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Haweswater Aqueduct Resilience Programme - Proposed Marl Hill Section

Environmental Statement

Volume 4

Appendix 7.1: Water Framework Directive Assessment

June 2021

United Utilities

Water for the North West

Haweswater Aqueduct Resilience Programme - Proposed Marl Hill Section

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Executive Summary

This report comprises a Water Framework Directive compliance assessment for the Haweswater Aqueduct Resilience Programme, specifically relating to the Proposed Marl Hill Section.

The assessment comprises a screening exercise to identify which activities within the enabling works/construction, operation, commissioning and decommissioning phases could lead to effects on WFD water bodies, and therefore require further assessment. These include site compounds, open cut trenches, permanent new overflows and tunnelling (including shaft construction).

Scoping has identified 15 WFD water bodies (14 surface water and one groundwater) within close proximity of the Proposed Marl Hill Section. Of these, three WFD water bodies have been identified as requiring further assessment:

- Hodder - confluence Easington Beck to conf confluence Ribble WFD surface water body (GB112071065560)
- Bashall Brook WFD surface water body (GB112071065520)
- Ribble Carboniferous Aquifers WFD groundwater body (GB41202G103000).

The last section provides a site-specific assessment of the relevant water bodies against the relevant elements and includes additional environmental control measures, including a monitoring plan and adaptive management strategy for the overflow discharges, where necessary. All activities are considered to meet the WFD objectives at this stage.

1. Introduction

1) This Water Framework Directive (WFD) (referred to as the Directive) compliance assessment report has been prepared for the Haweswater Aqueduct Resilience Project (HARP) and forms an appendix to support the HARP Environmental Statement. This report assesses the Proposed Marl Hill Section, which is outlined in Section 1.1.

1.1 Overview of the Proposed Marl Hill Section

2) The existing Haweswater Aqueduct, built between 1933 and 1955, has successfully served customers in Cumbria, Lancashire, and Greater Manchester for sixty years.

3) The existing Aqueduct takes raw water from Haweswater Reservoir in the Lake District National Park along a 16 km section of the aqueduct to a water treatment works (WTW) near Kendal for treatment. From this WTW, the aqueduct conveys treated water to customers in Greater Manchester, Cumbria, and Lancashire through water mains which branch off the main aqueduct.

4) The existing aqueduct comprises six single line tunnels and conduit sections (generally 2.6 m internal diameter) in addition to multi-line sections[1]. The flow of water along the entire length of the aqueduct is achieved under the influence of gravity; there are no energy-consuming pumps involved in supplying the water from north to south. Out of the total 110 km length of the aqueduct, the Proposed Programme of Works on the single line sections accounts for just under half this distance, about 53 km.

5) To maintain the integrity of the network, United Utilities are proposing the replacement of all six existing tunnel sections with five new ones along the length of the aqueduct. The new tunnel sections from north to south are referred to as follows (see Figure 1):

- Docker Section
- Swarther Section
- Bowland Section
- Marl Hill Section (the subject of this assessment)
- Haslingden and Walmersley Section.

6) Replacement of the Proposed Programme of Works is required to replace part of an ageing asset to secure a water supply serving Cumbria, Lancashire and Greater Manchester, and to mitigate potential risks to drinking water quality. The proposed baseline solution is to provide a full replacement of the six existing tunnel sections with five single line tunnel sections as illustrated in Figure 1. A brief description of the Proposed Marl Hill Section is provided in the following paragraphs.

7) Approximately 4.6 km in length, the Proposed Marl Hill Section would comprise the Bonstone Compound in the north (approximately 1.3 km south of Newton-in-Bowland) to the Braddup Compound in the south (approximately 1.3 km north of Waddington).

8) Between the Bonstone and Braddup Compounds, the existing aqueduct would be replaced with a single tunnel. It would be constructed by tunnel boring below ground level. Short lengths of open-cut surface trenching would be required at each end of the tunnel, making the connection back to the existing infrastructure. The new tunnel would be driven from the south to north, from a launch shaft within the Braddup compound to a reception shaft within the Bonstone Compound. Further details on the tunnel boring and associated works are provided within Volume 2 Chapter 3: Design Evolution and Development Description.

9) Following completion and commissioning (requiring discharge of treated water to surrounding watercourses at the Bonstone and Braddup Compounds) of the new sections of aqueduct, the tunnels serving the existing aqueduct would be taken out of service. A future maintenance and usage strategy for the redundant sections of aqueduct is being prepared. This strategy would include protection of

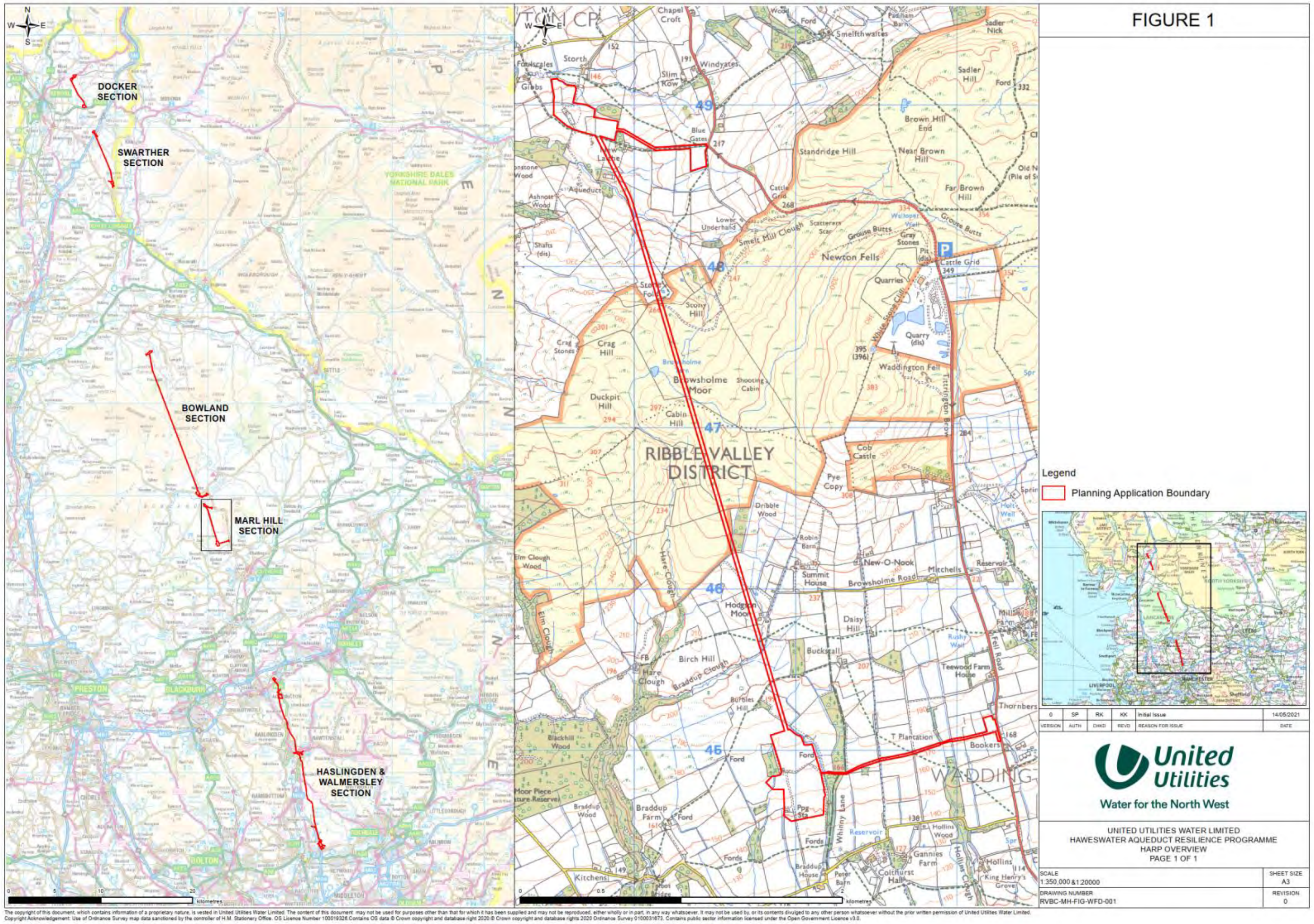
[1] The multi-line sections comprise four parallel pipes referred to as 'siphons', each of which is around 1.6 m internal diameter.

existing structures above the redundant sections and dealing with any flows arising from the decommissioned aqueduct by allowing them to discharge into Bashall Brook via the existing overflow pipe at the southern end of the Proposed Marl Hill Section.

10) To summarise, the Proposed Marl Hill Section would require the following activities to be undertaken:

- Boring of a tunnel (including sinking of launch/reception shafts) approximately 4.6 km long
- Open cut sections of pipework to enable connection of the MLS and the single line tunnel
- Creation of two construction compounds
- Connection of the existing highways network to construction compounds via access roads
- Discharge of water used in the commissioning of the Proposed Marl Hill Section to local watercourses
- Discharge of groundwater ingress from the existing aqueduct to the Bashall Brook, once the Proposed Marl Hill Section has been commissioned. This would make use of existing overflow infrastructure.

Figure 1: HARP overview including planning application boundary for the Proposed Marl Hill Section



1.2 Background to the Water Framework Directive

11) The WFD, transposed into English legislation as the Water Environment Regulations (Water Framework Directive) 2017, requires all natural 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.

12) 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).

13) The Directive requires that environmental objectives are set for all surface and groundwater bodies:

- 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.

14) Where there are sites protected under EU legislation, the Directive aims for compliance with any relevant standards or objectives for these sites. For the Proposed Marl Hill Section, this relates to designated sites that are within the assessment area (see Section 4.1) and designated under Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora), and transposed as the Conservation of Habitats and Species Regulations 2017.

15) Member States must meet the conditions of the Directive unless they meet the criteria laid out in Article 4(7). Where a development is unable to, because of disproportionate cost or technical infeasibility, considered to cause deterioration, or where it could contribute to a failure of the water body to meet Good Status/Potential, then an Article 4(7) assessment is required.

2. Methodology

2.1 WFD Assessment Methodology

16) The stages for undertaking compliance are outlined below. The methodology is based on Environment Agency guidance (Environment Agency, 2016[2]):

2.1.1 Screening

17) Screening provides an initial overview of the Proposed Marl Hill Section, outlining the activities in the enabling works/construction (including commissioning) and operation (including decommissioning of the existing pipeline) phases. These are either screened in for further assessment or screened out.

2.1.2 Scoping

18) Scoping identifies the relevant River Basin Management Plans (RBMPs) and WFD water bodies within the assessment area. The potential generic impacts are identified, establishing the risks from the Proposed Marl Hill Section activities to the WFD water bodies and their quality elements, scoping out those activities and WFD water bodies that do not require further assessment.

