Haweswater Aqueduct Resilience Programme

Proposed Bowland Section - EIA Scoping Report

October 2019

United Utilities

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1. Introduction

1.1 Background

1) Jacobs has been commissioned by UU to prepare an Environmental Impact Assessment (EIA) Scoping Report to inform the scope and content of an EIA for the proposed replacement of a tunnel section of the Haweswater Aqueduct in Lancashire. The proposed development is known as the *Proposed Bowland Section* and comprises the replacement of approximately 16.7 km of existing aqueduct.

2) The Proposed Bowland Section is a single development which forms part of the broader Haweswater Aqueduct Resilience Programme (*the Proposed Programme of Works).* The Proposed Bowland Section is necessary to enhance the resilience of the Haweswater Aqueduct, an essential part of United Utilities' water supply network in the North West region. Over two million United Utilities customers will benefit from the Proposed Bowland Section through a more resilient supply of clean drinking water.

3) The existing 110 km Haweswater Aqueduct was designed in the 1930s and construction was completed in 1955. It takes raw water from Haweswater Reservoir in the Lake District National Park along a 16 km section of the aqueduct to Watchgate Water Treatment Works (WTW) for treatment. From Watchgate WTW the aqueduct conveys treated water to customers in Greater Manchester, Cumbria and Lancashire through service reservoirs and water mains which branch off the main aqueduct.

4) The aqueduct comprises five unpressurised 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) The proposed baseline solution is to provide a full replacement of the five single line tunnel sections as illustrated in Figure 1.1. The existing single line tunnel sections are connected via transition well structures to multi-line siphons crossing several major valleys along the route. It is the intention to retain the existing multi-line siphons and, where possible, the associated well structures which are housed within valve house buildings.

6) The preliminary routing for the replacement sections is offset from but follows the existing Haweswater Aqueduct corridor to minimise the length of new tunnel and associated hydraulic losses, thereby enabling the continued transfer of flow by gravity.

1.2 Purpose of the Report

7) This document is an EIA Scoping Report prepared in support of a formal Scoping Request made by United Utilities plc to Lancaster City Council and Ribble Valley Borough Council. The Scoping Request is made under Regulation 15 of the 2017 EIA Regulations[2] and relates to a specific section of the Proposed Programme of Works (*the Proposed Bowland Section*) within Lancaster City Council's and Ribble Valley Borough Council's administrative areas.

8) The Scoping Report aims to provide the information necessary to accompany such a request, and to inform Lancaster City Council and Ribble Valley Borough Council when considering its Scoping Opinion in consultation with statutory and non-statutory stakeholders.

9) In total five Scoping Reports (corresponding with the five sections of replacement single line tunnelled structures) are being submitted as part of Scoping Requests to the seven local planning authorities in whose areas the Proposed Programme of Works is located, as follows:

- *The Proposed Docker Section*: South Lakeland District Council
- *The Proposed Swarther Section*: South Lakeland District Council and Yorkshire Dales National Park Authority
- *The Proposed Bowland Section*: Lancaster City Council and Ribble Valley Borough Council

[1] The multi-line sections comprise four parallel pressurised pipes referred to as 'siphons', each of which is around 1.6 m internal diameter.
[2] Statutory Instrument 2017 No. 571 The Town and Country Planning (Environmental Impact Assessment) Regulations 2017

- *The Proposed Marl Hill Section*: Ribble Valley Borough Council
- *The Proposed Haslingden and Walmersley Section*: Hyndburn Borough Council, Rossendale Borough Council and Bury Metropolitan Borough Council.

10) These sections will predominately consist of tunnelled structures of a minimum three meters (m) external diameter to be constructed below ground level (at present a maximum internal diameter of approximately 3.6 m is anticipated). On the Proposed Docker and Swarther sections there is an alternative solution of up to four parallel pressurised pipes of approximately 1.6 m internal diameter constructed using open-cut methods at ground level.

11) The approach to the EIA scoping for the Proposed Programme of Works is described further in Chapter 5.

1.3 United Utilities

12) United Utilities' is a FTSE 100 company whose activities span the north-west region of England as shown in Figure 1.2. The company abstracts water from a range of different sources, but predominantly from reservoirs in the Lake District and the Pennines, and also from Lake Vyrnwy in Wales. The remainder of customers' supplies are taken from rivers, boreholes and streams across the region. Of the 1,700 million litres that are supplied to customers every day, well over half is from Cumbria and Wales. The two biggest reservoirs are Thirlmere and Haweswater in Cumbria. Haweswater typically holds more than 84,800 million litres of water - equivalent to around 33,900 Olympic swimming pools.

