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4.0 PROPOSED DEVELOPMENT

4.1 Introduction

4.1.1 The Proposed Development comprises the construction, operation (including maintenance where relevant) and decommissioning of an approximately 1.2-Gigawatt Thermal (GWth) Lower Heating Value (LHV) Carbon Capture and Storage (CCS) enabled a Hydrogen Production Facility (the 'Production Facility') located in Teesside, along with the pipeline infrastructure required to supply hydrogen (H_2) to offtakers (customers) and the necessary utility connections.

4.1.2 This chapter is supported by Figures 4-1 - 4-8 (PEI Report, Volume II) which show the components of the Proposed Development, including the Main Site (the Foundry) and the Connection Corridors.

4.2 Proposed Development Overview

4.2.1 The Production Facility is an approximately 1.2 GWth LHV (Phase 1, 600-Megawatt thermal (MWth) LHV and Phase 2, 600 MWth LHV) Carbon, Capture and Storage (CCS) enabled Production Facility located in the Teesside industrial cluster area. In addition to the Production Facility, the Proposed Development includes the following:

- H_2 distribution pipelines to supply H_2 to various offtakers in Teesside and within the surrounding area;
- an Air Separation Unit (ASU) (located on the Main Site) to supply oxygen (O_2) and nitrogen (N_2) for the H_2 production process;
- O_2 and N_2 supply pipelines (as an alternative to the proposed ASU) to supply O_2 and N_2 for the H_2 production process, from an existing nearby third party ASU;
- carbon dioxide (CO_2) capture and compression facilities and a connection to the Northern Endurance Partnership (NEP) CO_2 gathering pipeline network for transportation of captured CO_2 to permanent storage;
- a natural gas supply connection for the supply of gas to the Production Facility;
- on-site, above ground H_2 storage not exceeding 11 tonnes;
- an electrical grid connection to provide power to the Proposed Development;
- water supply and treatment infrastructure;
- wastewater treatment and disposal infrastructure;
- other utilities connections, telecommunications, and other associated and ancillary infrastructure; and
- temporary construction and laydown areas.

4.2.2 The Production Facility will be located on the 'Main Site', as referred to in this PEI Report.

4.2.3 Demand for H_2 produced by H2Teesside will come from multiple end users, including supporting fuel switching from natural gas to H_2 within process heat, steam raising and power generation applications, therefore reducing CO_2 emissions from these industries.

4.2.4 The proposed capture technology uses an amine-based solvent to absorb CO_2 produced by the H_2 production process, with an anticipated design carbon capture rate in excess of 95%. This process is also known as '*pre-combustion amine-based absorption regeneration'*. The design capture rate will be defined in the Environmental Permit that will be required to operate the Proposed Development. H2Teesside will connect via a short CO_2 export connection to the NEP compression and pipeline infrastructure on the adjacent Net Zero Teesside (NZT) site. Based on current projections, H2Teesside will have the capacity to continuously export approximately 1.4 megatonnes (Mt) of dehydrated and compressed CO_2 per year per phase or use up to approximately 2.8 Mt/year once both phases are operational (100% utilisation) to NEP for offshore underground storage with no temporary CO_2 storage required on site.

4.2.5 At this stage in the design of the Proposed Development, there are still options being considered for various components. The design of the Proposed Development incorporates a necessary degree of flexibility to allow for the future selection of the preferred technology and layout at the Main Site, as well as the routing of the hydrogen pipeline and other connections. This will evolve as design and commercial agreements progress during the preparation of the DCO Application.

4.2.6 To ensure a robust assessment of the likely significance of the environmental effects of the Proposed Development, the EIA is being undertaken using the principles of the 'Rochdale Envelope' as set out in Advice Note Nine (The Inspectorate, 2018) where appropriate. This involves assessing the maximum (or where relevant, minimum) parameters for those elements of the Proposed Development where there is currently uncertainty in the final design (for example, building dimensions or operational modes), as set out in Section 4.9. Where this approach is being applied in the assessment, this is confirmed within the relevant chapters of this PEI Report. Justification for the need to retain flexibility in certain parameters is also outlined in this chapter and in Chapter 6: Alternatives and Design Evolution (PEI Report, Volume I). As such, this PEI Report represents a reasonable worst-case assessment of the potential impacts of the Proposed Development at its current stage of design.

4.2.7 Details regarding the construction phase of the Proposed Development are included in Chapter 5: Construction Programme and Management (PEI Report, Volume I). At this stage, a detailed construction programme is not available, as this is normally determined by the Engineering Procurement and Construction (EPC) contractor who has not yet been appointed. However, an indicative construction programme has been developed and is presented within Chapter 5: Construction Programme and Management (PEI Report, Volume I) on which the potential environmental effects of the construction of the Proposed Development have been assessed.

4.2.8 The Production Facility elements of the Proposed Development will be constructed in two 'phases', each comprising a single Auto Thermal Reformer (ATR) unit, carbon capture facilities and utilities. The first phase will be constructed, commissioned, and operated initially, with the second phase expected to be commenced during the Phase 1 commissioning period once the first unit is operational and when required by demand.

4.2.9 The following sections describe the Proposed Development in more detail as required for the purposes of this PEI Report and provide where possible a brief description of any optionality still being considered by the Applicant for each element.

4.3 Components of the Proposed Development

Hydrogen Production Facility

Overview

4.3.1 The Production Facility will be designed taking account of Best Available Techniques (BAT) as set out in the UK Government's guidance on emerging techniques for H_2 production with carbon capture (Environment Agency, 2023). The Production Facility will utilise natural gas as the feedstock. The natural gas will be converted to a syngas over a catalyst in Pre-Reformers and Autothermal Reformers (ATRs) with the addition of steam and O_2.

4.3.2 Although the syngas from the ATR is rich in H_2, it also contains high concentrations of carbon monoxide (CO). Therefore, this syngas will be further reacted in water-gas shift reactors to convert the CO using steam into H_2 and CO_2. The CO_2 will be removed from the gas via contact with an amine-based solvent, which will absorb (capture) the CO_2. The solvent will then be further regenerated to yield a CO_2 stream that will be compressed to medium pressure, dehydrated, and then exported to the NEP compression infrastructure on the NZT site to the east of the Main Site.

4.3.3 The captured CO_2 will be further compressed to high pressure by NEP to "dense phase" for transportation by a new pipeline to the NEP Endurance store beneath the North Sea. The onshore infrastructure required for compression and export (the high-pressure compression plant and CO_2 export pipeline) is subject to a separate consent, both through DCO for the NZT DCO Project (for which a decision on whether a DCO has been granted is expected in the second half of 2023) and consenting of the offshore elements under the Energy Act 2008 and the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020. The conditioned and compressed CO_2 will be transported offshore by NEP for storage at the Endurance underground store beneath the North Sea located approximately 145 km to the east/south-east of the Proposed Development Site. Geological storage and offshore CO_2 transportation will be managed and operated by NEP and would be subject to separate consents.

4.3.4 The low-carbon H_2 rich stream will be purified to >98 purity mol% H_2 and compressed and conditioned before being exported to offtakers located in the Teesside region via the proposed purpose-built hydrogen pipeline system.

4.3.5 Two potential technology options have been identified for consideration, as part of the Proposed Development. These are referred to as Case A (which involves ATR reforming) and Case B (which utilises an alternative proprietary Low Carbon Hydrogen technology) (see Section 4.10 below). Under Case A, steam required in the process will be raised in the ATR reformed gas boilers. The steam will be used to heat several process streams: in the heater, O_2 preheater, process condensate heater and the CO_2 dryer. If there is any excess steam, this could be used by a steam turbine generator (STG) to be installed on the Main Site, to power the Production Facility. Case B will not generate excess steam. An indicative schematic of the H_2 production process is provided in Plate 4-1[1].

4.3.6 The power generated by the steam turbine generator would not exceed 50 megawatts (MW) for both phases of the Proposed Development.

Production Capacity

4.3.7 Production is expected to build during the initial 12-18 months of operation in line with offtaker demand. The peak H_2 export rate for each phase is expected to be 600 MWth LHV (or approximately 22 tonnes/hr) with the associated peak CO_2 export rate being 161,710 kg/hr. For Phase 1 and 2 combined this equates to approximately 1.2 GWth LHV (44,350 kg/hr) peak H_2 production and export and 323,420 kg/hr CO_2 export.

