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Jacobs

Preston and South Ribble FRMS

Water Framework Directive Compliance Assessment

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Environment Agency

In partnership with:

Lancashire County Council

North West Regional Flood & Coastal Committee

Environment Agency

In partnership with:

Preston and South Ribble FRMS

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Author:	Judith Cudden
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3	Nov 2020	Further update following page turn.	JRC	SK	SK	SM

Contents

Important note about your report

- *This Water Framework Directive compliance assessment has been prepared for the Preston and South Ribble Flood Risk Management Scheme.*
- *Baseline data in the report was derived from the Environment Agency's catchment Data Explorer website (https://environment.data.gov.uk/catchment-planning). This is presumed accurate in preparing the report.*
- *If any of the proposed Scheme elements change then this will require the report to be re-evaluated.*
- *Jacobs excludes any warranty/guarantee (expressed or implied) to the data, observations and findings in the report to the extent permitted by law.*
- *The report should be read in full with no excerpts to be representative of the findings.*
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1. Introduction

This Water Framework Directive (WFD) compliance assessment report has been prepared for the Preston and South Ribble Flood Risk Management Scheme (FRMS) ('the Scheme') to be submitted as part of a planning application on behalf of the Environment Agency.

This assessment comprises a 'Clearing the Waters for All'[1] assessment, which only applies to transitional and coastal (TraC) water bodies.

1.1 Background

The WFD[2] requires all water bodies to achieve both good chemical status and good ecological status. For each River Basin District, a River Basin Management Plan (RBMP) outlines the actions required to enable natural water bodies to achieve this (Table 1.1). Water bodies that are designated in the RBMP as Heavily Modified Water Bodies (HMWB) or Artificial Water Bodies (AWB) may be prevented from reaching good ecological status by the physical modifications for which they are designated or purpose for which they were constructed (e.g. navigation, flood defence, urbanisation). Instead they are required to achieve good ecological potential, through implementation of a series of mitigation measures outlined in the applicable RBMP (and in some cases updated since the publication of the RBMP).

The Directive needs to be considered in the planning of all new activities in the water environment. The Environment Agency (EA), as competent authority in England and Wales are responsible for delivering the Directive through the Environment (Water Framework Directive) (England and Wales) Regulations 2017.

The WFD stipulates that all water bodies should meet good ecological status (GES) (or good ecological Potential (GEP) if an artificial or heavily modified water body) by a set timeframe. Overall ecological status (or potential) is made up of a number of biological, hydromorphological and chemical quality characteristics called elements. The overall status is determined by the lowest element status.

Any activity which has the potential to have an impact on ecology will need consideration in terms of whether it could cause deterioration in the ecological status or potential of a water body. It is, therefore, necessary to consider the possible changes associated with the options for the Scheme.

Where there are sites protected under EU legislation, the Directive aims for compliance with any relevant standards or objectives for these sites.

1 https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

2 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

Table 1.1: Environmental Objectives of the Water Framework Directive

Objectives
Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water.
Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015.
Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027.
Progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.
Prevent Deterioration in Status and prevent or limit input of pollutants to groundwater.

The generic environmental objectives set out below (based on Article 4.1 of the Directive and as described in Table 1.1) are used for the assessment of the Scheme in relation to the Directive:

- No changes affecting high status sites;
- No changes that will cause failure to meet surface water good ecological status or potential or result in a deterioration of surface water ecological status or potential;
- No changes which will permanently prevent or compromise the Environmental Objectives being met in other water bodies; and
- No changes that will cause failure to meet good groundwater status or result in a deterioration groundwater status.

Member states must meet the conditions of the WFD unless they meet the criteria laid out in Article 4.7. To be compliant, the following condition must be met: "the beneficial objectives served by the modifications or alterations of the water body cannot, for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option."

2. Outline of the scheme

2.1.1 Overview

The Preston and South Ribble FRMS offers an improved standard of protection to approximately 4778 properties along the Rivers Ribble and Darwen. The Scheme consists mainly of replacing and/or raising the existing concrete walls and earth embankments and is split into five areas. This WFD compliance assessment covers Areas 1 and 2 as they are in the first stage of the overall Scheme. The compliance assessment will be updated as Areas 3, 4 and 5 to support further planning applications. However, the description of the overall Scheme is given below for completeness.

- Area 1: Riversway and Broadgate;
- Area 2: Lower Penwortham;
- Area 3: Frenchwood & Walton-le-Dale (Ribble frontage);
- Area 4: Walton-le-Dale (Darwen frontage); and
- Area 5: Higher Walton.

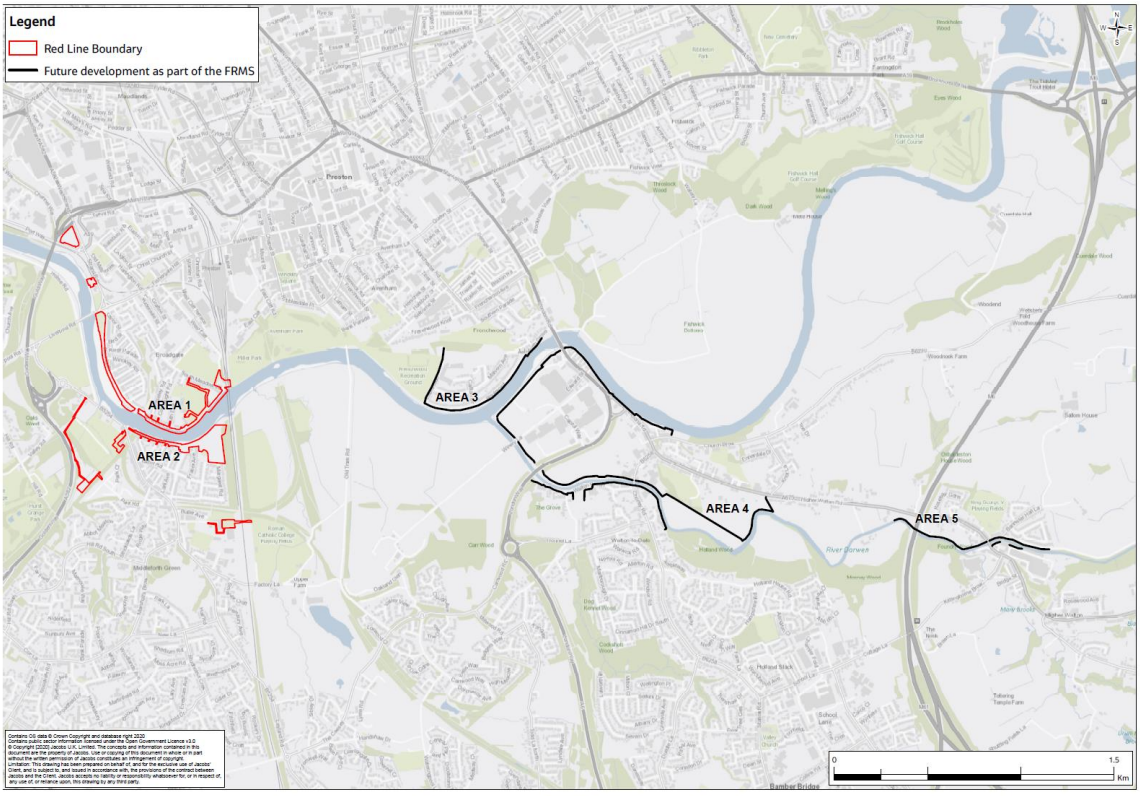

Figure 2.1 The five areas of the Preston and South Ribble FRMS.

2.2 Area 1: Riversway and Broadgate

Located on the right (north) bank of the River Ribble, to the south of the city centre. This area is approximately 1.2km long, extending from the West Coast Main Line (WCML), downstream to Liverpool Road Bridge. Proposed defences comprise:

- Replacement of the existing concrete wall, with a new concrete wall, between Liverpool Road bridge and Penwortham Old Bridge;
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside between Penwortham Old Bridge and Miller Gardens Apartments;
- A new flood gate located in front of Miller Gardens Apartments; The gate is a permanent structure and will be held in an open position against the wall until it is required to be used during flood conditions.
- A new concrete wall along the boundary of the BAC/EE Preston Social and Sports Association cricket pitch between Miller Gardens Apartments and Ribble Cottage;
- A new flood gate located close to Ribble Cottage;
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, running on the river side of the road between Ribble Cottage and the railway viaduct;
- A concrete wall and two flood gates at the entrance to the western end of the West Coast Main Line railway bridge; and
- In addition, three lengths (82m, 247m and 151m) of the existing river bank from just downstream of Old Penwortham bridge to the WCML will be stabilised with a blockwork (Redi-Rock) revetment (Figure 2.). The Redi-Rock will be seeded with tussocky grasses (above water level) and Phragmites (below water level) to encourage green niches and habitat creation. Figure 2. and Figure 2. show the length of encroachment into the Ribble estuary channel and the area of intertidal soft sediment (mudflat) lost beneath the works. Across both Areas 1 and 2 the total area of mudflat lost is 1,564.32m^2.

2.3 Area 2: Lower Penwortham

Located on the left (south) bank of the River Ribble, to the south of the city centre. This area is approximately 0.8km long, extending from the West Coast Main Line (WCML), downstream to Penwortham Old Bridge, and turning inland to tie into the abandoned railway embankment. Proposed defences comprise:

- A new concrete wall along the boundary of the Penwortham Methodist Church between the church and the allotments. In order to maintain security of the allotments, fencing will be installed along the top of the new wall.
- A new ramp to raise existing road levels at the entrance to Penwortham Methodist Church and a up and over ramp along the Golden Way Footpath between the Penwortham Methodist Church and the disused railway embankment.
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside Road extending upstream from the Cadent Gas pipe bridge;
- New concrete wall along the river front linking Riverside Road to Ribble Sidings. A blockwork retaining wall 70m in length (Redi-Rock) and inclined embankment will be constructed to stabilise the existing bank (Figure 2.3). The Redi-Rock will be seeded with tussocky grasses (above water level) and Phragmites (below water level) to encourage green niches and habitat creation. Figure 2. and Figure 2. show the length of encroachment into the Ribble estuary channel and the area of intertidal soft sediment (mudflat) lost beneath the works. Across both Areas 1 and 2 the total area of mudflat lost is 1,564.32m^2.;
- An earth embankment along the river front of Ribble Sidings, replacing the existing embankment;

In addition, there are two further isolated sections of defence:

- A short earth embankment in the gap in the abandoned railway embankment, at the access point to Penwortham Residential Park; and

- Filling in a culvert under the WCML, some 500m inland from the River Ribble.

2.4 Area 3: Frenchwood

Located on the left (south) and right (north) banks of the River Ribble, to the east of the city centre, upstream of the confluence with the River Darwen. This area comprises three sections of defence:

- 1.1km of earth embankment and concrete wall running along the Esplanade, and replacing or raising existing wall and embankment along the Boulevard in Frenchwood, on the north bank;
- Raising 0.5km of existing earth embankment and concrete wall between the confluence of the Ribble and Darwen and London Road Bridge on the south bank; and
- Replacement of the existing concrete wall (0.8km), with some sections of glass panels on top, between London Road Bridge and Kings Croft.