19) An assessment area has been defined for the WFD assessment as a 500 m buffer around the Proposed Marl Hill Section, capturing any WFD water bodies within, and immediately up- and downstream.

Assessment of the Proposed Marl Hill Section

20) The assessment follows five steps for the WFD water bodies and activities carried forward from the screening and scoping stages, including:

- Site specific assessment of the Proposed Marl Hill Section against WFD quality elements
- Assessment of the Proposed Marl Hill Section against RBMP Mitigation Measures
- Cumulative impact assessment with other proposed developments planned on the WFD water body
- Assessment of the Proposed Marl Hill Section against WFD status objectives
- Assessment of the Proposed Marl Hill Section against other EU legislation (Protected Areas).

2.2 Data Collection

2.2.1 Desk-based Study

21) A desk-based study has been carried out to inform this assessment, reviewing existing information for the assessment area to develop an initial baseline for the WFD water bodies. The following are the key data sources:

- Environment Agency Catchment Data Explorer (CDE) (Environment Agency, 2020a)[3]
- North West River Basin Management Plan (Environment Agency, 2018)[4]
- MAGiC MAP (Natural England, 2020)[5]
- Ecological datasets for the period 2009 – 2019 obtained via the Environment Agency Ecology and Fish Data Explorer website[6].

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[2] Environment Agency (2016). Protecting and improving the water environment: Water Framework Directive compliance of physical works in rivers. 11pp.

[3] Environment Agency (2020) Catchment Data Explorer. [Online] Available from: http://environment.data.gov.uk/catchment-planning/. [Accessed: 01/12/2020].

[4] Environment Agency (2018) North West River Basin Management Plan (RBMP). [Online]. Available from: https://www.gov.uk/government/publications/north-west-river-basin-district-river-basin-management-plan. [Accessed: 01/04/2020].

[5] Natural England (2019) Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Mapper. [Online]. Available from: http://www.magic.gov.uk/MagicMap.aspx. [Accessed: 16/08/2019].

[6] Environment Agency (2020b) Ecology and Fish Data Explorer website https://environment.data.gov.uk/ecology-fish/. [Accessed: 01/12/2020]

2.2.2 Field Surveys

22) Field survey data collected to inform the Environmental Statement have been used within this assessment also. These include:

- White-clawed Crayfish surveys
- Aquatic walkover surveys - establishing habitat for fish (including salmonids), obstructions/barriers to fish passage, sightings of fish, presence and distribution of macrophytes
- Geomorphological walkover surveys gathering information on flow, channel width and depth, bed substrate and features of the riparian zone
- Surveys to determine the presence of groundwater dependent terrestrial ecosystems (GWDTEs) and if present the degree of groundwater dependency of each GWDTE.

3. Screening

3.1 Screening of Activities

23) The main activities of the Proposed Marl Hill Section are presented in Table 1, alongside a screening assessment as to whether further assessment would be required of the activity.

Table 1: Screening of the Proposed Marl Hill Section activities

Stage	Activity	WFD Water Body Type	Screened In or Out?	Justification
Enabling works and construction (including commissioning)	Access track	Surface water	In	Potential impact on WFD surface water bodies by crossing or discharge from track drainage (i.e. an outfall) to the watercourses, leading to changes in biological, chemical and hydromorphological quality elements.
		Groundwater		Potential impact from excavation / soil compaction and groundwater flow disturbance.
	Site compound (impacts relating to soil storage areas, material laydown areas, hard standing areas, turning areas, soakaway from small car parks, attenuation ponds, construction of temporary overflow and site drainage including outfalls)	Surface water	In	Potential impact on WFD water bodies due to discharge from the site to watercourses (i.e. an outfall), changes in overland flow pathways, removal/partial loss of riparian vegetation, channel realignment and excavation below ground.
		Groundwater		Potential impact from excavation / soil compaction and groundwater flow disturbance.
	Tunnel (including the creation of shafts)	Surface water	Out	Due to the depth of the tunnel, tunnel construction technique and distance of shafts from watercourses, dewatering of surface waters is not anticipated.
		Groundwater	In	Potential impact from boring, excavation below ground level, dewatering and displacement of groundwater.
	Open cut crossing	Surface water	Out	No connectivity with surface waters.
		Groundwater	In	Potential impact from dewatering and excavation below ground level.
	Commissioning of pipeline	Surface water	In	Potential impact due to moderate to 'increases over base flows' discharge rates of flows to watercourses.
		Groundwater	Out	No discharge to ground.

Stage	Activity	WFD Water Body Type	Screened In or Out?	Justification
Operational (including decommissioning of existing aqueduct)	Tunnel (including shafts)	Surface water	In	Due to the depth of the tunnel and distance of shafts from watercourses, dewatering of most surface waters is not anticipated. However, in some isolated instances the decommissioned Haweswater Aqueduct runs shallow to watercourses which may lead to reduction in baseflow.
		Groundwater	In	Potential impact due to permanent structures altering groundwater flow paths.
	Overflow (continuous discharge of groundwater ingress from decommissioned aqueduct to watercourses)	Surface water	In	Potential impact from constant flow discharging from existing outfall (currently only used for emergency discharges), with unknown water quality, to watercourses.
		Groundwater		Dewatering of groundwater aquifers around the existing tunnel.

4. Scoping

4.1 Identification of WFD Water Bodies

24) The Proposed Marl Hill Section is located within the North West River Basin District (RBD). Management of the water environment within the RBD is supported by the North West RBD River Basin Management Plan (RBMP).

25) Scoping has identified the WFD water bodies directly linked to the Proposed Marl Hill Section and therefore potentially impacted, in addition to those up and downstream within the assessment area. An assessment has then been made to determine whether the WFD water bodies should be scoped in for further assessment or whether, due to likelihood of limited impacts/lack of impact pathway, they can be discounted.

26) Tables 2 and 3 outline the water body characteristics of each water body scoped in for further assessment, which are also shown in Figures 2a and 2b and Figures 3a to 3c. These are:

- Hodder - confluence Easington Beck to confluence Ribble WFD surface water body (GB112071065560)
- Bashall Brook WFD surface water body (GB112071065520)
- Ribble Carboniferous Aquifers WFD groundwater body (GB41202G103000).

27) The WFD surface water bodies scoped out due to distance, and therefore unlikely to be impacted, are:

- Dunsop (GB112071065360)
- Easington Brook (GB112071065380)
- Hodder - confluence Croasdale Beck to confluence Easington Beck (GB112071065350)
- Langden Brook (GB112071065370)
- Loud – Lower (GB112071065340)
- Mearley Brook (GB112071065510)
- Ribble – confluence Calder to tidal (GB112071065500)
- Ribble (Long Preston to Stock Beck) (GB112071065613)
- Ribble DS Stock Beck (GB112071065612)
- Skirden Beck (GB112071065570)
- Stock Beck (GB112071065540)
- Swanside Beck (GB112071065530).

Table 2: Scoped in WFD surface water body parameters (Cycle 2 (2019) data, Environment Agency, 2020)

Water body name	Hodder – confluence Easington Beck to confluence Ribble	Bashall Brook
Water body ID	GB112071065560	GB112071065520
Catchment size (km^2)	69.32	17.78
Hydromorphological designation	Not designated artificial or heavily modified	Not designated artificial or heavily modified
Overall status/potential	Moderate	Moderate
Chemical status	Fail	Fail
Biological quality elements		
Fish	Not recorded	Not recorded
Invertebrates	High	High
Macrophytes and phytobenthos (combined)	Good	Moderate
Hydromorphological quality elements		
Hydrological Regime	Supports Good	Supports Good
Morphology	Supports Good	Supports Good
Physico-chemical and Chemical (SW) quality elements		
pH	High	High
Ammonia (total as N)	High	Good
Phosphate	High	Poor
Dissolved oxygen	High	High
Temperature	High	High
Specific pollutants	High	Not recorded
Priority substances	Good	Good
Other pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Fail	Fail
Additional observations		
Protected areas	Bowland Fells (UK9005151) – Conservation of Wild Birds Directive,	Does not require assessment
Reasons for not achieving good status	No data available	Diffuse source pollution associated with agriculture (poor soil management) Point source pollution associated with transport and the water industry (continuous sewage discharge)

Table 3: Ribble Carboniferous Aquifers Water body WFD parameters (Cycle 2 (2019) data, Environment Agency, 2020)

Water body ID	GB41202G103000
Catchment size (km^2)	828.6
Overall Status/Potential	Poor
Quantitative status	
Quantitative dependent surface water body status	Good
Quantitative GWDTEs test	Good
Quantitative saline intrusion	Good
Quantitative water balance	Good
Chemical (GW) status	
Chemical dependent surface water body status	Good
Chemical drinking water protected area	Poor
Chemical GWDTEs test	Good
Chemical saline intrusion	Good
General chemical test	Good
Additional observations	
Reasons for not achieving Good status	Not specified
Other	Seven GWDTEs have been identified at the Ribble Carboniferous Aquifers groundwater body within the Proposed Marl Hill Section development envelope.

Figure 2a: Scoped in WFD surface water bodies within the Proposed Marl Hill Section