4.3.8 Once commissioned and operational, the Production Facility will be designed to operate twenty-four hours per day, seven days per week (including when only Phase 1 is built) until decommissioning, with brief exceptions for planned outages such as for maintenance and repair.

[1] Plate 4-1 shows the H_2 production process for Case A. Case B is similar but includes an additional heating step.

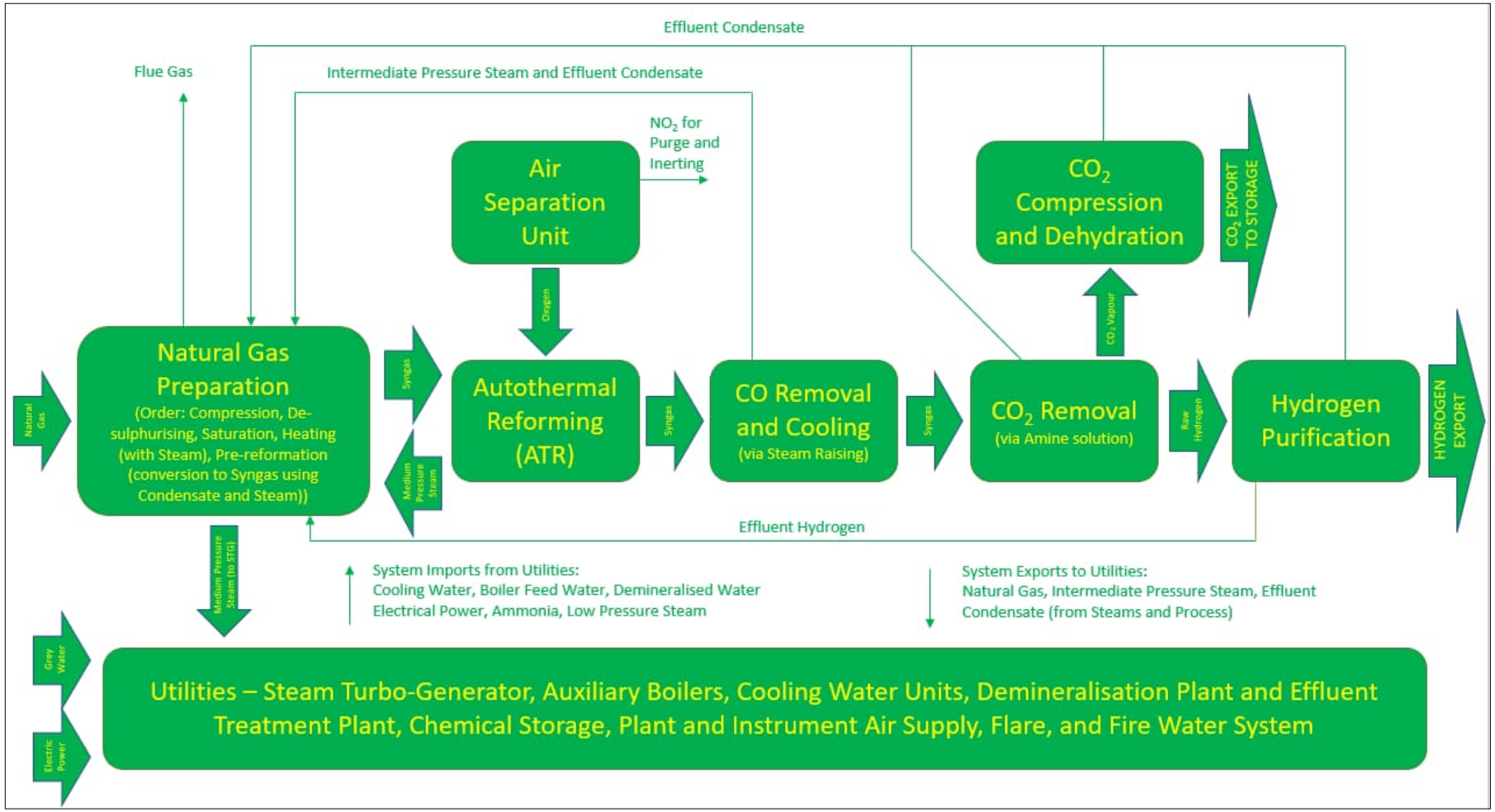

Plate 4-1: H_2 Production Process Schematic (Indicative for Case A)[1]

4.3.9 An outline description of the process infrastructure required for the operation of the Production Facility is presented below:

- a new Above Ground Installation (AGI) on the Main Site to receive natural gas which is common for both Phase 1 and Phase 2;
- a new AGI on the Main Site at the point of export of CO_2 which is common for both Phase 1 and Phase 2;
- a Hydrogen Unit in each phase where the main process of reforming occurs. Each Hydrogen Unit includes the following component units;
  - inlet natural gas compression;
  - pre-treatment to remove sulphur species;
  - pre-reformer to reform longer hydrocarbons to methane, H_2, CO and CO_2;
  - shift reactors for conversion of CO to H_2 and CO_2 and heat recovery in the form of steam for reuse in the process;
  - CO_2 absorber to separate the majority of the CO_2 from the syngas mixture;
  - compressors to increase the pressure of the CO_2 prior to drying (dehydration);
  - compressor where raw H_2 is recycled for input back into the natural gas feed for pre-treatment; and
  - a methanator and H_2 drying unit or Pressure Swing Adsorber (PSA) where raw H_2 is further purified and dehydrated and prepared for export to the pipeline networks, after passing through a compressor to achieve the required pipeline pressure of 40 bara and cooled to 30°C for export.

4.3.10 In addition, the following ancillary infrastructure may be required for the Proposed Development for each phase and in each Case (except where noted):

- Air Separation Units (ASU) for the compression and separation of air, which is passed through a rectification column to produce O_2 for use in the ATR. It also includes provision of liquid O_2 and liquid N_2 storage for back up. As an alternative, options to utilise O_2 and N_2 from a nearby supplier which would remove the requirement for an onsite ASU and onsite liquid storage are being investigated. This is subject to further discussions with the O_2 and N_2 provider and detailed design work, therefore the construction of new O_2 and N_2 ('Other Gases') pipelines to that potential supplier is included within the Proposed Development.
- Cooling Water Circulation System including cooling cells, pumps and circuit piping to supply cooling water where it is needed throughout the Production Facility. This will require topping up from time to time due to losses from evaporation and blowdown. Detail regarding the options for sourcing of water is included under 'Water Connections', below.

- Auxiliary Boiler to raise steam; depending upon the selected syngas licensor, these will either be natural gas fired and only used during start-up of the Production Facility or using an H_2 rich fuel fitted with SCR and in continuous operation.
- A Steam Turbine Generator (STG) (Case A only) which utilises steam produced in the process under Case A to produce electricity to help power the Production Facility. The power generated by the STG will not satisfy the total demand of the Production Facility, therefore electrical power will also be imported from the grid continuously.
- A Process Water Pre-treatment Plant will be used to pre-treat water from the Northumbrian Water raw water supply prior to the demineralisation stage and may include Dissolved Air Flotation (DAF) in case of use of River Water or treated Effluent, Ultrafiltration (UF) (for removal of fine solids) and reverse osmosis (RO) for removal of ions or other suitable pre-treatment technologies. This plant may be operated by the Applicant or another party. Any solids will be sent off site.
- A Demineralisation Plant to be used to treat water supplied to the Production Facility, stripped process condensate, flare knockout liquid and steam condensate from power generation and blowdown. This process would produce demineralised water (DMW) which will be pumped to all locations where it is required within the Production Facility, including for boiler feed water; therefore, this water will be used to produce H_2 and make up losses from the steam system.
- A Bio-treatment Plant, which will treat process condensate to reduce nitrogen concentration using nitrification and denitrification. The treated process condensate will be reused as makeup water in the Raw Water Pre-Treatment Plant. Any solids will be sent off site.
- An Effluent Treatment Plant (ETP), which will consist of an oily water separator, neutralisation sump, storm water sump and any other suitable treatment to meet agreed discharge standards. All oily water effluents produced by the Production Facility will be sent to the oil water separator. Post-separation, the liquid effluent will be sent to a Minimum Liquid Discharge Plant (MLD) on the Main Site that may consist of Ultrafiltration (UF) and Closed-Circuit Reverse Osmosis Plant (CCRO), this plant will produce a stream of clean water that will be reused in the process and a brine stream that will be tankered from Site to a suitable third party disposal site. Alternative options are to treat this effluent to an appropriate level associated with the use of BAT and disposed of via the NZT outfall. Any oily solids will be sent for disposal offsite.
- Flare, any fluid released from Production Facility during an emergency will be collected in the flare header system and sent to the flare drum where any liquid associated with the gas is separated. The gas from the flare drum will be sent to the flare system where it will be safely disposed by combustion. The liquid collected in the drum will be pumped by the flare pump to the ETP.
- A Fire Water System consisting of a fire water tank (supplied by grey or raw water), pumps and firefighting system.