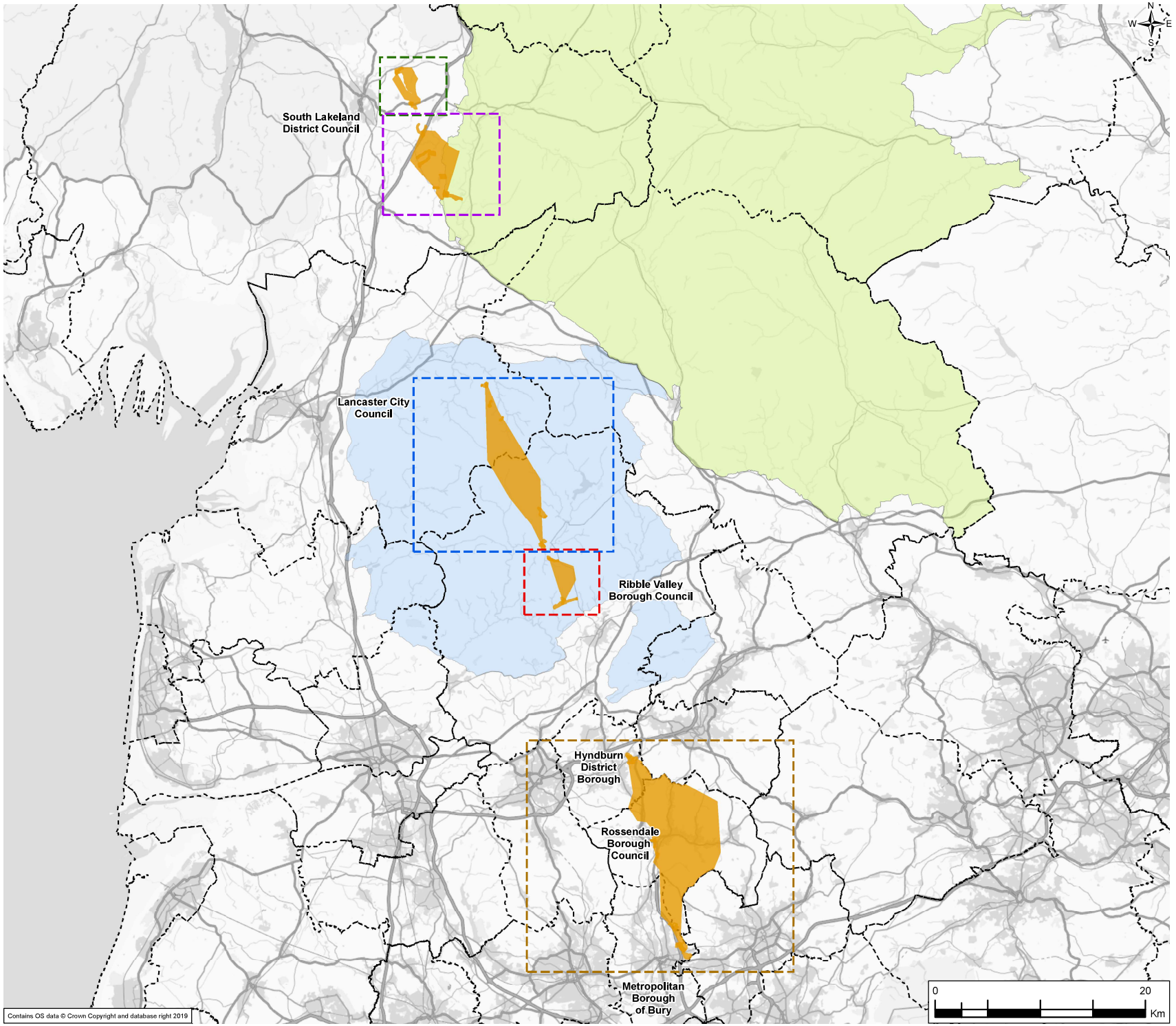
Figure 1.2: United Utilities provides water and wastewater services across the north-west region

1.4 Structure of the Scoping Report

13) This report is divided into eighteen chapters. Following this introduction, the report is structured as follows:

- Chapter 2 describes the Haweswater Aqueduct Resilience Programme, including the need for the Proposed Programme of Works, the regulatory framework governing EIA applications, and a description of alternative schemes to the proposed replacement of single line sections on the aqueduct
- Chapter 3 describes the general approach to the design of the Proposed Programme of Works, summarises the scope of the Proposed Bowland Section, and presents a provisional construction programme
- Chapter 4 explains the proposed approach to the EIA and planning applications, reflecting the fact that the Proposed Programme of Works comprises five distinct engineering components extending across seven planning authorities
- Chapter 5 summarises the approach to EIA scoping of the Proposed Bowland Section
- Chapters 6-18 address each of the environmental topics within the proposed ES, describing the nature and scope of proposed EIA activities, and highlighting some of the key environmental assets, resources and constraints that will be considered during the environmental assessment. There is a scoping overview of each of the EIA topic areas, summarising baseline conditions, the regulatory and policy framework, the potential significant effects of the Proposed Bowland Section, EIA methodology and how the outcome of the EIA will be presented in the ES.

FIGURE 1.1



Legend

- Indicative Development Envelope Boundary
- Proposed Docker Section
- Proposed Swarther Section
- Proposed Bowland Section
- Proposed Marl Hill Section
- Proposed Haslingden and Walmersley Section
- Planning Authority Boundary

Constraints

- Yorkshire Dales National Park Boundary
- Forest of Bowland Area of Outstanding Natural Beauty

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2. The Proposed Programme of Works

2.1 Introduction

14) The following chapter summarises the need for the Proposed Programme of Works, and explains the regulatory framework within which the Proposed Programme of Works is being delivered. There is a summary of the alternative options considered prior to adoption of the replacement line sections as the preferred solution.

2.2 Need for the Proposed Programme of Works

15) In the early 2000s United Utilities began planning major investment, which spanned over ten years, to ultimately enable the Haweswater Aqueduct to be taken out of service for the first time in over 60 years. The aim was to identify any future service risk to customers supplied by this aging asset.

16) To carry out a detailed inspection on the Haweswater Aqueduct, several major steps had to be taken including the £250 million construction of the West East Link Main (WELM), completed in 2011. The WELM, along with other activities such as upgrading Lostock Water Treatment Works to increase flow capacity, made it possible to take the Haweswater Aqueduct out of service (referred to as an outage) in 2013. A subsequent outage in 2016 allowed for more detailed investigations and some minor, targeted repairs.

17) Arranging and implementing outages on the aqueduct requires many months of planning, and the outages are very limited in terms of allowable duration (only a month or so) and the time of year they can be delivered (normally October). These tight constraints limit how much work can be undertaken during each aqueduct outage. It is not possible to deliver the Proposed Programme of Works during an outage.

18) The data collected from the inspections in 2013 and 2016 uncovered areas of concern in the single line sections of aqueduct relating to both future water supply and water quality risks. It is anticipated that the condition these single line sections will continue to deteriorate and a solution is required to address the risks to water supply and water quality. The company has therefore been looking at different solutions to mitigate these risks, including repairs of the existing asset, and concluded that replacement of the single line sections was the best option.

2.3 Need for the Bowland Section

19) The need for the Bowland Section is driven by the same need as the overall Proposed Programme of Works i.e. there is a requirement to replace part of an ageing strategic asset to secure a major water supply serving over two million people, and to mitigate potential risks to drinking water quality.

2.4 Regulatory Framework

20) As a statutory water services undertaker, United Utilities serves its customers, operates and maintains its assets, and invests in new infrastructure within a strict regulatory framework. The Office of Water Services, or Ofwat, is the statutory body responsible for economic regulation of the privatised water and sewerage industry in England and Wales. The Drinking Water Inspectorate (DWI) is the independent drinking water regulator serving England and Wales. The DWI is responsible for ensuring that water companies supply safe drinking water that is acceptable to consumers and meets the relevant legal standards. The Environment Agency, Natural England and other statutory bodies monitor the environmental performance of the company, for example, in relation to discharges of treated wastewater to watercourses, abstraction of water and the management of designated wildlife habitats and species across its substantial landholdings in the north-west. Additionally, United Utilities, as one of the biggest landowners in the north-west, has representation on or reports into many local non-statutory bodies with interests in the protection and enhancement of natural assets and community amenity.

21) The proposed replacement sections of the Haweswater Aqueduct Resilience Programme comprise one of the company's largest ever programme of works. The selection of the Proposed Programme of Works as the preferred solution for improving the resilience of the aqueduct has been subject to detailed financial modelling, customer surveys and engineering optioneering over the last several years.

