Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Environmental Statement

Volume 2

Chapter 8: Flood Risk

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Water for the North West

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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8. Flood Risk

8.1 Introduction

1) This chapter assesses the potential for the Proposed Bowland Section to give rise to likely significant effects on flood risk.

2) The chapter begins by reviewing the legislation and planning policies relevant to flood risk. The assessment area and methodology for the assessment are then outlined. The nature, value and sensitivity of the existing, baseline environment is then described before an assessment is made of the potential effects of the Proposed Bowland Section on flood risk. Embedded mitigation and good practice measures relevant to flood risk are summarised in Section 8.4 and have been taken into account in the assessment in Section 8.6.

3) A Flood Risk Assessment (FRA) Report (Appendix 8.1) has been prepared in accordance with the requirements of the National Planning Policy Framework (NPPF).[1] This is a stand-alone document to support the planning application for the Proposed Bowland Section, but for completeness is included within Appendix 8.1. The findings of the FRA are summarised in this chapter.

4) The FRA (Appendix 8.1) identifies that the Proposed Bowland Section is classified as water transmission infrastructure and is therefore considered within the NPPF to be a water compatible development that is suitable in all areas of flood risk providing that it is safe, can operate in times of flood and does not increase flood risk elsewhere.

8.2 Scoping and Consultations

8.2.1 Scoping

5) A flood risk chapter was included within the Scoping Report, which was submitted to the relevant planning authorities for comment in October 2019 followed by a Scoping Addendum in February 2021 due to design changes and refinements. Scoping Report responses were provided by each of the local authorities and these have been reviewed and October 2019 Scoping Report Responses incorporated into the assessment whilst a summary of the assessment scope is presented in Table 8.1. Scoping comments and responses are outlined in Appendix 4.1.

Table 8.1: Scoping Assessment Summary

Flood Source / Assessment Element	Assessment Summary	Conclusion
Assessment Area The assessment area of the Proposed Bowland Section defines the area used to identify sources of flood risk and the extents of potential impacts.	The FRA (Appendix 8.1) did not have a fixed assessment area. The assessment focused on the area within the planning application boundary and specifically on the surface and shallow works. As the design developed, the assessment was extended to include areas downstream of the planning application boundary and areas of deep tunnelling if appropriate due to the magnitude of the impacts and the sensitivity of the potential receptors.	Assessment area varies according to source
Coastal flood risk Flooding originating from the sea where water levels exceed the normal tidal range and flood onto the low-lying areas that define the coastline.	The Proposed Bowland Section is approximately 17 km from the River Lune Estuary and is at a minimum elevation of approximately 130 m above Ordnance Datum (AOD). Therefore, no risk from this source has been identified and no further assessment is necessary.	Scoped out

[1] Department for Communities and Local Government (2018) National Planning Policy Framework [Online] Available from: https://www.gov.uk/government/publications/national-planning-policy-framework--2. [Accessed: 22 May 2020].

Flood Source / Assessment Element	Assessment Summary	Conclusion
Fluvial flood risk (Main Rivers) Flooding originating from Main Rivers, including the River Hindburn and the River Hodder.	Environment Agency Flood Zone definitions are set out in the National Planning Policy Guidance (2014) and range from 1 to 3, with Flood Zone 1 having the lowest flood risk. The Proposed Bowland Section would be located within Flood Zone 1 except for the construction access road across the River Hodder. No other temporary or permanent above-ground crossings of Main Rivers are proposed. Construction phase discharges into the catchments of the River Hindburn and the River Hodder have the potential to increase flow and increase risk downstream and need to be considered in further detail. Discharges of groundwater ingress into the decommissioned section of the Haweswater Aqueduct into the River Hodder also need to be assessed.	Scoped in
Fluvial flood risk (Ordinary Watercourses) Flooding originating from minor watercourses, with localised flood risk issues.	During the enabling, construction and operational phases, features such as temporary access tracks and crossings, construction compounds and other above-ground structures such as valve houses would be constructed near or over Ordinary Watercourses. The scoping assessment identified that enabling and construction phase impacts were likely to be short term in duration, and could be mitigated effectively through the application of good design and construction practices. Long-term impacts to Ordinary Watercourses would be limited to small changes to surface water runoff rates from new valve houses and associated infrastructure which could also be mitigated through the application of good practice. The need for further detailed assessment of fluvial flooding from Ordinary Watercourses would be considered on a case-by-case basis once additional design information is available.	Scoped in
Surface Water (Pluvial) Flooding resulting from high intensity rainfall, with runoff travelling overland and ponding in local topographic depressions before the runoff enters any watercourse, drainage systems or sewer.	During the construction phase of the Proposed Bowland Section, construction access tracks and construction compounds would be constructed near or over surface water flow paths. These features also have the potential to increase runoff and flood risk downstream if not managed appropriately. Surface water flooding would need to be assessed in further detail on a case-by-case basis to determine if detailed assessment or mitigation beyond good practice would be required.	Scoped in
Groundwater Flooding due to a significant rise in the water table, normally as a	Earthworks associated with the construction of shafts, attenuation ponds and open-cut trenches have the potential to encounter groundwater. These works therefore have the potential to allow groundwater to flood excavation areas and reach the surface.	Scoped in

