Energy Recovery Facility - Water Framework Directive Assessment

Final Report

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Revision history

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This report describes work commissioned by Kieran Bostock, on behalf of Hartlepool Borough Council. Lucy Sumner of JBA Consulting carried out this work.

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Purpose

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Abbreviations

APC	Air Pollution Control
BOD	Biological Oxygen Demand
DrWPA	Drinking Water Protected Area
EA	Environment Agency
EfW	Energy from Waste
ERF	Energy Recovery Facility
FGT	Flue Gas Treatment
GWDTE	Groundwater Dependent Terrestrial Ecosystem
NVZ	Nitrate Vulnerable Zone
RBMP	River Basin Management Plan
SgZ	Safeguard Zone
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STDC	South Tees Development Corporation
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive

1 Introduction

1.1 WFD Overview

The Water Framework Directive (WFD) came into force in 2000 and is the most substantial piece of EU water legislation to date. All new activities in the water environment will need to take the Directive into account. The Directive imposes legal requirements to protect and improve the water environment.

1.1.1 Scope and Brief of the WFD Assessment

The EU Water Framework Directive was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These Environmental Objectives are listed below:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters.
- Aim to achieve at least good status/potential for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status/potential by 2021 or 2027.
- Meet the requirements of Water Framework Directive Protected Areas.
- Promote sustainable use of water as a natural resource.
- Conserve habitats and species that depend directly on water.
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment.
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.
- Dorian Latham BA PhD CEnv MIEEM Contribute to mitigating the effects of floods and droughts.

1.1.2 Preventing Deterioration in Status

Any activity which has the potential to have an impact on the ecology of a water body will need consideration in terms of whether it could cause deterioration in its Ecological Status or Potential.

For each water body, three different status objectives are identified within the River Basin Management Plan (RBMP). These are the overall status objective, the ecological status or potential objective and the chemical status objective. A default objective for all water bodies is to prevent the deterioration in the Ecological Status (or Ecological Potential for Heavily Modified and Artificial Water Bodies) of the water body.

The Ecological Status of a water body is determined through analysis of its constituent Biological Quality Elements. These elements are in turn supported by a series of Physico-Chemical and Hydromorphological Quality Elements. These Quality Elements are taken from Annex V of the Directive and are listed below. The overall Ecological Status is determined by the lowest element status. The Biological Quality Elements assessed in the WFD include:

- Fish
- Invertebrates

- Macrophytes
- Phytobenthos

The WFD defines the flow, shape and physical characteristics of a watercourse as its 'hydromorphology'. Any in-channel works can impact upon the shape of a watercourse and the natural processes that occur within it, including:

- Flow patterns
- Width and depth of a channel
- Features such as pools, riffles, bars and bank slopes
- Sediment availability/transport
- Interaction between a channel and its floodplain
- Ecology and biology (i.e. habitats which support plants and animals)

Any activity that has the potential to have an impact upon any of the Quality Elements will need consideration in terms of whether it could cause a deterioration in the status of a water body. The activity will also need to be considered in terms of whether it will compromise the ability of the water body to reach Good Ecological Status or Good Ecological Potential by the date specified in the Catchment Data Explorer.

Any adverse impacts can cause a water body's ecology to deteriorate and prevent environmental improvements from being undertaken. Nevertheless, in-channel works can also be beneficial if they can be designed to help achieve environmental improvements included in the RBMP, thus enhancing the water environment for plants and animals.

1.1.3 Artificial or Heavily Modified Water Bodies

Whilst good ecological status is defined as a slight variation from undisturbed natural conditions in natural water bodies, artificial and heavily modified water bodies are unable to achieve natural conditions. Instead, artificial and heavily modified water bodies have a target to achieve Good Ecological Potential, which recognises their important uses, whilst making sure ecology is protected as far as possible. Ecological potential is also measured on the scale high, good, moderate, poor and bad. The chemical status of these water bodies is measured in the same way as for natural water bodies.

Specific mitigation measures have been identified for each Artificial and Heavily Modified water body and are listed in the RBMP. These mitigation measures are necessary to reduce the existing hydromorphological impacts on the water body and all measures need to be in place for the water body to achieve Good Ecological Status or Potential.

1.2 Purpose of this WFD Assessment

JBA Consulting was commissioned by Hartlepool Borough Council to undertake a WFD assessment for an Energy Recovery Facility (ERF) in Grangetown.

This WFD assessment aims to determine the effects of the proposed ERF facility on ecological, hydromorphological and chemical quality and identify any potential impacts

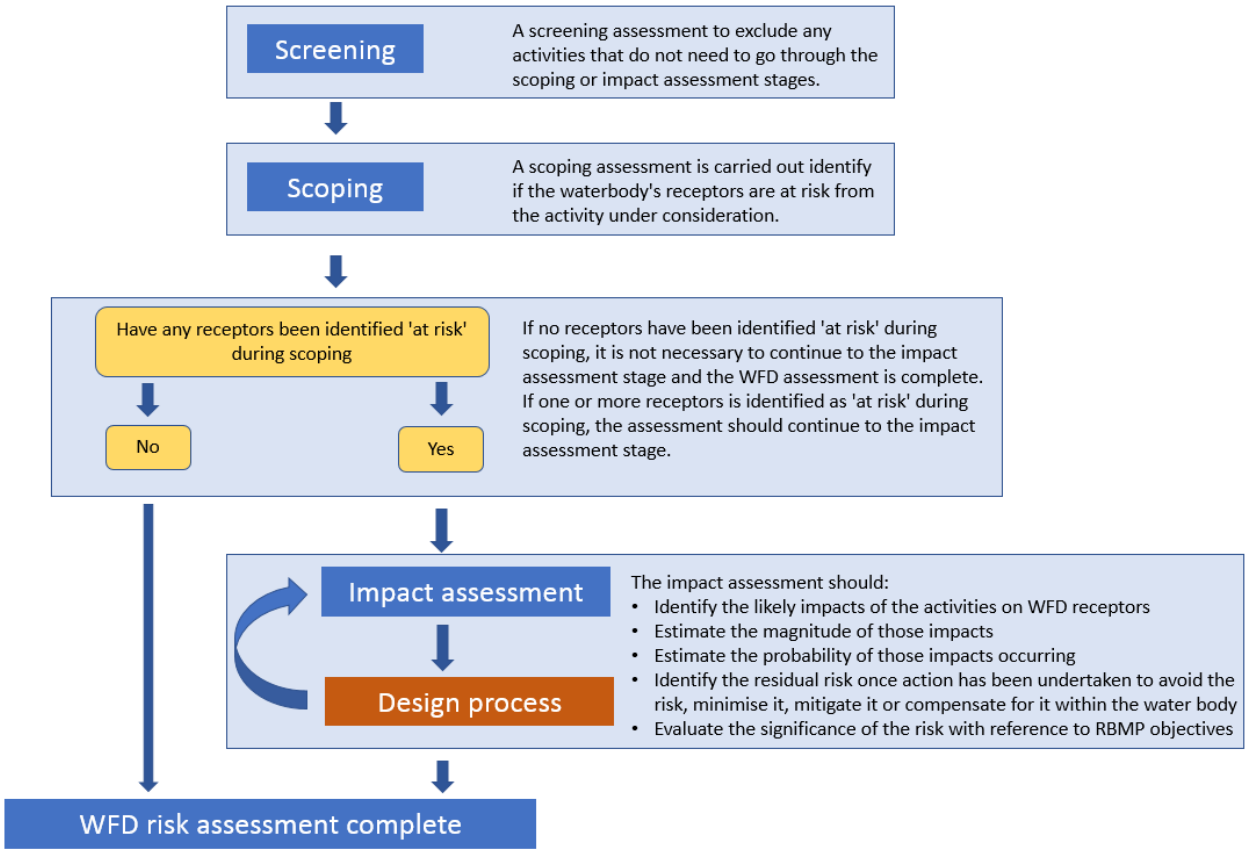
that could cause deterioration in the current status of the water body or could hinder the water body from meeting its WFD objectives in the future.