2.5 Area 4: Walton-le-Dale

Located on the right (east) and left (west) banks of the River Darwen, through Walton-le-Dale to the south of the city centre:

- On the right bank proposed defences comprise predominantly earth embankments, extending some 1.9km upstream from the confluence with the Ribble. Flood walls locally, only in close proximity of buildings;
- On the left bank, proposed defences comprise a combination of concrete wall, earth embankment and road ramps extending approximately 0.8km upstream of the confluence.

2.6 Area 5: Higher Walton

Located on the right (east) and left (west) banks of the River Darwen, at Higher Walton, extending upstream from the M6 motorway:

- On the right bank proposed defences comprise a combination of concrete walls and earth embankments, extending some 1.0km upstream from the motorway;
- On the left bank, proposed defences comprise predominantly concrete or sheet pile walls, extending approximately 0.5km upstream of the Cann Bridge.

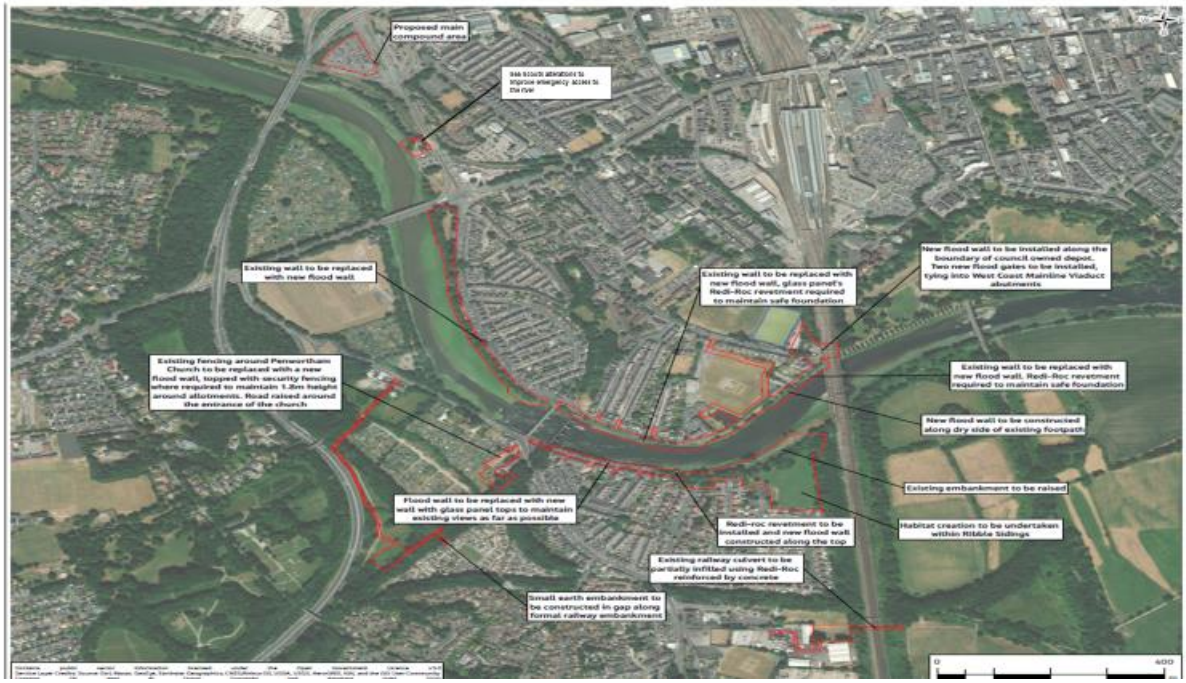

Figure 2.2: Scheme layout with redline boundary for planning

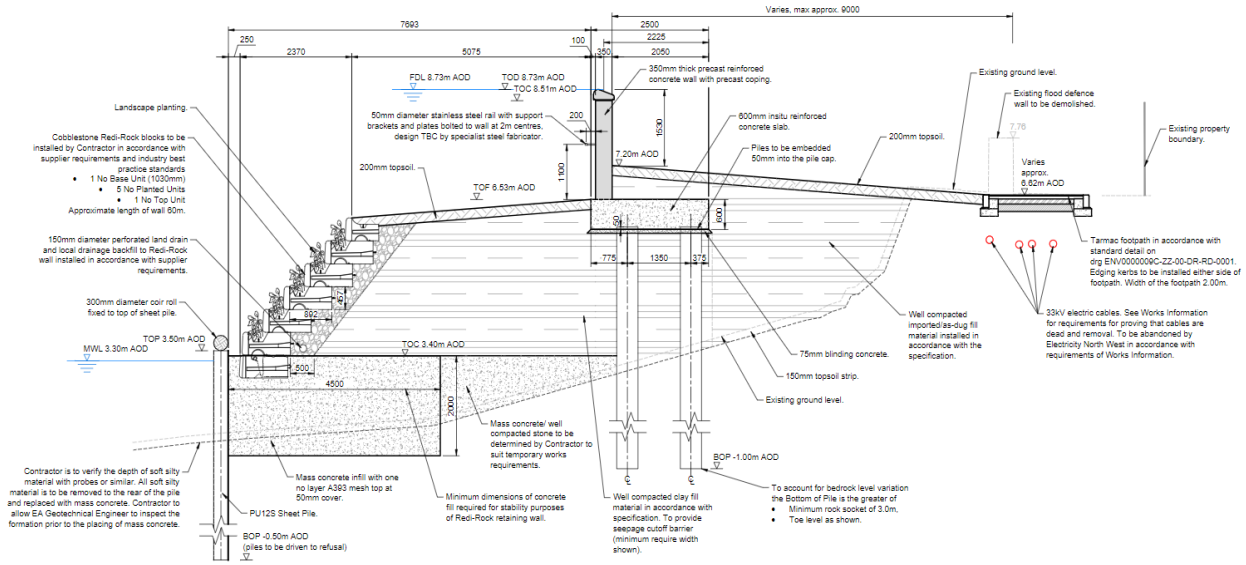

Figure 2.3: Cross section of typical Redi Rock solution.

2.7 Scheme design and build out into the channel

The design of the scheme along Riverside, Riverside Road and short section along the upstream extent of Broadgate, in Areas 1 and 2, includes the construction of a revetment in order to stabilise the existing river bank. These works will encroach on the existing channel. To assist in undertaking the WFD compliance assessment, hydraulic modelling and GIS analysis have been undertaken to investigate any impacts of the sections of the Scheme that are built out into the estuary on the following parameters:

- Area of encroachment (Figure 2.4);
- Area of mudflat lost under built-out sections of defence (Figure 2.5);
- Impacts of built out sections on fluvial and tidal levels and velocities within the channel (Figure 2.6).

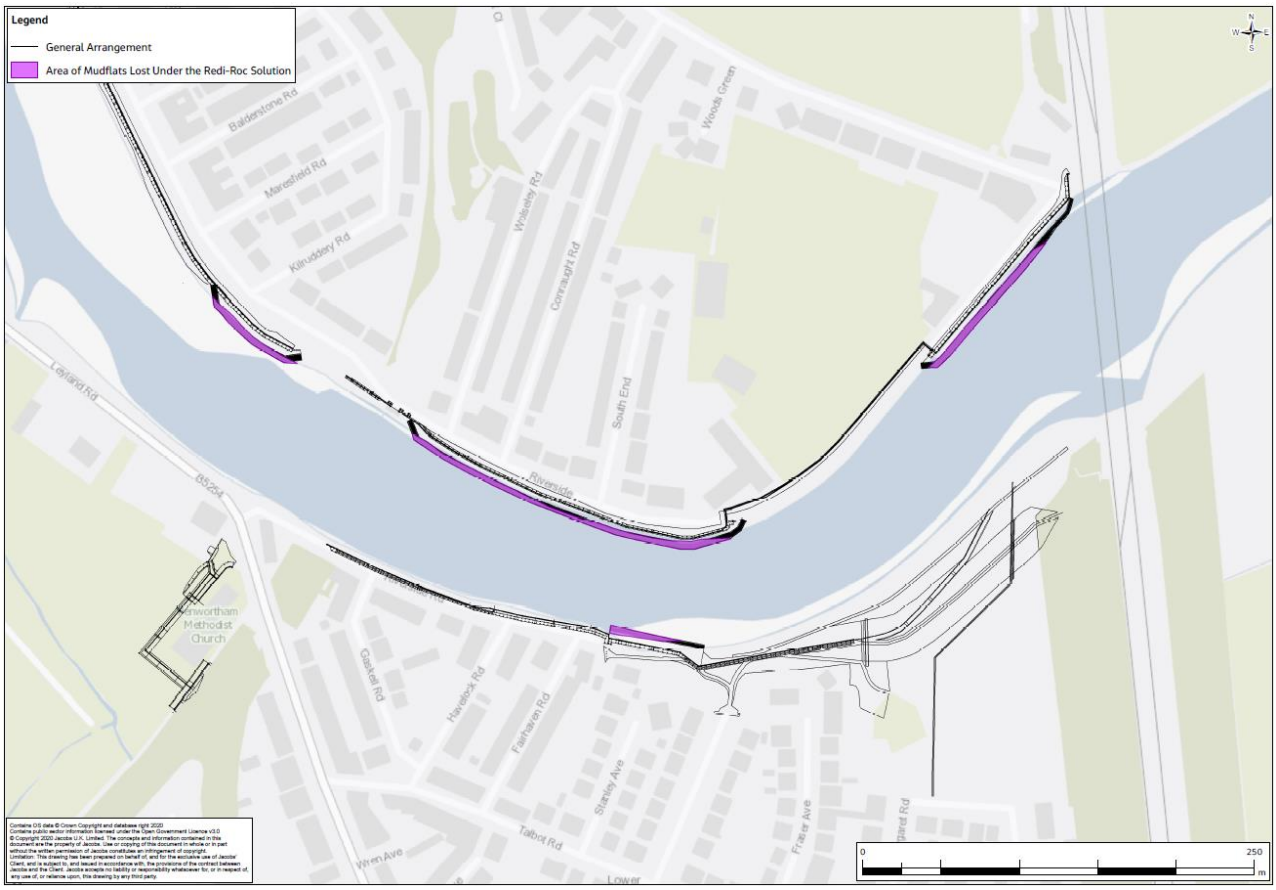

Figure 2.4: Areas of encroachment into the Ribble estuary for Area 1(North bank) and Area 2 (South bank) shown in purple.