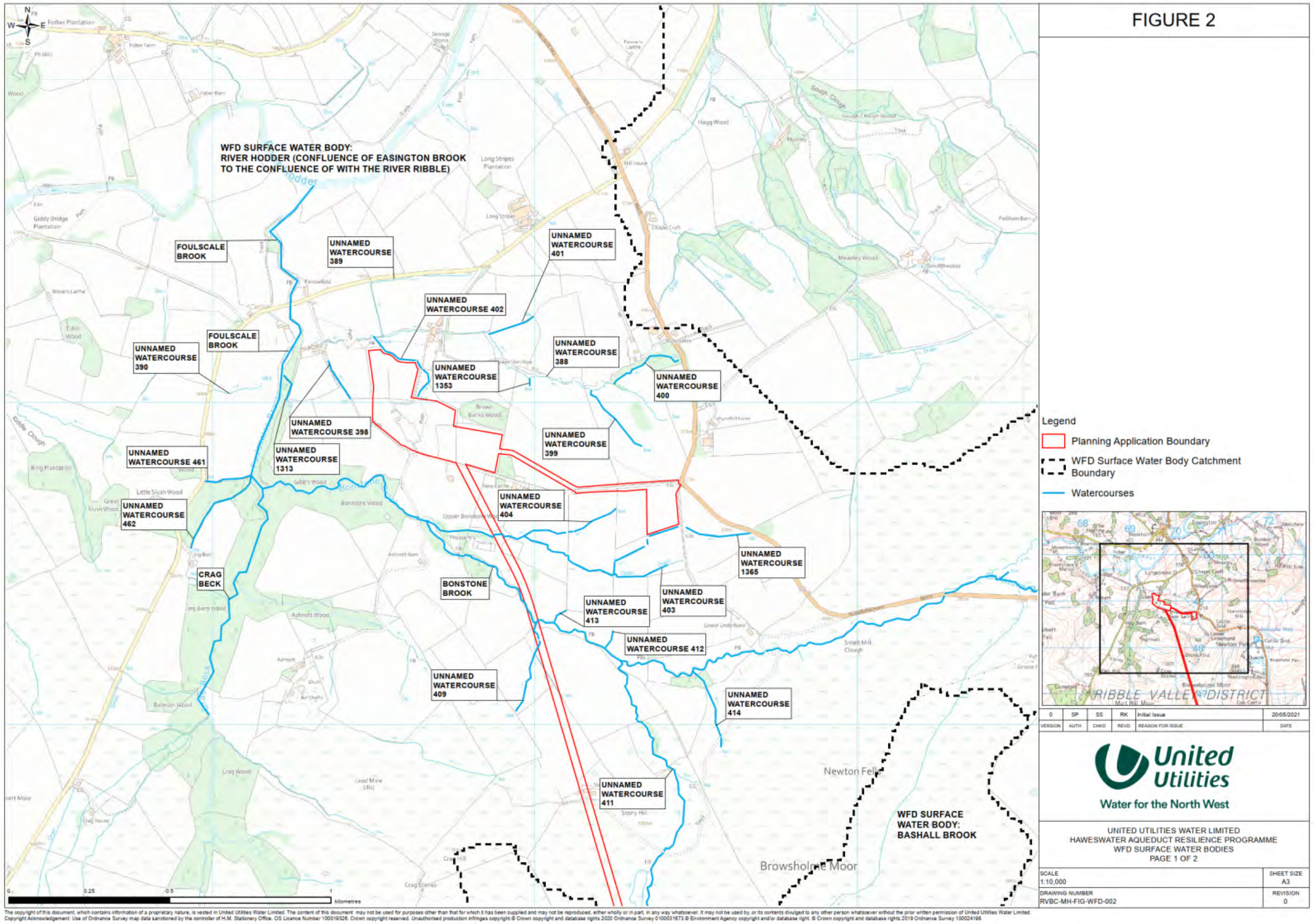


Figure 2b: Scoped in WFD surface water bodies within the Proposed Marl Hill Section

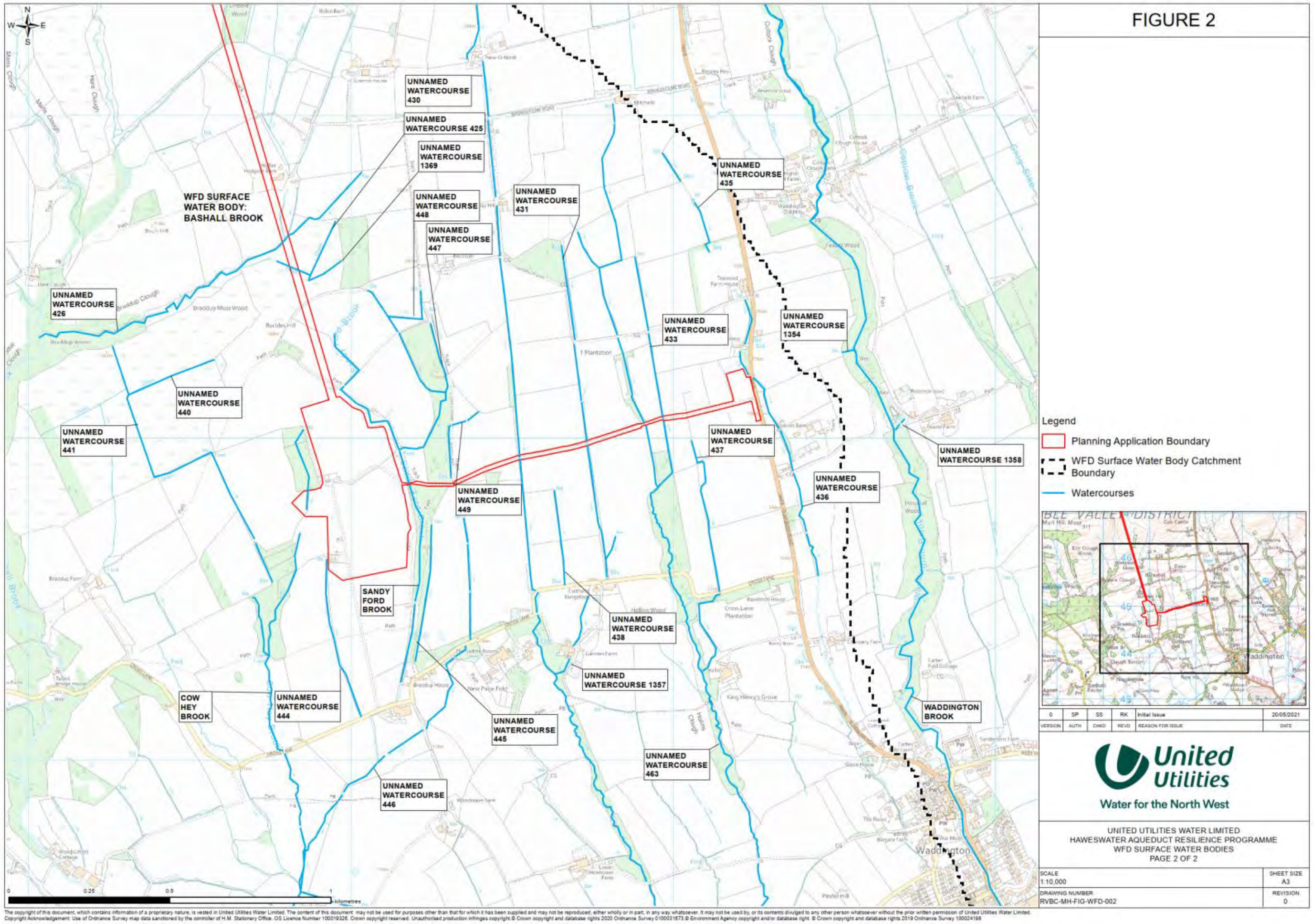


Figure 3a: Scoped in WFD groundwater bodies within the Proposed Marl Hill Section

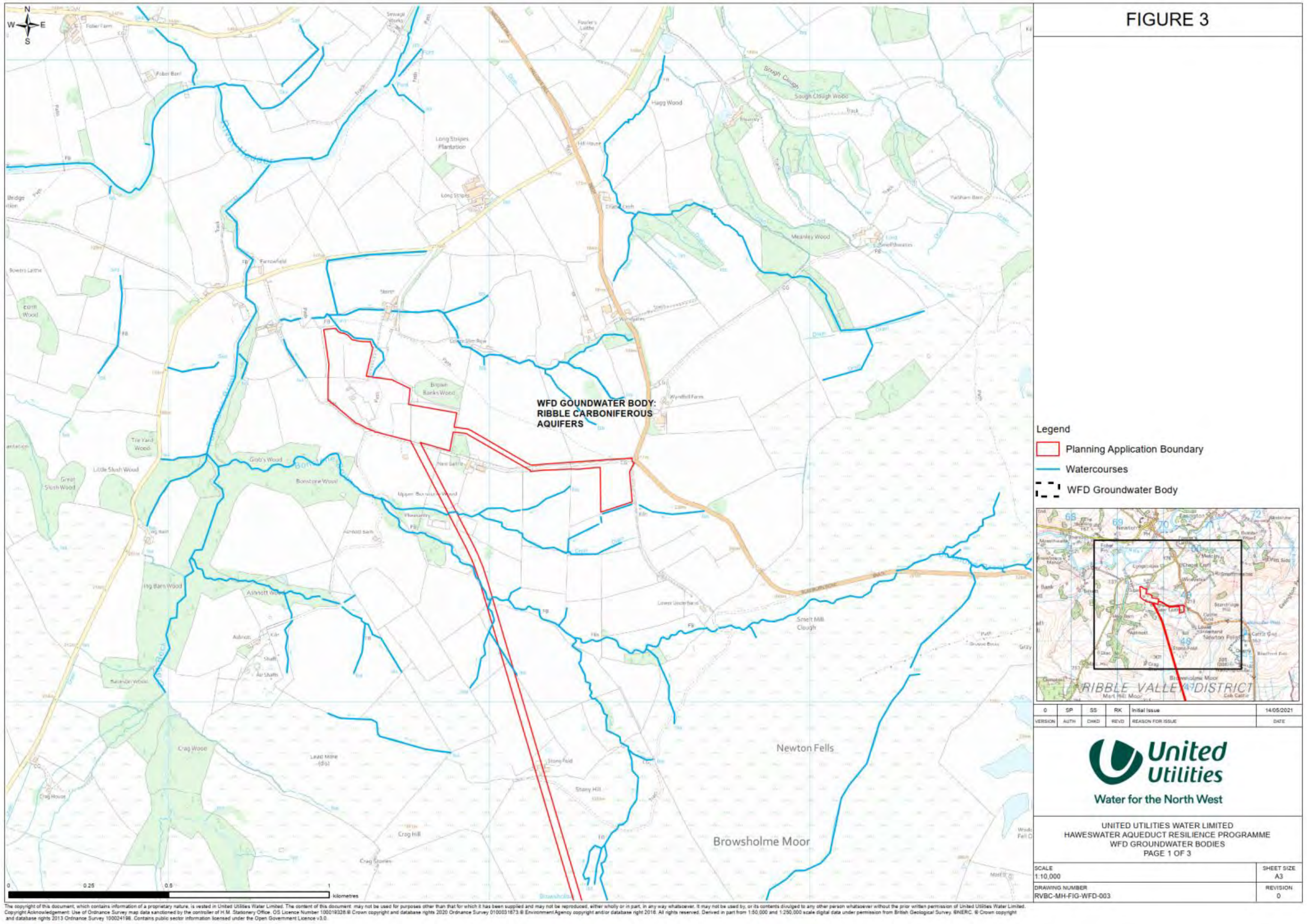


Figure 3b: Scoped in WFD groundwater bodies within the Proposed Marl Hill Section