The site is located adjacent to the Tees Transitional water body, Tees Estuary (S Bank), Tees Coastal Waterboand within the Tees Mercia Mudstone and Redcar Mudstone Groundwater water body (GB40302G701300). Morton West Beck Catchment (trib of Tidal Tees) is also located upstream of these waterbodies. The Environmental Objectives, together with the specific actions (mitigation measures) necessary to enable the water body to meet these objectives, are set out in the Northumbria RBMP (Environment Agency (EA), 2015) and Catchment Data Explorer (EA, 2019).

2 Assessment Methodology

2.1 Overview

The following flow chart summarises the WFD Assessment process.



2.2 Screening Assessment

The Screening Assessment aims to exclude any activities that do not need to go through the scoping or impact assessment stages.

The Northumbria RBMP and the EA's web-based Catchment Data Explorer were used to determine which water bodies could be potentially affected by the proposed works (EA, 2015). The names, ID numbers, designation, status classification and objectives for all relevant water bodies were obtained and downloaded from the EA's Catchment Data Explorer.

The initial stage of the assessment screens the proposed works against the Ecological and Chemical Status objectives for the water bodies potentially affected by the works, together with their Quality Elements. The aim of this process is to determine whether the works could have an impact upon any of these criteria. Those criteria for which no potential adverse effects are identified are not considered further in the assessment. Any potential adverse effects are screened into the assessment and are carried forward to a detailed assessment.

2.3 Scoping Assessment

A detailed assessment is then undertaken to determine the effects that the proposed works could have upon those Quality Elements screened into the assessment. Any

impacts identified are then considered in relation to the Ecological and Chemical Status of the water body and the status objectives.

The following assessment objectives are then used to determine whether the proposed works comply with the overarching objectives of the WFD. These objectives were therefore derived from the Environmental Objectives of the Directive (as listed in section 1.2).

- Objective 1: The proposed scheme does not cause deterioration in the Status of the Biological Elements of the water body.
- Objective 2: The proposed scheme does not compromise the ability of the water body to achieve its WFD status objectives.
- Objective 3: The proposed scheme does not cause a permanent exclusion or compromised achievement of the WFD objectives in other bodies of water within the same RBD.
- Objective 4: The proposed scheme contributes to the delivery of the WFD objectives.

In order to establish whether the strategy complies with the WFD it is necessary to ascertain whether the preferred options have the potential to result in:

- Failure of a water body to achieve Good Ecological Status or Potential; or
- Failure to prevent a deterioration in the Ecological Status or Potential of a water body

If the answer to these questions is 'no' the strategy can be considered WFD compliant. If either of these failures is identified and if any receptors are identified as 'at risk', further assessment may be required to identify if the strategy meets all the conditions set out by the WFD Legislation.

2.4 Impact Assessment

The third stage of the WFD Assessment, if determined as necessary from the Screening and Scoping Assessments, is to undertake an Impact Assessment to consider the impacts of the proposed scheme in more detail and recommend necessary mitigation measures. An impact assessment must be carried out for each receptor identified during scoping as being at risk from your activity.

The Impact Assessment describes how any identified impacts from the proposed scheme will be mitigated, to either avoid or minimise the impacts. The assessment shows how any impact on WFD receptor caused by the proposed activity fits with the objectives of any affected WFD water bodies. After the works have been amended to try and avoid, minimise, mitigate or compensate for the risks to WFD receptors the following questions will need to be answered:

- Could the activity still cause a water body to deteriorate from one WFD status class to another or cause significant localised impacts that could contribute to this happening?
- Could the activity prevent or undermine action to get water bodies to good status?

When these questions are answered, the following should be borne in mind:

- A water body deteriorates in status when one WFD receptor (an "element") is affected such that it drops from one WFD status class to another.
- A significant localised impact on an element is one that is either long-lasting; causes severe harm; or affects a wide area within a water body. These are

likely to contribute to a water body dropping from one status to another and highly likely to prevent action to get water bodies to good status.

- Elements at high status are very sensitive. The assessment will need to demonstrate that there will be a negligible impact on those aspects of the water environment
- Elements at bad status must not be made worse.

If it cannot be demonstrated with a high level of confidence that the activity supports RBMP objectives, then in order for the Environment Agency to permit the activity it must be shown that the activity meets the criteria set out in Article 4(7) of the WFD. Article 4(7) sets out stringent environmental and socio-economic tests to assess if a scheme meets struct environmental and sustainability criteria.

3 Project Description

3.1 Project Overview

The proposed Energy Recovery (ERF) site forms part of the South Tees Development Corporation (STDC) area, which totals to approximately 1,800 hectares (STDC, 2019). The location is referred to as the Grangetown Prairie site. The location has been divided into six specific development plots. The ERF site located in the northwestern corner of the . The site is located 3km east of Middlesbrough (centred on National Grid Reference NZ 54375 21325) and comprises of 25 Arces (10 ha) of brownfield land (Figure 3-1).

Figure 3-1 Grangetown Prairie site.

The proposed ERF facility will comprise of a collection of buildings, approximately 250 metres in length and by 40 metres high and a stack, 70-80 metres high, which will be capable of processing up to 450,000 tonnes of domestic waster per annum.