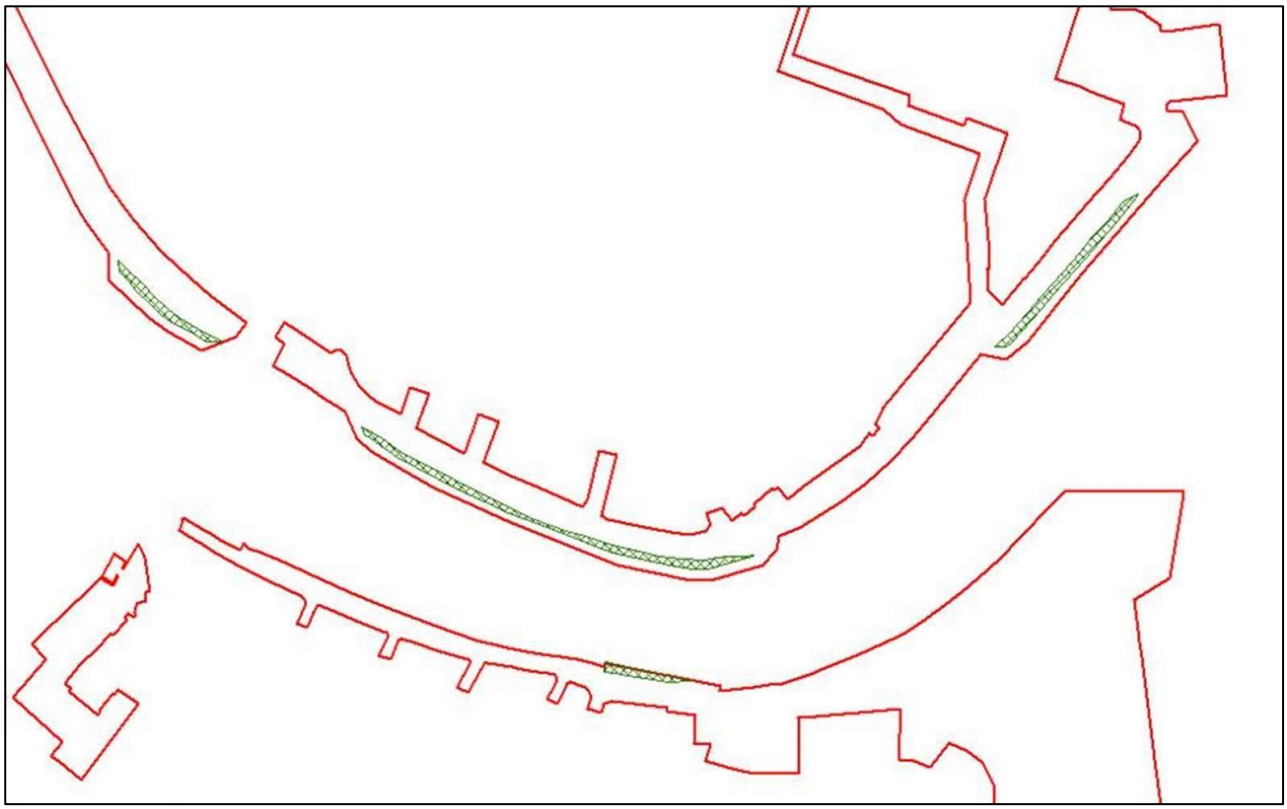

Figure 2.5: GIS representation of areas of encroachment (red outline) into the Ribble estuary for Areas 1 and 2 showing mudflat lost (green hatching) beneath the Scheme works. Across both Areas 1 and 2 the total area of mudflat lost is 1,564.32m^2 or 0.001km^2.

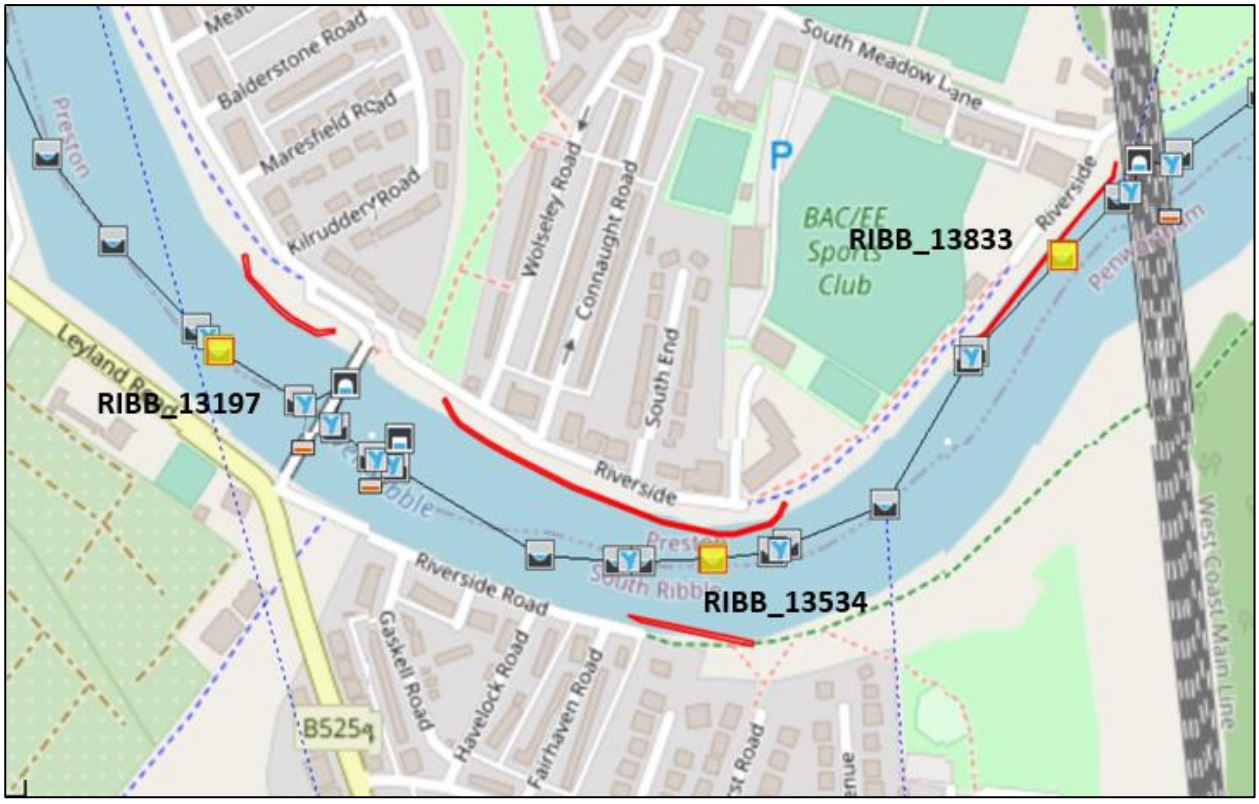

Figure 2.6: Model schematic showing "with scheme" model for Areas 1 and 2.

The hydraulic model has been modified to reflect the proposed channel, and flow rates and levels compared for the existing situation, and with the scheme in place. The results are discussed below.

Four scenarios have been modelled:

1) 1:10 year fluvial flows, 1:10 year tidal;
2) 1:10 year fluvial flows, Mean High Water Spring (MHWS) tidal;
3) 1:75 year fluvial flows, MHWS tidal; and
4) 1:10 year fluvial flows, 1:75 year tidal

These scenarios include consideration of climate change up to 2040.

The peak flows occur approximately 28 hours into the model, at this time the following flows are predicted (Table 2.1).

Table 2.1: Comparison of peak flow rates pre- and post- scheme

Maximum Flow (m^3/s)	**Scenario 1: 1:10 fluvial, 1:10 tidal**	**Scenario 2: 1:10 fluvial, MHWS tidal**	**Scenario 3: 1:75 fluvial, MHWS tidal**	**Scenario 4: 1:10 fluvial, 1:75 tidal**
Existing	955	953	1348	955
With scheme	948	946	1357	949
Difference	-6.6	-7.1	+9.0	-6.9
Percentage Change	-0.7%	-0.7%	+0.7%	-0.7%

From Table 2.1, it can be seen that the encroachment ("with Scheme" in Table 2.1) has minimal impact on river flow rates when compared to the existing situation ("Existing" in table 2.1). The peak flow of 1357 m^3/s occurs in the fluvial design event: the 1 in 75 year return period. With the channel being approximately 67 m wide, and the height from channel bed to top of defence approximately 10.5 m, the channel has a cross sectional area of approximately 500 m^2 when in flood (to the top of the defences, before water would spill over into the flood plain. This equates to an average velocity of 3 m/s. To put this speed into context, grassed earth embankments are typically considered to be safe from erosion by current alone in velocities of up to 3 m/s. Engineering calculations undertaken indicate that Redi-Rock will remain in-situ at these velocities. The use of a pre-seeded geotextile in the area between the top of the Redi-rock and the flood defence wall may be required to prevent erosion in flood events.

Maximum differences in stage along the channel are given in **Error! Reference source not found.** , 2.3 and 2.4.

Table 2.2: Comparison of stage (mAOD) levels pre- and post- scheme (at model node RIBB_13833 v27)

Maximum Stage (m AOD)	**Scenario 1: 1:10 fluvial, 1:10 tidal**	**Scenario 2: 1:10 fluvial, MHWS tidal**	**Scenario 3: 1:75 fluvial, MHWS tidal**	**Scenario 4: 1:10 fluvial, 1:75 tidal**
Existing	7.122	6.397	7.575	7.322
With scheme	7.149	6.564	7.833	7.341
Difference	0.027	0.167	0.257	0.019

Percentage Change	0.38%	2.62%	3.40%	0.26%

Table 2.3: Comparison of stage levels (mAOD) pre- and post- scheme (at model node RIBB_13534). This is where encroachment is required along both the north and south banks.

Maximum Stage (m AOD)	**Scenario 1: 1:10 fluvial, 1:10 tidal**	**Scenario 2: 1:10 fluvial, MHWS tidal**	**Scenario 3: 1:75 fluvial, MHWS tidal**	**Scenario 4: 1:10 fluvial, 1:75 tidal**
Existing	7.037	6.053	7.161	7.259
With scheme	7.053	6.204	7.405	7.269
Difference	0.016	0.150	0.244	0.010
Percentage Change	0.22%	2.48%	3.41%	0.14%

Figure 2.4: Comparison of stage levels (mAOD) pre- and post- scheme (at modal node RIBB_13197).

Maximum Stage (m AOD)	**Scenario 1: 1:10 fluvial, 1:10 tidal**	**Scenario 2: 1:10 fluvial, MHWS tidal**	**Scenario 3: 1:75 fluvial, MHWS tidal**	**Scenario 4: 1:10 fluvial, 1:75 tidal**
Existing	6.936	5.698	6.601	7.193
With scheme	6.923	5.701	6.621	7.188
Difference	-0.012	0.004	0.020	-0.005
Percentage change	-0.18%	0.06%	0.30%	-0.08%

Modelling therefore indicates the following for the "with scheme" scenario:

- Maximum water levels for fluvial dominated events within reach are increased with the presence of the scheme.
- There is little/no influence on tidal water levels.
- There are no significant impacts on flow for fluvial and tidal events.

2.8 WFD screening

This WFD assessment covers only those components of the scheme that could affect the tidal water body receptors, as per the requirements set out in the Clearing the Waters For All guidance[3]. These are:

- hydromorphology
- biology – habitats

[3] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

- biology – fish
- water quality
- protected areas

The assessment, as per the WFD Regulations' (2017) requirements, looks at the effect of new modifications to the water bodies and any changes to existing modifications.

3. Methodology

The EA's Catchment Data Explorer[4] was used to collate the baseline data for each relevant water body, and subsequently assess water bodies present within the Scheme's Study Area. It includes their ID numbers, designation and classification details. The WFD compliance mapping for groundwater risk and status assessment was also reviewed along with any other supporting data.