Flood Source / Assessment Element	Assessment Summary	Conclusion
result of prolonged and heavy rainfall over a sustained period.		
Failure of Water-Retaining Infrastructure Flooding due to the collapse and / or failure of man-made water-retaining features such as hydro-dams, water supply reservoirs, canals, flood defences structures, underground conduits, and water treatment tanks or pumping stations.	Environment Agency mapping indicates that flooding from Stocks Reservoir would flow in the direction of the construction access track for the Proposed Bowland Section. No canals or flood defences have been identified within the vicinity of the Proposed Bowland Section.	Scoped in for construction phase only
Failure of the Existing Haweswater Aqueduct	The risk of flooding from the aqueduct itself would not be assessed, as this is an existing risk and the Proposed Bowland Section would reduce the likelihood of failure.	Scoped out
Sewer and Water Mains Flooding due to surcharging of man-made drainage systems.	United Utilities have not identified any areas of sewer flood risk in close proximity to the Proposed Bowland Section and no discharges to the public sewer network are proposed. Failure of water mains are a potential source of flooding but are unlikely to impact this type of development. Therefore, no further assessment of these sources has been undertaken.	Scoped out
Land Drainage and Artificial Drainage Failure of land drainage infrastructure such as drains, channels and outflow pipes, which is most commonly the result of obstructions, poor maintenance and / or blockages.	No data are available on the location of local land drainage assets. Where these features are identified on site and affected, they would be replaced, if necessary, with assets that have the same performance. Therefore, the risk of flooding is unlikely to change, and no further assessment would be necessary.	Scoped out
Climate Change Climate change and the impacts associated with wetter winters and more intense storm events have the potential to increase flood risks.	The enabling and construction phase of the Proposed Bowland Section would be approximately seven years in duration starting in 2023. Therefore, the effects of climate change should not be considered in relation to this phase. Operational phase infrastructure is predominantly below ground. The impact of climate change on flood risk to permanent above-ground features should be undertaken on a case-by-case basis to determine if detailed assessments would be required.	Scoped in
Existing Infrastructure Existing components of the Haweswater Aqueduct and associated operational activities.	Existing structures and associated operational activities were excluded from the scope of the assessment. This includes the: ▪ Operation of existing washouts to drain the aqueduct for routine maintenance ▪ Existing overflows that enable discharge from the aqueduct into local watercourses in the event of a downstream blockage or collapse	Scoped out

Flood Source / Assessment Element	Assessment Summary	Conclusion
	▪ Existing tracks leading to valve houses that would be utilised by the Proposed Bowland Section. These structures would continue to operate as they do currently and would therefore not be affected by the Proposed Bowland Section.	

8.2.2 Consultation

6) A consultation meeting was undertaken with the Environment Agency prior to scoping submission to provide some background to the Propose Bowland Section and the range of potential impacts that had been identified at that time. Subsequent meetings have been held with the Environment Agency to provide additional details of the design of the Proposed Bowland Section as this has developed, to confirm the scope of the FRA and to provide early outputs of the assessment.

7) As Risk Management Authorities (RMAs), both the Environment Agency and United Utilities were consulted to obtain relevant historical and predictive flood risk datasets along with details and assets owned and operated that may influence flood risk. United Utilities responded to a data request to confirm that there are no public sewers within the assessment area or any sewer flooding incidents on record.

8) Consultation with Lancashire County Council as the Lead Local Flood Authority (LLFA) comprised its formal responses to the Scoping Report and virtual workshops providing details of the proposals. These workshops were held due to restrictions following the COVID-19 pandemic. Consultation to inform the planning and Environmental Permitting processes is ongoing.

8.3 Key Legislation and Guidance

9) Table 8.2 introduces the key flood risk legislation and guidance. National and local planning policies are covered in Chapter 5: Planning Policy and Context.

Table 8.2: Flood risk Key Legislation and Guidance

Applicable Legislation and Guidance	Description
National Planning Policy Framework (NPPF)[2]	The NPPF sets out the government's planning policies for England and how these are expected to be applied. It states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, it should be made safe throughout the life of the development without increasing flood risk elsewhere. The NPPF confirms that local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where informed by a site-specific FRA. Flood risk Assessments are also required for developments in low risk areas above 1 ha in size.
Flood and Water Management Act 2010[3]	This Act defined the responsibilities for RMAs and places a duty on all flood RMAs to co-operate with each other and to share information. It also places a duty on RMAs to aim to contribute towards the achievement of sustainable development when exercising their flood and coastal erosion risk management functions.

[2] Ministry for Housing, Communities and Local Government (2018) *National Planning Policy Framework*. [Online] Available from: https://www.gov.uk/government/publications/national-planning-policy-framework--2. [Accessed: 22-05-20].
[3] Flood and Water Management Act (2010) C. 29. [Online] Available from: https://www.legislation.gov.uk/ukpga/2010/29/contents [Accessed 10-06-21]

Applicable Legislation and Guidance	Description
Land Drainage Act 1991[4]	This legislation empowered drainage authorities to regulate works to Ordinary Watercourses (non-Main Rivers).
The Flood Risk Regulations 2009[5]	These regulations transposed the European Union (EU) Flood Directive (2007) into UK law. The regulations provide a framework for managing flood risk over a six-year cycle, and require the production of Preliminary Flood Risk Assessments, identify areas of potential significant risk and undertake flood hazard mapping and Flood Risk Management Plans.
Reservoirs Act 1975[6]	The Reservoirs Act, which replaced earlier similar legislation, was set up to promote the safety of Large Raised Reservoirs. These are defined as retaining more than 25,000 m^3 of water. The regulations require that any reservoir within the scope of the Act may only be designed, or construction supervised, by an engineer on the appropriate panel. Following construction, another panel engineer must inspect the reservoir within three years. During the life of the structure, a member of the Supervising Engineers panel must be retained to carry out regular inspections, typically every year.

8.4 Assessment Methodology and Assessment Criteria

8.4.1 Assessment Methodology

10) The methodology of this assessment has been developed in accordance with the NPPF and has drawn on previous experience of similar projects and knowledge of local flood risk within which the Proposed Programme of Works would be delivered. Further details of the methodology undertaken to inform flood risk is found in Section 2.4 of the FRA (Appendix 8.1) and is summarised below.

11) As identified in the Scoping Report, the main sources of risk that are relevant to the assessment of the Proposed Bowland Section are fluvial, surface water and groundwater flooding although a potential risk from reservoirs has also been identified.

12) Flood risk is conceptualised using the source-pathway-receptor model, where risk is dependent on all elements being present.

13) The assessment of flood risk has been determined using readily available national flood risk datasets, supplemented with hydrological and hydrogeological assessment, to develop a conceptual understanding of baseline flood risk and changes in flood mechanisms driven by potential impacts of the Proposed Bowland Section.

14) The baseline sensitivity for flood risk therefore considers:

- The probability (likelihood) of flooding from the flood source
- The consequences of flooding.