2.5 Consideration of Alternatives

22) The EIA process provides an opportunity to describe the design evolution of a proposed development as well as consideration of any alternative development options, including specifically considering the different potential environmental impacts of those options, before a final decision is taken on the design. In accordance with the EIA Regulations, the ES will describe alternatives that were considered by the applicant.

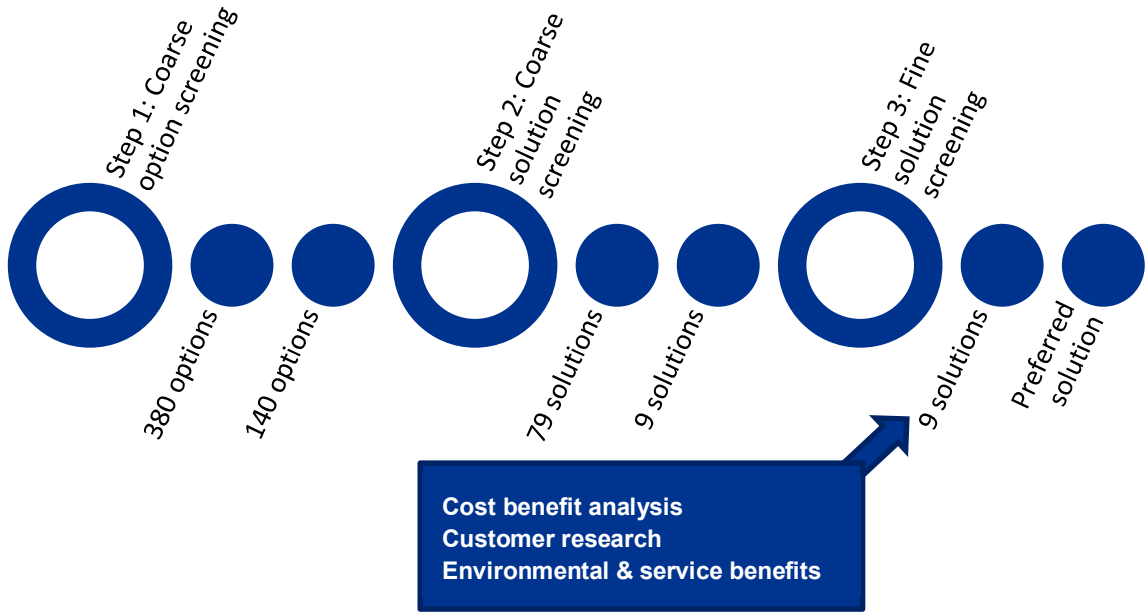
23) During 2017 United Utilities undertook an extensive process to identify and assess a full range of options to provide a reduction in the risk to customer supplies. These options were appraised against cost, environmental and technical considerations, and additionally a range of options were tested through extensive customer and stakeholder engagement. This section summarises the approach to how alternative options were considered.

24) The Proposed Programme of Works was chosen as the preferred baseline solution following an exhaustive three stage optioneering exercise which considered many potential combinations of engineering and operational solutions. The optioneering process followed three steps:

- Coarse option screening
- Coarse solution screening
- Fine solution screening.

25) This process involved taking approximately 380 unconstrained options to the preferred solution, as illustrated in Figure 2.1.

Figure 2.1: Three step optioneering process to develop a preferred solution



26) *Coarse option screening* looked to remove unviable options through the following three criteria:

- Technical feasibility – Options were reviewed in respect of whether the option will be technically possible and buildable in AMP7/8[3]
- Statutory/ environmental feasibility – Options were reviewed to evaluate the likelihood of permission being granted for the works to be constructed. United Utilities considered whether each proposed option had the potential to impact on important designated sites such as Special Areas of Conservation (SAC)

[3] Asset Management Plans (AMPs) are regulated business and investment plans produced by all water utility companies on a five yearly cycle. AMP 7 and AMP8 are United Utilities' next regulated business cycle scheduled for 2020 through to 2024 and 2025 to 2030 respectively.

- Addressing the need - An assessment was made of the impact that the option could have in supporting the need for improving the resilience of the Haweswater Aqueduct's supply through Cumbria and Lancashire and into Greater Manchester.

27) *Coarse solution filtering* grouped options into solutions, calculated simplified bill impacts, assessed risk reduction and screened out solutions using a dominance criterion (solutions with lower risk reduction for higher bill impact were removed).

