, culverts or otherwise installed underground.

3.4.2 Surface water drainage will discharge by one of two options: 1) to the Tees Estuary via an existing South Tees Development Corporation (STDC) outfall; or 2) to Tees Bay via the proposed NZT outfall.

3.4.3 The proposed drainage arrangements are outlined in Section 9.5 of Chapter 9 Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2). The Indicative Surface Water Drainage Plan (EN070009/APP/2.12) outlines the principles of the management and distribution of surface water within the Proposed Development. A Detailed Surface Water Drainage Strategy will be produced at a later stage for approval by the local planning authority, in consultation with Environment Agency and the Lead Local Flood Authorities (LLFAs) (RCBC and STBC), pursuant to the DCO.

3.4.4 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.

3.4.5 SuDS will be used 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 is recommended 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 is recommended. Pore spaces within the gravel matrix provide attenuation storage, reducing peak runoff rates. In additional the gravel provides a degree of pre-treatment.
- Swales are recommended for conveyance of road run-off.
- An attenuation pond will be present to provide storage and also will provide a degree of water quality treatment.

3.4.6 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.

3.4.7 Process operations on site will require storage and use of a range of potentially polluting chemicals. These may be associated with washdown water, tank water draw-offs, pump equipment drips and drains, draw-offs from sample connections, instruments, drain cocks and similar equipment fittings and other routinely

contaminated wastewater streams. The surface water drainage system for areas of site drainage that may contain chemical pollutants from minor leaks and spills (i.e., surface water drainage near chemical storage tanks or overlying pipework etc.) will therefore need to be separated from the main 'clean' surface water drainage system using appropriate methods such as kerbs, bunds, sumps. An oily water sewer system will be in place to convey the potentially contaminated water to an open drain sump where the water will be monitored. Where water is contaminated, this will be directed to an on-site package treatment plant and will be subject to a requirement of an Environmental Permit. The Applicant has also begun engagement with the Environment Agency under the enhanced pre-application scheme and is finalising an application for an Environmental Permit anticipated to be submitted in 2024.

3.4.8 In addition to the above sources of surface water, under exceptional circumstances firewater may be generated. Firewater 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 firewater and divert it away from the existing surface water SuDS system. The contaminated firewater 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 firewater is diverted (i.e. an automatic or manual operated system) will be further determined in consultation with Environment Agency, LLFAs and the Fire Service post-DCO consent during detailed design. At this stage, it is suggested that the capacity of the firewater 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 firewater plus leak scenario.

3.4.9 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 Detailed Surface Water Drainage Strategy will include an appropriate water quality risk assessment.

3.5 Process Wastewater

3.5.1 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 will include ammonia (NH_3), methanol (CH_3OH), carbon dioxide (CO_2), methane (CH_4) and hydrogen (H_2) that need removal before it can be discharged; and
- hazardous liquid wastes – to be taken off-site (e.g. amine).

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

3.5.3 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 and treated in a manner consistent with nutrient neutrality requirements by a) denitrification and discharge of resultant effluent within the habitats site catchment or b) discharging outside of the habitats site catchment. The treated wastewater from the ETP will be reused as make-up water in the Water Treatment Plant.

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

3.5.5 The continuous flows of effluent are summarised in Plate 3-1 and Plate 3-2. 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 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.

3.5.6 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. The first option is transport of liquid waste (concentrate sludge / waste) off-site for further treatment based on Minimalised Liquid Discharge from the ETP. The second is discharge of treated process water to the Tees Bay outfall that will be constructed as part of the NZT project. The concentration of total nitrogen discharged under this second scenario would not exceed 15 mg/l, which would be considered as part of the Environmental Permitting process. If there is discharge of process wastewater to the outfall at Tees Bay, then it is assumed that the wastewater discharge will meet the requirements of the Best Available Techniques (BAT) Reference Document (BREF) for Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector 2016 (European Commission, 2016).

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

3.5.8 Should treated wastewater be discharged to Tees Bay under Case 2B, the indicative effluent quality is given in Table 9-22 of Chapter 9 Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).

3.5.9 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, forming part of the Environmental Permit requirements.

3.6 Foul Wastewater

3.6.1 Foul wastewater from the Proposed Development will connect to the 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. The flow diagrams in Plate 3-1 and Plate 3-2 indicate an expected concentration of 49.24 mg/l Total Nitrogen (TN) in this foul effluent discharge (0.011 kg/hr) based on an indicative weekday shift of 52 personnel.