3.2 Proposed Works

The process of generating energy from the waste feedstock within the proposed ERF facility is described below:

- Domestic waste is transported by road to the ERF facility
- Waste is transferred to the ERF tipping hall and into the boiler hall
- Waste is combusted to produce heat, which is used to boil water and create steam
- Steam is then used to generate electricity, through the movement of turbines within the turbine hall, which is distributed to the national grid

- State of the art air pollution control equipment cools and cleans the gases, and a baghouse controls the emission within the air-cooling condenser and flue gas treatment building
- Emissions are released via the stack and are continuously monitored
- Particular matter is collected, and metals recovered for recycling
- Residual matter is beneficially reused and that which cannot is disposed of at landfill

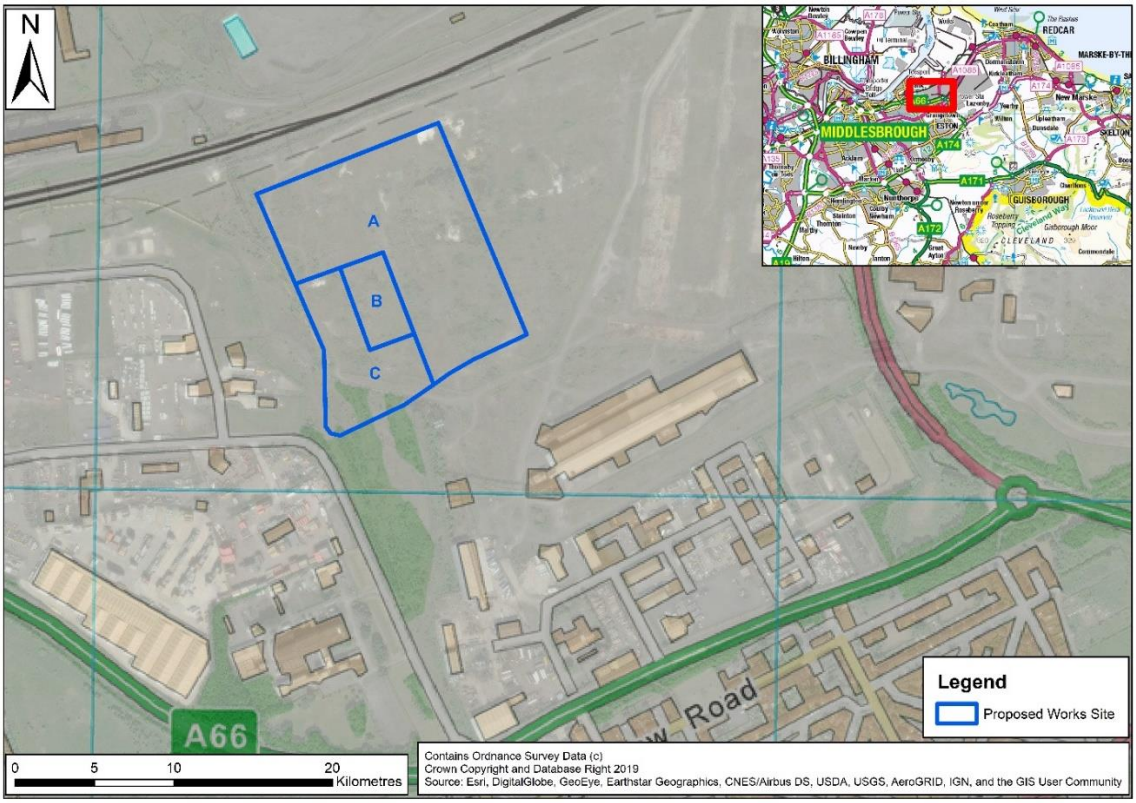


Figure 3-2 Location of the proposed ERF site. Area A shows the target area for the footprint of the buildings and roadways. Area B is the archaeological interest area and will be undeveloped. Area C will largely be undeveloped and form the ecological enhancement strategy together with lproposals for Area C.

The facility has been positioned to avoid industrial remains of historic value in Area B and to provide Environment Net Gain opportunities in Area C (and B). The facility buildings, roads, reception areas and car park will be Area A. Several buildings and structures are required for this process including:

- **Tipping Hall** – Heavy Goods Vehicles (HGVs) will back into the building to deliver waste. The tipping hall shall be totally enclosed with roll-up doors to prevent release of dust and odours. Odours will be controlled by continuously drawing air from the refuse pit for the combustion units i.e. the negative air pressure will suck any odours into the building rather than let them out. The tipping floor will be concrete, suitable for HGV, and the floor will be sloped to the bunded pit to contain any spillage.
- **Boiler Hall** - The boiler hall is where the waste feedstock combusts in a furnace, releasing heat. The hot gases which are generated pass through the boiler, which contains steam and water. As the combustion gases from the furnace pass through the boiler, they are cooled to a temperature suitable for

the flue gas cleaning system. Fuel oil is required to start and shutdown the plant, but once operating temperatures are reached, waste can be burned without the need for auxiliary fuel.

- **Turbine Hall** - The steam generated by the boilers passes a condensing steam turbine-generator. The overall net efficiency of the energy conversion process at the power plant is expected to be around 25%.
- **Flue Gas Treatment Building** - The flue gas treatment (FGT) building houses air pollution control (APC) equipment for the boilers, which cleans the gas prior to being discharged at atmosphere.
- **Residue Building** - Recovered metals and residual bottom ash will be stored prior to disposal off-site in a residue storage bunker building.
- **Air Cooled Condenser** - Steam is exhausted at low pressure from the turbine into an air-cooled condenser which condenses the steam back into water. The water is then pumped back into the boiler. The heat lost by the steam when it condenses is transferred to the atmosphere. The air-cooled condenser has fans which draw air across the condenser tubes, so there is no visible plume.
- **Stack** - Once cleaned, the flue-gases from the boilers are discharged to atmosphere via a stack. Stack height being between 70 and 80 metres.
- **Fuel Oil** - A fuel oil storage tank, with a secondary containment, will be provided. An HGV unloading area adjacent to the road will also be provided. This area will be bunded.
- **Fire Fighting Water Tank** - A fire protection water storage tank will be provided on site.
- **Standby Diesel Generator** - In case of a power interruption or outage, a standby diesel generator is provided. The generator and the diesel engine will be mounted on a steel base frame. The diesel generator shall be enclosed.

Final designs for the ERF facility have not yet been confirmed. As such, the following WFD assessment will assess both the potential for the proposed development to discharge into and abstract from the Tees Estuary. Construction of the facility will require removal of topsoil and other material to a depth of 2.5m only in the area where the facility will be built. This material will be processed on site and replaced. The buildings will be constructed on a concrete plinth that will be piled into the bedrock.