15) Accurately quantifying the consequences of flooding is complex and depends on several factors. Therefore, vulnerability of receptors (land uses and activities that could flood) has been adopted as a proxy for flood consequence. The vulnerability of receptors is a key element in determining flood consequences and is readily determined using classifications specified within Planning Practice Guidance[7] (PPG). The overall baseline sensitivity is based on the data available to determine probability

[4] Land Drainage Act (1991) C. 59 [Online] Available from: https://www.legislation.gov.uk/ukpga/1991/59/contents [Accessed: 22 May 2020].
[5] Flood Risk (England) Regulations (2009) SI 2019/3042 [Online] Available from: https://www.legislation.gov.uk/uksi/2009/3042/contents/made [Accessed: 22 May 2020].
[6] Reservoirs Act (1975) C. 23 [Online] Available from: https://www.legislation.gov.uk/ukpga/1975/23 [Accessed 22 May 2020]
[7] Department for Communities and Local Governments (2019) Planning Practice Guidance [Online] Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification [Accessed: 22 May 2020].

of flooding from all flood sources and the potential for multiple land uses to be at risk from this source (see Table 8.3). Where there is uncertainty regarding whether a land use would be at risk, the precautionary approach of including it has been taken.

16) The assessment of the flood risk posed to the Proposed Bowland Section and the magnitude of the change in flood risk considers the potential effects on all elements of flood risk including: flood frequency, extent, depth, velocity and combinations of these components (see Table 8.4).

17) The duration of anticipated changes to flooding is also considered when assessing flood risk impacts, where a distinction is made between temporary and permanent changes. Temporary changes can be long term or short term in nature.

18) The magnitude of change has been determined based on the data available for flood sources and the criteria set within Table 8.4.

19) The assessment area for the FRA varies depending upon the source of flooding. For fluvial and surface water flooding, a 50 m buffer from the planning application boundary associated with the above-ground elements of the Proposed Bowland Section was adopted. This has been extended along watercourses or identified flow routes where considered necessary.

20) The assessment area for fluvial and surface water flooding would not include the route of the tunnel where there would be limited potential with interaction with flooding at the surface.

21) Given the horizontal boring method proposed, the assessment area for groundwater flood risk does not include the route of the tunnel due to the short-lived and limited potential for change to groundwater levels from the construction method for the tunnel itself. The assessment area for groundwater includes all other construction activities within the red line boundary. The assessment also considers the decommissioning of the existing aqueduct due to potentially long duration impacts on groundwater flows.

8.4.2 Assessment Criteria

22) This section sets out a list of criteria for evaluating the associated environment effects:

- The sensitivity (see Table 8.3) of a feature or resource is typically determined by, among other things, its level of designation or protection (e.g. importance, value or rarity), its susceptibility to or ability to accommodate change. Within the context of flood risk, sensitivity is a function of the likelihood of flooding and the potential consequences (i.e. baseline flood risk)
- The magnitude of change (see Table 8.4) is a measure of the scale or extent of the change in the baseline condition, irrespective of the value of the feature or resource(s) affected (i.e. impact on flood risk)
- The significance of the overall flood risk (see Table 8.5) is a product of the baseline flood risk (sensitivity / value) of the resource or feature and the magnitude of the potential change. The assessment takes into account embedded design and good practice measures. Should the overall significance of flood risk be classified as moderate, large or very large, then this would be considered to be 'Significant' and further essential mitigation would be required. Any effects that cannot be mitigated would be recorded as residual effects.

23) An effect may be significant if it would meet at least one of the following criteria:

- It is likely that the planning authority would reasonably consider applying a condition, requirement or legal agreement to the grant of consent to require specific additional mitigation to reduce or overcome the effect
- It is likely to be material to the decision about whether the planning application should be approved.

Table 8.3: Flood Risk Sensitivity Criteria

Sensitivity	Criteria
Low	Fluvial – land having a less than 0.1 % Annual Exceedance Probability (AEP) of river flooding (Flood Zone 1). Surface water – land having a less than 1 % AEP of surface water flooding. Groundwater – areas with limited potential for groundwater flooding to occur. Artificial infrastructure – areas at risk of flooding from failures of water infrastructure. Land use that is defined within the NPPF as water compatible.
Medium	Fluvial – land having between a less than 1 % AEP but greater than 0.1 % AEP of river flooding (Flood Zone 2). Surface water – land having between a less than 1 % but greater than 3.3 % AEP of surface water flooding. Groundwater – areas with potential for groundwater flooding of receptors situated below ground level Land use including productive farmland or unclassified roads.
High	Fluvial – land having a 1 % AEP or greater of river flooding (Flood Zone 3). Surface water – land having a greater than 3.3 % AEP of surface water flooding. Groundwater – areas with potential for groundwater flooding to occur at surface level. Land uses classified as “Less Vulnerable” within the NPPF or local transport networks and infrastructure.
Very high	Fluvial – land where water must flow or be stored in times of flood, referred to as Functional Floodplain (Flood Zone 3b). Land uses classified as “Essential Infrastructure”; “More Vulnerable”; or “Highly Vulnerable”; or where the increase in flood risk would result in a risk to life (i.e. a flood hazard that is dangerous for all).

Table 8.4: Magnitude of Flood Risk Effects

Magnitude	Criteria
Major	A large adverse or beneficial change in flood depth, flood extent, velocity or peak flow that may have an impact some distance upstream or downstream. Potential to significantly change flood frequency. Potential change in risk to life. A large adverse or beneficial change in groundwater levels and flows which would affect groundwater flooding susceptibility over catchment scale.
Moderate	A moderate adverse or beneficial change in flood depth, flood extent or peak flow that may have limited impact some distance upstream or downstream. Potential for some change in flood frequency. Minor changes in floodplain flow pathways that increase velocity or extent of flooding but do not lead to new areas being inundated or new flow pathways forming. A moderate adverse or beneficial change in groundwater levels and flows which would affect groundwater flooding susceptibility over catchment scale or a large adverse or beneficial change in groundwater levels and flows which would affect groundwater flooding susceptibility over local scale.
Minor	A small or very localised adverse or beneficial change in flood depth, extent or peak flow with no perceptible impact upstream or downstream or in the floodplain. Small changes in flood frequency.

Magnitude	Criteria
	A small adverse or beneficial change in groundwater levels and flows which would affect groundwater flooding susceptibility over catchment scale or a moderate adverse or beneficial change in groundwater levels and flows which would affect groundwater flooding susceptibility over local scale.
Negligible	Very limited potential for change. No change in flood frequency.

Table 8.5: Significance of Effects

		Magnitude			
		Negligible	Minor	Moderate	Major
Sensitivity	Low	Neutral	Neutral	Slight	Moderate / Large
	Medium	Neutral	Slight	Moderate	Large
	High	Neutral	Slight / Moderate	Moderate / large	Large / Very large
	Very High	Neutral	Moderate / Large	Large / Very large	Very large

Embedded Mitigation

24) The design has sought to avoid impacts as part of the design process. Chapter 3: Design Evolution and Development Description explains the evolution of the design with input from the environmental team, including mitigation workshops and the use of GIS-based constraints data.