There follows a baseline assessment of the main water bodies, and a Clearing the Waters for All scoping assessment of the principal receptors potentially affected by the works. This is followed by the impact assessment, which considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and indicates if an activity may cause deterioration or jeopardise the water body achieving GEP/GES.

There are several stages to this assessment:

- A scoping assessment of the main receptors including protected areas for nature conservation, bathing water etc (section 4);
- An assessment against quality elements including hydromorphology, biology, water quality, protected areas and invasive species (section 5);
- An assessment of the receptors scoped in section 4 against scheme elements (section 6);
- Assessment of the scheme against mitigation measures (section 7); and a cumulative assessment against other proposed schemes (section 6); and
- Assessment against other EU Directives (section 8).

[4] Catchment Data Explorer, http://environment.data.gov.uk/catchment-planning/

4. Baseline scoping

4.1 Water body scoping

The following WFD water bodies are relevant to the Scheme:

- Ribble Transitional/Coastal (TRaC) (WFD ID: GB531207112400) (Figure 4.1). This is a transitional water body. Scheme elements for Areas 1 and 2 (in this assessment) and Areas 3 and 4 are located within this water body. The water body is therefore scoped in.
- Darwen – confluence Roddlesworth to tidal (WFD ID: GB112071065300) (Figure 4.2). This is a surface water body (fresh water). Scheme elements for Area 5 and the upstream extent of Area 4 are located within this water body. As it is upstream of the tidal limit it is unlikely that any impacts of the Areas 1 and 2 Scheme will propagate upstream and it has therefore been scoped out of the Areas 1 and 2 WFD compliance assessment. However, the WFD water body status details are given below in Table 4.1 as this water body will be scoped into the assessments for Areas 4 and 5.
- Fylde Permo-Triassic Sandstone Aquifers WFD ID: GB41201G100500. (Figure 4.3). This is the groundwater body underlying the scheme and has been scoped in as piling is required.

The water bodies are shown in Figure 4.1 to Figure 4.3. A summary of the status of these water bodies is included in Table 4.1.

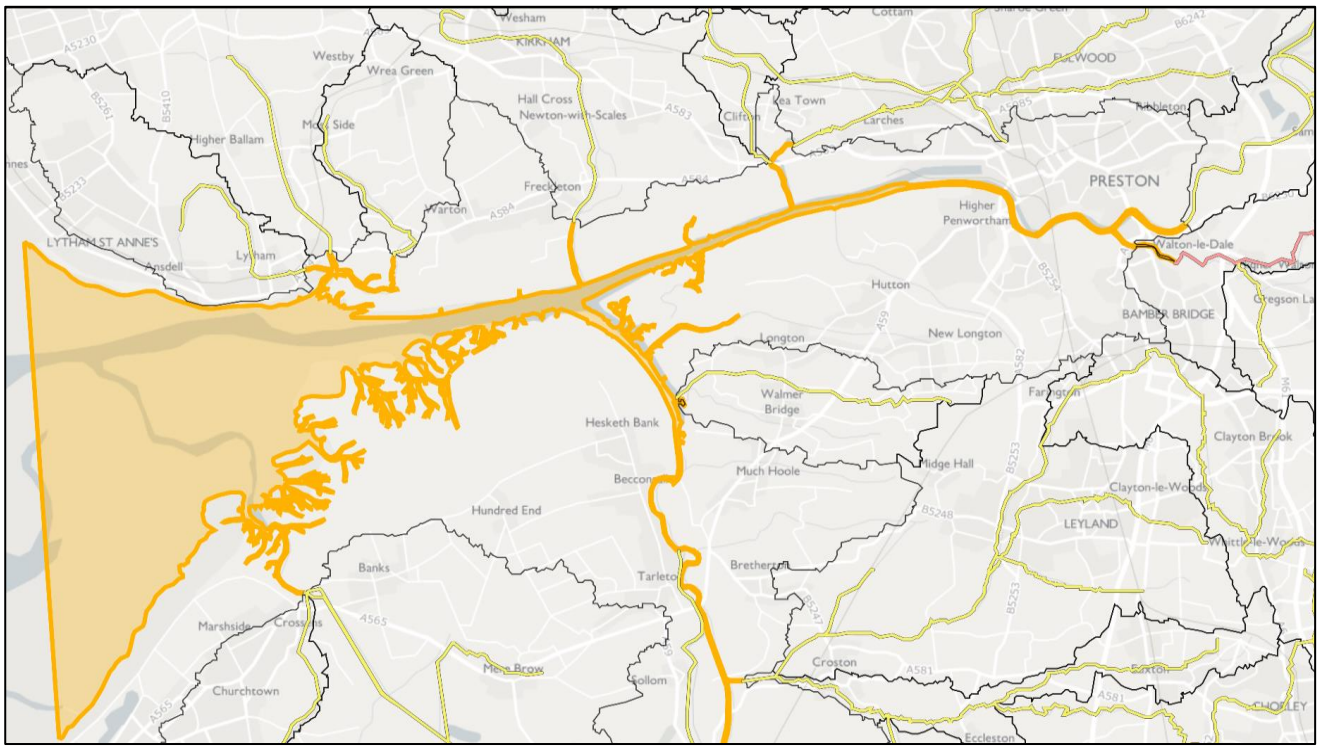

Figure 4.1: Ribble Transitional Water Body. Source: https://environment.data.gov.uk/catchment-planning/

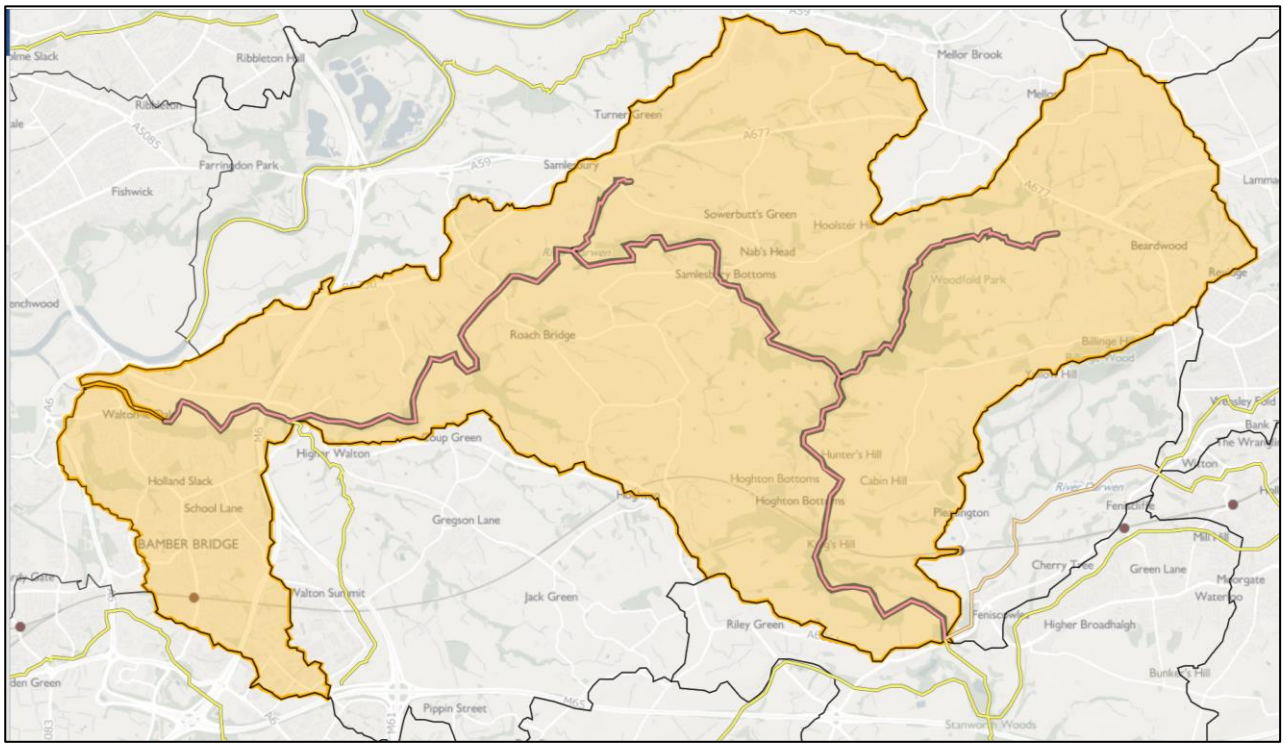

Figure 4.2: Darwen – confluence Roddlesworth to tidal surface Water Body. Source: https://environment.data.gov.uk/catchment-planning/

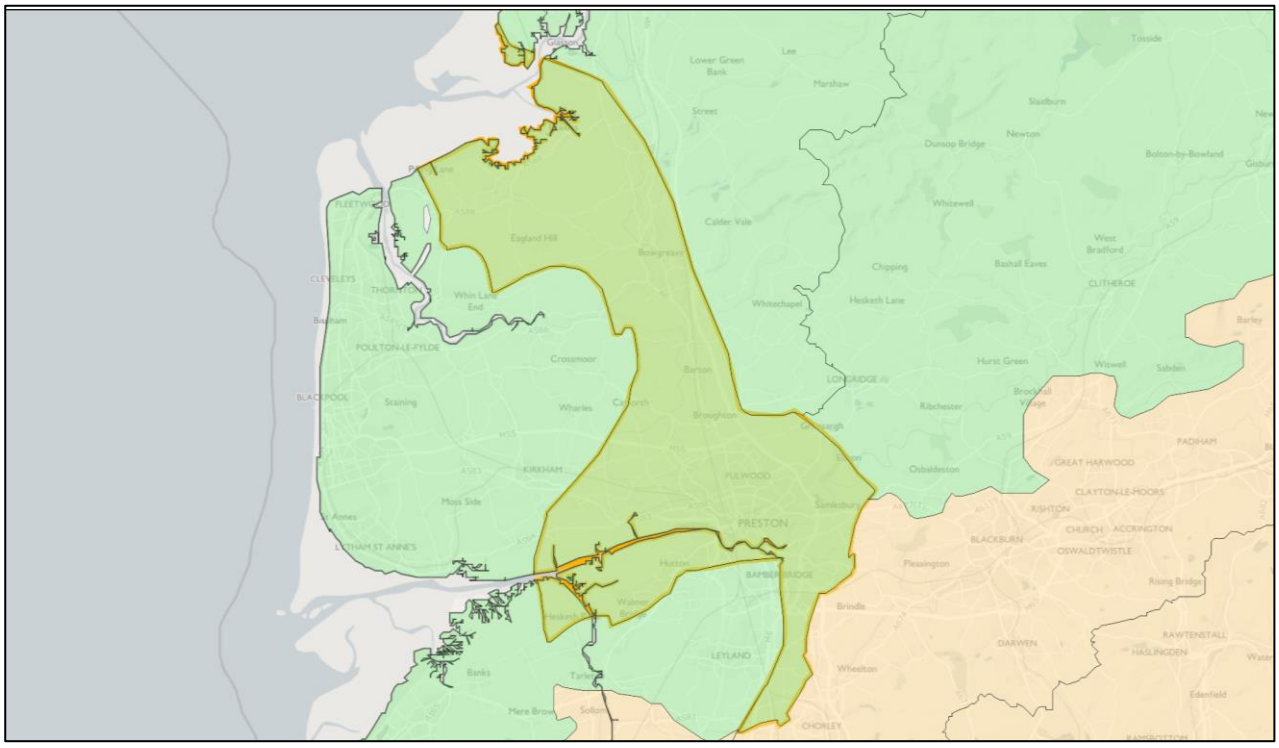

Figure 4.3: Fylde Permo-Triassic Sandstone Aquifers Groundwater Body. Source: https://environment.data.gov.uk/catchment-planning/