4 WFD Screening Assessment

4.1 Overview

This screening assessment aims to screen any works that require WFD Assessment and to identify which WFD water bodies are within and near to the proposed works.

The results of the assessment are presented below. A full and detailed WFD assessment would be required should it be concluded that the scheme could cause deterioration in the status of the water body or prevent it from achieving its status objectives. The baseline status of elements within water bodies screened into the assessment are discussed in this chapter.

It is likely that the WFD assessment will need to be reviewed when reserve matters are resolved, or a full application is made.

4.2 WFD water bodies

The site is located 1km south of the Tees Transitional water body (GB510302509900), 1.2km west of Tees Estuary (S Bank) River (GB103025072320), 6km south west of Tees Coastal Water (GB650301500005) and within the Tees Mercia Mudstone and Redcar Mudstone Groundwater water body (GB40302G701300). Morton West Beck Catchment (trib of Tidal Tees) River (GB103025072210) is upstream of the waterbodies described above, 3km west at its nearest point.

4.2.1 Current status

Details of the water bodies' classification, status and objectives, as described by the EA Catchment Data Explorer (2019), are summarised in Table 4-1 below.

Table 4-1: Current WFD status

Water body ID	Name of water body	Hydromorphological designation	Current Overall Status/ Potential	Overall Status Objective
GB510302509900	Tees	Heavily modified Transitional water body	Moderate	Moderate in 2015
GB103025072320	Tees Estuary (S Bank)	Heavily modified River	Moderate	Good by 2027
GB40302G701300	Tees Mercia Mudstone and Redcar Mudstone	Groundwater water body	Poor	Poor in 2015
GB650301500005	Tees Coastal Water	Heavily modified Coastal water body	Moderate	Good by 2027
GB103025072210	Morton West Beck Catchment (trib of Tidal Tees)	Heavily modified River	Moderate	Good by 2027

4.3 Screening Outcome

Table 4-2 indicates which water bodies have been screened in or out of the assessment and the reasons for this decision.

Table 4-2 Outcome of WFD Screening Stage

Water body/ies	Reason	Screening outcome
Tees	There is potential for the proposed development to discharge into the Tees Estuary and as such these waterbodies may be impacted.	Screened in
Tees Coastal	There is potential for any discharges into the Tees Estuary to reach and impact these downstream waterbodies.	
Tees Estuary (S Bank)		
Tees Mercia Mudstone and Redcar Mudstone	The proposed development is located within this Groundwater water body and therefore may be impacted, as construction of the facility will require excavation to a depth of 2.5m.	
Morton West Beck Catchment (trib of Tidal Tees)	The upstream water body is considered sufficiently distant from the proposed development and no hydrological pathways were identified that may impact the water body.	Screened out

4.4 Baseline Status of screened-in water bodies

For each water body screened into the assessment, details on the status of each element, as described by the EA Catchment Data Explorer (2019), are given below.

4.4.1 Tees (GB510302509900)

Table 4-3 Biological Quality Elements Status

Biological Quality Element	Current Status (2016)	Objective
Macrophytes and Phytobenthos Combined	Macrophytes – Moderate Phytobenthos – Good	Macrophytes – Moderate in 2015 Phytobenthos – Good in 2015
Fish	Good	Good in 2015
Invertebrates	Moderate	Good by 2027

Table 4-4 Hydromorphological Quality Element Status

Hydromorphological Quality Element	Current Status (2016)	Objective
Hydrological Regime	Supports Good	Supports Good in 2015

Table 4-5 Physico-Chemical Quality Elements Status

Physico-Chemical Quality Element	Current Status (2016)	Objective
Un-ionised ammonia	High	High in 2015
Biochemical Oxygen Demand (BOD)	N/A	N/A
Dissolved Inorganic Nitrogen	Moderate	Moderate in 2015
Dissolved Oxygen	Good	Good in 2015
pH	N/A	N/A
Phosphate	N/A	N/A
Temperature	N/A	N/A
Specific pollutants	High	High in 2015

4.4.2 Tees Estuary (S Bank) (GB103025072320)

Table 4-6 Biological Quality Elements Status

Biological Quality Element	Current Status (2016)	Objective
Macrophytes and Phytobenthos Combined	N/A	N/A
Fish	N/A	N/A
Invertebrates	Not assessed in 2016, Moderate in 2015	Good by 2027

Table 4-7 Hydromorphological Quality Element Status

Hydromorphological Quality Element	Current Status (2016)	Objective
Hydrological Regime	Supports Good	Supports Good in 2015

NB Physico-chemical quality elements were not assessed in 2015 for Tees Estuary (S Bank) and no objectives have been provided.

4.4.3 Tees Mercia Mudstone and Redcar Mudstone (GB40302G701300)

Table 4-8 Quantitative Status Elements

Quantitative Status Element	Current Status (2016)	Objective
Quantitative Saline Intrusion	Good	Good in 2015
Quantitative Water Balance	Good	Good in 2015
Quantitative GWDTEs test	Good	Good in 2015
Quantitative Dependent Surface water body Status	Good	Good in 2015

Table 4-9 Chemical Status Elements

Chemical Status Element	Current Status (2016)	Objective
Chemical Drinking Water Protected Area	Good	Good in 2015
General Chemical Test	Good	Good in 2015
Chemical GWDTEs Test	Good	Good in 2015
Chemical Dependent Surface water body Status	Poor	Poor in 2015
Chemical Saline Intrusion	Good	Good in 2015

4.4.4 Tees Coastal (GB650301500005)

Table 4-10 Biological Quality Elements Status

Biological Quality Element	Current Status (2016)	Objective
Macrophytes and Phytobenthos Combined	N/A	N/A
Fish	N/A	N/A
Invertebrates	High	Good in 2015

Table 4-11 Physico-Chemical Quality Elements Status

Physico-Chemical Quality Element	Current Status (2016)	Objective
Dissolved Oxygen	High	Good in 2015
Specific Pollutants Arsenic Copper Iron Zinc	High	Not assessed in 2015

4.5 Protected Areas

The WFD specifies that areas requiring special protection under other EC Directive and waters used for the abstraction of drinking water are identified as protected areas. These areas have their own objectives and standards. Article 4 of the WFD requires Member States to achieve compliance with the standards and objectives set for each protected area by 22nd December 2015, unless otherwise specified in the community legislation under which the protected area was established.