3.7 Atmospheric Deposition of Nitrogen

3.7.1 There is potential for atmospheric deposition of nitrogen from emissions from the Proposed Development and modelling of this potential impact has been undertaken, and appropriate assessment through the Report to Inform Habitats Regulations Assessment (EN070009/APP/5.10).

3.7.2 An estimation of TN load across Tees Bay has been made. Initial analysis suggests that this will have a negligible impact on ambient dissolved inorganic nitrogen (DIN) concentrations. Annual loads of between 0.0005 and 0.02 kg N/ha/yr have been modelled, with the highest values found in the immediate vicinity of the Proposed Development. Values at Teesmouth are less than 0.01 kg N/ha/yr, with Seal Sands receiving <0.002 kg N/ha/yr.

3.7.3 Given the very small deposition rates in the Tees estuary, nitrogen contributions from this source are considered insignificant. It is also noteworthy that in other areas of England where nutrient neutrality for effluent and surface runoff is a requirement, this has not been extended to include atmospheric sources of nitrogen.

4.0 NUTRIENT NEUTRALITY ASSESSMENT

4.1 Nutrient Neutrality Screening

4.1.1 The Proposed Development has the potential to release nitrogen via:

- surface water runoff;
- process water effluent discharge;
- foul water discharge; and
- atmospheric deposition.

4.1.2 Table 4-1 provides a screening table summarising the nutrient output from these various streams and whether or not the potential nitrogen source required any further assessment.

Table 4-1: Nutrient Neutrality Screening

NITROGEN SOURCE	DEVELOPMENT DETAILS FOR NITROGEN SOURCE	SCREEN IN?
Surface Water Runoff	A Surface Water Drainage Strategy will be prepared for the Proposed Development (as a Requirement of the DCO), with surface water runoff intended to be discharged to Tees Bay or Tees Estuary following attenuation. Using the Natural England nutrient budget calculator to determine changes in land use, it is clear that the only applicable classification for the existing and proposed land use is 'commercial and industrial'. There is no other option for brownfield land. As such, it is considered that there will be no significant change in land use between the current site and the Main Site that would be distinguishable in the Natural England nutrient budget calculator (and thus no potential for the development to alter the nutrient load from existing site runoff). The Natural England nutrient budget calculator loading for commercial and industrial land uses in the catchment is 5.78 kg TN/ha/yr for. In the absence of specific nutrient loading data from schemes of this type, this is the current best estimate of nutrient loading from surface water runoff in the absence of mitigation. It should also be noted that there is a potential for betterment in terms of nutrient load reduction across the Main Site given proposed	No – the Proposed Development does not constitute a significant change in land use within the Natural England methodology and thus there is no potential for the development to alter the nutrient load from existing site runoff.

NITROGEN SOURCE	DEVELOPMENT DETAILS FOR NITROGEN SOURCE	SCREEN IN?
	use of SuDS. However, this is not taken into account in this screening process.	
Process Water	There are two options for discharge of process water effluent: 1. Off-site transport of Minimalised Liquid Discharge waste from the ETP. This would contain 710 mg/l TN or 2.8 kgTN/hr (Case 1B). Minimalised Liquid Discharge waste will be treated in a manner consistent with nutrient neutrality requirements by either a) denitrification and discharge of resultant effluent within the habitats site catchment or b) discharging outside of the habitats site catchment 2. Discharge to Tees Bay via NZT outfall at 15 mg/l TN and at a discharge flow rate of 75 m^3/hr (Case 2B) (bp, 2022). This equates to a load of 1.1 kg/hr TN[1]. Hydrodynamic modelling is required to determine the extent to which this would be dispersed into Tees Estuary and sensitive locations such as Seal Sands.	Case 1B – No – liquid waste to be denitrified if discharged within the habitats site catchment or otherwise taken outside of the habitats site catchment for disposal. Case 2B – Yes – wastewater discharge from the NZT outfall would be to the SPA/Ramsar site, with modelling required to determine extent of impact should the NZT outfall be used.
Foul Wastewater	Foul wastewater will be discharged to Bran Sands WwTW or Marske-by-the-Sea WwTW. The nutrient neutrality assessment method from Natural England is intended to estimate the nutrient budget from all types of development that would result in a net increase in population served by a wastewater system. This is indicated by development that would include overnight accommodation. It states that "*other types of business or commercial development, not involving overnight accommodation, will generally not need to be included in the assessment unless they have other (non-sewerage) water quality implications*." It is not anticipated that there would be an increase in overnight accommodation in the	No – Natural England guidance indicates that operational staff who also live in the catchment do not need to be considered as foul water generated is already part of the baseline.