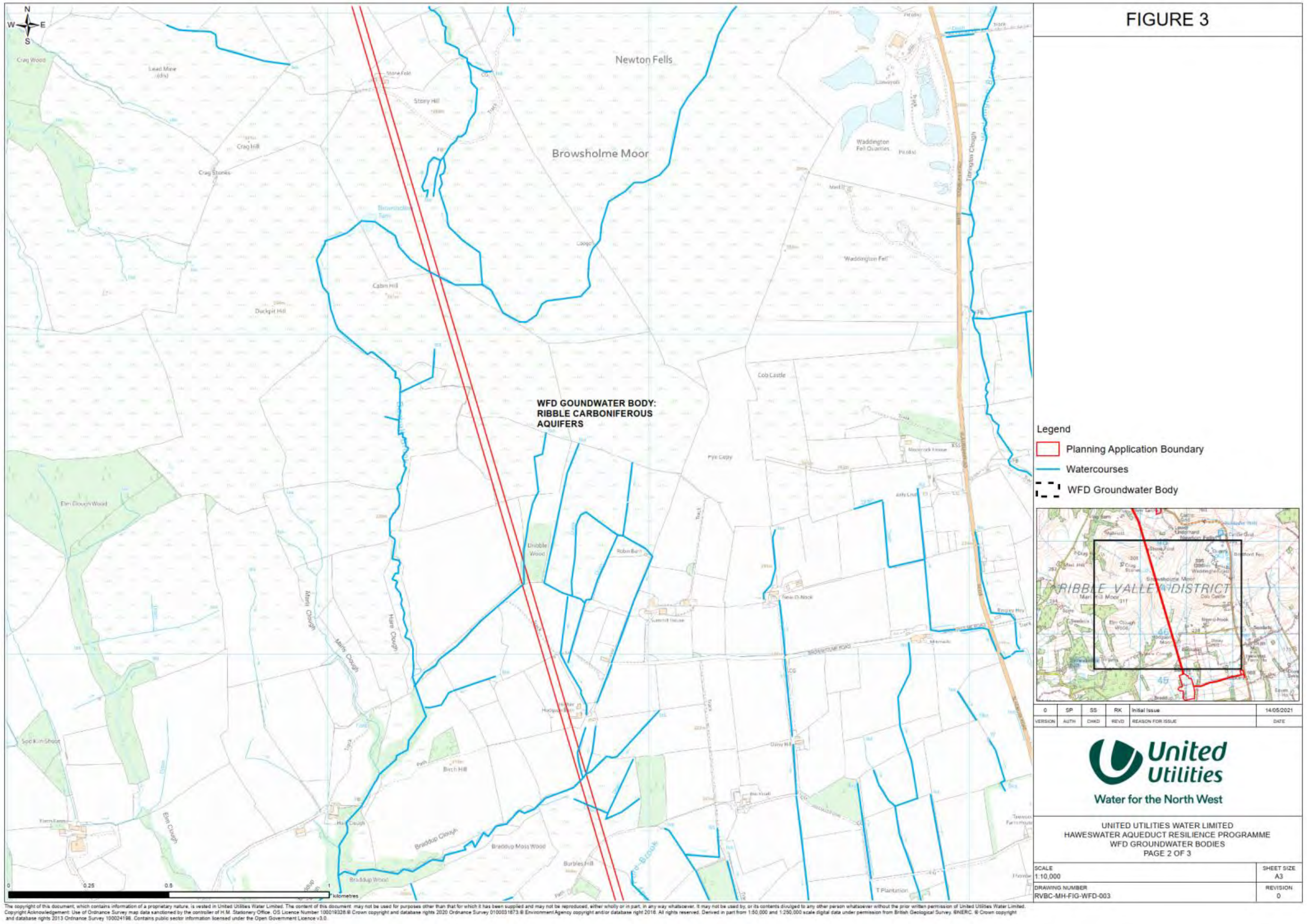
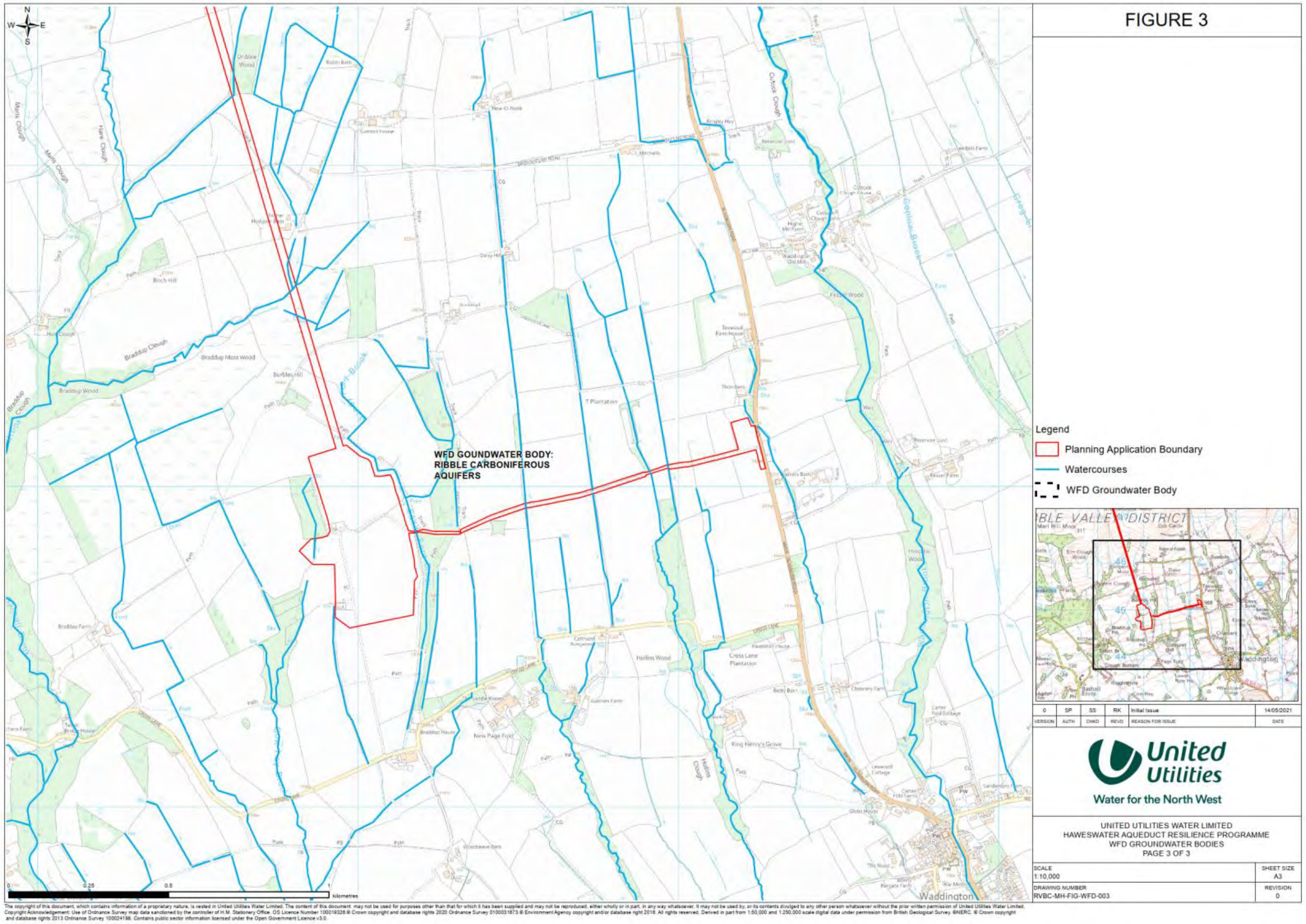


Figure 3c: Scoped in WFD groundwater bodies within the Proposed Marl Hill Section



4.2 Scoping of WFD Quality Elements

28) Table 4 and Table 5 outline the potential generic impacts of each of the Proposed Marl Hill Section activities outlined in Section 3 on the scoped in WFD surface water bodies and groundwater bodies respectively. Where an impact would not be anticipated, the quality element has been scoped out.

29) Chemical quality elements (priority substances, other pollutants and priority hazardous substances) have been scoped out of further assessment as it is unlikely that any of the proposed activities would involve the use, creation, or discharge of these substances.

30) Section 5 provides a more comprehensive assessment of those quality elements scoped in.

Table 4: Scoping of Proposed Marl Hill Section activities and WFD quality elements for scoped in WFD surface water bodies

<table>
<tr><th colspan="2" rowspan="2">Quality elements</th><th colspan="5">Potential Impacts Per Activity</th></tr>
<tr><th>Access tracks</th><th>Site compound</th><th>Commissioning</th><th>Tunnel</th><th>Overflow</th></tr>
<tr><th colspan="7">Hodder - confluence Easington Beck to confluence Ribble</th></tr>
<tr><td rowspan="3">Biological</td><td>Macro-invertebrates</td><td rowspan="6">Scoped Out
▪ Pre-existing access track would not interact with watercourses (either directly or indirectly) in the WFD water body.</td><td rowspan="3">Scoped In
▪ Drainage from site compound could introduce fine sediment and contaminants into downstream watercourses, disrupting/removing habitats.</td><td>Scoped Out
▪ Temporary discharge unlikely to lead to changes in invertebrate habitat or assemblages.</td><td rowspan="3">Scoped Out
▪ Operation of new tunnel (or decommissioning of existing tunnel) would not impact Biological quality elements.</td><td rowspan="3">Scoped Out
▪ Not located in the WFD water body.</td></tr>
<tr><td>Macrophytes and phytobenthos (combined)</td><td rowspan="2">Scoped Out
▪ No change anticipated due to temporary nature of discharge.</td></tr>
<tr><td>Fish</td></tr>
<tr><td rowspan="3">Physico-chemical</td><td>pH</td><td>Scoped Out
▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on pH.</td><td rowspan="3">Scoped Out
▪ Treated flow temporarily discharged into watercourse, unlikely to lead to changes in quality element.</td><td rowspan="3">Scoped Out
▪ Operation of new tunnel (or decommissioning of existing tunnel) could cause localised changes in water quality, however, these would not be of sufficient magnitude to cause change in quality element status.</td><td rowspan="3">Scoped Out
▪ Not located in the WFD water body.</td></tr>
<tr><td>Ammonia (total as N)</td><td rowspan="2">Scoped Out
▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on water quality.</td></tr>
<tr><td>Phosphate</td></tr>
</table>

Quality elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Commissioning	Tunnel	Overflow
	Dissolved oxygen		**Scoped Out** ▪ Changes to oxygenation resulting from new outfalls changing flow patterns likely to be localised.			
	Temperature		**Scoped Out** ▪ No likely source of impact from compound activities.			
Hydro-morphological	Quantity and dynamics of water flow		**Scoped In** ▪ Changes to flow from drainage outfall discharge.	**Scoped Out** ▪ Changes in flow processes likely, but for a short (six week) period before returning to baseline conditions.	**Scoped In** ▪ Potential for reduction in baseflow.	**Scoped Out** ▪ Not located in the WFD water body.
	Connection to groundwater		**Scoped Out** ▪ Localised changes to infiltration from constriction in floodplain, however, no change to watercourses anticipated.	**Scoped Out** ▪ No change anticipated.	**Scoped In** ▪ Dewatering caused by the decommissioning of the existing Haweswater Aqueduct could reduce surface – groundwater connectivity.	
	River continuity		**Scoped In**	**Scoped Out** ▪ No change anticipated.	**Scoped Out**	

Quality elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Commissioning	Tunnel	Overflow
			▪ Outfalls located on banks could locally disrupt lateral connectivity between the watercourse and the surrounding floodplain.		▪ No change anticipated.	
	River depth and width variation		**Scoped In** ▪ Drainage from site compounds could alter local flow processes, potentially causing disturbance to the bed and banks of the channel.	**Scoped In** ▪ Changes in stream energies for a period during discharge potentially leading to erosion and channel adjustment.	**Scoped Out** ▪ No change anticipated.	
	Structure and substrate of the river bed		**Scoped In** ▪ Creation of bare earth surfaces arising from vegetation clearance and topsoil stripping, creating a source of fine sediment.	**Scoped In** ▪ Potential for change in bed substrate composition and presence of hydromorphological features.	**Scoped Out** ▪ No change anticipated.	
	Structure of the riparian zone		**Scoped In** ▪ Land use changes could result in the creation/disruption of sediment source pathways. ▪ Localised removal/disruption of riparian vegetation	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.	