- Emergency Diesel Generator, emergency diesel generator which would be operated in the event of emergency to support safe shutdown of the plant and will be intermittently energized for periodic testing purpose.
- Chemical Storage for additives and fuel such as aqueous ammonia (NH_3), amines and diesel, which are imported by tanker.

4.3.11 In addition, there will be above ground pressurised H_2 storage shared between each phase, including high pressure compression and let down facilities.

4.3.12 The proposed approach for water supply and management is summarised under 'Water Connections', below.

4.3.13 In addition to the above, the following components and facilities will be incorporated into the layout of the Main Site as required:

- Main Site entrance (main access with gated entry) as well as a secondary access point(s) and emergency access;
- internal access roads;
- vehicle turning areas;
- internal and external storage areas;
- workshop and maintenance stores;
- a control room and administration buildings;
- lighting;
- car parking; and
- lorry holding and security inspection areas.

4.3.14 The Production Facility will be fenced securely with some internal operations having further internal fencing installed around them as required.

CO_2 Export Connection Corridor

4.3.15 CO_2 captured and compressed after analysing and metering will be exported from H2Teesside to the NEP CO_2 gathering network on the adjacent NZT site via a CO_2 export connection pipeline of up to 22" diameter at a Maximum Operating Pressure (MOP) of 28 barg. There will be an AGI at each end of the connection pipeline for metering, analysing and pigging. This export connection including the two AGIs is part of the Proposed Development and is being consented under this DCO.

4.3.16 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the land required for the CO_2 export options for the Main Site are shown on Figure 4-3: CO_2 Export Corridor (PEI Report, Volume II) to account for all options. It is expected that the extents of these will be refined further as the preparation of the EIA progresses. At this stage in the design development, the CO_2 export connection may be entirely above or below ground or a combination of the two. As a reasonable worst-case, open-cut construction methods have been assessed.

Natural Gas Supply Connection

4.3.17 Natural gas will need to be imported to the Production Facility for use in the reforming process. The exact routing of this connection is subject to ongoing design. However, at this stage, it is anticipated that a 24" pipeline will be constructed which will connect the Production Facility at the Main Site to an existing pipeline.

4.3.18 The natural gas connection may be entirely above or below ground or a combination of the two. At this stage it is assumed that below ground construction of the natural gas connection will use open-trench techniques dependent upon engineering and environmental constraints. As a reasonable worst-case, open-cut methods have been assessed unless otherwise stated.

4.3.19 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the potential areas required for the gas connection options have been depicted as a broad corridor (as shown by Figure 4-5: Natural Gas Connection Corridor (PEI Report, Volume II)) to account for all options. It is expected that the extent of this will be refined further, and the routing options reduced as the EIA progresses.

Hydrogen Pipeline Corridor

4.3.20 A gaseous phase hydrogen pipeline network is required to connect various potential industrial offtakers across the Tees Valley to the Production Facility at the Main Site, as shown on Figure 4-4: Hydrogen Pipeline Corridor (PEI Report, Volume II).

4.3.21 Once processed to the required specification and compressed at the Main Site, H_2 would be exported using the proposed hydrogen pipeline, at up to 24" diameter and with a MOP of up to 49 barg. The Hydrogen Pipeline Corridor would require a crossing under the River Tees to export to offtakers located to the northern side of the river. The hydrogen pipelines would run up to end-of-line AGIs including metering and pigging skids and tie-in points with the relevant offtaker (likely to be, but not necessarily having to be) within the offtakers' site boundaries. At this stage, any works beyond these AGIs and tie-in points are assumed to be progressed separately by the relevant offtaker.

4.3.22 Various route options and construction methodologies are being considered throughout the proposed hydrogen pipeline network with a reasonable worst case assessed where options are being considered. This includes trenchless crossings of watercourses or railway lines (using Horizontal Directional Drilling (HDD) for example), below ground open trench (buried), the installation of new or existing above ground support structures, and the repurposing and reuse of existing pipelines (where possible). This is subject to ongoing design work, discussions with landowners and statutory consultees, and is being informed by environmental sensitive receptors and constraints and surveys. Further details are included in Chapter 5: Construction Programme and Management.

4.3.23 At the north-western extent of the hydrogen pipeline network various route and construction options are being considered and assessed with a reasonable worst case assessed where options are being considered. Several options are also being considered for crossing under the River Tees, including the construction of a new

trenchless crossing (by HDD, using a micro-bored tunnel (MBT)) or repurposing an existing pipeline.

4.3.24 Since the preparation of the EIA Scoping Report, further refinement of the hydrogen pipeline route options and construction methodologies has been carried out, informed by engineering feasibility work, the outcome of environmental studies and consultation with statutory consultees such as Natural England and the Environment Agency (EA). Further detail on this is presented in Chapter 6: Need, Alternatives and Design Evolution (PEI Report, Volume I).

4.3.25 Table 4-1 provides a summary of the route options and construction methodologies being considered based on the studies carried out to date. However, the selection of a final route and construction methodology is the subject of on-going studies which will continue as the EIA progresses.

4.3.26 Ultimately, a single route option to each offtaker will be selected. Final routing and methodologies will take into consideration the location of sensitive environmental receptors including but not limited to statutory designated sites within the area. Where possible, the selected route will seek to avoid environmentally sensitive areas and utilise existing established pipeline routes, and/or the least intrusive construction methodologies (e.g., trenchless methods, as opposed to open-cut trench).

Table 4-1: Hydrogen Pipeline Routing Optionality and Construction Methodologies

CONSTRUCTION METHODOLOGY	REQUIREMENT IN RELATION TO CURRENT ROUTING OPTIONS	COMMENTARY
Open cut trench-buried	Currently being considered as a construction methodology for some sections of the network.	Whilst trenchless methods are proposed to avoid sensitive areas, open cut trenching (resulting in buried pipelines) is still proposed to be used within less sensitive areas (while considering where appropriate, the environmental impacts of this method and development of appropriate mitigation). Alternative construction methodologies are being considered where possible to reduce the amount of open cut required.
Trenchless (HDD/MBT)	Trenchless crossings (either HDD/MBT) are proposed for all of the River Tees crossing options, and for the	The hydrogen pipeline corridor in the Greatham Creek area interfaces with various environmentally sensitive receptors and constraints. No other scenario is being considered other than trenchless

CONSTRUCTION METHODOLOGY	REQUIREMENT IN RELATION TO CURRENT ROUTING OPTIONS	COMMENTARY
	crossing of Greatham Creek. Trenchless technologies are also currently being considered in other areas, where the pipeline corridor crosses particularly sensitive areas. Proposed Development will also include trenchless crossing of some roads, utilities infrastructure and public railways where there are no existing crossings.	methods for the crossing of Greatham Creek or the River Tees. The proposed trenchless technologies will be at a depth sufficient to minimise the risk of damage or harm to the watercourse.
Utilising existing pipeline corridors and other pipeline infrastructure	Currently being considered for various parts of the hydrogen pipeline corridor. Once the hydrogen pipeline crosses the River Tees the preferred and most likely option will be to follow the existing link line corridor through North Tees to Billingham.	For the majority of the Hydrogen Pipeline Corridor, it is proposed to route along existing established pipeline corridors (generally above ground) where possible. It is anticipated that new pipelines would be installed in parallel and working to one side of the existing pipelines. The design and installation methodology would need to be formally agreed with existing asset owners and routing carefully coordinated with other developers who plan to use these corridors, including the possibility of repurposing existing pipelines.