25) Embedded mitigation measures were also considered when determining potential impacts on flood risk. Measures of particular relevance to flood risk are set out below:

- The sequential approach was adopted to avoid placing assets, features and activities within areas at high flood risk where possible
- Discharge surface water runoff solutions for construction compounds were adopted as high up the drainage hierarchy and implementing sustainable drainage systems (SuDS) as reasonably practicable, to avoid or reduce impacts on receiving watercourses
- The management of groundwater discharges within the surface water drainage system
- Design of a single span bridge over the River Hodder that has a soffit set 600 mm above the 1 % AEP peak flood level and includes flood relief culverts in the proposed ramps.

Good Practice Measures

26) Good practice measures are contained in Appendix 3.2: Construction Code of Practice (CCoP). These include:

- The design of temporary watercourse crossings in accordance with CIRIA C786[8] so that they are appropriately sized
- The design of temporary drainage and permanent valve houses to take into account local sources of risk including groundwater and surface water
- Good materials management such as adding breaks into stockpiles to minimise disruption of flow
- The design of construction access tracks and associated drainage to maintain natural catchments and minimise the impact on floodplains

[8] CIRIA (2019) *Culvert, Screen and Outfall Manual (C786)*, CIRIA, London

- The development of flood response plans including the subscription to flood warning services where available, the monitoring of water levels and plans to move equipment and staff to safety in the event of a flood.

8.4.3 Assumptions and Limitations

27) General assumptions of the EIA process are detailed in Chapter 4: EIA Methodology whilst assumptions and limitations specific to this chapter are detailed below.

- The assessment is based on the design details that were available at the time of writing. Whilst the location of most infrastructure components has been confirmed, full details for all outline designs were not available, including the vertical alignment of construction access tracks and the sizes of new culverts where the construction access track crosses watercourses
- Consultation with Lancashire County Council as LLFA comprised its formal response to the Scoping Report and virtual workshops to discuss the proposals.
- The Draft Factual GI Report available at the time of writing was not a finalised and fully checked set of data. The assessment is reliant on the accuracy of the information reported by the ground investigation (GI) contractor at the time of writing
- It is assumed that in addition to embedded mitigation measures the elements of the Proposed Bowland Section that have not yet been designed in detail would be designed and constructed using appropriate flood design standards and good practice to ensure any potential flood risks and development impacts would be mitigated. The Construction Code of Practice (CCoP) has been produced to provide an overview of appropriate flood design principles, standards and good practice to be considered at later stages of the design process.

8.5 Baseline Conditions

28) This section details the flood risk baseline conditions for the assessment area with regard to flooding. Baseline data were collated from a variety of sources in compiling this assessment, including:

- A desk-based assessment of publicly available information as detailed in Table 8.6
- Field Surveys undertaken by Jacobs staff between December 2019 and May 2020.

8.5.1 Information Sources

29) The assessment was undertaken with reference to the sources detailed in Table 8.6.

Table 8.6: Key Information Sources

Data Source	Reference
Environment Agency flood map for planning	https://flood-map-for-planning.service.gov.uk/
Environment Agency Risk of Flooding from Surface Water mapping	https://assets.publishing.service.gov.uk/What-is-the-Risk-of-Flooding-from-Surface-Water-Map.pdf
Risk of Flooding from Reservoirs mapping	https://data.gov.uk/dataset/44b9df6e-c1d4-40e9-98eb-bb3698ecb076/risk-of-flooding-from-reservoirs-maximum-flood-extent-web-mapping-service
Recorded Flood Outlines	https://data.gov.uk/dataset/16e32c53-35a6-4d54-a111-ca09031eaaaf/recorded-flood-outlines
British Geological Survey mapping	https://mapapps2.bgs.ac.uk/geoindex/home.html
Lancaster City Council Strategic Flood Risk Assessment	https://www.lancaster.gov.uk/assets/attach/1427/Strategic%20Flood%20Risk%20Assessment%20(Jacobs%202007).pdf

Data Source	Reference
Ribble Valley Borough Council Strategic Flood Risk Assessment	https://www.ribblevalley.gov.uk/download/downloads/id/7085/strategic_flood_risk_assessment.pdf
United Utilities Asset data	Consultation

30) A feature by feature assessment of baseline sensitivity is presented in Annexe A of the FRA (Appendix 8.1). A summary of this assessment is presented in Table 8.7. The features assessed are identified on Figures 2 to 4 within the FRA (Appendix 8.1).

Table 8.7: Baseline Summary

Feature	Value	Justification
Fluvial flood risk – River Hodder (Main River)	Very high	The baseline assessment indicated that this Main River posed a high risk of flooding. The floodplain of the river is classified as Flood Zone 3 indicating a high probability of flooding. Receptors identified include the B6478, a water treatment works and agricultural land.
Fluvial flood risk – River Hindburn (Main River)	High	The River Hindburn would be approximately 800 m from the northern extent of the Proposed Bowland Section. The floodplain of the river was classified as Flood Zone 3 indicating a high probability of flooding. Receptors identified included farmland and unclassified roads.
Fluvial flood risk – tributaries (Ordinary Watercourses) of the River Hindburn and the River Hodder	Low to very high	The baseline assessment identified several Ordinary Watercourses present within and adjacent to the Proposed Bowland Section assessment area. These Ordinary Watercourses were identified to be small, low order streams with small catchments that are tributaries of either the River Hindburn or the River Hodder. The baseline assessment identified that these watercourses did not have hydraulic models associated with them. Therefore, the probability of flooding from these watercourses was inferred from the Environment Agency's Risk of Flooding from Surface Water mapping. The probability of flooding from these watercourses was found to be generally low (between 1 % and 0.1 % AEP) but areas of high risk (greater than 3.33 % AEP) were identified. Existing land use was observed to be agricultural with isolated farm properties.
Surface water flood risk	Low	The probability of surface water Flood risk across the study area was found to be low, with a probability of flooding less than 0.1 % AEP.
Reservoir flood risk from Stocks Reservoir	Low	The failure of Stocks Reservoir would pose a risk to land within the River Hodder floodplain that the Proposed Bowland Section passes through. However, the probability of failure would be low.
Groundwater flood risk from superficial deposits (Glacial Till and River Terrace Deposits)	Low to very high	The baseline assessment identified that the risk of groundwater emergence at the surface varied from low to very high. The B6478 and a Waste Water Treatment Works (WwTW) would be located in the vicinity of the Proposed Bowland Section. Therefore, there would be a high sensitivity to changes in flood risk.
Groundwater flood risk from bedrock (Millstone Grit Formation)	Low to very high	The risk of groundwater emergence at the surface varies from low to very high. The B6478 and a WwTW are located in the vicinity of the Proposed Bowland Section. Therefore, there would be a high sensitivity to changes in flood risk.