28) *Fine solution filtering* of the options considered Ofwat's resilience principles, most notably: 'resilience in the round' (Principle 1); 'Naturally resilient' (Principle 2); 'Customer engagement' (Principle 3); 'Broad option set' (Principle 4); 'Best value solution' (Principle 5).

29) The approach to Robust Decision Making (RDM) was to consider three main areas to inform the selection of a preferred solution that provides best value for customers. The three areas were as follows:

- Customer engagement: focused customer research to understand customer preferences for risk reduction and associated costs via the impact on their bills
- Cost benefit assessment (CBA): a detailed CBA using specific and standard economic metrics
- Multi-criteria Decision Analysis: a wider analysis looking at resilience in the round covering metrics beyond those provided by customers and included within the CBA. The five 'Decision Metrics' used in the multi-criteria analysis were:
  - Bill Impact
  - Economic Impact
  - Resilience Risk
  - Environmental Impact
  - Willingness to pay benefit.

30) The five solutions presented to customers as part of the fine filtering process are presented in Table 2.1. An additional four solutions, informed by customer preference and forming the nine referred to above, were tested in the CBA and multi-criteria analysis. When applying RDM techniques of sensitivity and weighting to the decision-making criteria, Solution D emerged as the most beneficial across the wide range of sensitivity tests.

Table 2.1: Outcome of the Robust Decision Making approach

Solution	Description	Evaluation/Reasoning
A	Volumetric (new and / or modified alternative supply) and targeted repairs of the Haslingden and Walmersley Section (with a new and / or modified treatment installation).	Unrepaired sections of Haslingden and Walmersley and all upstream sections continue to deteriorate with associated risk to quality and supply. Insufficient risk reduction to water quality and risk of supply interruptions.
B	Replacement of the Haslingden and Walmersley Section and UV/Metals Treatment (new and / or modified treatment installations).	Unrepaired upstream sections continue to deteriorate with associated risks to supply. Insufficient risk reduction to water quality and risk of supply interruptions.
C	Turn Haweswater Aqueduct to raw water and provide three new and / or modified treatment installations at strategic supply points. Solution	Solution included new and / or modified alternative supplies and new and / or modified service reservoirs – Addresses quality issues however all sections continue to deteriorate with associated risk to supply.

Solution	Description	Evaluation/Reasoning
	included new and / or modified alternative supplies and new and / or modified service reservoirs.	
D (Preferred Solution)	**Replacement of all single line Haweswater Aqueduct sections.**	**Addresses the risk to water quality and of supply interruptions.**
E	Volumetric (new and / or modified alternative supplies and new and / or modified treatment installations) and replacement of all single line HA aqueduct sections.	Addresses the risk to water quality and of supply interruptions but significant increase in bill impact to achieve nominal increase in risk reduction compared to preferred Solution D.
F	Replacement of the Haslingden and Walmersley Section, conversion to raw water aqueduct and provide 3 new and / or modified treatment installations at strategic supply points.	Addresses quality issues however, sections not replaced continue to deteriorate with associated risk to supply. Greater cost and less risk reduction than the preferred Solution D.
G	Haweswater Aqueduct volumetric (new and / or modified alternative supply) and lining of all single line aqueduct sections.	Addresses quality and supply issues. Significant increase in bill impact and lesser risk reduction compared to preferred Solution D. Thickness of lining reduces diameter and capacity of Haweswater Aqueduct.
H	Haweswater Aqueduct volumetric (new and / or modified alternative supply), targeted repair of all single line aqueduct sections and conversion to raw water aqueduct	Addresses quality issues, however, unrepaired sections continue to deteriorate with associated risk to supply which is largely mitigated by the new sources. Greater cost and less risk reduction than the preferred Solution D.
I	Over-pumping and Lining of all single line Haweswater Aqueduct sections.	Addresses quality and supply issues. Significant increase in bill impact and lesser risk reduction compared to preferred Solution D. Thickness of lining reduces diameter and capacity of the Haweswater Aqueduct. Insufficient risk reduction as preferred by customers.

31) Solution D, the preferred solution, comprises a full replacement of each single line section of the existing aqueduct conveying drinking water from Watchgate WTW (Cumbria) downstream to Woodgate Hill WTW (Bury).

32) The ES will summarise the design evolution of the Proposed Bowland Section and the way in which any comments received during consultation on the Proposed Bowland Section have influenced the decision-making.