The Tees Transitional water body and the Tees Estuary (S Bank) River are both linked to the Teesmouth and Cleveland Coast which is designated as a Special Protection Area (SPA) and Ramsar site with further areas which are designated as a potential SPA and proposed Ramsar site. These designations are due to the water bird assemblage that these sites are able to support. These designations underlie the current designation as a Site of Special Scientific Interest (SSSI) for its nationally important geology and mosaic of coastal and freshwater habitats, which support a diverse assemblage of birds, invertebrates associated with sand dunes and breeding harbour seals *Phoca vitulina*.

The Tees Transitional water body is also associated with the Seal Sands, Tees Estuary Urban Waste Water Treatment Directive (UWWTD). This Directive aims to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors and concerns the collection, treatment and discharge of these waste waters. This Directive relates to the area to the north of the Tees Estuary.

The Tees Coastal is also associated with Teesmouth and Cleveland Coast protected areas. This water body is also associated with several Bathing Waters, which are protected under the Bathing Water Directive (1975):

- Redcar Coatham
- Filey
- Whitby
- Saltburn
- Seaton Crew North
- Marske Sands
- Cayton Bay
- Runswick Bay
- Redcar Lifeboat Station
- Robin Hoods Bay
- Seaton Carew North Gare
- Seaton Carew Centre
- Scarborough North Bay

- Sandsend
- Scarborough South Bay
- Redcar Granville
- Redcar Stray
- Reighton

4.5.1 Nitrate Vulnerable Zone (NVZ)

The European Commission Nitrates Directive requires areas of land that drain into waters polluted by nitrates to be designated as Nitrate Vulnerable Zones (NVZs). The Tees is associated with two NVZs, 244 (ID: NVZ12SW012450) and 245 (ID: NVZ12SW012440), which are located 7.7km upstream of the closest point of the Tees Estuary to the site.

4.5.2 Drinking Water Groundwater Safeguard Zones (SgZ)

Drinking Water Protected Areas (DrWPA) are designated under the Water Framework Directive, with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water. SgZs are areas where actions will be targeted to address the causes of DrWPA objective failure/risk of failure.

The site is located within the Tees Mercia Mudstone and Redcar Mudstone Groundwater water body, which is also designated as a DrWPA (UKGB40302G701300).

5 WFD Scoping Assessment

5.1 Overview

This scoping assessment identifies whether the water body's receptors, identified during the screening assessment, are at risk from the proposed works discussed in Chapter 3. The proposed development works are being appraised in terms of their impact on WFD status and objectives.

Some WFD Quality Elements have not been formally assessed as part of the classification for this water body. However, due to the scale and nature of the proposed works, all WFD Quality Elements have been included in this screening and any identified impacts have been considered in relation to the ecological and chemical status of the water body and the status objectives.

Article 4.7 of the Directive defends deterioration in status or failure to meet WFD objectives resulting from new modifications or sustainable human development activities (if all conditions set out under this Article are met). If the assessment procedure predicts that an activity will cause deterioration in water body status or prevent a water body from meeting its ecological objectives, then an assessment is also required against the conditions listed in Article 4.7 of the WFD. European Member States will not be in breach of the WFD if all the assessment conditions are met.

Tees Transitional water body

5.1.1 Biological Quality Assessment

Table 5-1 presents an assessment of the proposed works against the biological quality elements of the Tees Transitional water body.

Table 5-1: Assessment of works against the biological quality elements for the Tees

WFD Quality Element	Current Status	Potential Impact	Consider in impact assessment?
Fish	Good	If the proposed development involves any discharges into the Tees Estuary, there is potential to negatively impact fish, invertebrate, macrophyte and phytobentho populations through accidental pollution events and local disturbance at discharge point(s). Construction of the ERF facility may also result in discharges into the Tees Estuary. Deposition of discharged materials may cover fish gravels or estuary bed, damaging habitat for these species. There is potential for entrapment of fish as a result of abstraction.	Yes
Invertebrates	Moderate		
Macrophytes and Phytobenthos	Macrophytes were Moderate Phytobenthos were Good		

5.1.2 Hydromorphological Quality Assessment

Table 5-2 presents an assessment of the proposed works against the hydromorphological quality elements of the Tees Transitional water body.

Table 5-2: Assessment of works against the hydromorphological quality elements for the Tees

WFD Quality Element	Potential Impact	Consider in impact assessment?
Depth variation	If the proposed development involves any discharges into the Tees Estuary there is potential for water depth to vary depending on the timings and volumes of discharge from the ERF facility. If abstraction from the Tees Estuary is required, this will also impact depth variation.	Yes
Quantity, structure and substrate of the bed	If discharges are made into the Tees Estuary this may result in deposition of materials which will alter the estuary bed.	Yes
Structure of the intertidal zone	Any abstraction and discharge processes have the potential to impact on the intertidal zone, depending on their timings and scale.	Yes
Freshwater flow	Freshwater flow from WFD and non-WFD waterbodies, including run off from the site, into the Tees Estuary may be impacted as the proposed ERF facility may contaminate the freshwater.	Yes
Wave exposure	No impacts are anticipated.	No

5.1.3 Physico-Chemical Quality Assessment

Table 5-3 presents an assessment of the proposed works against the physico-chemical quality elements of the Tees Transitional water body.

Table 5-3: Assessment of works against the physico-chemical elements for the Tees

WFD Quality Element	Potential Impact	Consider in impact assessment?
Transparency	If the proposed development involves discharging into the Tees Estuary, there is potential to directly impact all these physico-chemical elements dependent on the nature of the discharge. Construction of the ERF facility may also result in discharges into the Tees Estuary. If abstraction is also required, there is potential to influence these physico-chemical elements.	Yes
Thermal conditions		
Oxygenation conditions		
Salinity		
Nutrient conditions		
Specific Pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water		

5.2 Tees Estuary (S Bank) River

5.2.1 Biological Quality Assessment

Table 5-4 presents an assessment of the proposed works against the biological quality elements of the Tees Estuary (S Bank) River.

Table 5-4 Assessment of works against the biological quality elements for the Tees Estuary (S Bank)

WFD Quality Element	Current Status	Potential Impact	Consider in impact assessment?
Fish	Not assessed	If the proposed development involves any discharges from construction and / or operation of the ERF facility into the Tees Estuary have the potential to reach the river and negatively impact fish, invertebrate, macrophyte and phytobentho populations through pollution. Discharged materials which reach the river may be deposited, covering fish gravels or smother invertebrate habitat.	Yes
Invertebrates	Not assessed in 2016, Moderate in 2015		
Macrophytes and Phytobenthos	Not assessed		

5.2.2 Hydromorphological Quality Assessment

Table 5-5 presents an assessment of the proposed works against the hydromorphological quality elements of the Tees Estuary (S Bank) River.