4.3.27 Where optionality is maintained, as a reasonable worst-case, it has been assumed that open-cut methods will be required for the crossings of minor watercourses and drains. In such cases, it is assumed that flow would be temporarily over-pumped, diverted around or flumed through the working area and the watercourse fully reinstated as before.

4.3.28 The extent of the Hydrogen Pipeline Corridor has been depicted as a broad corridor (as shown by Figure 4-4: Hydrogen Pipeline Corridor (PEI Report, Volume II)). In places where the Hydrogen Pipeline Corridor includes areas of existing operational

land or facilities (e.g., in the area around Wilton International) this does not imply that it is proposed to carry out works or lay pipelines in all these areas. At this stage the corridor covers a wider area until the specific routes, offtakers, and construction methodologies are refined as the design progresses. The extent of the Hydrogen Pipeline Corridor and the routing options have been refined slightly since submission of the EIA Scoping Report and will continue to be refined as the EIA progresses.

Electrical Connection Corridor

4.3.29 An electricity supply would also be required for both Cases (although for Case A, a proportion of its energy requirements may be generated onsite via the STG). Various options are being considered which include a connection to existing and proposed 66 kilovolt (kV) substations at Teesworks or connection to NZT's electrical network. 'There is also potential to connect at other substations, operated locally by Northern Power Grid, such as Lackenby and/or Grangetown 66kV substations. The final decision on substation/connection choice will be subject to design development and further work based on constructability and electrical network resilience and capacity. The electrical connection will be installed below ground.

4.3.30 The size and location of any connection will be determined in consultation with the relevant stakeholders. The final decision of connection will be subject of commercial agreement and technical feasibility, constructability, electrical network resilience and capacity. These discussions will be ongoing as the EIA progresses.

4.3.31 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the land required for the electrical connection option has been depicted as a broad corridor (as shown by Figure 4-6: Electrical Connection Corridor (PEI Report, Volume II)) to account for all options. It is expected that the extent of this will be refined further as the EIA progresses.

Water Connections

4.3.32 Plate 4-2 summarises the ‘base case’ for water management. The blue boxes relate to the treatment of source water, whilst the green boxes relate to wastewater treatment. The options being considered are described in further detail in the following text.

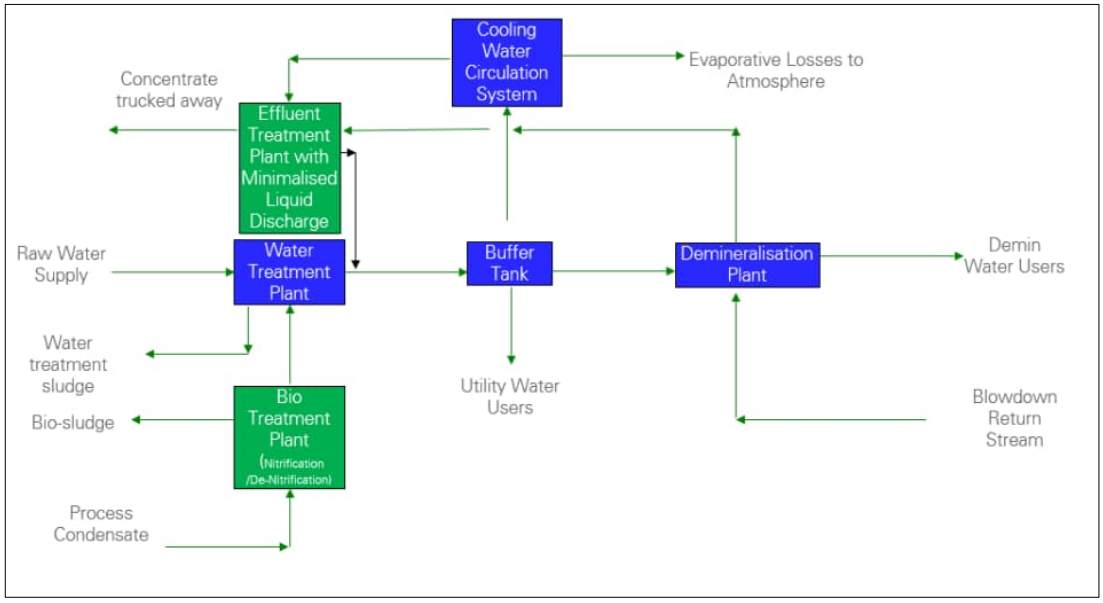

Plate 4-2: Water Management Options (Indicative)

Water Supply

4.3.33 Water supply and discharge connections are required for the process at the Production Facility, including for cooling water purposes and discharge of treated effluent.

4.3.34 It is expected that water (for process and sanitary uses) will be supplied via either:

- the existing NWL raw water supply to the Teesworks 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.

4.3.35 Alternatively, during the operation of the Proposed Development, use of reclaimed water (treated effluent) from a local Wastewater Treatment Works (WwTW) (Bran Sands) could be a potential viable option. Testing and evaluation is required for this alternative, therefore this is considered as a future opportunity and would require construction of a pipeline between the Main Site and Bran Sands WwTW but is not included in the DCO application.

4.3.36 As outlined earlier in this chapter, a Raw Water Pre-treatment Plant will be used to pre-treat the source water prior to the demineralisation stage and the Demineralisation Plant will be used to treat water supplied to the Production Facility, stripped process condensate, flare knockout liquid and steam condensate from power generation and blowdown.

4.3.37 The Proposed Development also allows for a pipeline for the supply of demineralised water via a new pipeline connection to the Wilton International site.

4.3.38 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the land required for the water connection options currently proposed for the Main Site has been depicted as a broad corridor, as shown by Figure 4-7: Water Connections Corridor (PEI Report, Volume II) to account for all options. It

is expected that the extents of these will be refined further as the EIA progresses. The water connections may be entirely above or below ground or a combination of the two; as a reasonable worst-case, open-cut methods have been assessed.

Wastewater Disposal

4.3.39 There are a number of wastewater streams that would be created within the Main Site that need to be handled appropriately, so that they can be treated and reused, namely:

- process wastewater (which is a process condensate stream from the reforming process);
- cooling tower blowdown (as part of the cooling water system);
- demineralisation plant rejects (as part of the demineralised water plant);
- other streams under non-ordinary operations, such as oily water (during maintenance), first flush stormwater/ firewater and clean second flush stormwater and firewater; and
- domestic/sanitary effluent.

4.3.40 The process wastewater would be treated in a Bio-treatment Plant while the other wastewater streams would be treated in an Effluent Treatment Plant. Both would be located on the Main Site. The treated wastewater from both the Bio-treatment Plant and Effluent Treatment Plant would be reused as makeup water in the Water Treatment Plant.

4.3.41 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 Effluent Treatment Plant will be reused as makeup water in the Raw Water Pre-Treatment Plant. A liquid waste stream containing salts and residual nutrients would be taken offsite for disposal. The second option is an alternative to MLD and requires discharge of process effluent to the NZT outfall in Tees Bay under NZT's Environmental Permit and subject to a nutrient neutrality assessment and identified mitigations, as required. Uncontaminated surface water runoff would be discharged to Tees Bay via the NZT outfall.

4.3.42 Discharge of domestic/sanitary effluent would be to the local sewage system for treatment with a tie-in to Bran Sands or export to Marske-by-the-Sea sewage treatment works by tanker. In terms of waste disposal from the water plant, sludge from the Raw Water Pre-Treatment Plant, Bio-treatment Plant may be processed at Bran Sands WwTW. With Brine from the Effluent Treatment Plant being discharged to a suitable site, which does not discharge to a designated site.

4.3.43 Clean stormwater could be discharged to Dabholm Gut under an existing pipeline and using NWL infrastructure at Bran Sands, or directly using a separately consented pipeline. Alternative options for clean stormwater that are being explored are to use land drain to discharge into the Tees, or via the NZT outfall that discharges into Tees Bay, or via the Teesworks drainage system.

4.3.44 It is recognised that any discharge of treated effluent to the receiving water must comply with the Water Framework Directive (WFD) and Natural England's policy on Nutrient Neutrality.

4.3.45 The Water (including wastewater) Connections Corridor includes a pipeline between the Main Site and Bran Sands WwTW, as well as a potential connection to NZT and a demineralised water plant at Wilton.