8.6 Assessment of Likely Significant Effects

31) The following section describes the effects of the Proposed Bowland Section on flood risk during the construction and operational phases. As noted in Section 8.4.4, the assessments take into account embedded mitigation and good practice measures, but are prior to implementation of any essential mitigation (refer to Section 8.7).

8.6.1 Enabling Works Phase

32) Enabling works would include the construction of temporary access roads that would need to cross the River Hodder (Main River) as well as tributaries (Ordinary Watercourses) of the River Hodder and River Hindburn. These temporary crossings would have the potential to restrict flood flows and to displace water from the floodplain increasing flood risk upstream. Whilst the risks from Ordinary Watercourses at crossing locations would be managed through use of embedded mitigation and good practice including appropriately sized culverts, the temporary River Hodder crossing is predicted to have a greater impact.

33) During the outline design stage of the Proposed Bowland Section, several crossing locations for the Hodder Bridge were considered, taking into account a range of design and environmental considerations, including flood risk. The proposed location of the access road and temporary bridge crossing has been confirmed, as it is believed to be the best location due to the stable straight channel, the relatively narrow floodplain and its proximity to the existing road network.

34) Whilst the detailed design of the bridge has not yet been finalised, the outline design of the preferred option comprises the following embedded mitigation features to reduce the risk of flooding and the impacts on the bridge structure elsewhere:

- The bridge soffit level would be set at the 1 % AEP peak flood level plus 600 mm freeboard
- Structures (e.g. piers) within the river channel would be avoided with the river being crossed in a single span from ramps located on either bank
- Flood relief culverts would be built into the ramps (4 x1 m box culverts).

35) However, at this stage it is noted that due to the width of the floodplain, other potential impacts and capital costs, it would not be practical to cross the floodplain in a single span. Therefore, some structures within the floodplain would be required.

36) Structures across the floodplain would act as a barrier to floodplain flow and would also reduce the volume of floodplain storage. Hydraulic modelling of the baseline situation and the proposed bridge is summarised in the FRA (Appendix 8.1). This shows that due to the confined nature of the floodplain at the crossing location, the constriction of flood flows by the bridge would result in an increase in flood levels within agricultural land upstream of the structure of 0.27 m during the 10 % AEP flood event. However, flood extents are not predicted to significantly increase with any significant increase in peak flood levels limited to the agricultural land (already located in the floodplain) and the WwTW. The United Utilities Operations team have confirmed that standard operating practices at the WwTW would provide resilience to flooding. Therefore, the magnitude of the impact of this increase to the WwTW would be negligible. However, the magnitude of the impact to the agricultural land has been assessed to be moderate.

37) The existing B6478 river crossing would also be impacted; however, due to the relatively steep gradient of the River Hodder in this location and the difference in floodplain levels between sections upstream and downstream of the road, any increase in flood levels along the road would be minimal (0.01 m during the 10 % AEP flood event) and no changes to flood frequency would occur. This small change in depth would not increase the flood hazard classification and the magnitude of the impact to the B6478 has been assessed to be negligible.

38) The majority of proposed access roads and the construction compounds would be located on existing greenfield sites currently comprising agricultural land. The compaction of soil and the creation of impermeable surfaces associated with the proposed features have the potential to increase the rate of

surface water runoff. This can have impacts on local surface water flood risk and / or fluvial flood risk within the receiving watercourse.

39) Dewatering of excavations has the potential to reduce groundwater levels locally whilst the use of soakaway drainage has the potential to result in localised increases in groundwater levels.

40) Embedded mitigation and good practice measures to limit the potential effects described above are detailed within the CCoP. Good practice design and construction measures are assumed to be adequate to ensure that the magnitude of these effects would be negligible. These measures would include:

- Avoidance of areas of flood risk where reasonably practicable
- Use of hydraulic modelling to optimise the design of the bridge across the River Hodder and limit flood risk impacts
- Design of culverts in accordance with CIRIA C786[9]
- Good materials management such as adding breaks into stockpiles to minimise disruption of flow
- Attenuation of surface water runoff prior to discharge to the ground or to a watercourse at a rate agreed with the relevant RMA
- The design of access tracks and associated drainage to maintain natural catchments and minimise the impact on floodplains.

41) A summary of enabling works effects and their significance is shown in Table 8.8.

42) Based on assumptions outlined in Section 8.4.3, it is anticipated that the magnitude of impact on flood risk from the effects associated with the enabling phase works would generally be negligible resulting in a significance of neutral. However, the significance of the impact of the River Hodder crossing would be large and additional mitigation would be required. This is detailed in Section 8.7.

Table 8.8: Summary of Potential Enabling Works Effects (Pre-Essential Mitigation)

Environmental / Community Asset	Value / Sensitivity	Effect	Duration	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Fluvial flood risk – the River Hodder (Main River)	High	Constriction of floodplain flood flows and displacement of floodwater increasing in flood levels upstream.	Temporary – enabling and construction phase only	Moderate	Large - Significant
Fluvial flood risk – tributaries (Ordinary Watercourses) of the River Hindburn and the River Hodder	Low to high	Constriction of fluvial flows by new culvert crossings.	Temporary – enabling and construction phase only	Negligible	Neutral – Not Significant
Fluvial flood risk – tributaries (Ordinary Watercourses) of the River Hindburn and the River Hodder	Low to very high	Increase in surface water runoff rates into receiving watercourses from the creation of low permeability surfaces including compounds and tracks.	Temporary – enabling and construction phase only	Negligible	Neutral – Not Significant

[9] CIRIA (2019) *Culvert Screen and Outfall Manual (CIRIA C786)*. London.