[1] For context, the NZT project reported a base case of effluent flow through the outfall to Tees Bay of 36-640 m^3/hr effluent with 0.015 kgN/hr additional nitrogen discharged, and for their Option A had an effluent flow of 1,340 m^3/hr with 24.7 kgN/hr additional nitrogen discharged.

NITROGEN SOURCE	DEVELOPMENT DETAILS FOR NITROGEN SOURCE	SCREEN IN?
	catchment as a result of the Proposed Development and thereby no net increase in population served be a wastewater system.	
Atmospheric Deposition	Air quality modelling indicates that TN loads would be very small from this source and given its distribution and dilution across a wide area of Tees Bay and Tees Estuary would likely be insignificant.	No – given small TN load, particularly in Tees estuary, and degree of dilution this source is not significant.

4.1.3 Natural England confirmed via a consultation meeting undertaken on 12 June 2023 that their concern with regard to nutrients (and their impact to the integrity of the site) for the Teesmouth & Cleveland Coast SPA/Ramsar site is primarily within the terrestrial and inter-tidal sections of the site, particularly the Seal Sands area. Where any discharge from the Proposed Development might occur to the sea and dispersion modelling can indicate no pathway to the terrestrial and inter-tidal sections of the site, then there would likely be no issue with regard to nutrient neutrality and no further assessment or mitigation is likely to be required.

4.1.4 The screening assessment in Table 4-1 indicates that the only aspect of the Proposed Development that would potentially generate additional nutrient load to the terrestrial and inter-tidal sections of the Teesmouth & Cleveland Coast SPA/Ramsar site (notably Seal Sands) is process water discharge in the event of Case 2B being taken forward. Under this Case, a total nitrogen load of 1.1 kg/hr would discharge to Tees Bay. To determine whether this TN discharge is likely to be dispersed towards the Tees Estuary, hydrodynamic dispersion modelling has been undertaken.

4.2 Dispersion Modelling of Effluent

4.2.1 Given the potential of the Proposed Development to discharge nitrogen via 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. The outcomes are summarised briefly below with full details given in Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4).

4.2.2 The discharged effluent from the Main Site will comprise 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. There is also a possibility that surface water runoff will be discharged via the NZT outfall, depending which option is taken forward post consent (as outlined in Section 4B.4). As such, the modelling has incorporated a scenario that includes surface water runoff.

4.2.3 Water quality data for the River Tees was provided by NWL and combined with information from Environment Agency and details of water treatment technology planned for the Proposed Development to characterise final discharge effluent flows and loads for the modelling exercise.

4.2.4 Pollutant concentrations determined for the final effluent were compared with Environmental Quality Standards (EQS) for Tees Bay under the WFD. The available information shows that effluent concentrations of DIN (as well as benzo(b)-fluoranthene, benzo(g,h,i)-perylene, fluoranthene, PFOS, polyaromatic hydrocarbons (PAHs), chromium, copper, iron, lead, mercury, zinc and diazinon) may exceed EQS values (these contaminants are derived from the source river water and not from the Hydrogen Production Facility). Effective volume flux calculations have been carried out and show that DIN would be discharged above the allowable volume flux value. DIN was therefore taken forward for modelling using an EQS proxy of 5% above ambient while mixing zones for DIN were defined using near field modelling based on EQS limits.

4.2.5 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 (for which consent has been granted through the NZT DCO application) 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.

4.2.6 The near field and far field modelling show that the impact of the Proposed Development process effluent discharge is small for DIN (and for all other affected polluting substances and temperature) at all stages of the tidal cycle. 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 any model cell in any layer is 0.017 mg/l for DIN, which is not sufficient to breach EQS values (0.252 mg/l). The far field and near field modelling therefore shows that process effluent discharges from the Main Site, in isolation, would not result in a reduction in water quality in Tees Bay at any point over a tidal cycle.