4.3.46 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the land required for the water connection options currently proposed for the Main Site has been depicted as a broad corridor, as shown by Figure 4-7: Water Connections Corridor (PEI Report, Volume II) to account for all options. It is expected that the extents of these will be refined further as the EIA progresses. The wastewater connections may be entirely above or below ground or a combination of the two; as a reasonable worst-case, open cut methods have been assessed.

4.4 Other Gases Connections

4.4.1 Other gas connection pipelines may be required for the transportation of compressed O_2 and N_2 for use at the Production Facility, should a third-party ASU be used to supply the required gases.

4.4.2 At this stage in the design and assessment process and in applying the Rochdale Envelope approach, the land required for the other gases connection options currently proposed for the Main Site have been depicted as a broad corridor, as shown by Figure 4-8: Other Gases Connection Corridor (O_2 and N_2) (PEI Report, Volume II)). It is expected that the extents of this these will be refined further as the EIA progresses. The connections for other gases may be entirely above or below ground or a combination of the two; as a reasonable worst-case, open-cut methods have been assessed.

4.5 Hydrogen Storage

4.5.1 On-Site above ground storage of H_2, located at the Main Site, will be utilised to provide resilience to the hydrogen production network. The hydrogen storage will have a capacity of approximately 5 tonnes usable volume (up to 11 tonnes total inventory for 100 bar storage pressure), which is common (shared) for Phases 1 and 2 of the Proposed Development. As this exceeds the relevant threshold, permission will be sought from the Hazardous Substances Authority, Health and Safety Executive (HSE) and Local Planning Authority (LPA) for storage, under the Control of Major Accident Hazards (COMAH) and Hazardous Substance Consent regimes respectively.

4.5.2 Off-site storage of H_2 is not required for the Proposed Development. Should there be the requirement for off-site storage, it is expected that this would be owned and operated by a third-party provider who would be responsible for any consenting requirements.

4.6 Material Storage

4.6.1 Chemicals required for the operation of the Production Facility would need to be stored and used at the Main Site. Some of these materials may be classed as hazardous. Where any substance could pose a risk to the environment through its uncontrolled release (e.g., through the surface water drainage system), appropriate containment facilities would be used including (but not limited to) bunds and concrete surfaces appropriately designed and sized for their intended use. Chemical storage will comply with requirements under the site's Environmental Permit.

4.6.2 An inventory of materials to be stored on the Main Site would be finalised through the detailed design. However, where storage of hazardous materials, individually or in-combination exceeds the relevant thresholds, separate permissions will be sought from the Hazardous Substances Authority, HSE and LPA for their storage, under the COMAH and Hazardous Substance Consent regimes respectively. All chemical storage will be regulated by the EA through an environmental permit that will be required for the operation of the Proposed Development.

4.6.3 Further information regarding hazardous substances likely to be present during the operational phase of the Proposed Development, including their transport and storage, is included at Chapter 20: Major Accidents and Disasters (PEI Report, Volume I).

4.7 Operational Access Requirements

15.1.1 The Main Site would be accessed from Steel House Gate roundabout on the A1085 Trunk Road, a dual carriageway road running north-east to south-west between Redcar and the A1053 Tees Dock Road. The road is subject to the national speed limit. Travelling south-west from the Main Site access, the A1085 Trunk Road provides a link to the A1053 Tees Dock Road, which in turn connects to the A174 to the south and the A66 to the north. The A1053 Tees Dock Road and A174 are part of National Highways core network.

15.1.2 Access routes to the Hydrogen Pipeline Corridor network north of the River Tees are assumed via the A1046 Haverton Hill Rd/Port Clarence Road and the B1275. Access routes to Connection Corridors south of the River Tees are assumed via the A1085 Trunk Road and Steel House Gate roundabout.

4.8 Design Parameters

4.8.1 The design of the Proposed Development is iterative and may change as the EIA process progresses. The evolution of the Proposed Development at this stage is presented in Chapter 6: Alternatives and Design Evolution (PEI Report, Volume I). This will be refined during the EIA and reported in the ES.

4.8.2 A number of the design aspects and features of the Proposed Development cannot be confirmed until the EPC construction contractor has been appointed. For example, the building sizes may vary depending on the contractor selected and their specific configuration and selection of plant. Focussed use of the Rochdale Envelope approach has been adopted to define appropriate parameters for use in the EIA.

4.8.3 Maximum parameters have been devised to enable the EIA to progress in the absence of the final design information and to enable the compilation of a robust assessment based on a reasonable and appropriate worst-case option.

4.8.4 The flare will be the tallest element of the Proposed Development; a maximum height of 100 m for the flare (i.e., ≤108 m AOD[2]) has been considered. All other structures on the Main Site will be 60 m high or less. All development associated with the Production Facility will fall within the confines of the Main Site, as illustrated on Figure 4-2: Parts of the Proposed Development Site (PEI Report, Volume II).

4.8.5 Existing ground levels at the Main Site are approximately 6-8 m AOD. Development platform elevations post site clearance and remediation will not be lower than 7.1 mAOD, and final finished floor levels are the subject of on-going studies. For the purposes of this PEI Report, assumptions have been made where required. Further information on the limits of deviation will be provided in the ES.

4.9 Proposed Development Operation

Operational Modes

4.9.1 Two potential technology options have been identified for consideration, as part of the Proposed Development. These are referred to as Case A (which involves ATR based reforming) and Case B (which utilises an alternative proprietary low carbon hydrogen technology). Only one of these technologies will be selected. A summary of the key differences between Case A and Case B is provided in Table 4-2.

Table 4-2: Key Differences Between Case A and Case B

	CASE A	CASE B
Technology	Autothermal Reforming (ATR)	Proprietary Gas Heated Reformer (GHR) – ATR combination process
Process heat integration	Process heat is used to generate power (via steam turbine)	Process heat is used to drive reforming reaction in a GHR
Hydrogen purity	> 98 mol%	> 99 mol%
Process condensate	Stripped with steam to the reduce the methanol/ NH_3 content prior to water treatment	No stripper column and thus has a higher methanol/ NH_3 compositional potential in the process condensate. An additional biological treatment step is required as part of the water treatment configuration.

[2] Worst case heights above ordnance datum for the Main Site elements used in the LVIA assume a maximum development platform level of 8 m AOD following site clearance and associated earthworks. The worst-case assessed for Air Quality for emissions points is lower and outlined within Chapter 8: Air Quality (PEI Report, Volume I).

	CASE A	CASE B
Liquid effluent flow	Higher	Lower
Cooling water flow	Higher	Lower
Gaseous effluent flow	Lower	Higher
Natural gas consumption	Higher	Lower
Power import	Lower	Higher
Overall energy efficiency	Lower	Higher

Hours of Operation

4.9.2 Once commissioned and operational (including for Phase 1 only), the Production Facility will be designed to operate twenty-four hours a day, seven days per week until decommissioning, with brief exceptions for planned outages such as for maintenance and repair.

Staff

4.9.3 Peak workforce numbers during operation will be a maximum of approximately 120 staff (if both Phase 1 and Phase 2 of the Proposed Development are progressed). Operations staffing will be on a shift basis to be spread over a 24-hour period. Normally staff levels would be 40-50 peak during the week, however, during 28-day maintenance periods which are likely to occur approximately every four years, there would be up to 400 people on-site.

Maintenance

4.9.4 The objective of plant maintenance is to ensure the Production Facility and the connections 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. These maintenance activities will require additional contractors to work on-site. The contractors would access the Proposed Development Site via the main entrance.

4.9.5 Inspection and maintenance activities are key criteria for determining the footprint and layout of the 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 Production Facility, each major element would have appropriate access and laydown areas, whilst the internal road layout for the Main Site would enable free movement for cranes and heavy lifting equipment.

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

4.9.7 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.

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

Hazard Prevention and Emergency Planning

4.9.9 To protect human health, site activities will be safely and responsibly managed on-site. A Health and Safety Plan covering the works, commissioning and operation of the Proposed Development will be prepared by the operator. For design and construction, a competent and adequately resourced Principal Designer (under the Construction (Design and Management) Regulations) and Principal Contractor will be appointed. The Applicant will ensure that its own staff, designers and contractors follow the Approved Code of Practice (ACoP) laid down by the CDM Regulations 2015.