Quality elements		Potential Impacts Per Activity: Access tracks	Site compound	Commissioning	Tunnel	Overflow
			resulting from site clearance.			
Bashall Brook						
Biological	Macro-invertebrates	**Scoped In** ▪ Fine sediment inputs could disrupt or remove habitats for invertebrates ▪ Removal and disruption of habitats from culverting.	**Scoped In** ▪ Potential introduction of fine sediment and contaminants into downstream watercourses, disrupting/remove invertebrate habitats.	**Scoped Out** ▪ Temporary discharge unlikely to lead to changes in invertebrate habitat or assemblages.	**Scoped Out** ▪ Operation of new tunnel (or decommissioning of existing tunnel) would not impact Biological quality elements.	**Scoped In** ▪ Potential water quality implications affecting macroinvertebrate habitats and assemblages.
	Macrophytes and phytobenthos (combined)		**Scoped In** ▪ Potential for drainage to introduce fine sediment and contaminants into downstream watercourses, disrupting/remove macrophytes and phytoplankton habitats.	**Scoped Out** ▪ No change anticipated due to temporary nature of discharge.		**Scoped In** ▪ Potential for increased flows from groundwater ingress to lead to localised removal of aquatic macrophytes and habitats.
	Fish		**Scoped Out** ▪ No change anticipated, with no in-channel working.			**Scoped In** ▪ Potential water quality implications affecting fish from pollutants.
Physico-chemical	pH	**Scoped Out**	**Scoped Out** ▪ Runoff from the site compound would be	**Scoped Out** ▪ Treated flow temporarily discharged into	**Scoped Out** ▪ Operation of new tunnel (or	**Scoped In** ▪ Potential for groundwater being

Quality elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Commissioning	Tunnel	Overflow
		▪ Impacts unlikely to lead to changes in quality element status.	attenuated and treated prior to discharge, with limited potential impact on pH.	watercourse, unlikely to lead to long-term changes.	decommissioning of existing tunnel) could cause localised changes in water quality, however, these would not be of sufficient magnitude to cause change in quality element status.	discharged to lead to changes in water quality depending on its chemical composition.
	Ammonia (total as N)		**Scoped Out** ▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on water quality.			
	Phosphate					
	Dissolved oxygen		**Scoped Out** ▪ Changes to oxygenation resulting from new outfalls changing flow patterns likely to be localised.			
	Temperature		**Scoped Out** ▪ No likely source of impact from compound activities.			
Hydro-morphological	Quantity and dynamics of water flow	**Scoped Out** ▪ No new culverts would be constructed, with existing culverts extended where required. No significant change in baseline flow conditions.	**Scoped In** ▪ Changes to flow from drainage outfall discharge.	**Scoped Out** ▪ Changes in flow processes likely, but for a short (six week) period before returning to baseline conditions.	**Scoped In** ▪ Potential for reduction in baseflow	**Scoped In** ▪ Changes in localised flow processes from new continuous discharge.

Quality elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Commissioning	Tunnel	Overflow
	Connection to groundwater	**Scoped Out** ▪ Localised changes to infiltration from construction in floodplain, however, no change to watercourses anticipated.	**Scoped Out** ▪ Localised changes to infiltration from constriction in floodplain, however, no change to watercourses anticipated.	**Scoped Out** ▪ No change anticipated.	**Scoped In** ▪ Dewatering caused by the decommissioning of the existing Haweswater Aqueduct could reduce surface – groundwater connectivity.	**Scoped Out** ▪ No change anticipated.
	River continuity	**Scoped Out** ▪ No new culverts would be constructed, with existing culverts extended where required. No significant change in baseline continuity, with reduction in lateral connectivity negligible.	**Scoped In** ▪ Potential local disruption to lateral connectivity between the watercourse and the surrounding floodplain.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.
	River depth and width variation	**Scoped In** ▪ Localised changes to channel width and depth at watercourse crossing (i.e. culverts) locations. ▪ Localised change in morphological processes (scour/deposition) due	**Scoped In** ▪ Drainage from site compounds could alter local flow processes, potentially causing disturbance to the bed and banks of the channel.	**Scoped In** ▪ Changes in stream energies for a period during discharge potentially leading to erosion and channel adjustment.	**Scoped Out** ▪ No change anticipated.	**Scoped In** ▪ Increased flow from groundwater ingress could lead to localised bed and bank scour.

Quality elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Commissioning	Tunnel	Overflow
		to channel culverting for access road.				
	Structure and substrate of the river bed	**Scoped In** ▪ Stripping of surface layer would expose bare earth, creating a source of fine sediment.	**Scoped In** ▪ Stripping of surface layer exposes subsurface sediments, creating a source of fine sediment.	**Scoped In** ▪ Potential for change in bed substrate composition and presence of hydromorphological features.	**Scoped Out** ▪ No change anticipated.	**Scoped In** ▪ Increased flow from groundwater ingress could lead to localised bed scour and alteration of sediment transportation regime.
	Structure of the riparian zone	**Scoped In** ▪ Localised loss of riparian vegetation.	**Scoped In** ▪ Localised loss of riparian vegetation.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated

Jacobs

Table5: Scoping of Proposed Marl Hill Section activities for the Ribble Carboniferous Aquifers WFD groundwater bodies

Quality elements		Potential impacts per activity				
		Access tracks	Site compound	Tunnel (including shafts)	Open-cut trenches	Overflow
Quantitative	Saline intrusion	**Scoped Out** ▪ No local coastal sources or other saline waters.				
	Water balance	**Scoped Out** ▪ Limited or no dewatering required for access tracks, therefore limited potential for change to water balance.	**Scoped Out** ▪ Limited or no dewatering required for site compounds, therefore limited potential for change to water balance.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows due to dewatering required for shaft construction. ▪ Once constructed, the tunnel would not significantly affect flows at the groundwater body scale.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows from dewatering required for open-cut.	**Scoped In** ▪ Dewatering around redundant aqueduct potentially causing changes to water balance within surrounding aquifer.
	GWDTEs (non-designated)	**Scoped In** ▪ Crossing of GWDTEs by access tracks could alter the quality and quantity of habitat available.	**Scoped In** ▪ Removal or change to GWDTEs by soil stripping, hard standing and compound area as well as excavations to construct drainage ponds could alter habitat quality and quantity.	**Scoped Out** ▪ Dewatering required for construction of shafts could cause a temporary reduction in groundwater flows or levels to a GWDTE. However, an assessment of impacts from shaft dewatering has identified no significant impacts are likely to GWDTEs.	**Scoped In** ▪ Potential dewatering effect during construction ▪ Potential long-term flow disruption following backfilling.	**Scoped In** ▪ Impacts to GWDTEs from dewatering at the decommissioned aqueduct would be reported separately in a standalone document.
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required; therefore,	**Scoped Out** ▪ No significant excavation required; therefore,	**Scoped Out** ▪ Dewatering rates for shaft construction are unlikely to lead to significant impacts	**Scoped Out** ▪ Dewatering rates for the open cut crossing are unlikely	**Scoped Out**

Quality elements		Potential impacts per activity				
		Access tracks	Site compound	Tunnel (including shafts)	Open-cut trenches	Overflow
		dewatering would not affect surface waters.	dewatering would not affect surface waters.	on surface water baseflows given the distance to the surface waters.	to lead to significant impacts on surface water baseflows given the distance to the surface waters.	▪ No discharge to ground or groundwater for the overflow from the redundant aqueduct.
Chemical	Saline intrusion	**Scoped Out** ▪ No local coastal sources or other saline waters.				
	Drinking Water Protected Area	**Scoped Out** ▪ Impacts on water quality from access road construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from site compound activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from tunnelling are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from the open cut crossing are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the redundant aqueduct.
	GWDTEs (non-designated)	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from vehicles using the access tracks ▪ Potential sediment mobilisation from soil stripping.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from vehicles using the site compound ▪ Potential sediment mobilisation from soil stripping.	**Scoped Out** ▪ Potential sediment mobilisation from shaft construction. However, an assessment of impacts from shaft dewatering has identified no significant impacts are likely to GWDTEs.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from construction activities ▪ Potential sediment mobilisation from trenching.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the redundant aqueduct.

Quality elements		Potential impacts per activity				
		Access tracks	Site compound	Tunnel (including shafts)	Open-cut trenches	Overflow
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required; therefore, dewatering would not affect baseflow quality to surface waters.	**Scoped Out** ▪ No significant excavation required; therefore, dewatering would not affect baseflow quality to surface waters.	**Scoped Out** ▪ New pipeline located up to approximately 120 m below ground and not considered to be linked to surface waters. ▪ Construction of shafts is unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ Excavation and dewatering for the open cut trenches are unlikely to lead to significant impacts on baseflow quality given the distance to the surface waters.	**Scoped Out** ▪ Decommissioned aqueduct would generally be located approximately 120 m below ground and not considered to be linked to surface waters, except where sections of conduit run shallow. These are addressed in the assessment of surface water bodies. ▪ No discharge to ground or groundwater for the overflow from the redundant aqueduct.
	Chemical test	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the redundant aqueduct.

5. Assessment of the Proposed Marl Hill Section

5.1 Site Specific Assessment Against WFD Quality Elements

31) This section provides a comprehensive site-specific assessment of the scoped in Proposed Marl Hill Section activities on the WFD quality elements at WFD water body scale (Table 6).

32) Impacts are assessed in terms of risk of deterioration to WFD elements using the following:

- White – Negligible risk of deterioration of status with local impacts anticipated
- Green - Low risk of deterioration of status with localised impacts anticipated (impacts managed by industry good practices)
- Orange - Medium risk of deterioration of status (additional mitigation required)
- Red - High risk of deterioration of status (potential for non-compliant in-combination with other impacts).