Table 4.1: Water body status. Cycle 3 (2019) data. (Data extracted from https://environment.data.gov.uk/catchment-planning/)

	Ribble	Darwen – confluence Roddlesworth to tidal	Fylde Permo-Triassic Sandstone Aquifers
Water body Type	Transitional	Surface Water	Groundwater
Water body ID	GB531207112400	GB112071065300	GB41201G100500
Hydromorphological designation	Heavily Modified (flood protection)	Not designated Heavily Modified	N/A
NGR	SD3459822935	SD5834627584	SD3998159692
Catchment Area (km^2)	-	36.758	-
Length (km)	-	19.7	-
Surface Area (km^2)	45.277	-	320.498
Groundwater Area (ha)	-	-	32049.84
Current Status / Potential	Bad	Moderate	Poor
Objective status/ Potential and reasons for not achieving good	Good by 2027 Disproportionate burdens	Good by 2027 Disproportionate burdens	Good by 2015
Reasons for not achieving good (RNAG)	▪ Physical modification: (Mitigation Measures assessment) ▪ Sewage discharge (continuous): Macroalgae ▪ Sewage discharge (continuous): Dissolved inorganic nitrogen ▪ Sewage discharge (continuous): Phytoplankton	▪ Sewage discharge (continuous): Macrophytes and Phytobenthos Combined; Phosphate; Ammonia (Phys-Chem); Fish; Tricolsan; Invertebrates; Benzo (ghi) perelyene and indeno (123-cd) pyrene, Invertebrates ▪ Misconnections: Phosphate; Ammonia (Phys-Chem) ▪ Poor nutrient management: Phosphate ▪ Private sewage treatment: Invertebrates; Ammonia (Phys-Chem) ▪ Barriers – ecological discontinuity: Fish	No data shown.
Supporting Elements (Surface Water)	▪ Mitigation Measures Assessment: Moderate or less	-	-
Biological Quality Elements	▪ Angiosperms: Good ▪ Fish: Moderate ▪ Invertebrates: Good ▪ Macroalgae: Good ▪ Phytoplankton: Bad	▪ Fish: Moderate ▪ Invertebrates: Poor ▪ Macrophytes and phytobenthos combined: Moderate	-
Hydromorphological Supporting Elements	▪ Hydrological regime: Supports Good	▪ Hydrological regime: Supports Good ▪ Morphology: Supports Good	-

	Ribble	Darwen – confluence Roddlesworth to tidal	Fylde Permo-Triassic Sandstone Aquifers
Physico-chemical quality elements	▪ Dissolved inorganic nitrogen: Moderate ▪ Dissolved oxygen: High	▪ Acid neutralising capacity: High ▪ Ammonia (Phys-chem): Moderate ▪ Dissolved Oxygen: High ▪ pH: High ▪ Phosphate: Poor ▪ Temperature: Good	-
Specific Pollutants	▪ Chromium (VI): High ▪ Arsenic: High ▪ Copper: High ▪ Iron: High ▪ Un-ionised ammonia: High ▪ Zinc: High	▪ Chlorothalonil: High ▪ Pendimethalin: High ▪ Manganese: High ▪ Arsenic: High ▪ Copper: High ▪ Iron: High ▪ Zinc: High	-
Chemical quality elements	▪ Priority substances: Good ▪ Other pollutants: does not require assessment ▪ Priority hazardous substances: Fail	▪ Priority substances: Good ▪ Other pollutants: does not require assessment ▪ Priority hazardous substances: Fail	-
Protected Areas	▪ Conservation of Wild Birds Directive: Ribble and Alt Estuaries Special Protection Area (SPA) ▪ Conservation of Wild Birds Directive: Liverpool Bay SPA Urban Waste Water Treatment Directive: River Darwen ▪ Habitats and Species Directive: Sefton Coast Special Area of Conservation (SAC) ▪ Shellfish Water Directive: Ribble	▪ Urban Waste Water Treatment Directive: River Darwen	▪ Drinking Water Protected Area: Fylde Permo-Triassic Sandstone Aquifers (UKGB41201G100500)
Higher sensitivity habitats present	▪ Saltmarsh (2418.40 ha)	▪ -	▪ -
Lower sensitivity habitats present	▪ Intertidal soft sediment (sand, mud and mixed) (5520.35 ha)	▪ -	▪ -
Quantitative Status element	-	-	▪ Quantitative Saline Intrusion: Good ▪ Quantitative Water Balance: Poor ▪ Quantitative Ground Water Dependent Terrestrial

	Ribble	Darwen – confluence Roddlesworth to tidal	Fylde Permo-Triassic Sandstone Aquifers
			Ecosystems (GWDTEs) test: Good ▪ Quantitative Dependent Surface Water Body Status: Good
Chemical (groundwater) status element	-	-	▪ Chemical Drinking Water Protected Area: Good ▪ General Chemical Test: Good ▪ Chemical GWDTEs test: Good ▪ Chemical Dependent Surface Water Body Status: Good ▪ Chemical Saline Intrusion: Good

4.2 Clearing the Waters assessment scoping

4.2.1 Protected areas

The WFD requires that activities are also in compliance with other relevant legislation, as considered below. The Clearing the Waters for All guidance recommends that the following are looked at as part of the assessment:

4.2.2 Nature conservation designations

These are areas previously designated for the protection of habitats or species where maintaining or improving the status of water is important for their protection. They comprise the aquatic part of Natura2000 sites – Special Protection Areas (SPAs) designated under the Birds Directive (79/409/EEC) and Special Areas of Conservation (SACs) designated under the Habitats Directive (92/43/EEC).

Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources; in the UK, Ramsar sites are afforded the same status as SPAs and SACs.

The MAGIC website (https://magic.defra.gov.uk/MagicMap.aspx) was used to find out the nature conservation designations within 2 km of the site. There are no protected areas within 2km of the Scheme. The nearest protected area is the Ribble and Alt Estuaries SPA which is approximately 6.2km downstream of the scheme.

The Ribble Estuary is designated as a Marine Conservation Zone (MCZ) (UKMCZ0067) (1542.795 ha). The Scheme sits within this MCZ. An assessment of impacts on the MCZ is outside the scope of the WFD Regulations, and therefore not part of this compliance assessment. An MCZ assessment and has been undertaken separately; however, the reports have synergies and have been developed in collaboration.

4.2.3 Bathing waters

Bathing waters are those designated under adopted Bathing Water Directive (2006/7/EC).

There are no bathing water sites within 2km of the Scheme. The closest are at Lytham St. Anne's approximately 21km downstream from the scheme, so this is scoped out of further assessment

4.2.4 Nutrient sensitive areas

Nutrient sensitive areas comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Waste Water Treatment Directive (UWWTD)(91/271/EEC). The UWWTD aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban waste water. Sensitive areas under the UWWTD are water bodies affected by eutrophication associated with elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

There are no nutrient sensitive sites within 2km of the Scheme. The closest Nitrate Vulnerable Zone is 2.5 km from the Scheme to the south west, and is scoped out of further assessment. There are no Coastal Sensitive Areas (Eutrophic) within 2km of the Scheme.

4.2.5 Shellfish waters

The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. However, the latest standards for the implementation of the WFD in England and Wales suggest 'Protected areas under WFD include shellfish waters and we are proposing to direct the Agencies to continue to endeavour to observe the microbial standard in shellfish waters, to contribute to a high quality shellfish product directly edible by humans' (Department for Environment, Food and Rural Affairs (Defra), 2014). However, while the guideline bacteriological standard of the former directive has been retained, it is understood that the water column standards have been dispensed with as these are considered to be adequately covered by other aspects of the WFD (Environment Agency and Water UK, 2013).

There are no shellfish waters within 2km of the Scheme.

5. Assessment against quality elements

This section details a site-specific assessment of the Scheme against quality elements for biology, physico-chemical and hydromorphological elements for the transitional water bodies following the 'Clearing the Waters for All' guidance.

5.1 Hydromorphology

This section provides a summary of the known existing hydromorphology risk issues for the Ribble transitional water body (Table 5.1).

Table 5.1: Hydromorphology scoping summary

	Ribble TrAC
Consider if your activity could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status?	No. The Ribble transitional water body is not at high status (it is currently at Bad status).
Consider if your activity could significantly impact the hydromorphology of any water body?	Yes (potential changes to hydromorphology as a result of works). Changes could include narrowing of the estuary due to encroachment of flood defences seaward. Modelling has indicated no significant impacts on flows and small increases in maximum water levels for fluvial dominated events within reach between Areas 1 and 2. There is little/no influence on tidal water levels. However, an impact assessment is required. This will also support low sensitivity habitats that have been scoped in as part of the biological (habitat) quality elements.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	Yes. The Ribble transitional water body is designated as a HMWB due to flood protection. Impact assessment is therefore required.

5.2 Biology

5.2.1 Habitats

5.2.1.1 Current habitat within the channel in the vicinity of Areas 1 and 2

Inspection of the river banks to be replaced with Redi-Rock planted terracing in the most upstream section of the northern bank (Area 1) to be replaced by Redi-Rock planted terracing at Riverside to the rail bridge has generally almost vertical banks. This offers moderate fish refuge depending on the tidal height, with some vegetation around the high-water mark. Crevices and accumulations of revetment material and the presence of short wooden post structures and submerged tree trunk sections are likely to provide refuge areas and habitat for fish. The habitat improves immediately upstream of this section by the rail bridge with a vegetated bank of a shallower gradient.

The bank along the central encroachment stretch of Area 1 (at Riverside, upstream of Penwortham old bridge) offers a range of habitat with some steep sides with vegetation (sometimes short) along the upper tidal limit. Submerged tree trunks, exposed tree roots, eroded stands of vegetation and mud at lower tidal levels are also present. It offers moderate value smelt habitat when inundated as bank are comparatively steep.

The bankside habitat on the furthest downstream bank to be replaced by Redi-Rock planted terracing (downstream of Penwortham old bridge, Area 1) provides relatively poor fish refuge habitat at most tidal states compared to immediately downstream. It consists of broken up stone revetment with less vegetation present and less opportunity for low flow areas, although at the highest tide there is refuge within the bankside vegetation (Figure 5.1).