4.9.10 Written procedures clearly describing responsibilities, actions and communication channels will be available for operational personnel dealing with emergencies. Procedures will be externally audited, and contingency plans written in preparation for any unexpected complications.

4.9.11 Depending on the volumes of hazardous materials stored within the Proposed Development Site, a Hazardous Substances Consent and, if necessary, a COMAH Licence will be obtained. This will introduce additional hazard prevention and emergency planning procedures. At this stage, it is anticipated that the Production Facility will qualify as a Top Tier COMAH establishment.

External Lighting

4.9.12 Some external lighting (and signage) would be required to ensure the Production Facility can operate safely at all times. It would be at the appropriate luminance required to provide safe working conditions. Lighting would be designed, positioned and directed to prevent or minimise light disturbance to sensitive receptors (human and ecological) and low-energy fittings would be used where possible.

4.9.13 An Indicative Lighting Strategy will be prepared and submitted as part of the DCO Application and used as the basis of assessment in the ES. The strategy will require the final lighting scheme to be designed in accordance with relevant standards, such as the Guidance Notes for the Reduction of Obtrusive Light (2021) published by the Institute of Lighting Engineers and/or Chartered Institution of Building Services Engineers (CIBSE) requirements, as appropriate. This will ensure that safe working

conditions are provided, whilst reducing light pollution and the visual impact on the local environment.

Environmental Management During Operation

4.9.14 The Production Facility will require an Environmental Permit and activities will comply with this under the Environmental Permitting (England and Wales) Regulations 2016 so that any impacts of emissions to air, soil, surface and groundwater, to the environment and human health are minimised and avoided where possible. In addition, when granted, the DCO will include Requirements to control *inter alia* landscaping and biodiversity protection management and enhancement; public rights of way and access land; surface and foul water drainage; flood risk mitigation; contaminated land and groundwater; archaeology; protected species; noise and vibration.

4.9.15 The Proposed Development will be operated in line with appropriate standards, whilst the operator will implement and maintain an Environment Management System (EMS) which will be certified to International Standards Organisation (ISO) 14001. The EMS will outline requirements and procedures required to ensure that the Proposed Development Site is operating to the appropriate standard.

4.9.16 Any requirements for sampling and analysis of pollutants will be undertaken where required in accordance with the Environmental Permit.

Heavy Goods Vehicle Movements and Traffic

15.1.3 During the operational phase of the Proposed Development, it is anticipated that there would be a maximum workforce of approximately 120 staff that will be required on a shift basis to be spread over a 24-hour period (if both Phase 1 and Phase 2 of the Proposed Development are progressed). Staff will travel to and from work in a variety of directions. The ES will make reasonable assumptions about the regional distribution of journeys to and from the Proposed Development Site. Operational (including maintenance) traffic movements (including HGVs) are expected to be very low – significantly lower than those experienced during the construction period.

4.9.17 Natural gas would be delivered by pipeline. Other operational and maintenance consumables will be managed to be kept as low as is reasonably practicable thereby minimising traffic movements.

4.9.18 For further detail regarding expected traffic movements during construction and operation please refer to Chapter 15: Traffic and Transport (PEI Report, Volume I).

4.10 Proposed Development Decommissioning

4.10.1 The Phase 1 and Phase 2 production facilities will each 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 decommissioned, 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. The Applicant will assess at that time whether any infrastructure should be retained for future use.

4.10.2 For the purposes of this assessment, the same design life is assumed apply for the hydrogen pipeline and utility connections.

4.10.3 A Decommissioning Plan (including Decommissioning Environmental Management Plan) would be produced pursuant to a DCO Requirement. The Decommissioning Environmental Management Plan 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 DEMP would be secured by a Requirement on the draft DCO, if granted. The Decommissioning Plan will include an outline programme of works.

4.10.4 During decommissioning and demolition there will be a requirement for the provision of office accommodation and welfare facilities.

4.10.5 Any demolition contractor would have a legal obligation to consider decommissioning and demolition under the CDM Regulations 2015, or the equivalent prevailing legislation at that time.

4.10.6 Decommissioning activities will be conducted in accordance with the appropriate guidance and legislation at the time of the Proposed Development's closure. All decommissioning and demolition activities will be undertaken in accordance with the waste hierarchy. Materials and waste produced during decommissioning and demolition would be stored in segregated areas to maximise reuse and recycling. All materials that cannot be reused or recycled would be removed from the Proposed Development Site and transferred to suitably permitted waste recovery/disposal facilities. It is anticipated that a large proportion of the materials resulting from demolition will be recycled and a record kept demonstrating that the maximum level of recycling and reuse has been achieved.

4.10.7 Upon completion of the decommissioning programme the relevant regulatory authority at the time (e.g., the EA) will be invited to witness a post-decommissioning inspection by site staff. All records from the decommissioning process will be made available for inspection by the EA and other relevant statutory bodies, in accordance with the Environmental Permit requirements.

4.11 Elements of the Proposed Development Consented under a Deemed Marine Licence

4.11.1 In England, the Marine and Coastal Access Act 2009 (MCAA) provides that a Marine Licence (ML) is required for certain 'licensable activities' within the UK Marine Area (Section 42, MCAA). For the purposes of the EIA, the marine environment is defined as any area seaward of the mean high-water springs (MHWS) mark of any tidally influenced water body. This includes intertidal zones, which are periodically exposed by the tide and subtidal zones which are always submerged.

4.11.2 It is acknowledged that for the purposes of marine consenting, the UK Marine Area (Section 42, Marine and Coastal Access Act 2009) also includes areas that are

temporarily or permanently separated from the natural course of the tide (i.e., by a lock gate or other similar means).

4.11.3 MLs can be issued via a 'standalone' Marine Licence Application (MLA) or a licence 'deemed' within the body of the DCO (i.e. a Deemed Marine Licence (DML)). The Marine Management Organisation (MMO) is the body responsible for issuing, revoking, and enforcing a ML, other than where a licence is in the form of a DML, in which case, it will be granted by the powers of the SoS.

4.11.4 Some aspects of the Proposed Development could require a ML, namely the construction and operation of the crossing of the River Tees for the proposed hydrogen pipeline, and the potential for crossings of Greatham Creek below MHWS, north of the Tees and to the west of the Main Site. The design work for all crossings is ongoing. However, currently it is proposed that the crossing under the Tees would be constructed using either HDD or MBT techniques, thereby minimising disturbance during construction. For crossing Greatham Creek the use of HDD techniques is being considered. For other minor crossings various construction methodologies are being considered.

4.11.5 Preliminary advice using the MMO's online interactive assistance tool identifies that an MLA will not be required for trenchless crossings of the River Tees and Greatham Creek on the basis that it involves the construction of bored tunnels wholly under the seabed and will not significantly adverse any part of the environment of the UK marine area or the living resources it supports. This preliminary assessment will need to be confirmed including through consultation with the MMO.

4.11.6 If an MLA is required, the Application will include a request to secure the ML for activities below MHWS via a DML. The scope of the DML will be discussed and agreed in consultation with the MMO during the DCO Application process but these activities have been considered in this PEI Report and will be assessed in the ES.

4.11.7 The Application will therefore include a request to secure the ML for activities below MHWS via a DML. The scope of the DML will be discussed and agreed in consultation with the MMO during the DCO Application process.

4.12 Consultation

4.12.1 An EIA Scoping Opinion was requested from the Planning Inspectorate ('the Inspectorate') in April 2023, with a response received on 17th May 2023. A high-level summary of responses to the Scoping Opinion comments relevant to the description of the Proposed Development is provided in Table 4-3.