4.2.7 Plate 4-1 shows the increase in average DIN concentrations in the deepest model layer in Tees Bay based on Main Site discharges only and modelled over repeated tidal cycles. The increase in DIN concentrations is very small and insufficient to reach EQS values and the increase in DIN in other model layers is smaller than in the deepest layer. No additional DIN is expected to enter the River Tees as a result of the Proposed Development. The addition of surface water runoff via the Tees Bay

outfall to the model reduces pollutant concentrations within Tees Bay in comparison to process effluent discharges only and the mapped increase in DIN would be smaller than shown in Plate 4-1. Refer to Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4)) for further details.

4.2.8 The far field and near field modelling therefore show that discharging the combined process effluent and surface water discharges from the Main Site would not result in a reduction in water quality in Tees Bay at any point over a tidal cycle.

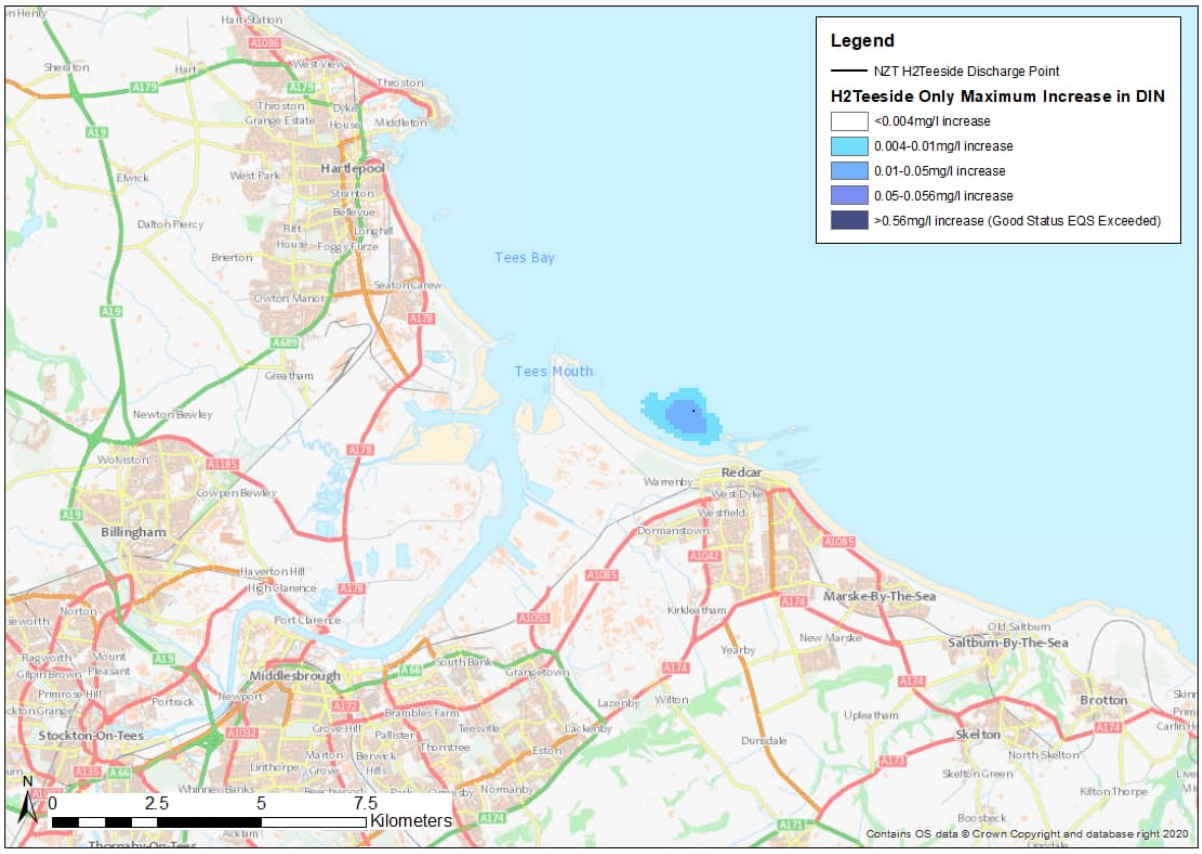

Plate 4-1: Increase in Maximum Seabed DIN Concentrations in Tees Bay after Multiple Tidal Cycles (H2Teesside Process Effluent Only)

4.2.9 The conservation and WFD objectives for the estuary and Teesmouth & Cleveland Coast SPA/Ramsar site also require nitrogen loading of the estuary to be reduced. In particular, it is the intertidal and terrestrial areas of the Tees estuary that are of most concern (notably Seal Sands), and 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. It is also notable that given that the raw water for the Proposed Development is abstracted from the River Tees upstream, the overall load of nutrients in the Seal Sands area and intertidal sections of the Estuary would be reduced, given that the process water discharge does not return any nitrogen to the estuary.