Table 6: Assessment of the Hodder – confluence Easington Beck to confluence Ribble and Bashall Brook WFD surface water bodies and Ribble Carboniferous Aquifers WFD groundwater Body for the Proposed Marl Hill Section activities and quality elements scoped in for further assessment

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
Construction					
Access Track	Biological	Macrophytes and phytobenthos (combined)	The exposure of bare earth surfaces because of topsoil stripping, vegetation clearance, and earthworks could lead to mobilisation of fine sediment, resulting in smothering of bed substate and reduced light availability. Culvert crossings would also change flow dynamics and cause habitat loss (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions). This would directly affect Unnamed Watercourses 430, 433, 436, 463 and Sandy Ford Brook. All five of the watercourses contain areas which were dry during the ecological walkover surveys due to low antecedent rainfall and lacking in conditions required for a diverse macrophyte community. Therefore, it is unlikely that there would be a change in quality element status especially when industry good practice is followed during construction relating to matters such as appropriate sediment management techniques and in-channel working.	**Bashall Brook**	None required
		Macro-invertebrates	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourses 430, 433, 436, 463 and Sandy Ford Brook. The macroinvertebrate community of the Bashall Brook WFD surface waterbody is indicative of good water quality and slightly/minimal sedimentation. This is based on data from six Environment Agency monitoring locations on the Bashall Brook across a 10-year period. Both $WHPT_{ASPT}$ and PSI (Indicator of sedimentation impacts) scores were high across all sampling occasions ($WHPT_{ASPT}$ ranging from 6.15-7.54 and PSI ranging from 54-84). Due to hydrological connectivity, the macroinvertebrate communities in the lower reaches of tributaries of the Bashall Brook are likely to have similar community composition and sensitivity as those in the Bashall Brook, but with reduced diversity due to the smaller watercourse size and lower habitat variation. Given the distance between the Bashall Brook and the watercourses which would directly interact with this activity (over 1 km) it is unlikely that the macroinvertebrate communities of the Bashall Brook would be impacted, with any impacts restricted to Unnamed Watercourses 430, 433, 436, 463 and Sandy Ford Brook. Further, the watercourses were observed to contain dry areas where they would interact with the proposed Marl Hill Section , making them unlikely to contain diverse or sensitive communities. Consequently, it is unlikely this activity would lead to a change in quality element status, especially when industry good practice is followed during construction, such as appropriate sediment management techniques and in-channel working.	**Bashall Brook**	None required
		Fish	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourses 430, 433, 436, 463 and Sandy Ford Brook. All five watercourses contained areas which were dry during the walkover surveys and do not provide optimum habitat to support a diverse fish community. There was a lack of suitable habitat for juvenile lamprey and salmonid species noted throughout the Bashall Brook WFD surface water body, therefore, it is unlikely that there would be a change in quality element status.	**Bashall Brook**	
	Hydro-morphological	River depth and width variation	In-channel working during the extension of the culvert crossings across Unnamed Watercourses 430, 431, 433 and 463, and Sandy Ford Brook, could lead to local bank destabilisation, particularly on Unnamed Watercourses 430 and 433 where there is evidence of incision and bank erosion occurring. These processes could be exacerbated, potentially leading to channel destabilisation. These potential impacts would be managed enough by following industry good practice during construction, such as appropriate culvert design methodologies, sensitive channel reinstatement and appropriate in/near-channel working techniques, to prevent a change in quality element status.	**Bashall Brook**	None required
		Structure and substrate of the river bed	The mobilisation of fine sediment during construction could potentially smother the local bed substrate of Unnamed Watercourses 430, 431, 433 and 463, and Sandy Ford Brook, on which significant coarse sediment features such as steps and bars were observed. It is possible that these features could become smothered by an increase in fine sediment volumes. The culverts would also replace the natural channel substrate along a 7 m section of channel on all watercourses.	**Bashall Brook**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
			These potential impacts would be managed enough by following industry good practice during construction, such as sensitive channel reinstatement and sediment management techniques, to prevent a change in quality element status.		
		Structure of the riparian zone	Removal of vegetation and compaction of the banks to accommodate the construction and operation of the access track and associated culverts could increase the risk of bank destabilisation and quantities of fine sediment entering the watercourses crossed. This is particularly relevant to Unnamed Watercourse 430, where bank erosion has been observed and the riparian vegetation is likely providing some degree of bank stability. Adherence to industry good practice during construction, such as landscape reinstatement and appropriate sediment management techniques, and the localized nature of these impacts would make it unlikely that there would be a change in quality element status.	**Bashall Brook**	None required
	Quantitative (groundwater)	GWDTEs (non-designated)	Construction of the access roads across three GWDTEs (New Laithe, Whinny Lane East and Slaidburn Road West) would result in direct impact to GWDTEs and disruption to shallow groundwater flow for adjacent areas. Given that the GWDTE sites are not designated, impacts would not result in a deterioration of quality element status. However, the areas are identified as GWDTEs and mitigation would still be explored, and ideally, placed as close to the relevant site as possible.	**Ribble Carboniferous Aquifers**	Opportunities to reduce compaction effects by spreading the load of heavy vehicles and plant along access areas should be considered during the Detailed Design phase. Direct impacts on habitats at Slaidburn Road West should be avoided by widening the existing access road to the south (i.e. removing the need for topsoil stripping within the site).
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of the access roads could lead to increase in sediment in the aquifers and leaks of chemicals, fuels and oils from vehicle movements across three GWDTEs (New Laithe, Whinny Lane East and Slaidburn Road West). This could then lead to impacts on the GWDTEs' water quality. Adherence to industry good practice during construction would significantly reduce changes to groundwater quality, especially those relating to the treatment of surface water drainage (for example use of sediment traps, settlement ponds and buffer strips and adherence to the Pollution Incident Control Plan (or equivalent). Adherence to industry good practice and given the GWDTE sites are not designated, there would be no change in quality status.	**Ribble Carboniferous Aquifers**	Stagger topsoil stripping activities, i.e. smaller sections at a time rather than the whole compound footprint. Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value. Direct impacts on habitats at Slaidburn Road West should be avoided by widening the existing access road to the south (i.e. removing the need for topsoil stripping within the site).
Site Compound	Biological	Macrophytes and phytobenthos (combined)	Mobilisation of fine sediment, as a result of exposure of bare earth surfaces from topsoil stripping, vegetation clearance, and earthworks could lead to a smothering of bed substate and changes in water quality (if fertilisers are present), whilst discharge of construction/surface water could also change flow dynamics (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions). Water quality could also be impacted by introduction of chemicals, fuels and oils from construction activities being discharged to watercourses. This would directly affect Unnamed Watercourses 388 and 402, with potential indirect impacts on the downstream River Hodder. The macrophyte/diatom community of the Hodder – confluence Easington Beck to confluence Ribble WFD surface water body is considered indicative of disturbed waters based on the Trophic Diatom Index (TDI). This is based on data from two Environment Agency monitoring locations (Site ID: 160989 (Hodder) and 69622 (Greystonely Brook) across a 10-year period, which gives TDI scores from 28.65 to 66.87 (moderate to high nutrient conditions). Percentage Motile Taxa data indicates proportions of phytobenthos taxa within the community that are motile. A high proportion of motile taxa (>50%) can indicate that light availability is influencing the community, which can be brought about by pressures such as siltation and high covers of filamentous algae. The available baseline scores for the sites ranged from 10.93 % to 56.35 % across the 10-year period. Consequently, the macrophyte community in this WFD surface water body are likely to be relatively resilient to any changes in sediment and nutrient conditions relating to use and establishment of site compounds Adherence to industry good practice during construction, such as appropriate sediment management, chemical storage and water treatment techniques, would reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	
			The potential impacts identified in the assessment of this activity for the Hodder – confluence Easington Beck to confluence Ribble WFD surface water body are also relevant for this WFD surface water body. This would directly affect Unnamed Watercourse 444, Cow Hey Brook and Sandy Ford Brook. There is no baseline monitoring data available for the Bashall Brook WFD surface water body to determine TDI and Percentage Motile Taxa scores. However, it is anticipated that similar conditions to those described on Unnamed Watercourses 430, 433, 436, 463 (see assessment of Access Road) would also be encountered here. Consequently, it is unlikely that there would be a change in quality element status especially when industry good practice if followed during construction relating to matters such as appropriate sediment management techniques and in-channel working.	**Bashall Brook**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		Macroinvertebrates	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourses 388 and 402, with potential indirect impacts on the downstream Foulscale Brook and River Hodder. The macroinvertebrate communities of the Hodder – confluence Easington Beck to confluence Ribble WFD surface water body are indicative of good water quality and slightly/minimal sedimentation. This is based on data from one Environment Agency monitoring location across a ten-year period. Both $WHPT_{ASPT}$ and PSI (indicator of sedimentation impacts) scores were high across all sampling occasions ($WHPT_{ASPT}$ ranging from 6.97-7.11 and PSI averaging 83). Due to hydrological connectivity, the macroinvertebrate communities in the lower reaches of tributaries of the River Hodder are likely to have similar community composition and sensitivity as those in the River Hodder, but with reduced diversity due to the smaller watercourse size and lower habitat variation. Given the distance between the River Hodder and the impacted watercourses (over 1 km), it is unlikely that impacts identified would propagate enough to affect these communities. Adherence to industry good practice during construction, such as appropriate sediment management, chemical storage and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this element would lead to a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourse 444, Cow Hey Brook and Sandy Ford Brook. As identified in the assessment of the Access Road , macroinvertebrate communities in the Bashall Brook are sensitive to sedimentation. They are also likely to be sensitive to changes in water quality, which could result in mortality in some communities. Given the distance between the Bashall Brook and the impacted watercourses (over 1 km), it is unlikely that impacts identified would propagate enough to affect these communities. Adherence to industry good practice during construction, such as appropriate sediment management, chemical storage and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Bashall Brook**	
		Fish	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourses 388 and 402, with potential indirect impacts on the downstream Foulscale Brook and River Hodder. Historical data from Environmental Agency monitoring locations within the Hodder- confluence Easington Beck to confluence Ribble WFD surface waterbody have shown the presence of diverse fish communities which would be sensitive to water quality and habitat changes (e.g. Brown trout, Atlantic salmon and European Eels). The impacts identified would be localised and occur on tributaries which do not demonstrate the same quality of physical habitat associated with the downstream River Hodder. Lack of direct physical interaction with the River Hodder channel and adherence to industry good practice during construction, such as appropriate sediment management, chemical storage and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to greenfield runoff rates would also prevent changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourse 444, Cow Hey Brook and Sandy Ford Brook, with potential indirect impacts on the downstream Bashall Brook.	**Bashall Brook**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
			Historical data from Environmental Agency monitoring locations within the Bashall Brook WFD surface waterbody have shown the presence of diverse fish communities which would be sensitive to water quality and habitat changes (e.g. Brown trout, Atlantic salmon and European Eels). The impacts identified would be localised and occur on tributaries which do not demonstrate the same quality of physical habitat associated with the downstream Bashall Brook. Lack of direct physical interaction with the Bashall Brook channel and adherence to industry good practice during construction, such as appropriate sediment management, chemical storage and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.		
	Hydro-morphological	Quantity and dynamics of water flow	Unnamed Watercourse 402 would receive discharge from construction compounds at a maximum rate, following attenuation, of 6.2 l/s. Anticipated greenfield runoff rates for the Bonstone Compound footprint is approximately 6.2 l/s, therefore the impact on this quality element would be negligible.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			Sandy Ford Brook would receive discharge from construction compounds at a maximum rate, following attenuation, of 10 l/s. Anticipated greenfield runoff rates for the Braddup Compound footprint is approximately 10 l/s, therefore the impact on this quality element would be negligible.	**Bashall Brook**	
		River Continuity	The temporary outfall in Unnamed Watercourse 402 would provide temporary and localised disruption to the lateral connectivity of the watercourse and its floodplain. However, disruption would not be enough to cause a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			The temporary outfall in Sandy Ford Brook would provide temporary and localised disruption to the lateral connectivity of the watercourse and its floodplain. However, disruption would not be enough to cause a change in quality element status.	**Bashall Brook**	
		River depth and width variation	For Unnamed Watercourse 402, discharge of construction drainage would not significantly alter the baseline flow regime, therefore, an increase in bed and bank erosion would be unlikely to occur at the outfall location.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			For Sandy Ford Brook, discharge of construction drainage would not significantly alter the baseline flow regime, therefore, an increase in bed and bank erosion would be unlikely to occur at the outfall location.	**Bashall Brook**	
		Structure and substrate of the river bed	Topsoil stripping, vegetation clearance and earthworks associated with the construction and use of the Bonstone Compound could lead to silt laden runoff entering Unnamed Watercourse 402, as well as the downstream Unnamed Watercourse 388. Increases in fine sediment supply could lead to the coarser bed substrate and features present in these watercourses being smothered. However, the volumes of fine sediment produced would likely be minimal where industry good practice relating to construction is followed, such as treatment of construction water prior to discharge, use of silt fences and positioning of soil stockpiles away from surface water flow paths. Consequently, this activity would not lead to a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			Topsoil stripping, vegetation clearance and earthworks associated with the construction and use of the Braddup Compound could lead to silt laden runoff entering Sandy Ford Brook. Increases in fine sediment supply could lead to the smothering of bed substrate and features (such as riffles and bars) in the Sandy Ford Brook. Significant bed scour (and therefore sediment entrainment and alteration of the bed substrate) from the discharge of construction water to the Sandy Ford Brook would be unlikely (see River depth and width variation assessment). However, the volumes of fine sediment generated would likely be minimal where industry good practice relating to construction is followed, such as treatment of construction water prior to discharge, use of silt fences and positioning of soil stockpiles away from surface water flow paths. Consequently, this activity would not lead to a change in quality element status.	**Bashall Brook**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		Structure of the riparian zone	The construction of the drainage outfall would require the removal of riparian vegetation and compaction of the right bank of Unnamed Watercourse 402. However, the scale of clearance required for outfall construction would not be enough to result in a change in quality element status.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			The construction of the drainage outfall would require the removal of riparian vegetation and compaction of the right bank of Sandy Ford Brook. However, the scale of clearance required for outfall construction would not be enough to result in a change in quality element status.	**Bashall Brook**	
	Quantitative (groundwater)	GWDTEs (non-designated)	Construction of site compounds across one GWDTE (Braddup House) would result in direct impact to the GWDTE. Given that the GWDTE site is not designated, impacts would not result in a deterioration of the quality element status. However, the area is identified as a GWDTE and mitigation would still be explored and placed as close to the relevant site as possible.	**Ribble Carboniferous Aquifers**	Minimise footprint of topsoil stripping and vegetation clearance wherever possible. This would have a direct beneficial impact on reducing the extent of potentially significance of effects caused by this activity. Reduce dewatering durations to encourage greater chance of vegetation recovery.
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of the site compounds could lead to increase in sediment in the aquifers and leaks of chemical, fuels and oils stored in the compound within or near the GWDTE (Braddup House). This could lead to impacts on the GWDTE's water quality, although measures outlined in the CCoP would significantly reduce risk of changes to groundwater quality. Adherence to industry good practice during construction would significantly reduce changes to groundwater quality, especially those relating to the treatment of surface water drainage (for example use of sediment traps, settlement ponds and buffer strips and adherence to the Pollution Incident Control Plan (or equivalent). Adherence to industry good practice and given the GWDTE sites are not designated, there would be no change in quality status.	**Ribble Carboniferous Aquifers**	Stagger topsoil stripping activities, i.e. smaller sections at a time rather than the whole compound footprint to limit the concentration of suspended solids and associated solutes entering the aquifer(s) and would reduce peak contaminant concentrations. Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					Set trigger levels for suspended solids concentrations. To identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value. Minimise footprint of topsoil stripping and vegetation clearance wherever possible.
Tunnel (including shafts)	Hydro-morphological	Quantity and dynamics of water flow	Bonstone Brook and Unnamed Watercourse 403 could experience a reduction in baseflow because of decommissioning the existing Haweswater Aqueduct. It is not clear, however, by how much baseflow could be reduced, as drawdown in groundwater levels would only occur once the existing Haweswater Aqueduct has been decommissioned. Whilst there could be a localised reduction in flow, overall flow within the water body would likely remain unaltered, as the quantities of groundwater captured by the decommissioned asset would be relatively small over the section in question (see assessment of Overflow) despite any groundwater being discharging into Bashall Brook (in the neighbouring Bashall Brook WFD surface water body). Localised impacts are assessed as part of the Environmental Statement, with mitigation identified in the form of flow monitoring (where necessary) to help quantify the magnitude of any impact in the future.	**Hodder – confluence Easington Beck to confluence Ribble**	None required
			Cow Hey Brook and Unnamed Watercourse 426 could experience a reduction in baseflow because of decommissioning the existing asset. It is not clear, however, by how much baseflow could be reduced, as drawdown in groundwater levels would only occur once the existing Haweswater Aqueduct has been decommissioned. Whilst there could be a localised reduction in flow, overall flow within the waterbody would likely remain the same, as any groundwater captured by the decommissioned asset would be discharged into the Bashall Brook. Localised impacts are assessed as part of the Environmental Statement, with mitigation identified in the form of flow monitoring (where necessary) to help quantify the magnitude of any impact in the future.	**Bashall Brook**	None required
		Groundwater connectivity	Groundwater levels may reduce local to the decommissioned Haweswater Aqueduct, as groundwater enters the decommissioned asset through structural defects. Assessment of the water balance quality element suggests that this would be a relatively small rate when considered across the length of the decommissioned asset and a WFD groundwater body scale. Therefore, there would be unlikely to cause a noticeable change in connectivity across the WFD surface water body, resulting in no change to the quality element status	**Hodder – confluence Easington Beck to confluence Ribble** **Bashall Brook**	None required
	Quantitative (groundwater)	Water balance	Initial estimations suggest that construction of the tunnel by tunnel boring machine would result in little loss of groundwater from the bedrock aquifer (typically 1.20 l/s). Therefore, groundwater disturbance within the bedrock would be expected to be minor and localised and short lived. As a result, any changes to the water balance would be expected to be minor at the scale of the groundwater body. Dewatering would be required for the construction of shafts at each end of the tunnel. The maximum estimated inflows, with the shafts at their design total depth but before they are sealed, would be 580 l/day for the Proposed Bonstone Compound Shaft and 480 l/day for the Proposed Braddup Compound Shaft. These values are well below the Environment Agency's groundwater abstraction licencing threshold and consequently they would be exempt from licensing and the potential magnitude of impact on the bedrock aquifer is likely to be minor. Therefore, groundwater disturbance would be expected to be localised and temporary. As a result, any changes to the water balance would be expected to be negligible and not result in change to quality element status.	**Ribble Carboniferous Aquifers**	None required
Open-cut trenches	Quantitative (groundwater)	Water balance	Dewatering would be required for the construction of the open cut trench for the construction of connections to the existing aqueduct and overflow structures. Excavations would not exceed 5 m depth and dewatering of the trenches is not expected to require large quantities of water to be abstracted and would be temporary. As a result, any changes to the water balance would be negligible at a WFD groundwater body scale. The connections and overflow pipes are expected in the long term to have very limited and localised effects on groundwater flows, with potential for the backfilled trenches to act as a drain for groundwater. The scale of the impact would not lead to a change in quality element status.	**Ribble Carboniferous Aquifers**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		GWDTEs (non-designated)	The open cut connection for the Proposed Braddup Compound is located within Braddup House GWDTE. Dewatering would be required for the construction of the open cut trench for the construction of connections to the existing aqueduct and overflow structures. Excavations would not exceed 5 m depth and are expected to produce a zone of influence of less than 25 m. Groundwater disturbance within the superficial deposits and bedrock during construction could have a temporary, yet significant impact on GWDTEs. There could also be a potential longer-term impact to the GWDTE due to backfilling of the trench which could cause it to act as a preferential pathway, draining shallow groundwater from the GWDTE. Given that the GWDTE site is not designated, impacts would not result in a deterioration of the quality element status, however, as the area is identified as a GWDTE mitigation would still be explored and placed as close to the relevant site as possible.	**Ribble Carboniferous Aquifers**	Keep dewatering durations to a minimum required to encourage greater chance of vegetation recovery. Use clay bunds when back-filling open cut trenches to reduce disruption to groundwater flow. During the Detailed Design phase, the opportunity to move the overflow pipe and connection (associated with the Braddup Compound), further north should be considered. This would avoid the need for excavation and reduce potential dewatering impacts on habitats associated with Braddup House. Clay bunds should be used to prevent backfilled open-cut trenches from acting as a groundwater drain within the Braddup Compound. This would mitigate against long term potential impacts to Braddup House.
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of the open cut trench within Braddup House GWDTE has the potential to mobilise sediment which could discharge to the GWDTE. This would likely impact on the GWDTE's water quality, which would require additional measures to mitigate. Given that the GWDTE site is not designated, impacts would not result in a deterioration of the quality element status. However, the area is identified as a GWDTE and mitigation would still be explored, and ideally, placed as close to the relevant site as possible.	**Ribble Carboniferous Aquifers**	Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis. Set trigger levels for suspended solids concentrations.