Table 5-5 Assessment of works against the hydromorphological quality elements for the Tees Estuary (S Bank)

WFD Quality Element	Potential Impact	Consider in impact assessment?
Hydrology: Quantity and dynamics of water flow	Abstraction and discharge processes (from construction and / or operation of the ERF facility) have the potential to impact Tees Estuary resulting in impacts to the quantity and dynamics of the river's water flow, dependent on the timings and scale.	Yes
Hydrology: Connection to groundwater bodies	No impacts are anticipated due to the location of the river 1.2km west of the site.	No
River continuity	No impacts are anticipated.	No
Morphology: River depth and width variation	Abstraction and discharge processes (from construction and / or operation of the ERF facility) have the potential to impact Tees Estuary resulting in impacts to the depth and width of the river, dependent on the timings and scale.	Yes
Morphology: Structure and substrate of the river bed	If discharged materials reach the river there is potential to alter the structure and substrate of the river bed, in particular at its westernmost end.	Yes
Morphology: Structure of the riparian zone	No impacts are anticipated.	No

5.2.3 Physico-Chemical Quality Assessment

Table 5-6 presents an assessment of the proposed works against the physic-chemical quality elements of the Tees Estuary (S Bank) River.

Table 5-6 Assessment of works against the physico-chemical quality elements for the Tees Estuary (S Bank)

WFD Quality Element	Potential Impact	Consider in impact assessment?
Thermal conditions	Abstraction and discharge processes (from construction and / or operation of the ERF facility) have the potential to impact Tees Estuary resulting in impacts to the physico-chemical elements of the river, dependent on the timings and scale.	Yes
Oxygenation conditions		
Salinity		
Acidification status		
Nutrient conditions		
Specific Pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water		

5.3 Tees Coastal water body

5.3.1 Biological Quality Assessment

Table 5-7 presents an assessment of the proposed works against the biological quality elements of the Tees Coastal water body.

Table 5-7 Assessment of works against biological quality elements for the Tees Coastal

WFD Quality Element	Current Status	Potential Impact	Consider in impact assessment?
Phytoplankton	N/A	Any discharges from construction and / or operation of the ERF facility into the Tees Estuary have the potential to reach this coastal water body and negatively impact phytoplankton, other aquatic flora and benthic invertebrate fauna through pollution. Discharged materials which reach the coastal water body may be deposited, damaging habitat for these species.	Yes
Other aquatic flora	N/A		
Benthic invertebrate fauna	Invertebrates High in 2016		

5.3.2 Hydromorphological Quality Assessment

Table 5-8 presents an assessment of the proposed works against the hydromorphological quality elements of the Tees Coastal water body.

Table 5-8 Assessment of works against the hydromorphological quality elements for the Tees Coastal

WFD Quality Element	Potential Impact	Consider in impact assessment?
Morphology: Depth variation	No impacts are anticipated.	No
Morphology: Structure and substrate of the coastal bed	Any discharged materials which reach the coastal water body may be deposited, in particular at the mouth of the Tees Estuary, which may impact the structure and substrate of the coastal bed and the structure of the intertidal zone.	Yes
Morphology: Structure of the intertidal zone		
Tidal regime: Direction of dominant currents	No impacts are anticipated.	No
Tidal regime: Freshwater flow	Abstraction and discharge processes into the Tees Estuary may impact freshwater flow into this coastal water body.	Yes
Tidal regime: Wave exposure	No impacts are anticipated.	No

5.3.3 Physico-Chemical Quality Assessment

Table 5-9 presents an assessment of the proposed works against the physico-chemical quality elements of the Tees Coastal water body.

Table 5-9 Assessment of works against the physico-chemical quality elements for the Tees Coastal

WFD Quality Element	Potential Impact	Consider in impact assessment?
Transparency	Any abstraction and discharge processes (from construction and / or operation of the ERF facility) have the potential to impact Tees Estuary resulting in impacts to all the physico-chemical elements of the coastal water body, dependent on the timings and scale.	Yes
Thermal conditions		
Oxygenation conditions		
Salinity		
Nutrient conditions		
Specific Pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water		

5.4 Impacts of works on protected sites

Table 5-10 presents an assessment of the proposed works against any protected sites.

Table 5-10: Assessment of works on protected sites

Protected Site	Potential Impact	Consider in impact assessment?
Teesmouth and Cleveland Coast SPA, pSPA, Ramsar, pRamsar and SSSI	Any discharges into the Tees Estuary have the potential to reach these designated sites, causing pollution effects that will impact the coastal habitats and its associated bird assemblages. There is potential for disturbance due to noise and also air pollution which will negatively affect the bird populations	Yes
Bathing Waters	Any discharges into the Tees Estuary have the potential to reach these designated sites, causing pollution effects that will impact bathing waters along the coastline.	Yes
Seal Sands, Tees Estuary UWWTD	This Directive relates to the area to the north of the Tees Estuary and therefore is not considered to be impacted by the proposed development.	No
NVZs 244 and 245	These NVZs are upstream of the Tees Estuary and will not be impacted by the proposed development.	No
Tees Mercia Mudstone and Redcar Mudstone DrWPA	This DrWPA will be negatively impacted by pollution from discharges during construction and / or operation of the ERF facility.	Yes

6 WFD Impact Assessment

6.1 Overview

The Scoping Assessment presented in Chapter 5 identified some receptors that may potentially be at risk from the proposed works. An Impact Assessment is therefore required to describe how these identified impacts will be mitigated.

The Impact Assessment needs to consider if there is a pathway linking the pressure to the receptor. If there is no pathway there can be no impact on the receptor and there is no need for any further assessment of that receptor to be carried out. If there is a potential pathway the assessment should consider if the activity, and the pressure it creates, may cause deterioration of the receptor.

In order to effectively assess the potential impacts of the proposed works and decide upon suitable mitigation measures, a good understanding of the propose scheme and design is required. Should any revisions be made to the proposed works that could impact any of the WFD Quality Elements, this section should be revised.

6.2 Impact assessment

Table 6-1 discusses each of the receptors identified as being potentially at risk in the scoping assessment. Mitigation measures are recommended to mitigate the effects of the proposed works. It should be noted that these mitigation measures differ to the Mitigation Measures identified for any Heavily Modified water body.