Figure 5.1: Downstream of Penwortham old bridge, Area 1: example habitat to be replaced

Immediately downstream of this encroachment stretch within Area 1, the bank provides relatively good fish habitat particularly at mid to high water with habitat heterogeneity under overhanging trees (wood, eroded clumps of vegetation and mud substrate). Similarly, the wider area within Area 1, downstream of the encroachment areas (i.e. between Liverpool Road Bridge and the encroachment downstream of Penwortham old bridge) contains areas of relatively good fish refuge habitat that will be retained as part of the scheme. It comprises a relatively shallower gradient, mud substrate and eroded clumps of vegetation with creek-like crevices. (Figure 5.2).

Figure 5.2: Bank/intertidal habitat in Area 1, downstream of encroachment areas.

The bankside habitat on the southern bank (Area 2) to be replaced by Redi-Rock comprises eroded mudflats, some marginal vegetation and offers potential fish refuge around high water.

Although these stretches of banks are to be replaced, the Redi-rock planted terracing habitat will offer comparable value for fish refuge in the long term, as it would provide a permanent and more robust base for planting, particularly if retaining media were incorporated (i.e. brushwood).

As the conservation objective for smelt is to return to favourable condition and with no smelt recorded in TraC surveys between 2014 and 2018, this habitat enhancement incorporated into the new flood defences will assist in this. Guidance for the tidal Thames (ZSL, 2016) suggests the installation of terracing or sloping faces to make developments more fish friendly. The Redi-Rock terracing proposed would provide habitat of this type and make the flood defence face less steep and provide more features than standard vertical flood defence structures. This terracing will be seeded with tussock forming grasses which on the lower levels will help trap and retain sediment. Coir rolls will be seeded with species such as Phragmites. Where possible flow deflectors and/or fixed tree trunk sections can also provide areas of slower flow or back-eddies, which are important to allow fish to hold station particularly on their upstream migrations.

Although these stretches of banks are to be replaced, the Marine Conservation Zone assessment notes that replacement Redi-Rock planted terracing habitat will offer comparable value for fish refuge. As the conservation objective for smelt is to return to favourable condition and with no smelt recorded in TraC surveys between 2014 and 2018, this habitat enhancement incorporated into the new flood defences will assist in this. Guidance for the tidal Thames (ZSL, 2016) suggests the installation of terracing or sloping faces to make developments more fish friendly. The Redi-Rock terracing proposed would provide habitat of this type and make the flood defence face less steep and provide more features than standard vertical flood defence structures. This terracing will be planted up.

Table 5.2 presents a summary of biology (habitat) considerations and associated risk issues for the works for the transitional water body.

Table 5.2: Biology scoping summary

	Ribble TrAC
Is the footprint of the activity 0.5 km^2 or larger?	No. In **Area 1** the total length of Redi-Rock is 460m. The average encroachment seawards into the estuary is 3.75m. Therefore, the area is 1725m^2. In **Area 2** the total length of Redi-Rock is 75m. The average encroachment is 6m. Therefore, the area of encroachment seawards into the estuary is 450m^2. In total over **Areas 1** and **2** the total encroachment seawards into the estuary is 2175m^2 or 0.002km^2. Note this is larger than the area of mudflat covered by the defences as mudflat is not present in all areas of the channel where Redi-Rock will be constructed.
Is the footprint of the activity 1% or more of the water body's area?	No. The surface area of the Ribble TrAC water body is 45.277km^2. 1% of this is 0.45km^2. The area of encroachment is 0.002km^2
Is the footprint of the activity within 500 m of any higher sensitivity habitat?	No. There are no higher sensitivity habitats within 500m of the Scheme. The nearest higher sensitivity habitats are saltmarsh approximately 3.5km downstream and is not affected by the scheme. There is no direct pathway attributed to the activity to impact it as a receptor. With tidal forcing and currents combined, there is unlikely to be any effect propagated this far downstream
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	No. There is only one type of lower sensitivity habitat within the Ribble Trac water body. This is intertidal soft sediment (sand, mud and mixed). There are 5520ha (55.2km^2) of intertidal soft sediment within the Ribble transitional water body[1]. GIS analysis (Figure 2.) has indicated that the total area of mudflat lost under the defences is 1564.32m^2 or 0.001km^2

	Ribble TrAC
	Therefore activities in Areas 1 and 2 will not cover 0.55km^2 (1%) of this total mudflat habitat within the water body.

1 Source:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/658333/wfd_water_body_summary_table.XLSX

Even though the biological (habitats) receptor could be scoped out of further assessment, it has been scoped in due to the overlap between the hydromorphology of the estuary and the intertidal soft sediments of lower sensitivity which support the hydromorphology.

5.2.2 Fish

Activities occurring within an estuary or inshore environment could impact on expected fish behaviour such as movement, migration or spawning. Table 5.3 presents a summary of biology (fish) considerations and associated risk issues for the works. As at least one biology (fish) consideration indicates that a risk could be associated with the works, this receptor has been scoped into the impact assessment for the transitional water body.

Table 5.3: Biology (fish) scoping summary

	Ribble TrAC
Consider if your activity is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary?	Yes. Smelt migrate into and spawn within the estuary. Salmonids have also been recorded in the estuary. Impact assessment required.
Consider if your activity could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)?	Yes. Piling noise and vibration, and associated change in suspended sediment concentrations and construction plumes could potentially disturb fish. The flood defence structure could also impact on fish movement. Areas of encroachment into the channel on both banks may restrict flow. This reduction in potential wetted width may reduce availability for fish holding areas along this section. If flows are increased as a result of the encroachment there is a possibility that fish won't be able to navigate through this section as there won't be any refuge areas and potentially may impact on the selective tidal stream transport of fish/eel. Impact assessment required.
Consider if your activity could cause entrainment or impingement of fish?	No. Impact assessment not required.

The risks to the receptor are due to encroachment, noise and vibration from construction of the flood walls, and also potential release of suspended sediment concentrations and the creation of plumes as a result. Noise and vibration are likely to be temporary and localised and during the period of construction. Suspended sediment concentrations released as a result of construction works, and due to disturbance of the seabed (subtidal)/and intertidal zones, are likely to be very temporary and very localised. Mitigation measures related to suspended sediment will be implemented. Most suspended sediment will be dispersed by currents and tidal processes. Should there be any settlement, this is unlikely to cause disturbance to fish. Winnowing of fine sediment from the bed / banks on the tide is more likely to entrain fines than the works.

Due to the importance of fish (smelt in particular), this impact is scoped in for further assessment.

5.3 Water quality

Consideration should be made regarding whether phytoplankton status and harmful algae could be affected by the works, as well as identifying the potential risks of using, releasing or disturbing chemicals. Table 5.4 presents a summary of water quality considerations and associated risk issues of the works for the transitional water body.

Table 5.4: Water Quality scoping summary

	Ribble TrAC
Consider if your activity could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)?	Yes. Construction activities will extend beyond a 14-day period; long term effects on water quality anticipated. Requires impact assessment.
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	Yes (phytoplankton classification is bad). Impact assessment is required.
Consider if your activity is in a water body with a history of harmful algae?	No history of harmful algae[2].
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if the chemicals are on the Environmental Quality Standards Directive (EQSD) list?	Construction could cause a temporary increase in suspended sediment concentrations within the water columns Impact assessment required. Due to the industrial history within the estuary, construction may release chemicals which are on the EQSD. Impact assessment required.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if it disturbs sediment with contaminants above Cefas Action Level 1?	Construction could cause a temporary increase in suspended sediment concentrations within the water column. Impact assessment required. Due to the industrial history within the estuary, construction may release chemicals which are above Cefas Level 1. Impact assessment required
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the Environmental Quality Standards Directive (EQSD) list?	No (not applicable). Impact assessment not required.

2 Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/658333/wfd_water_body_summary_table.XLSX

As at least one water quality consideration indicates that a risk could be associated with the works, this receptor has been scoped into the impact assessment.

5.4 Protected areas

Consideration should be made regarding whether WFD protected areas are at risk from a proposed activity. Table 5.5**Error! Reference source not found.** presents a summary of protected area considerations and associated risk issues of the works. As the protected areas considerations indicate that a risk could be associated with the works, this receptor has been scoped into the impact assessment.

Table 5.5: Protected Areas

	Ribble TrAC
Consider if your activity is within 2 km of any WFD protected area?	There are no Protected Areas under the WFD legislation within 2km of the Scheme.

	Ribble TrAC
	The works are within a Marine Conservation Zone (MCZ) but this is being assessed separately as it is not part of the WFD requirements. The WFD and MCZ assessments have both been completed in collaboration with respect to impacts on fish.

5.5 Invasive Non-Native Species (INNS)

Consideration should be made regarding whether there is a risk the activity could introduce or spread INNS. Risks of introducing or spreading INNS include materials or equipment that have come from, had use in or travelled through other water bodies, as well as activities that help spread existing INNS, either within the immediate water body or other water bodies. Table 5.6 presents a summary of INNS considerations and associated risk issues of the works.

Table 5.6: INNS considerations

	Ribble TrAC
Introduction or spread of INNS	Yes. Mitten Crab have been found in the Morecambe Bay area downstream of the Ribble Estuary. Himalayan Baslam, Japanese knotweed and Giant Hogweed have been recorded within the study area. In line with compulsory EA best practice there will be a management /control plan to deal with INNS and this will be embedded into ways of working for pre/during/post construction.

5.6 Groundwater scoping

Table 5.7 screens the WFD groundwater body quality elements against the proposed Scheme. A source-pathway-receptor relationship needs to be evident for elements to be screened for further consideration.

Table 5.7: Screening of WFD Groundwater Body Quality Elements for Further Consideration

Quantitative Elements	**Scoped In or Out**
Saline intrusion	In – piling is required.
Water balance	Out - No effect.
Groundwater dependent terrestrial ecosystems	Out - No effect.
Surface water	Out - No effect.
Chemical Elements	**Scoped In or Out**
Drinking Water Protected Area	Out - No effect. There are no Drinking Water Protected Areas near the Scheme.
General quality	Out - No effect.
Groundwater dependent terrestrial ecosystems	Out - No effect.
Surface water	Out - No effect.
Saline intrusion	In – scoped in as piling is required.

5.7 WFD quality element assessment summary

The site-specific impacts of the scheme on the biological, physico-chemical and hydromorphological quality elements of the water bodies are shown in the assessment above and summarised in Table 5.8.

Table 5.8: Scoping summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	In heavily modified water body (Ribble Estuary) and could impact hydromorphology.
Biology: habitats	Yes	Area of scheme is less than 0.5km^2. However low sensitivity habitats have been scoped in due to being part of the supporting elements of the hydromorphology
Biology: fish	Yes	Potential disturbance from piling noise.
Water quality	Yes	Works could disturb sediment.
Protected areas	No	Marine Conservation Zone assessment has been completed separately.
Invasive non-native species	Yes	Always a risk, and included as reportable
Groundwater receptors Saline intrusion (groundwater)	Yes	Piling is required.