4.2.10 On the basis of the modelling results it is also considered that process water effluent discharge under Case 2B can also be screened out of the nutrient neutrality

assessment. Refer to Appendix 9B: Water Quality Modelling Report (ES Volume III, EN070009/APP/6.4) for the detailed modelling results.

4.3 Nutrient Neutrality

4.3.1 Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements as a result of the effects of nutrient loading from new developments on habitats sites. The general assessment process is illustrated in Plate 4-2. Natural England considers nutrient neutrality as an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effects on the integrity of habitats sites.

4.3.2 As this assessment demonstrates that the Proposed Development does not have the potential to impact on water quality on the identified receptor in the Tees Estuary no further nutrient nitrogen assessment is required.

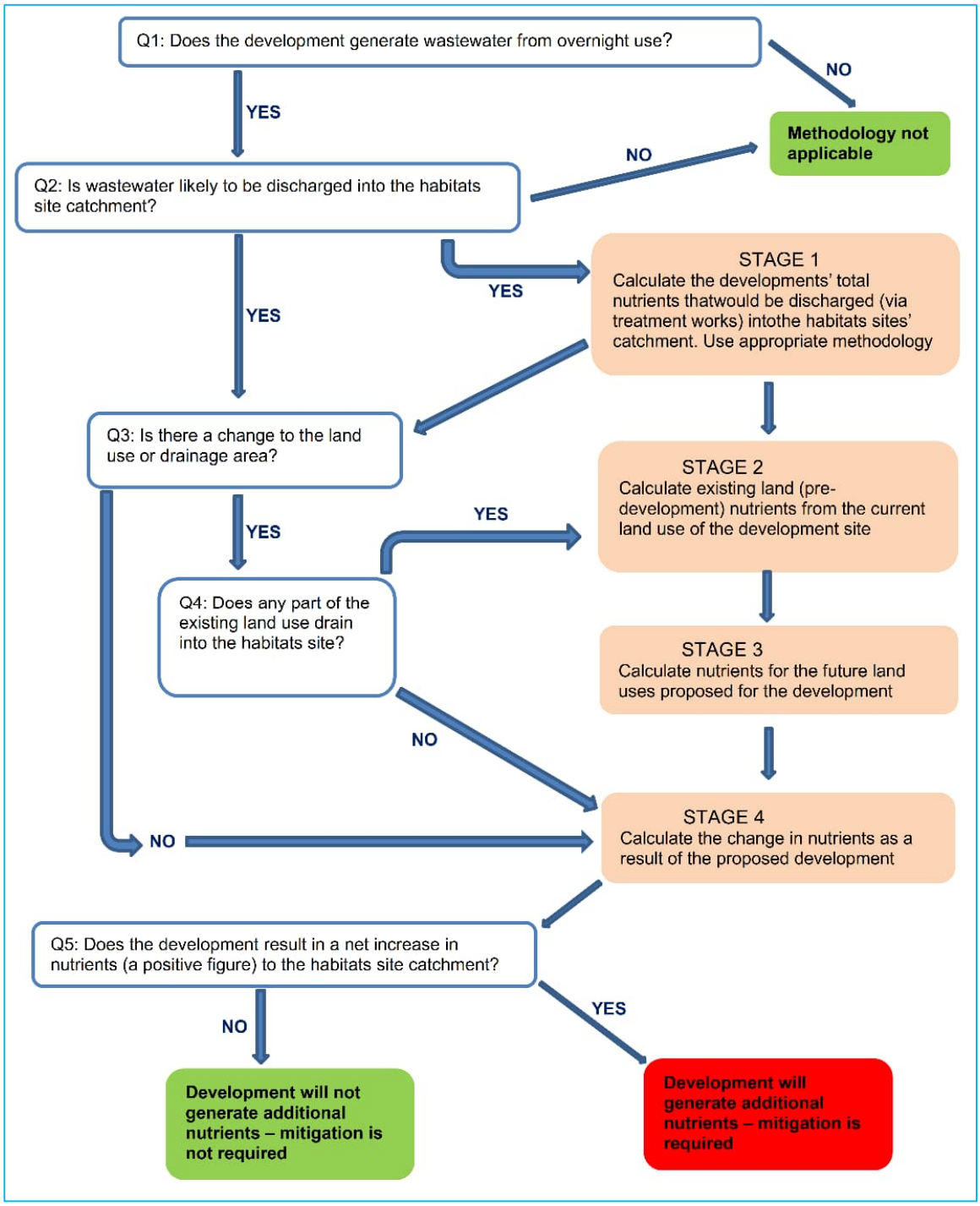

Plate 4-2: Natural England Nutrient Neutrality Assessment Decision Tree (March 2022)

5.0 SUMMARY

5.1.1 On 16 March 2022, Natural England informed The Planning Inspectorate, RCBC, STBC and HBC that as a Competent Authority under the Habitats Regulations, the LPAs (and the Secretary of State for DCO applications) must carefully consider the nutrients impacts of any new plans and projects on the Teesmouth & Cleveland Coast SPA/Ramsar site and whether those impacts may have an adverse effect on the site that requires mitigation, including through nutrient neutrality.

5.1.2 The Proposed Development has the potential to release nutrients via i) process water effluent discharge (where it introduces a new nitrogen load rather than just concentrating nitrogen already present in raw water and being returned to the habitats site); ii) surface water runoff; iii) foul water discharge; and iv) atmospheric deposition of nitrogen.

5.1.3 A nutrient screening assessment was undertaken for each potential source of nitrogen, and it was determined that only process water effluent discharge should be screened in for Case 2B, where nitrogen may enter the habitats site catchment via discharge to Tees Bay. Surface water runoff is considered to be 'no change' from the existing situation using Natural England land use classifications, given it is currently an industrial site and so this was screened out. The potential impact from foul effluent was also screened out on the basis that operational workers are assumed to already live in the habitats site catchment and so no 'new' overnight stays are created. Impact from atmospheric deposition was screened out given the minimal deposition that has been modelled over Tees Estuary which will be insignificant given the dilution and dispersal potential of the waterbody.