<table>
<tr><th>Activity</th><th colspan="2">WFD Quality Element</th><th>Potential Impacts</th><th>Relevant WFD Water Body</th><th>Additional Mitigation Required</th></tr>
<tr><td rowspan="4">Commissioning</td><td rowspan="4">Hydro-morphological</td><td rowspan="2">River depth and width variation</td><td>Potential for channel adjustment through erosion of the bed and/or banks because of the 25 l/s commissioning discharge. Whilst Unnamed Watercourse 402 was observed as being largely stable, commissioning flows could trigger new erosive processes given water is being discharged at the head of a relatively small watercourse. This could lead to a long-term destabilisation of the channel and change in channel dimensions. Similar impacts would also be expected to occur at the confluence with Unnamed Watercourse 388 (250 m downstream).</td><td>Hodder – confluence Easington Beck to confluence Ribble</td><td rowspan="4">Monitoring plan during commissioning discharges of the receiving watercourses, including an adaptive management strategy should erosion or other channel change be noted</td></tr>
<tr><td>Potential for channel adjustment through erosion of the bed and/or banks because of the 25 l/s commissioning discharge. Whilst Sandy Ford Brook was observed as being largely stable, commissioning flows could trigger new erosive processes, especially where they interact with the culvert located immediately downstream of the outfall. This could lead to a long-term destabilisation of the channel, damage to the culvert, and change in channel dimensions.</td><td>Bashall Brook</td></tr>
<tr><td rowspan="2">Structure and substrate of the river bed</td><td>Increased flow during commissioning could mobilise existing fine sediment in Unnamed Watercourse 402, as well as adding new sources of fine sediment through bank erosion (see assessment of River depth and width variation). Step-pool features were observed along the reach, which would be smothered or degraded by increases in flow. Increased fine sediment could also smother coarse bed substrate and features observed on Unnamed Watercourse 388.</td><td>Hodder – confluence Easington Beck to confluence Ribble</td></tr>
<tr><td>Increased flow during commissioning could mobilise existing fine sediment in Sandy Ford Brook, as well as adding new sources of fine sediment through bank erosion (see assessment of River depth and width variation). Step-pool and bar features were observed along the reach, which would be smothered or degraded by increases in flow.</td><td>Bashall Brook</td></tr>
<tr><th colspan="6">Operational</th></tr>
<tr><td rowspan="4">Overflow</td><td rowspan="3">Biological</td><td>Macroinvertebrates</td><td rowspan="3">No water quality data related to groundwater ingress are available, which could contain unknown levels of pollutants/contaminants from either natural or other sources (e.g. historical mines). Change in water quality (e.g. pH levels) could lead to mortality in the communities present. The volumes of water being discharged (25 l/s) could also cause loss of habitat and increase in turbidity levels.