Environmental / Community Asset	Value / Sensitivity	Effect	Duration	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Surface water flood risk	Low	Increase in surface water runoff rates from the creation of low permeability surfaces including compounds and tracks.	Temporary - enabling and construction phase only	Negligible	Neutral – Not Significant
Groundwater flood risk	Low to very high	Change in groundwater levels due to dewatering of excavations and soakaway drainage.	Temporary – enabling and construction phase only	Negligible	Neutral – Not Significant
Reservoir flood risk – Stocks Reservoir	Low	Constriction of flood flows and displacement of floodwater increasing in flood levels upstream.	Temporary – enabling and construction phase only	Negligible	Neutral – Not Significant

8.6.2 Construction Phase

43) During the construction phase of the Proposed Bowland Section, enabling phase works would remain in place and the potential effects of those activities would continue. Embedded mitigation has been incorporated into the design of the Proposed Bowland Section to avoid or reduce the potential for the following construction phase effects on flood risk:

- Increased flow rates within watercourses receiving groundwater discharges from the dewatering of the tunnel, the shaft or portal at each end of the tunnel and the open-cut trench proposed to connect the new tunnel to the existing aqueduct. Groundwater discharges to surface water would be managed through attenuation storage and permitted. This would enable discharge rates of groundwater into the receiving watercourses to be limited to greenfield runoff rates or a maximum of 5 l/s, which is the lowest discharge rate that can be realistically achieved without a significant risk of blockage within the system. Estimates of the groundwater ingress rate into excavations indicate that the actual discharge rate would be much lower than this maximum rate. With the proposed controls in place, the discharge of groundwater would have an effect of negligible magnitude on flood flows, depths and extents within the receiving watercourses and there would be a negligible magnitude of impact on flood risk downstream. The magnitude of the effect of dewatering on groundwater levels has been assessed as negligible
- Changes in groundwater level due to dewatering of groundwater from shafts have been assessed to have a negligible magnitude.

44) A summary of construction works effects are shown in Table 8.9.

45) Based on assumptions outlined in Section 8.4.3, it is anticipated that the magnitude of impact on flood risk from the effects associated with the construction phase works would be negligible resulting in a significance of neutral.

Table 8.9: Summary of Construction Phase Effects

Environmental / Community Asset	Value / Sensitivity	Effect	Nature of Effect	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Fluvial flood risk – Cod Gill (Ordinary Watercourse) Tributary of the River Hindburn	High	Potential increase in fluvial flows in watercourse from groundwater discharge.	Temporary – construction phase only	Negligible	Neutral – Not Significant
Fluvial flood risk – River Hodder (Main River)	High	Potential increase in fluvial flows from groundwater discharge.	Temporary - construction phase only	Negligible	Neutral – Not Significant
Groundwater flood risk	Low to very high	Potential decrease in groundwater levels due to dewatering.	Temporary – construction phase only	Negligible	Neutral – Not Significant

8.6.3 Commissioning Phase

46) Following the construction phase, a commissioning process is required during which the proposed sections of tunnel would be flushed through with potable water to wash away any debris from the construction phase. This wash water would then be attenuated in an attenuation lagoon located within the Lower Houses Compound and Newton-in-Bowland Compound areas. These attenuation ponds would be approximately 50 m long, 25 m wide and 2 m deep. Water would then be discharged to Cod Gill or the River Hodder via a dechlorination plant at a maximum rate of 25 l/s. Depending on which decommissioning option is selected, this process could extend over a period of approximately six weeks.

47) Without any mitigation, commissioning phase activities would have the potential to cause the following effects on flood risk:

- Increased flow rates within watercourses receiving commissioning discharges
- Diversion of surface water flow routes around the attenuation lagoons.

48) An assessment of the impact of the commissioning flows discharged into the River Hodder has been undertaken and is detailed within Section 4 of the FRA (Appendix 8.1). This indicates that the volume of water that would be discharged during commissioning of the Proposed Bowland Section would represent less than 1 % of river flows during the mean annual maximum flood (QMED) event. Therefore, the magnitude of this impact of this discharge on flooding is considered to be negligible.

49) Data on flow rates within Cod Gill that would receive commissioning flows in the north of the Proposed Bowland Section are not available and nor is any information on the capacity of any key pinch points such as culvert crossings. Although the discharge would be attenuated and very short in duration, it is not possible to assess the actual impact that these discharges would have on flood risk downstream. It is therefore assumed that the magnitude of the impact to receptors along Cod Gill would be moderate and that additional mitigation would be required.

50) All commissioning phase activities would be located in areas of low surface water flood risk and therefore the impact on the diversion of flows would be of negligible magnitude. No groundwater flood risk impacts have been identified.

51) The summary of commissioning phase effects is shown in Table 8.10.

52) Based on assumptions outlined in Section 8.4.3, it is anticipated that the magnitude of impact on flood risk from the effects associated with the commissioning phase works would range from negligible to moderate. Therefore, whilst the significance of effect on the River Hodder would be neutral, the significance of effect to Cod Gill is assumed to be large and further mitigation would be required. This mitigation is detailed within the FRA (Appendix 8.1) and is summarised within Section 8.7.

Table 8.10: Summary of Commissioning Phase Effects

Environmental / Community Asset	Value / Sensitivity	Effect	Duration	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Fluvial flood risk – Cod Gill (Ordinary Watercourse) Tributary of the River Hindburn	High	Potential increase in fluvial flows in receiving watercourse from commissioning flows.	Temporary – commissioning phase only	Assumed to be moderate	Large - Significant
Fluvial flood risk – River Hodder (Main River)	High	Potential increase in fluvial flows in receiving watercourse from commissioning flows.	Temporary – commissioning phase only	Negligible	Neutral – Not Significant
Surface water flood risk	Low	Diversion of surface water flows around attenuation lagoons.	Temporary – commissioning phase only	Negligible	Neutral – Not Significant

8.6.4 Operational Phase

53) Embedded mitigation has been incorporated into the design of the Proposed Bowland Section to avoid or reduce the potential for the following operation phase effects on flood risk:

- Increase in surface water runoff from hardstandings including construction tracks and valve house buildings impacting downstream receptors
- Changes in groundwater levels due to new sub-surface features including backfilling of excavations.

54) Surface water management strategies would be developed for each valve house and the associated hardstanding post-planning. These drainage strategies would aim to discharge surface runoff as high up the hierarchy of drainage options as reasonably practicable, seeking to discharge into the ground (infiltration) as a first preference. If this was not feasible, then flows would be attenuated and discharged to local watercourses at greenfield runoff rates. Following these principles would ensure a negligible magnitude of impact on flood risk associated with potential changes to surface water runoff rates.