Table 6-1: Impacts and mitigation measures

WFD Quality Element	Pathway (direct/ indirect/ none)	Potential Impact/ Mitigation measures
Biological:		
Fish	Direct and Indirect	The potential for discharge into the Tees Estuary may result in pollution, dependent on the nature of the discharged materials. Deposition of these materials may also cover fish gravels. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks. A fish guard must be installed to prevent entrapment within the abstraction pipe(s). Discharge and abstraction points shall be minimised wherever possible to decrease the levels of disturbance to these biological elements.
Invertebrates	Direct and Indirect	
Macrophytes and phytobenthos	Direct and Indirect	
Phytoplankton	Direct and Indirect	
Other aquatic flora	Direct and Indirect	
Benthic invertebrate fauna	Direct and Indirect	

WFD Quality Element	Pathway (direct/ indirect/ none)	Potential Impact/ Mitigation measures
Hydromorphological:		
Depth variation	Direct	Discharge and abstraction processes will impact depth variation of the Tees Estuary, depending on timings and the scale of these processes. A Water Resources licence will be required, which regulates levels of water abstraction.
Quantity, structure and substrate of the estuary, river and coastal bed	Direct and Indirect	There will be direct impacts to the structure and substrate of the Tees Estuary bed as a result of deposition of discharged materials. There will also be indirect impacts to the river and coastal water body as discharged materials are carried into these waterbodies. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Structure of the intertidal zone	Direct and Indirect	There will be direct impacts to the structure of the Tees Estuary's intertidal zone as a result of deposition of discharged materials. There will also be indirect impacts to coastal intertidal zone as discharged materials are carried into these waterbodies. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Freshwater flow	Direct and Indirect	Discharge and abstraction processes will impact freshwater flow into the Tees Estuary, depending on timings and the scale of these processes, and subsequently into the river and coastal water body. A Water Resources licence will be required, which regulates levels of water abstraction. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Hydrology: Quantity and dynamics of water flow	Indirect	Discharge and abstraction processes into the Tees Estuary may indirectly impact quantity and dynamics of water flow into the river. A Water Resources licence will be required, which regulates levels of water abstraction. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Morphology: River depth and width variation	Indirect	Discharge and abstraction processes into the Tees Estuary may indirectly impact river depth and width variation. A Water Resources licence will be required, which regulates levels of water abstraction. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.

WFD Quality Element	Pathway (direct/ indirect/ none)	Potential Impact/ Mitigation measures
Physico-chemical:		
Transparency Thermal conditions Oxygenation conditions Salinity Acidification status Nutrient conditions Specific Pollutants Pollution by all priority substances identified as being discharged into the body of water Pollution by other substances identified as being discharged in significant quantities into the body of water	Direct and Indirect	The potential for discharge into the Tees Estuary may result in direct pollution and indirect pollution to the Tees Estuary (S Bank) River and Tees Coastal water body, dependent on the nature of the discharged materials. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Teesmouth and Cleveland Coast SPA, pSPA, Ramsar, pRamsar and SSSI	Direct and Indirect	There is potential for direct and indirect impacts to these designated sites as a result of the potential abstraction and discharge processes linked to the Tees Estuary. This may damage coastal and freshwater habitats utilised by water birds through pollution and potential alteration of the intertidal zones. A Habitats Regulations Assessment (HRA) must be undertaken to determine the impacts to the SPA, pSPA, Ramsar and pRamsar sites. A Water Resources licence will be required, which regulates levels of water abstraction. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks. Best practice biosecurity must be followed to prevent the risk of introducing invasive or damaging biological agents.
Bathing Waters	Indirect	The Bathing Waters may be indirectly impacted by discharges into the Tees Estuary which have the potential to reach these areas. Discharges into the environment must be through connections to mains sewage. If this is not possible, an appropriate Environmental Permit must be obtained from the EA. Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.
Tees Mercia Mudstone and Redcar Mudstone DrWPA	Direct	The DrWPA may be directly impacted by abstraction and discharge processes (during construction and / or operation of the ERF facility). Pollution prevention measures shall be implemented during construction works to prevent excessive sediment input and mitigate impacts in the event of oil or fluid leaks.

6.3 Water Body Mitigation Measures

There are mitigation measures contributing to better ecological potential for the water body identified in the EA's Catchment Planning System. The ability of the proposed works to deliver these mitigation measures, or the risk that the works could prevent

their implementation, is considered further in the table below. Note, only the measures considered within the scope of the proposed works have been considered.

Table 6-2: Assessment of the proposed works against the water body's mitigation measures

water body	Reasons for not achieving Good	Mitigation Measures
Tees	Diffuse Pollution Physical modification	Physical modification – Flood Protection Use. Navigation, ports and harbours use. There are several mitigation measures not currently in place. Relevant mitigation measures include Water Management and Habitat Creation. The proposal is not related to Flood Protection or Navigation etc. and not adjacent to the water body. The proposal does not impact the ability to achieve the mitigation measures. The proposal provides Net Biodiversity Gain and therefore contributes to the mitigation measures.
Tees Coastal	Physical modification	Physical modification – Flood Protection Use. Navigation, ports and harbours use. Coast protection use. There are no mitigation measures currently allocated.
Tees Estuary (S Bank)	Physical modification	Physical modification – Morphology and Urbanisation. There are no mitigation measures currently allocated. The proposal provides Net Biodiversity Gain and therefore contributes to future mitigation measures relating to habitat creation.
Tees Mercia Mudstone and Redcar Mudstone	None – Relevant (Minewater Treatment)	

6.4 WFD Assessment Objectives

Following consideration of the potential impacts and recommended mitigation measures, as well as the appraised Mitigation Measures for the water body, Table 6-3 assesses whether the proposed works comply with the overarching objectives of the WFD.

Table 6-3: Assessment of proposed works against WFD objectives

WFD Assessment Objectives	Assessment of works
Objective 1: The proposed works do not cause deterioration in the Status of the Biological Elements of the water body	Overall the waterbodies have Moderate ecological potential. Action to reach Good would have significant adverse impacts on the current use of the Tees and Tees Estuary (S Bank). The Tees Coastal water body however does aim to achieve Good potential by 2027. The proposed development should not deteriorate the current status of the water body as long as the suggested mitigation measures identified in Table 6-1 are implemented.
Objective 2: The proposed works do not compromise the ability of the water body to achieve its WFD status objectives	The Tees Estuary (S Bank) river and Tees Coastal water body have WFD objectives in places to improve their statuses. Therefore, implementation of the mitigation measures in Table 6-1 will ensure this can be achieved.
Objective 3: The proposed works do not cause a permanent exclusion or compromised achievement of the WFD objectives in other bodies of water within the same RBD	The impacts of the proposed development will remain within the catchment as long as mitigation measures are followed.
Objective 4: The proposed works contribute to the delivery of the WFD objectives	There is limited potential for the proposed works to contribute towards delivery of the WFD objectives. However, the proposal provides Net Biodiversity Gain and therefore contributes to the mitigation measures that will contribute to the delivery of the WFD objectives.