5.1.4 For discharges to Tees Bay via the NZT project outfall (Case 2B), hydrodynamic dispersion modelling was undertaken to determine whether there is potential for nutrients to enter the Tees Estuary, particularly Seal Sands as the area of most concern in terms of eutrophication (as confirmed by Natural England). This modelling exercise indicated that there is no significant increase in DIN within Tees Estuary as a result of the process water discharge. Furthermore, it would be expected that the nitrogen load at Seal Sands would be reduced overall given abstraction of water from the River Tees upstream to supply the Proposed Development. This would be discharged to Tees Bay and would not be returned into the estuary.

5.1.5 An assessment of WFD compliance has also been undertaken and is presented in the Water Framework Directive Assessment (EN070009/APP/5.14). This includes consideration of how the new discharge may impact achievement of conservation objectives for the designated sites. WFD compliance considers cumulative nitrogen loads (i.e. in combination with the NZT project). Under the WFD the Proposed Development must not cause deterioration or prevent improvement to good ecological potential of Tees transitional water body, taking into account the conservation objectives for the SPA / Ramsar site designations. This includes long term aspirations to lower the nutrient load in the estuary to reduce the extent of

algal matts that are believed to hinder access to benthic fauna for bird species that are qualifying features.

5.1.6 To conclude, on the basis of this assessment and following hydrodynamic modelling, it has been possible to screen out process water discharge, surface water runoff, foul drainage and atmospheric deposition from further assessment for both Case 1B and Case 2B. The Proposed Development is therefore considered nutrient neutral.

6.0 REFERENCES

- bp (2022). *Net Zero Teesside DCO Document 9.36 Nutrient Nitrogen Briefing Paper.*
- Department for Environment Food and Rural Affairs (Defra) (2020). *Teesmouth and Cleveland Coast SPA, Ramsar Site and SSSI ; You asked, You Said, We Did.*
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- HM Government (2023a). *Levelling-up and Regeneration Act 2023.*
- HM Government (2023b). *Spring Budget 2023.*
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- Natural England (2022a). *Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites.*
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