55) The permanent reinstatement of construction phase features such as open-cut trenches and shafts has the potential to result in localised changes in groundwater level by creating a barrier to flow or preferential flow pathways. However, due to the limited size of the excavations that would be reinstated,

the changes to groundwater levels have been assessed to be localised and would result in a negligible magnitude of change to groundwater flood risk.

56) A summary of operational phase effects is shown in Table 8.11.

57) Based on assumptions outlined in Section 8.4.3, it is anticipated that the magnitude of impact on flood risk from the effects associated with the operational phase would be negligible resulting in a significance of neutral. No additional essential mitigation is therefore required.

Table 8.11: Summary of Operational Phase Effects

Environmental / Community Asset	Value / Sensitivity	Effect	Nature of Effect	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Fluvial flood risk – Cod Gill (Ordinary Watercourse) Tributary of the River Hindburn	High	Increase in surface water runoff rates into the receiving watercourse.	Long term Permanent	Negligible	Neutral – Not Significant
Fluvial flood risk – Unnamed Watercourse (W384) (Ordinary Watercourse) Tributary of the River Hodder	High	Increase in surface water runoff rates into the receiving watercourse.	Long term Permanent	Negligible	Neutral – Not Significant
Surface water flood risk	Low to high	Increase in surface water runoff rates.	Long term Permanent	Negligible	Neutral – Not Significant
Groundwater flood risk	Very high to low	Changes in groundwater levels.	Long term Permanent	Negligible	Neutral – Not Significant

8.6.5 Decommissioning Phase

58) The decommissioning phase of the Proposed Bowland Section would include the discharge of groundwater infiltrating into the decommissioned section of the aqueduct into the River Hodder via the existing overflow structure. This activity would have the potential to increase fluvial flow within the River Hodder, which would have the potential to increase both the frequency and severity of fluvial flooding.

59) An assessment of the impact of the groundwater discharged into the River Hodder from the decommissioned aqueduct has been undertaken and is detailed within Section 6 of the FRA. This indicates that the volume of water that would be discharged from the decommissioned section of aqueduct would represent less than 1 % of river flows during the mean annual maximum flood (QMED) event. During more extreme flood events, the contribution would be even lower. The effects of climate change which are predicted to increase peak flood flows would also mean that the percentage contribution of the groundwater discharge to total flood flows would decrease over time. Therefore, the magnitude of impact of this discharge on flooding is considered to be negligible.

60) An assessment has also been undertaken of the impact of the ingress of groundwater in the decommissioned aqueduct on groundwater flooding and is detailed within Chapter 7: Water Environment of the Environmental Statement. This assessment concluded that whilst the existing

aqueduct would drain some groundwater, decommissioning of the existing aqueduct would not be expected to generate any significant impacts to groundwater flooding due to the relatively small rate of inflow to the tunnel and associated drawdown at the aquifer scale. Therefore, the magnitude of impact has been assessed as negligible

61) A summary of decommissioning phase effects is shown in Table 8.12.

62) Based on assumptions outlined in Section 8.4.3, it is anticipated that the magnitude of impact on flood risk from the effects associated with the decommissioning phase works would be negligible resulting in a significance of neutral.

Table 8.12: Summary of Decommissioning Phase Effects

Environmental / Community Asset	Value / Sensitivity	Effect	Nature of Effect	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Fluvial flood risk – River Hodder	High	Increase in fluvial flow in the receiving watercourse from groundwater discharges.	Long term Permanent	Negligible	Neutral – Not Significant
Groundwater flood risk	Low to very high	Reduction in groundwater levels along decommissioned aqueduct.	Long term Permanent	Negligible	Neutral – Not Significant

8.7 Essential Mitigation and Residual Effects

63) As explained in Section 8.4.4, the assessment of effects in Section 8.6 takes into account the application of both embedded mitigation and good practice measures. This section identifies additional topic-specific essential mitigation identified through the assessment process, and then sets out the residual effects taking all three categories (embedded, good practice and essential) into account. Essential mitigation has been identified as being required for the potential effects of the enabling phase works although effects associated with the proposed River Hodder crossing would continue during the construction phase. Essential mitigation would also be required for the commissioning flows into Cod Gill.

64) A summary of mitigation and residual effects following essential mitigation is shown in Table 8.13.

65) Effects of neutral to slight significance did not require additional essential mitigation, and therefore remain as set out in Tables 8.8 to 8.12 in Section 8.6.

8.7.1 Commissioning Flows

66) The FRA (Appendix 8.1) identified that with effective implementation of the embedded mitigation measures, limited significant residual effects would be anticipated. However, a potentially significant increase in flood flows is predicted within Cod Gill during commissioning where there is currently insufficient information on the flow rate. Additional mitigation would be needed to address this potential impact on fluvial flooding. Short-term significant impacts are also predicted associated with the temporary River Hodder crossing.

67) It is understood that mitigation measures associated with the potential impacts to Cod Gill during commissioning would be likely to include:

- Further detailed analysis to assess the actual level of flood risk impacts to the receiving watercourse and receptors downstream to determine appropriate discharge rates; for example, to determine trigger levels at which there would be a risk of flooding downstream such as bank levels or the soffit levels of downstream watercourse crossings (Mitigation Item FR1)
- Design changes to restrict maximum discharge rates and / or monitoring of downstream water levels and a system in place to restrict discharges during high water levels in the receiving watercourse (Mitigation Item FR2).

68) With this mitigation in place, the residual magnitude of the impact would be negligible with a significance of neutral. Details of these agreements would be confirmed and presented as part of the environmental permit application along with detailed design drawings of the commissioning phase infrastructure.

8.7.2 River Hodder Crossing

69) A range of mitigation measures have been considered to reduce the impact of the temporary River Hodder crossing. Section 3.6 of the FRA (Appendix 8.1) discusses these in detail. As mitigation options including floodplain compensation have been assessed to be ineffective or impractical, it is proposed to mitigate the predicted adverse impacts through agreement with landowners to compensate them for any temporary loss of productivity or damages incurred as a direct result of the construction of the crossing (Mitigation Item FR3). Section 159 of the Water Industry Act 1991 provides the necessary statutory powers to United Utilities to undertake the proposed works, and compensation payable in accordance with Schedule 12 of same act would be agreed as part of this process. United Utilities has confirmed that existing operating practices at the WwTW would mitigate against the identified moderate magnitude of impact on flood risk.