5.8 Scoping of scheme elements in Areas 1 and 2

Scheme elements that do not impact on the estuary as they are set back and have no works within the channel can be scoped out of the impact assessment. These are summarised below:

Area 1 Scheme element	Scoped in or out
Replacement of the existing concrete wall, with a new concrete wall, between Liverpool Road bridge and Penwortham Old Bridge.	In. There is a short section (82m of Redi-Rock blockwork that encroaches into the estuary.
Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside highway between Penwortham Old Bridge and Miller Gardens Apartments.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
A new flood gate located in front of Miller Gardens Apartments.	Out. Set back from the channel and no in-channel working.
A new concrete wall along the boundary of the BAC/EE Preston Social and Sports Association cricket pitch between Miller Gardens Apartments and Ribble Cottage.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
A new flood gate located close to Ribble Cottage.	Out. Set back from the channel and no in-channel working.
Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, running on the river side of the road in front of the Continental Public House restaurant.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.

Area 1 Scheme element	Scoped in or out
A concrete wall and two flood gates under the western end of the West Coast Main Line railway bridge.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
Lengths of the existing river bank between Old Penwortham bridge and the WCML will be stabilised with a blockwork revetment.	In. two lengths of Redi-Rock (247m and 151m) of encroachment into the estuary.
Area 2 Scheme element	**Scoped in or out**
A new concrete wall to the west and south of the Penwortham Methodist Church, tying into the abandoned railway embankment.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside Road extending upstream from the Cadent Gas Pipebridge to the Network Rail embankment.	In. Approximately 200m of temporary encroachment into the river for construction. No permanent encroachment
New concrete wall along the river front linking Riverside Road to Ribble Sidings. A blockwork retaining wall and inclined embankment will be constructed to stabilise the existing bank.	In. Partly built out section approximately 70m long starting from upstream end at Riverside Road. Further upstream the wall retires back onto the river bank and runs for a further 100m approximately.
An earth embankment along the river front of Ribble Sidings, replacing the existing embankment.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
A short earth embankment in the gap in the abandoned railway embankment, at the access point to the Penwortham Residential Park area.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.
Filling in a culvert under the WCML inland from the River Ribble with concrete.	Out. The works are set back from the estuary. The works will reduce the linkage between the estuary and the floodplain but this is the nature of the flood defence scheme and impacts should be negligible on the water body scale.

6. Assessment of receptors against individual scheme elements

The following section provides further detail on how each scheme component per FRMS Area could impact on the receptors assessed above in Section 5 (Table 6.1). Only the receptors scoped in are taken forward into this assessment. As all scheme elements that include working within or building out into the estuary have similar impacts, they have been grouped together (within their Scheme areas) as impacts and mitigation will apply to all.

Table 6.1: Screening of the Scheme's Options against Status Objectives and Elements for water quality elements

Key to Impact							
Negative		Negligible		Positive		No change	

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
Area 1		
Replacement of the existing concrete wall, with a new concrete wall, between Liverpool Road bridge and Penwortham Old Bridge. There is a short section (82m) of Redi-Rock blockwork that encroaches into the estuary.		
Lengths of the existing river bank between Old Penwortham bridge and the WCML will be stabilised with a blockwork revetment. The first section is immediately downstream of the Old Bridge.		
Biology: Fish	Working within or close to the channel could disturb fish presenting a temporary but localised risk to species within the channel during works. Potential increased suspended sediment concentrations could cause smothering of redds during spawning. Working in channel could disturb species due to increased noise. Noise and vibration from piling could disturb species within the estuary at this point, which could include temporary interruption to any migration (if occurring).	Plan work at appropriate tidal phases and work above the High Water Mark (HWM) if practicable to avoid any potential for underwater noise pollution and vibration and hence disturbance to fish. No night working (to avoid lighting in the channel). No working within the channel should be undertaken during periods of fish migration and spawning (1st February to 15th June for smelt, coarse fish, and eel).
Biology: Fish	Loss of fish habitat and fish refuge areas in places where banks are to be replaced by Redi-Rock (See Section 2.8 for description of habitats).	The replacement Redi-Rock planted terracing habitat will offer comparable value for fish refuge. Guidance for the tidal Thames (ZSL, 2016) suggests the installation of terracing or sloping faces to make developments more fish friendly. The Redi-Rock terracing proposed would provide habitat of this type and make the flood

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
		defence face less steep and provide more features than standard vertical flood defence structures. This terracing will be planted up. . Any habitat loss relating to migratory adult as well as juvenile habitat e.g. shallow vegetated margins can be mitigated through these measures such as terracing and marginal planting. The area lost is considered to be very small, constituting 0.02 % of the water body area as a whole. With construction mitigation and operational enhancement measures, the level of habitat loss and deterioration as a result of the Scheme's activities are not capable of significantly affecting the fish populations or any ecological or geomorphological processes that they are dependent on within the water body. There is the potential to create up to 700m^2 of intertidal / mudflat creation by lowering the bank in front of Ribble Sidings.
Biology: Fish	Potential increases in flows due to narrowing of the estuary as embankments are built-out may cause funnelling affect and prevent fish migration through the estuary. Modelling has shown that flows are not significantly impacted with the Scheme in place and are similar to present day flows. As a result, channel narrowing is not likely to significantly increase water velocities across the width of the channel under normal conditions in the affected stretches.	The Redi-Rock embankments will be planted up with vegetation to provide habitat diversity and refuges to allow fish to hold station on the ebb tide.
Biology: Fish	Pollution incidents during construction may damage fish habitat.	Mitigation measures relating to water quality (pollution) impacts include best practice, i.e. implementing pollution prevention measures particularly when mixing and installing concrete and using fuels and oils. Put Environmental Management Plan in place during construction. With construction mitigation measures, any water quality deterioration as a result of the Scheme's activities should not significantly affect the fish populations or any ecological or geomorphological processes that they are dependent on within the

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
		water body. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.
Hydromorphology: Depth variation	Structures added to the estuarine environment as a result of flood defence schemes can cause localised changes to tidal level. Modelling indicates (Section 2.7) that there is no significant increase in water levels under tidally dominated scenarios within the channel with the Areas 1 and 2 Scheme in place when compared to the current day scenario. There is an increase in water level under fluvial dominated scenarios but this is the nature of the scheme. Increased depth is a function of the scheme as flows are held within the channel rather than spilling on to the floodplain.	No suitable mitigation measures available.
Hydromorphology: Structure of the intertidal zone	An area of 0.001km^2 of intertidal soft sediments (mudflat) will be lost under the scheme in Areas 1 and 2. This is less than 1% of the total area of mudflat within the water body. Areas of bank will also be lost (see Section 2.8).	Terracing and marginal planting (e.g. of the Redi-Rock embankments) can mitigate for some loss of habitat. There is the potential to create up to 700m^2 of intertidal / mudflat creation by lowering the bank in front of Ribble Sidings.
Hydromorphology: Quantity, structure and substrate of the bed	Penetration and/or disturbance of the substrate on and below the surface of the seabed (subtidal and intertidal). Modelling shows that changes in flow velocities will not be sufficient to alter patterns of erosion or sediment deposition, therefore there will be no change in the quality, structure and substrate of the bed.	No pile driving at high tide. Plan work at appropriate tidal phases to avoid any potential for the suspension of soils or potential contaminants during construction. Put Environmental Management Plan in place during construction. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.
Hydromorphology: Freshwater flow	Structures added to the estuarine environment as a result of flood defence schemes can change local flow conditions.	No cross-channel structures planned. Structure follows line of existing road / gardens / embankments – mainly parallel to the

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
	Modelling indicates that there is no significant increase in flows within the channel with the Areas 1 and 2 Scheme in place when compared to the current day scenario.	HWM. Modelling has shown that there are no significant hydrological changes at the water body level.
Hydromorphology: Wave exposure	Structures used in flood defence can cause wave attenuation to the project frontage, changing wave height in the local area. Reduced flooding of land behind the defence is an aim of the scheme.	No suitable mitigation measures available.
Water quality	Pile driving may cause a highly localised and temporary increase in suspended sediment levels in the direct vicinity of the works causing localised plumes.	No pile driving at high tide. Plan work at appropriate tidal phases to avoid any potential for the suspension of soils or potential contaminants during construction. Put Environmental Management Plan in place during construction. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.
INNS	Risk of spread of invasive species if present (Himalayan Balsam and Japanese Knotweed are present along the riverbanks). Mitten Crab have recently been found in the Morecambe Bay area, potential for them to destroy native habitats.	INNS are reportable and should be reported if found. Compile and adhere to a Construction Environmental Management Plan (CEMP) and ensure materials do not pollute substrate or water body and minimise spread of species. All pollution to be controlled under current legislation and best practice. Any sightings of Mitten Crab need to be reported to Defra. Construction will not involve vessel movements, dredging or man-made floating structures. Site is estuarine with supply of freshwater and therefore site is considered low risk for marine INNS contamination.
Groundwater: saline intrusion	Sheet piling in river will form a coffer dam and the ultimate toe of Redi-Rock. A causeway of stone/working platform will be formed from bank piles driven into river bed to form a coffer dam. Stone	Slow start to piling to reduce disturbance. No working in the channel at high tide.

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
	behind will be removed and replaced with a concrete base for the Redi-Rock. The Redi Rock will then be constructed and back filled.	
Area 2		
Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside Road extending upstream from the Cadent Gas Pipebridge to the Network Rail embankment. Approximately 200m. Temporary encroachment into the river for construction. No permanent encroachment		
New concrete wall along the river front linking Riverside Road to Ribble Sidings. A blockwork retaining wall and inclined embankment will be constructed to stabilise the existing bank. Partly built out section approximately 70m long starting from upstream end at Riverside Road. Further upstream the wall retires back onto the river bank and runs for a further 100m approximately.		
Biology: Fish	Working within or close to the channel could disturb fish presenting a temporary but localised risk to species within the channel during works. Potential increased suspended sediment concentrations could cause smothering of redds during spawning. Working in channel could disturb species due to increased noise. Noise and vibration from piling could disturb species within the estuary at this point, which could include temporary interruption to any migration (if occurring).	Plan work at appropriate tidal phases and work above the High Water Mark (HWM) if practicable to avoid any potential for underwater noise pollution and vibration and hence disturbance to fish. No night working (to avoid lighting in the channel). No working within the channel should be undertaken during periods of fish migration and spawning (1st February to 15th June for smelt, coarse fish and eel).
Biology: Fish	Loss of fish habitat and fish refuge areas in places where banks are to be replaced by Redi-Rock (See Section 2.8 for description of habitats).	The replacement Redi-Rock planted terracing habitat will offer comparable value for fish refuge. Guidance for the tidal Thames (ZSL, 2016) suggests the installation of terracing or sloping faces to make developments more fish friendly. The Redi-Rock terracing proposed would provide habitat of this type and make the flood defence face less steep and provide more features than standard vertical flood defence structures Any habitat loss relating to migratory adult as well as juvenile habitat e.g. shallow vegetated margins can be mitigated through these measures such as terracing and marginal planting. The area lost is considered to be very small, constituting 0.02 % of the water body area as a whole. With construction mitigation and operational enhancement measures, the level of habitat loss and deterioration as a result of the Scheme's activities are not capable of significantly