Table 4-3: Responses to Scoping Comments

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
The Inspectorate	Scoping Opinion 17th May 2023	<u>CO_2 export via Northern Endurance Partnership (NEP) infrastructure.</u> The Scoping Report states that CO_2 from the Proposed Development would be exported to an offshore facility via NEP infrastructure on the adjacent Net Zero Teesside (NZT) site. NZT development consent order (DCO) application was due to be determined by the Secretary of State on 10 May 2023 but the Inspectorate notes that a new deadline of no later than 14 September 2023 was set on 9 May 2023. The ES should clearly describe the relationship between the Proposed Development and any connected projects including the offshore CO_2 facility. This should include the extent to which the Proposed Development is dependent on their delivery and the development timelines of the other projects, with an explanation of how these will be coordinated.	A high-level summary of this information is included in this chapter. Further detail will be included within the ES.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Natural resources</u> The Scoping Report states that natural gas, oxygen (O_2), nitrogen (N_2) and water will be required for the operational phase of the Proposed Development. Paragraph 2.1.2 states that O_2 and N_2 will be from local sources; an	This PEI Report chapter includes a description of how these resources will be transported to the site and included in the assessment of likely significant effects in Chapters 8-23 (PEI Report, Volume I) Further information regarding this, along with estimates of the

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		alternative option for O_2 and N_2 supply from an air separation unit (ASU) is also identified (paragraph 3.1.1). The ES should include an estimate of the likely volume of the different natural resources, including those identified above, that will be required in the operation of the Proposed Development, how these will be transported to the site, and an assessment of any likely significant effects arising from the use of such resources.	likely quantities of natural resources required, will be included in the ES.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Carbon Capture</u> The Scoping Report states that CO_2 would be captured at a rate in excess of 95%, which is anticipated to be secured through an environmental permit. Should the draft DCO (dDCO) allow for the generating station component to operate independently of the carbon capture, a worst case assessment of likely significant effects should be undertaken. If assessments in the ES rely on a capture rate of 95% it should be clear how this would be secured in the dDCO.	We appreciate that the Production Facility on its own without carbon capture would be a reasonable worst case, however, due consideration is not given to this scenario during normal operations (i.e., excluding commissioning and start up) as this does not align with bp's strategy of transforming to an integrated energy company. Teesside is at the forefront of efforts to achieve the government's ambitious target for the UK to be the world's first major economy to be net zero, by 2050, therefore the Proposed Development without carbon capture is not a viable option being considered and this will be secured by a requirement in the DCO.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Flexibility</u> The Inspectorate notes the Applicant's desire to incorporate flexibility into their dDCO and its intention to apply a 'Rochdale Envelope' approach for this purpose.	These comments are noted and Planning Inspectorate Advice Note 9: Rochdale Envelope has been considered. As outlined in Chapter 2: Assessment Methodology (PEI Report, Volume I) and other relevant PEI Report

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		This includes options for the various required connection corridors required as part of the project, eg CO_2 export, hydrogen, natural gas, electrical and water connection. Paragraph 3.1.7 states that it is expected that optionality would be reduced, and preferred options confirmed prior to submission of an application. Paragraph 3.1.8 describes that some aspects and features will not be confirmed until an engineering, procurement and construction contractor has been appointed, ie post grant of any DCO. In this instance, it is stated that the Rochdale Envelope will be adopted to define appropriate parameters for use in the EIA. The Applicant should make every attempt to narrow the range of options and explain clearly in the ES which elements of the Proposed Development have yet to be finalised and provide the reasons. At the time of application, any Proposed Development parameters should not be so wide-ranging as to represent effectively different developments. The parameters should use the maximum envelope within which the built development may be undertaken to ensure a worst case assessment. The ES should identify the parameters that have been assumed as the worst case scenario for each aspect scoped in to the assessment and ensure that interactions between aspects are taken into account relevant to those scenarios.	chapters, the 'Rochdale Envelope' approach has been adopted. However, optionality has already been reduced, and will continue to be reduced further as the design and the EIA progresses. The ES will clearly define any optionality in the design at that stage and the reasoning for it. The worst-case design parameters will be narrowed as far as reasonably possible, clearly outlined, and assessed. Interactions between different topics will be assessed. The Inspectorate's comments relating to alternatives are noted and considered elsewhere within this table.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		The development parameters should be clearly defined in the dDCO and in the accompanying ES. The Applicant, in preparing an ES, should consider whether it is possible to robustly assess a range of impacts resulting from a large number of undecided parameters. The description of the Proposed Development in the ES must not be so wide that it is insufficiently certain to comply with the requirements of Regulation 14 of the EIA Regulations. The Inspectorate draws the Applicant's attention to Advice Note 9: Rochdale Envelope, which states that "it will be for the authority responsible for issuing the development consent to decide whether it is satisfied, given the nature of the project in question, that it has 'full knowledge' of its likely significant effects on the environment." Please also note the Inspectorate's comments regarding alternatives at ID 2.1.17 of this Scoping Opinion. It should be noted that if the Proposed Development materially changes prior to submission of the DCO application, the Applicant may wish to consider requesting a new scoping opinion.	
The Inspectorate	Scoping Opinion 17th May 2023	<u>Phasing</u> The Scoping Report states that the Proposed Development would be phased, with a total design capacity of 1.2 gigawatt (GW) thermal for hydrogen production facility	As outlined in Chapter 2: Assessment Methodology (PEI Report, Volume I), the ES will include an assessment of any likely significant effects arising from the phased nature of the Proposed Development, including risks of

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		across two phases of up to 600 megawatt (MW) thermal in each phase. Table 3-2 of the Scoping Report provides an indicative construction timeline, with Phase 1 commencing mid-2025 and lasting approximately 2 years and Phase 2 commencing late 2027/ early 2028 and lasting 2-3 years. The ES should include an assessment of any likely significant effects arising from the phased nature of the Proposed Development, including risks of major accidents from the proximity of construction activity to the operational hydrogen production plant. Measures required to mitigate any significant effects should be clearly described in drafts of the construction environmental management plan (CEMP) and/ or operational environmental management plan (OEMP) submitted with the application.	major accidents from the proximity of construction activity to the operational hydrogen production plant. If required, appropriate mitigation measures will be clearly outlined in the Framework CEMP.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Hydrogen production facility-built parameters</u> Section 3.2 of the Scoping Report describes the above ground infrastructure that is likely to be required as part of the hydrogen production facility but does not specify any built parameters. The ES should confirm the final parameters (minimum and maximum height, width, length and depth) and location of each component of above ground infrastructure and assess any likely significant effects resulting from their construction, operation/ maintenance, or decommissioning.	Information regarding maximum heights is provided in this PEI Report chapter. More detailed information, including minimum and maximum heights, widths, lengths and depths will be included within the ES.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
The Inspectorate	Scoping Opinion 17th May 2023	<u>Construction working width and pipeline trenches</u> The ES should define the applicable parameters for the construction working width and the pipeline trenches, including depth, or apply a worse case. It should be clear how these parameters are secured through the dDCO. Where significant effects are identified the ES should set out the mitigation proposed to avoid, reduce or offset such effects including where appropriate the specification of construction methods and / or limitations placed on construction activities, and how this would be secured. The Applicant's attention Is drawn to the Environment Agency's (EA) comments in Appendix 2 regarding pipeline design [reproduced below for reference]. "Pipeline Design • Where the pipeline crosses a flood defence structure below ground, designs for the pipeline must include a load case for the top water level. This may be different at each location. The pipeline must also be at a suitable depth to ensure the stability of the flood defence structure, this is to be demonstrated in submitted designs; • The scoping report states the pipeline will not cross our flood defence structure above ground. If this is to change, loading to our asset will need to be considered and the design must not impede access for routine	These parameters will be outlined within the ES and the worst case will be assessed. Appropriate mitigation measures will be outlined. It is anticipated that the design parameters will be secured by Requirement in the draft DCO. The EA's comments regarding pipeline design have been noted and will be considered throughout the design process.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		maintenance and inspections of the flood defence structure; • If the pipeline crosses a watercourse above ground, it must be appropriately designed and positioned to prevent accumulation of debris and localised increases in water levels; • Where the pipeline is to utilise existing pipework that crosses watercourses, it is expected that modifications to the structure will be made where possible for improved conveyance and reduce debris accumulation; and • 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."	
The Inspectorate	Scoping Opinion 17th May 2023	<u>Special crossings</u> The Scoping Report outlines that a range of crossing methodologies are under consideration for the natural gas supply and hydrogen pipeline corridors. This could include open cut and/ or trenchless methodologies depending on engineering and environmental constraints. The ES should confirm the minimum and maximum depths of the crossings. The ES should clarify whether it is intended to adopt a similar approach in respect of any below ground	The ES will clearly outline the proposed construction methodologies for each pipeline (including the utility connections), including the proposed minimum and maximum depths of crossings. Open cut trenching will not be used to cross flood defences. Trenchless technologies will be used instead. When selecting the preferred construction methodologies, the potential environmental effects are