70) Assuming that the landowners agree to the temporary change to flood risk on their land, the residual impact is considered to be of negligible magnitude resulting in a significance of neutral. Details of these agreements would be confirmed and presented as part of the environmental permit application along with detailed design drawings of the bridge and its associated structures.

Table 8.13: Summary of Mitigation and Residual Effects

Development Component	Mitigation	Magnitude (With Essential Mitigation)	Residual Effect and Significance
Commissioning outfall into Cod Gill	Detailed analysis of the hydrology in the receiving watercourse FR1. Management of discharge rates to restrict discharges during high water levels in the receiving watercourse FR2.	Negligible	Neutral – Not Significant
Temporary River Hodder crossing	Landowner agreements to manage any potential disruption and to compensate for any losses FR3.	Negligible	Neutral – Not Significant

8.8 Cumulative Effects

71) The following section provides an overview of the potential cumulative effects from different proposed developments and land allocations, in combination with the Proposed Bowland Section (i.e. inter-project cumulative assessment). Data on proposed third party developments and land allocations contained in development plan documents were obtained from various sources, including local planning authority websites, online searches, and consultations with planning officers. Proposed development data were then reviewed with a view to identifying schemes or land allocations whose nature, scale and scope could potentially give rise to significant environmental effects when considered in combination with the likely effects arising from the Proposed Bowland Section.

72) Intra-project cumulative impacts, i.e. two or more types of impact acting in combination on a given environmental receptor, property or community resource, are considered in Chapter 14: Communities and Health.

73) It is important to note that future growth on the local road network was taken into account in the traffic modelling described in Chapter 16: Transport Planning. For this reason, the potential cumulative effects of future traffic growth between the Proposed Bowland Section and other proposed developments are embedded into predicted road traffic-related impacts on highways capacity, air quality and noise.

74) The over-arching cumulative effects of the Proposed Programme of Works i.e. the five proposed replacement tunnel sections in combination, are considered in Chapter 19: Cumulative Effects. In addition, Chapter 19 examines the cumulative effects associated with the outcomes from Volume 2 (delivery and operation of the main construction compounds, tunnel, and construction traffic routes), Volume 5 (proposed off-site highways works and satellite compounds), and Volume 6 (Proposed Ribble Crossing).

75) As identified in Chapter 3: Design Evolution and Development Description, the Proposed Bowland Section would be part of a wider project to replace the existing tunnelled sections of the Haweswater Aqueduct. Therefore, consideration has been given to the potential for multiple project sections of the wider Haweswater Aqueduct Resilience Programme to have a cumulative impact on flood risk.

76) Discharges into the Lune catchment from the northern part of the Proposed Bowland Section would be limited to construction phase discharges from the Lower Houses TBM Reception Site Compound and potential operational discharges of surface water runoff from the proposed valve house building at this location. This FRA has concluded that the attenuation of all surface water and groundwater discharges into the Lune catchment would result in a negligible impact on runoff rates within the receiving watercourses.

77) In addition to discharges into the Lune from the Proposed Bowland Section, the Proposed Swarther Section of the Haweswater Aqueduct Resilience Programme would involve temporary and permanent discharges into the River Lune. However, these discharges are also considered to have a negligible impact on flood risk. The confluence of the River Hindburn and the River Lune would be more than 7 km downstream from the discharge point of either project section. Therefore, the cumulative impacts of the two project sections are considered to be negligible.

78) The River Hodder is part of the wider River Ribble catchment which would receive construction phase discharges from the Proposed Marl Hill Section and the Proposed Haslingden and Walmersley Section of the Proposed Programme of Works. Operational discharges of groundwater from the Proposed Marl Hill Section would also discharge into the River Ribble catchment. However, the impact of all these discharges on local watercourses has been assessed to be negligible. Therefore, the cumulative impact on the wider Ribble catchment is also considered to be negligible.

79) None of the developments identified within 5 km of the Proposed Bowland Section would be likely to cause a cumulative effect on the groundwater environment.

8.8.1 Proposed Ribble Crossing

80) Potential significant flood risk effects have been identified in Volume 6 of the ES which deals with the Proposed Ribble Crossing. These relate to the constriction of floodplain flows and the loss of floodplain storage. Essential mitigation would be required to offset these impacts and further work to inform mitigation decisions is underway in the form of a detailed flood risk assessment, to be submitted under separate cover. With this additional essential mitigation effectively applied, the Proposed Ribble Crossing would have a neutral overall effect on flood risk. The Proposed Ribble Crossing is therefore predicted to be safe from flooding throughout its operational life and would not increase the risk of flooding elsewhere. In turn, it would comply with the requirements of both the NPPF and local planning policies and guidance.

8.8.2 Off-site Highways Works

The assessment of likely significant effects associated with off-site highways WORKS in Volume 6 has not identified any further flood risk issues that require consideration as part of the broader EIA for the Proposed Bowland Section.

8.9 Conclusion

81) Following a scoping assessment, four sources of risk were identified as requiring assessment: fluvial flooding, surface water, groundwater and reservoirs. The assessment of fluvial, surface water and reservoir flood risk has focused on the above-ground elements of the Proposed Bowland Section as well as the impact of groundwater discharges to receiving watercourses. The scope of the assessment did not include the risk of failure from the aqueduct itself; the ongoing operation of existing infrastructure such as washouts and overflows; or flood risk from the failure of the aqueduct.

82) The Proposed Bowland Section would be designed using appropriate flood design standards and good practice to ensure the flood risks and potential impacts would be mitigated. CCoP has been produced to provide an overview of appropriate flood design principles, standards and good practice to be considered at later stages of the design process.

83) Significant potential effects have been identified relating to the commissioning flows and the temporary Hodder crossing and additional mitigation would be required relating to these impacts. However, with this additional essential mitigation effectively applied, the Proposed Bowland Section would have a neutral overall effect on flood risk.

84) In conclusion, with additional essential mitigation implemented the Proposed Bowland Section has been assessed to be safe from flooding throughout its operational life and would not increase the risk of flooding elsewhere. Therefore, it would comply with the requirements of the NPPF and with the requirements of local planning policies and guidance.

8.10 Glossary and Key Terms

85) Key phrases and terms used within this technical chapter relating to Flood Risk are defined within Appendix 1.2: Glossary and Key Terms.