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
		affecting the fish populations or any ecological or geomorphological processes that they are dependent on within the water body. There is the potential to create up to 700m^2 of intertidal / mudflat creation by lowering the bank in front of Ribble Sidings. This may include installation of tree stems and root plates in this location subject to being able to avoid services.
Biology: Fish	Potential increases in flows due to narrowing of the estuary as embankments are built-out may cause funnelling affect and prevent fish migration through the estuary. Modelling has shown that flows are not significantly impacted with the Scheme in place and are similar to present day flows. As a result, channel narrowing is not likely to significantly increase water velocities across the width of the channel under normal conditions in the affected stretches	The Redi-Rock embankments will be planted up with vegetation to provide habitat diversity and refuges to allow fish to hold station on the ebb tide.
Biology: Fish	Pollution incidents during construction may damage fish habitat.	Mitigation measures relating to water quality (pollution) impacts include best practice, i.e. implementing pollution prevention measures particularly when mixing and installing concrete and using fuels and oils. Put Environmental Management Plan in place during construction. With construction mitigation measures, any water quality deterioration as a result of the Scheme's activities should not significantly affect the fish populations or any ecological or geomorphological processes that they are dependent on within the water body. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
Hydromorphology: Depth variation	Structures added to the estuarine environment as a result of flood defence schemes can cause localised changes to tidal level. Modelling indicates (Section 2.7) that there is no significant increase in water levels under tidally dominated scenarios within the channel with the Areas 1 and 2 Scheme in place when compared to the current day scenario. There is an increase in water level under fluvial dominated scenarios but this is the nature of the scheme. Increased depth is a function of the scheme as flows are held within the channel rather than spilling on to the floodplain.	No suitable mitigation measures available.
Hydromorphology: Structure of the intertidal zone	An area of 0.001km^2 of intertidal soft sediments (mudflat) will be lost under the scheme in Areas 1 and 2. This is less than 1% of the total area of mudflat within the water body. Areas of bank will also be lost (see Section 2.8).	Terracing and marginal planting (e.g. of the Redi-Rock embankments) can mitigate for some loss of habitat. There is the potential to create up to 700m^2 of intertidal / mudflat creation by lowering the bank in front of Ribble Sidings. This may include installation of tree stems and root plates in this location subject to being able to avoid services.
Hydromorphology: Quantity, structure and substrate of the bed	Penetration and/or disturbance of the substrate on and below the surface of the seabed (subtidal and intertidal). Modelling shows that changes in flow velocities will not be sufficient to alter patterns of erosion or sediment deposition, therefore there will be no change in the quality, structure and substrate of the bed.	No pile driving at high tide. Plan work at appropriate tidal phases to avoid any potential for the suspension of soils or potential contaminants during construction. Put Environmental Management Plan in place during construction. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.
Hydromorphology: Freshwater flow	Structures added to the estuarine environment as a result of flood defence schemes can change local flow conditions. Modelling indicates that there is no significant increase in flows within the channel with the Areas 1 and 2 Scheme in place when compared to the current day scenario.	No cross-channel structures planned. Structure follows line of existing road / gardens / embankments – mainly parallel to the HWM. Modelling has shown that there are no significant hydrological changes at the water body level.

WFD element likely to be impacted	Description of impact	Options for environmental mitigation
Hydromorphology: Wave exposure	Structures used in flood defence can cause wave attenuation to the project frontage, changing wave height in the local area.	No suitable mitigation measures available.
Water quality	Pile driving may cause a highly localised and temporary increase in suspended sediment levels in the direct vicinity of the works causing localised plumes.	No pile driving at high tide. Plan work at appropriate tidal phases to avoid any potential for the suspension of soils or potential contaminants during construction. Put Environmental Management Plan in place during construction. The contractor will undertake sediment sampling to ensure a full understanding of the release of potential pollutants in the river sediment. The contractor will develop (if required) a management regime/plan (in conjunction with the EA) to deal with the sediments.
INNS	Risk of spread of invasive species if present (Himalayan Balsam and Japanese Knotweed are present along the riverbanks). Mitten Crab have recently been found in the Morecambe Bay area, potential for them to destroy native habitats.	INNS are reportable and should be reported if found. Compile and adhere to a Construction Environmental Management Plan (CEMP) and ensure materials do not pollute substrate or water body and minimise spread of species. All pollution to be controlled under current legislation and best practice. Any sightings of Mitten Crab need to be reported to Defra. Construction will not involve vessel movements, dredging or man-made floating structures. Site is estuarine with supply of freshwater and therefore site is considered low risk for marine INNS contamination.
Groundwater: saline intrusion	Sheet piling in river will form a coffer dam and the ultimate toe of Redi-Rock. A causeway of stone/working platform will be formed from bank piles driven into river bed to form a coffer dam. Stone behind will be removed and replaced with a concrete base for the Redi-Rock. The Redi Rock will then be constructed and back filled.	Slow start to piling to reduce disturbance. No working in the channel at high tide.

7. Assessment of the scheme against mitigation measures

Within each RBMP, there is a list of mitigation measures, or environmental improvements, which have been identified by the RBMP, which need to be implemented in order to improve the ecology of water bodies by a specified date in order for the UK to meet the target date set by the Water Framework Directive. Part of the WFD compliance assessment is to consider mitigation measures and assess whether a proposed Scheme can contribute to them, or might obstruct any of them from being delivered.

Table 7.1 provides a list of all mitigation measures applicable to the Ribble TraC water body, and an explanation of why the Scheme might/might not be able to achieve or contribute to mitigation measures.

Table 7.1: Mitigation measures and assessment of whether the scheme will help to contribute to these (management plan)

Mitigation Measure	Will the Scheme help to achieve or contribute to mitigation measure?
Bank rehabilitation / reprofiling	The locations recommended for bank rehabilitation / reprofiling listed in the Ribble Mitigation Measures do not fall within the Preston FRMS Scheme area. However, the current Preston FRMS does not impede any of this work from going ahead, and therefore continues to support the RBMP's requirements.
Managed realignment of flood defence	The majority of locations recommended for Managed Realignment of flood defences listed in the Ribble Mitigation Measures do not fall within the Preston FRMS Scheme area. There is one location near Penwortham New Bridge (A59) opposite Area 1 where flood defences are recommended to be set back. This is not covered in the Preston FRMS, however the Scheme also does not impede this work from going ahead.
Remove obsolete structure	The two obsolete structures listed in the Ribble Mitigation Measures are downstream of Areas 1 and 2 and no work will be undertaken on them as part of this Scheme. However, the Scheme does remove failing walls and sheet piling along the bank of Area 1 and replaces this with a Redi-Rock structure which includes habitat niches, and provides the opportunity for contributing to wider habitat improvement, and therefore supports the requirements of both the Regulations and the RBMP.
Indirect / offsite mitigation (offsetting measures)	Yes. Creation of habitat by lowering banks adjacent to Ribble Sidings could provide approximately 700m^2 of intertidal habitat if it were to become part of the Scheme.

None of the Ribble TraC Mitigation Measures listed are located within the Preston FRMS area.

The Ribble TrAC is currently at Bad potential due to phytoplankton and fails for priority hazardous substances. The Reason for Not Achieving Good (RNAG) for phytoplankton is given as sewage discharges. The current Preston FRMS will not change this as no work is planned on any sewage outfalls, and is outside of the Scheme's scope. Conversely the Preston FRMS does not prevent any work to improve outfalls from going ahead.

7.1 Cumulative assessment

Table 7.2 provides a summary of other proposed (and relevant) schemes within the area of the Scheme. These have been identified from a list of those which have been submitted as planning applications.

Table 7.2: Summary of other proposed schemes

Description	Location
Preston FRMS Areas 3-5	Frenchwood, Walton-le-Dale and Higher Walton For details of the planned works see Sections 2.4 to 2.6.

Description	Location
	Detailed design of these stages of the Preston FRMS is going ahead under a separate planning application and the WFD will be updated to take account of these when further details are available. Areas 3 and 4 are located within the Ribble TrAC water body which extends are far as Fishwick Bottoms. Scheme works in Areas 3 and 4 will not encroach into the channel, and there is no planned in-channel working. Therefore, there is no impact to the TraC water body from these works.
Ribble Crossing (Lancashire County Council)	This is a potential future project for a crossing of the Ribble to create a 'ring road' from the M65 – M55 around Preston. This would be developed within the Ribble TrAC water body downstream of Areas 1 and 2. There are no definite dates associated with the project and it is uncertain if it is going ahead.

7.2 Assessment of the proposed scheme against WFD objectives

Taking into consideration the impacts of the Scheme on the biological, physico-chemical and hydromorphological quality elements, it is unlikely to compromise progress towards achieving good ecological potential or cause a deterioration of the overall ecological potential of the water bodies that are in scope (therefore does not require assessment under Article 4.7). This is dependent on the implementation of the designs of the Scheme and the site-specific impact assessment (Table 6.1).

8. Compliance conclusions and Assessment of the proposed scheme against Article 4.8, 4.9 and other EU legislation

The WFD also requires consideration of how a new scheme might impact on other water bodies and other EU legislation. This is covered in Articles 4.8 and 4.9 of the WFD.

Article 4.8 states: '…a Member State shall ensure that the application does not permanently exclude or compromise the achievement of the objectives of this Directive in other bodies of water within the same river basin district and is consistent with the implementation of other Community environmental legislation.

A cumulative assessment of the works for this Scheme and for other schemes within the catchments has concluded that only this scheme affects the water body (Section 7.1). The current scheme will not significantly impact the water body within which it is located, with no obvious conflict with WFD objectives. Therefore, the current Scheme complies with Article 4.8.

Article 4.9 of the WFD requires that "Member States shall ensure that the application of the new provisions guarantees at least the same level of protection as the existing Community legislation".

The Drinking Water Directive (1998) requires that drinking water is wholesome and clean. It sets down maximum acceptable concentrations for a number of potential contaminants. The scheme does not impact any drinking water protected areas and therefore should be compliant with the Drinking Water Directive.

The Habitats Directive (1992) promotes the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance. There are no European designated sites in the vicinity of the Scheme.

Compliance with the key objectives against which the impacts of proposed works on a water body need to be assessed are outlined below in Table 8.1, and for the affected water bodies, the Scheme is unlikely to cause deterioration to WFD status elements, and therefore complies with the Directive.

Taking into consideration the anticipated impacts of the Scheme on the screened in WFD quality elements (Section 6, Table 6.1), it is unlikely to compromise progress towards achieving good ecological potential or cause a deterioration of the overall ecological potential of any of the water body that is in scope. Therefore, the Scheme does not require assessment under Article 4.7 (Table 8.1).

Table 8.1: Compliance of the scheme with the environmental objectives of the WFD.

Environmental Objective	Scheme	Compliance with the WFD Directive
No changes affecting high status sites.	There are no high status sites.	YES
No changes that will cause failure to meet surface water Good Ecological Status or Potential or result in a deterioration of surface water Ecological Status or Potential.	After consideration as part of the detailed compliance assessment, the Scheme options will not cause deterioration in the status of the water body if mitigation is put in place.	YES
No changes which will permanently prevent or compromise the Environmental Objectives being met in other water bodies.	The Scheme options will not cause a permanent exclusion or compromise achieving the WFD objectives in other bodies of water within the same River Basin District (RBD)	YES

No changes that will cause failure to meet good groundwater status or result in a deterioration groundwater status.	The Scheme options will not cause deterioration in the status of the of the groundwater water body.	YES