As identified in the assessment of the Access Road and Site Compound , macrophyte, macroinvertebrate and fish communities in the Bashall Brook are sensitive to changes in water quality, with biological indicators and physico-chemical quality element baseline information suggesting quality of water is currently of high quality. If groundwater ingress were to change pH, nitrous or dissolved oxygen levels in the Bashall Brook, community compositions could change, mortality rates could increase, and health (quality and quantity) of fish populations reduce. Bed and near-bank habitat could also be disrupted (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions).

Given the sensitivity of the biological communities present and the uncertainty surrounding changes to water quality (see assessment of Physico-chemical quality elements for further detail) it is possible that this element could lead to changes in quality element status.</td><td rowspan="3">Bashall Brook</td><td rowspan="3">The potential impacts arising from the discharge of groundwater ingress are largely associated with the unknown quality of the water. To mitigate for this a water quality monitoring programme would be required to understand the baseline quality of groundwater ingress and monitor change over time.
The monitoring programme would be supported by an adaptive management strategy, to enable timely response if contaminants/pollutants are detected in quantities that would impact on the biological WFD quality elements of the Bashall Brook WFD surface body</td></tr>
<tr><td>Macrophytes and phytobenthos (combined)</td></tr>
<tr><td>Fish</td></tr>
<tr><td>Physico-chemical</td><td>pH</td><td>No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). This could alter current pH levels, and in turn disrupt established macroinvertebrate and macrophyte communities (see Biological quality element assessments for additional detail).
Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.</td><td>Bashall Brook</td><td>The potential impacts arising from the discharge of groundwater ingress are largely associated with the unknown quality of the water. To mitigate for this a water quality monitoring programme</td></tr>
</table>

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		Ammonia (total as N) and phosphate	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. agricultural practices). If groundwater contains high levels of ammonia and phosphate this could alter the nutrient balance within the Bashall Brook. This could promote excessive growth of algae and aquatic flora, with further impacts on dissolved oxygen levels (levels fluctuating due to photosynthesis/respiration) and disruption of established communities of aquatic fauna and flora. Increased levels of nitrogen could also lead to fish mortality (see Fish quality element assessments for additional detail) Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		would be required to understand the baseline quality of groundwater ingress and monitor change over time. The monitoring programme would be supported by an adaptive management strategy, to enable timely response in the event that contaminants/pollutants are detected in quantities that would impact on the physico-chemical WFD quality elements of the Bashall Brook WFD surface body.
		Dissolved oxygen	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). Dissolved oxygen levels would be indirectly impacted if there are elevated levels of ammonia/phosphate in the groundwater being discharged (see Ammonia (total as N) and phosphate quality element assessment for additional detail) Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		
		Temperature	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). If the groundwater being discharged varies significantly in temperature from water in the Bashall Brook, local changes in temperature would occur. This could result in disruption of seasonal water temperature variations, influence other water quality parameters (e.g. dissolved oxygen levels), or cause stress to local fish populations. Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		
	Hydro-morphological	Quantity and dynamics of water flow	Groundwater ingress would discharge from the existing outfall on the left bank of the Bashall Brook continuously at a rate of 26 l/s. The current Q95 flow of the Bashall Brook is estimated at 10 l/s, whilst the additional discharge would increase flow to approximately 36 l/s, exceeding the current Q70 flow. The same pattern would be followed during Q70 flow events, which would match current Q50 flows when streamflow is combined with flow from the overflow. This would present a significant departure from current the flow regime, therefore would likely result in change in quality element status. Local flow dynamics would also be altered significantly with increased turbulent flow likely to be present at the outfall.	**Bashall Brook**	Monitoring of the reach to record changes in bed and bank conditions would be undertaken. This would occur monthly for the first 12 months following commencement of discharge, then on a six-monthly basis every October and February to capture the period when the watercourse would likely be most active. Review of the need for monitoring would be carried out after five years in consultation with the Environment Agency. Formation of an adaptive management plan would also be required, which would be activated once predefined conditions are met.
		River depth and width variation	Significant increase in flow on Bashall Brook arising from the discharge of groundwater ingress could cause bed and bank erosion at the outfall location. The position of the outfall is also unknown. If it is positioned above the water level, water could be discharged in a manner analogous to a waterfall, which could encourage scour pool formation. This would have implications for channel bed/bank stability, both at the site of the outfall and also upstream if the scour pool were to migrate upstream. Increased incidence of bed and bank erosion is could also occur further downstream as flow (and therefore sediment entrainment capabilities) are increased, although this would likely be limited to the reach up to the weir located at Cross Lane which would continue to regulate flows downstream of the structure.		
		Structure and substrate of the river bed	Sediment entrainment analysis shows a change in flow regime would also see an increase in entrainment thresholds, with larger sediment clasts capable of being mobilised on a more regular basis. This would likely increase the volume of sediment being transported downstream, whilst reducing the opportunity for replenishment of depositional features observed along the Bashall Brook (such as bars and berms) following high magnitude flow events. Disruption of the sediment regime in this manner could also lead to bed substrate becoming increasingly homogenous.		
	Quantitative (groundwater)	Water balance	Modelling of groundwater ingress to the decommissioned existing tunnel has predicted ingress rates of 15.28 to 26.49 l/s for the entire existing Marl Hill Section which is about 4.3 km long, equating to an ingress rate of 3.57E-03 to 6.19E-03 l/s/m. This represents a small dewatering rate, therefore the impact on this quality element would be negligible.	**Ribble Carboniferous Aquifers**	None required
		GWDTEs (non-designated)	Details regarding impacts to GWDTEs from decommissioning of the existing aqueduct would be provided in a standalone document. However, as the GWDTE sites are not designated, there would be no change in the status of this quality element.	**Ribble Carboniferous Aquifers**	If required would be recorded in standalone document.

5.2 Review of WFD Specific Mitigation Measures

33) Within each RBMP, there is a list of mitigation measures or environmental improvements specifically for HMWBs, which have been identified for implementation by a specified date for the UK to meet the target date set by the WFD. Part of the a WFD compliance assessment is to consider these WFD specific mitigation measures and assess whether the Proposed Marl Hill Section can contribute to them, or could obstruct any of them from being delivered. None of the WFD water bodies covered by this assessment are A/HMWBs, therefore there are no mitigation measures to assess.

5.3 Cumulative Assessment with other Proposed Development s

34) Future planned developments (approved and pending planning decisions) have been screened to determine whether there would likely be any cumulative effects when considered in conjunction with the Proposed Marl Hill Section. The closest planned developments would occur at least 1.5 km from the Proposed Marl Hill Section red line boundary; therefore, it is unlikely that there would be any cumulative effects on WFD surface water quality elements.

35) The Proposed Marl Hill Section would interact with the Hodder – confluence Easington Beck to confluence Ribble WFD Surface Water Body, which also interacts with the Proposed Bowland Section of HARP. It is not anticipated that there would be any cumulative/intra-development impacts which would cause either development to be non-compliant.

36) For groundwater, given the distance from the red line boundary of the other identified developments and that extensive dewatering would not be needed for the development s, these planned developments are unlikely to lead to cumulative impacts for groundwater bodies.

37) In relation to construction and operation of other sections of the aqueduct and the decommissioned existing aqueduct, as some of these sections occur in the same groundwater body, there is potential that the works for individual sections could have an impact on the same groundwater body. However, at a WFD groundwater body scale the cumulative impact from these separate sections would not be significant and the impact on groundwater bodies would be no greater than shown in this document.

5.4 Compliance with WFD Objectives

38) Table 7 provides a summary of the compliance of the Proposed Marl Hill Section against the WFD objectives outlined in Section 1.2. In summary, it is considered that the Proposed Marl Hill Section would be compliant for all three WFD water bodies assessed.

Table 7: Compliance with the environmental objectives of the Water Environment Regulations

Environmental Objective	Conclusions for The Proposed Marl Hill Section	Compliant With the Regulations
No changes affecting high status sites	Not applicable – no high-status water bodies present.	Yes
No changes that would cause failure to meet surface water Good Ecological Status or Potential or result in a deterioration of surface water Ecological Status or Potential	The Proposed Marl Hill Section as outlined would not cause deterioration in the status of any water body, but this needs to be confirmed.	Yes
No changes which would permanently prevent or compromise the Environmental Objectives being met in other water bodies	The Proposed Marl Hill Section options would not cause a permanent exclusion or compromise achieving the objectives in other bodies of water within the same River Basin District.	Yes
No changes that would cause failure to meet good groundwater status or result in a deterioration of groundwater status.	The Proposed Marl Hill Section would not cause deterioration in the status of any groundwater body.	Yes, as whilst some GWDTEs would be significantly impacted, there are no statutory designations attached to them (SAC or SSSI). Consequently, there would be no grounds for deterioration in the quality element status at a WFD scale. However, local impacts would be considered by the Environmental Statement (Document Reference Number RVBC-MH-ES-007).