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		routeing for the electrical, water and other gases connections. Table 3-1 of the Scoping Report confirms that only trenchless techniques are being considered for crossings of the River Tees and horizontal directional drilling (HDD) or use of existing pipeline for Greatham Creek. The Inspectorate welcomes the use of trenchless techniques in environmentally sensitive areas but notes that trenchless techniques have different land requirements; the full range of environmental effects should be considered when determining a preferred construction method. The ES should confirm the crossing methodologies assumed for each connection corridor. If flexibility is sought regarding the use of open cut or trenchless techniques, the ES should assess the available options or identify and assess a worst case scenario as relevant to each aspect and identify relevant mitigation, and how this would be secured. The Applicant's attention is drawn to the EA's comments in Appendix 2 regarding construction methodologies, including those affecting existing flood defences [reproduced below for reference]. "Pipeline Construction • Open trench methodology is not permitted when crossing a flood defence. Excavations near the footprint	being considered, along with other factors such as engineering feasibility, land acquisition and cost. If optionality in construction methodology is maintained at ES stage, an appropriate worst-case will be assessed. Appropriate mitigation measures will be identified and clearly stated where required. The EA's comments regarding pipeline construction have been noted and will be considered throughout the design process.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		of a flood defence must remain a safe distance away from the toe of the defence to ensure stability of the defence. This must be demonstrated in submitted designs; and • Directional drilling would be permitted when crossing a flood defence provided: – The drilling operation does not affect the stability of the flood defence structure by inducing a geotechnical failure, including when it is retaining flood water; and – The drilling or permanent works do not provide a conduit for water seepage underneath the flood defence structure, including when it is retaining flood water."	
The Inspectorate	Scoping Opinion 17th May 2023	<u>Electrical connection corridor</u> The Scoping Report states that in addition to on-site electricity generated from the Steam Turbine Generator, an alternative supply will be required with options under consideration. Paragraph 3.6.4 of the Scoping Report states that the electrical connection could be above or below ground or a combination. The ES should confirm the final parameters for the selected electrical connection. If above ground, this should include the maximum number, height and locations of any pylons,	This information will be included within the ES. Current information on this topic is set out in Chapter 5: Construction Programme and Management (PEI Report, Volume I).

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
		and length of overhead line. The assessment of likely significant effects should take account of this infrastructure alongside the plan and other associated infrastructure.	
The Inspectorate	Scoping Opinion 17th May 2023	<u>Construction access</u> The ES should identify the locations of access routes to site for construction and maintenance of the connection corridors. Any likely significant effects resulting from their construction, operation and decommissioning should be assessed.	This information will be included within the ES. A plan will accompany the ES, showing the locations of construction access points. Current information on this topic is set out in Chapter 5: Construction Programme and Management (PEI Report, Volume I).
The Inspectorate	Scoping Opinion 17th May 2023	<u>Construction deliveries</u> The Scoping Report indicates that options are being explored for construction materials to be delivered by boat and/ or rail. The ES should include an assessment of the worst case allowed for in the dDCO.	In addition to road access, the Applicant is investigating opportunities to make use of existing river and rail infrastructure; in particular, the use of the existing RBT quayside is considered in the PEI Report. Further information regarding this will be included within the ES.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Temporary working areas and construction compounds</u> The ES should identify the location and size of the temporary working areas for the connection corridors, as well as the temporary construction compounds. Any likely significant effects resulting from their use should be assessed.	Preliminary information regarding temporary working areas, laydown areas and construction compounds is included within Chapter 5: Construction Programme and Management (PEI Report, Volume I). Further detail will be included within the ES. A plan will accompany the ES, showing the locations of construction access points and laydown areas.

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/ HOW COMMENTS HAVE BEEN ADDRESSED
The Inspectorate	Scoping Opinion 17th May 2023	<u>Site clearance and remediation</u> Site A would be carried out by Teesworks under a separate consent. It is therefore not proposed to assess this within the ES. The ES should make clear the scope and status of the consent for site remediation, as well as the timescales for the works, and a clear description of how and at what point the baseline has been defined for the purpose of assessment. For Main Site B these powers would be sought within the DCO application, and an assessment is proposed within the ES, should this site be selected. The ES should include an assessment of any likely significant effects arising from site clearance and remediation works, for which powers are sought within the dDCO and confirm how this is to be secured. The ES should include information about works required to facilitate development that is proposed outside of the DCO application, including their scope and extent, status of any relevant consents required, timescales and degree of certainty.	The proposed approach for the remediation of the Main Site (the Foundry) is outlined at Section 4.8 of this PEI Report chapter. Further information will be outlined clearly in the ES. Main Site B (RBT) is no longer under consideration and as such is not discussed further.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Waste</u> In order to inform a robust assessment of likely significant effects, the ES should provide information on the storage, management and disposal of waste, including tunnel arisings. Any assumptions in this regard, for example traffic	This information will be included in the ES. Current information on this topic is set out in Chapter 5: Construction Programme and Management, Chapter 10: Geology, Hydrogeology and Contaminated Land; Chapter

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		movements, waste handling and contaminated land, should be clearly stated in the ES.	15: Traffic and Transport and Chapter 21: Materials and Waste, (PEI Report, Volume I)
The Inspectorate	Scoping Opinion 17th May 2023	<u>Lighting</u> In addition to operational lighting, the ES should clearly describe the location and design of lighting required along the construction working widths and at construction compounds. Any likely significant effects should be assessed.	This information will be included in the ES. Current information on this topic is set out in Chapter 5: Construction Programme and Management (PEI Report, Volume I).
The Inspectorate	Scoping Opinion 17th May 2023	<u>Decommissioning</u> The ES assessment of impacts resulting from decommissioning should be proportionate but include a description of the process and methods of decommissioning, land use requirements and estimated timescales. A description of any assumptions made in the assessment, eg about the approach to retention or removal of pipelines, should be provided. Any decommissioning associated with dismantling and replacing elements of the Proposed Development once they reach the end of their design life should be assessed if significant effects are likely to occur. The Inspectorate notes paragraph 4.2.3 of the overarching NPS for Energy (NPS EN-1), which states that the ES should cover the environmental effects arising from decommissioning of the project.	This information will be included in the ES. Current information on this topic is set out in Chapter 5: Construction Programme and Management (PEI Report, Volume I).

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The Inspectorate	Scoping Opinion 17th May 2023	<u>Alternatives</u> The Scoping Report identifies that several alternative options are under consideration, including two sites (Main Site A and Main Site B) for the hydrogen production plant. Paragraph 4.3.7 of the Scoping Report states that if alternatives still exist at the time of application, the ES will consider and assess the worst-case impacts. The Inspectorate's comments at ID 2.1.4 about flexibility apply equally to alternatives. For the avoidance of doubt, the ES should consider the worst-case impacts and identify mitigation as required for any options that are sought within the dDCO.	Design options that are still under consideration at the time of preparation of the ES will be clearly outlined the worst-case will be assessed – see Chapter 6: Need, Alternatives and Design Evolution in this PEI Report. Main Site B (RBT) is no longer under consideration.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Easements</u> The description of the physical characteristics of the Proposed Development in the ES should include the details of required easements, to ensure that the extent of the likely impacts from the Proposed Development (for example, sterilisation of mineral resource) is fully understood.	This information will be included in the DCO application.
The Inspectorate	Scoping Opinion 17th May 2023	<u>Hydrogen pipeline safety criteria</u> The ES should explain what design guidelines and safety criteria are being followed for the hydrogen pipeline, and how any health and safety risks would be managed during operation/ maintenance. The Inspectorate notes that hydrogen is an emerging technology and that the	This information will be included in the ES.

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		regulatory framework and standards are likely to continue to evolve. Please also refer to the Inspectorate's comments at ID 3.13.3 of this Scoping Opinion.	

4.13 References

- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast) (Text with EEA relevance) (2010). *Official Journal* L334. P17.
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- *Marine and Coastal Access Act 2009* (c. 23). London: The Stationery Office.
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- The Planning Inspectorate (2018). *Advice Note 9: Rochdale Envelope* [online]. Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-nine-rochdale-envelope./
- Environment Agency (2023*). Emerging techniques for hydrogen production with carbon capture* [online]. Available at: https://www.gov.uk/government/publications/emerging-techniques-for-hydrogen-production-with-carbon-capture.