7 Discussion and Conclusions

7.1 Assessment Summary

7.1.1 Biological Assessment

Overall the waterbodies have Moderate ecological potential which may be negatively impacted by the proposed development through potential abstraction and discharge processes (during construction and / or operation). This may cause pollution effects, disturbance as well as alteration and damage to quality habitats that are utilised by water birds, features of the protected sites.

7.1.2 Hydromorphological Assessment

The potential abstraction and discharge processes will impact several elements of hydromorphology, such as depth variation, flow dynamics and structure and substrates of the bed. These impacts will depend on the timings and scale of the discharge and abstraction as well as the nature of discharged materials.

7.1.3 Physico-Chemical Assessment

There is potential for discharge during construction and / or operation which will cause direct impacts to the Tees Estuary and indirect impacts to the other waterbodies as discharged materials are transported downstream. The effects on the physico-chemical elements will depend on the nature of the discharged materials.

7.2 Scheme Recommendations / Key Considerations

Overall the impacts to the biological, hydromorphological and physico-chemical elements of the waterbodies can all be mitigated against using the same measures:

- Completion of an HRA, implementing the resulting conclusions and recommendations
- Discharge through connection to mains sewage or obtain an appropriate Environmental Permit from the EA
- Abstraction from a Surface Water (including the Tees Estuary) obtaining a Water Resource licence

The following measures are specific to mitigate impacts to biological elements:

- Installation of a fish guard to prevent entrapment within the abstraction pipe(s)
- Minimise discharge and abstraction points wherever possible to limit disturbance

Pollution prevention and biosecurity measures must also be implemented as outlined below.

7.2.1 Pollution Prevention Measures

Appropriate mitigation measures shall be implemented to ensure that habitats within proximity of the works are not degraded as a result of pollution events during the construction phase. Mitigation should include:

- Abiding by relevant pollution prevention measures e.g. CIRIA Guidance: Control of water pollution from construction sites. Guidance for consultants and contractors (C532D) (Master-Williams, 2001). Information useful for Toolbox Talks on working near water and pollution prevention can be found at:

https://www.ciria.org/Resources/All_toolbox_talks/Env_toolbox_talks/Working_on_or_near_watercourses.aspx [site accessed: 28/11/19].

- Preventing accidental oil and fuel leaks can be achieved by the following actions:
  - Any chemical, fuel and oil stores should be located on impervious bases within a secured bund with a storage capacity 110% of the stored volume.
  - Biodegradable oils and fuels should be used where possible.
  - Drip trays should be placed underneath any standing machinery to prevent pollution by oil/fuel leaks. Where practicable, refuelling of vehicles and machinery should be carried out on an impermeable surface in one designated area well away from any watercourse or drainage (at least 10m).
  - Emergency spill kits should be available on site and staff trained in their use.
  - Operators should check their vehicles on a daily basis before starting work to confirm absence of leakages. Any leakages should be reported immediately.
  - Daily checks should be carried out and records kept on a weekly basis and any items that have been repaired/replaced/rejected noted and recorded. Any items of plant machinery found to be defective should be removed from site immediately or positioned in a place of safety until such time that it can be removed.
- Silt run off should be prevented by incorporating the following actions:
  - Silt curtains should be used where appropriate to prevent silt from the construction works entering the watercourse.
  - Exposed bare earth should be covered as soon as possible to prevent soil erosion and silt run off. This can be achieved by selecting a fast growing and soil binding seed mix such as Boston Seed's EA Special Mixture No.10 for river bank reinstatement: http://www.bostonseeds.com/advice/1/Grass-Seed/96/River-Bank-Reinstatement/ [site accessed 28/11/19]. Alternatively, geotextile coverings can be used to cover any exposed earth and prevent soil erosion.
- Water quality downstream of the works should be monitoring regularly to detect any changes that could indicate a pollution incident. Should monitoring indicate potential pollution from the construction activities, works should be stopped, and a solution found to prevent the pollution source entering the watercourse. Monitoring could include:
  - Visual monitoring to see if water colour has changed or if a plume is visible indicating sediment input.
  - Water quality meter measurements for Dissolved Oxygen and pH.

7.2.2 Biosecurity

Good biosecurity practices are vital for preventing the spread of invasive non-native species and pathogens such as waterborne fish diseases. Measures should be adopted so that the construction activities do not lead to the spread of invasive non-native

species or pathogens, especially as invasive non-native species have been recorded in the area within the last 5 years. Recommended Biosecurity measures should include:

- All site personnel and site visitors should be informed of any known invasive non-native species present on site and that they are jointly responsible for preventing their spread/impacts. They should be made aware of what these species look like so they can avoid them where possible and take appropriate actions.
- All site personnel and visitors should be inducted in good biosecurity practices. This should include adoption of the check-clean-dry campaign (NNSS, 2015).
- The check-clean-dry poster should be displayed in the site office as a reminder of good biosecurity practices: http://www.nonnativespecies.org/downloadDocument.cfm?id=608 [site accessed: 28/1/19].
- All equipment, tools, vehicles and PPE used on site should be checked for any invasive non-native species seeds, leaves etc before leaving the area. If invasive non-native species seeds etc are identified, the items should be cleaned and removed seeds etc should be destroyed.
- Under no circumstances should soils with the potential to contain invasive non-native species seeds or fragments leave the site except to a waste handler able to receive this type of waste. Any earth movements within areas containing invasive non-native species should be minimised where possible.

The spread of waterborne diseases should be limited through the adoption of the check-clean-dry campaign. This would entail the use of a suitable disinfectant e.g. Virkon® S Aquatic to decontaminate all machinery and PPE prior to entering site and upon leaving site. Following application of a suitable disinfectant, machinery and PPE should be allowed to fully dry for at least 72 hours before being used on another aquatic site.

7.3 Conclusions

All of the waterbodies have an Overall Classification as Moderate. The main impacts will be to the Tees Estuary, which will subsequently impact the other waterbodies assessed. Implementation of the mitigation measures described above will ensure the proposed development of an ERF facility will be compliant with WFD Objectives.

This WFD assessment should be updated following confirmation of, and further details on, discharge and / or abstraction processes required for the operation of the ERF facility.

References

Directive 76/160/EEC concerning the quality of bathing water

EA (2015) Part 1: Northumbria river basin district River basin management plan. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718333/Northumbria_RBD_Part_1_river_basin_management_plan.pdf [Accessed 20 November 2019]

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