3. The Proposed Bowland Section

3.1 Introduction

33) The following chapter describes how the Proposed Bowland Section could be constructed and operated based on current design options, and provides a general description of construction techniques. An indicative construction and commissioning programme is also provided.

3.2 Indicative Development Envelope

34) Figure 3.1 and Figure 3.2 show the land that presently falls within the indicative '*worst-case*' (using a Rochdale Envelope approach)[4] development envelope for the Proposed Bowland Section. It is important to note that Figures 3.1 and 3.2 are not intended to imply that this is the total development area. Instead it shows indicative areas of land within which construction and operation phase activities might take place.

35) These indicative areas are based on reasonable worst-case assumptions (based on professional judgment and experience of other similar projects) concerning the nature and scope of both construction phase and operation activities for the Proposed Bowland Section. At this early stage of the design process it encourages a robust worst case which will be assessed as part of the EIA, including in the siting of construction activities in response to potential environmental constraints which may be identified in later stages of the EIA, and in response to feedback from statutory bodies, non-governmental organisations (NGOs) and local communities.

36) As the design for the Proposed Bowland Section progresses, and the outcomes of the EIA process start to emerge, it is anticipated that the current indicative worst-case development envelopes will be refined and reduced in size. It is important to note that the indicative tunnel alignment shown in Figure 3.1 represents where the replacement single line tunnels for the Proposed Bowland Section could be constructed *below ground level*. In these locations, there would generally be no construction activities or development at the surface.

3.3 The Existing Asset

37) The total length of the existing Bowland Tunnel section is approximately 16.7 km. At its deepest point the Bowland Tunnel is approximately 370m below ground level.

38) The Bowland Tunnel is connected to the Lunesdale multi-line siphon which is located to the north of the Bowland Section, and the Hodder multi-line siphon to the south.

3.4 General Approach to Design

39) United Utilities started the initial design in 2018 and commenced ground investigation (GI) and environmental surveys in 2019. It is currently proposed that the first planning applications to local planning authorities will be submitted in late 2020. Construction could start in 2023 with completion of the Proposed Programme of Works anticipated in 2029. There are various technical requirements that will influence its design, including:

- A need for the replacement aqueduct sections to be connected to retained sections of pipework
- To maintain a gravity flow along its entire length and, ultimately, along the full length of the Haweswater Aqueduct
- A need for the Proposed Bowland Section to be designed, built and operated safely
- A requirement for an aqueduct outage to enable connection of the newly-built infrastructure. This is a considerable undertaking and one that could only be delivered over a short timescale, potentially four weeks during the month of October
- The replacement sections are proposed to be delivered over five distinct sections.

40) Extensive site investigations will be undertaken along the route of the Proposed Programme of Works in 2019 and 2020 to characterise the underlying geology and ground conditions. Some boreholes may be

[4] The Rochdale Envelope approach is a method [of providing] flexibility in design options where details of the whole project are not available…while ensuring the impacts of the final development are fully assessed during the EIA. https://transform.iema.net/article/using-rochdale-envelope (accessed 9 October 2019)

drilled to considerable depths below ground level, reflecting the depth at which tunnel sections of the aqueduct would be constructed. To supplement intrusive investigations, geophysical surveys will be carried out and geotechnical models will be constructed to describe the ground conditions. Areas where there is believed to be high groundwater pressure will also be identified.

3.5 Proposed Bowland Section

41) The Proposed Bowland Section would be constructed in tunnel below ground level over approximately 16.4km with a very small additional distance (approximately 400m) of open-cut trenching at the surface to transition from the new tunnel to the retained multi-line sections. Once the new section of aqueduct has been constructed, the replaced section of aqueduct would be decommissioned. Current thinking on approaches to decommissioning are presented below. The new asset would be tested and commissioned before the existing sections of aqueduct are decommissioned.

42) It should be noted that the engineering design and construction techniques for the Proposed Bowland Section are under development. All scheme descriptions and dimensions should therefore be viewed as 'work in progress' and may well change in response to ongoing design development, consultations with external stakeholders, including local people, and outcomes from the EIA process.

43) The indicative development envelope for surface-based activities associated with the Proposed Bowland Section encompasses some 78 ha of predominantly agricultural land. This includes the indicative development envelope for construction accesses, construction areas and proposed discharge pipe. The purpose of the indicative development envelope at the scoping stage is to provide design flexibility until further environmental assessment, consultation and engineering design activities have been undertaken.

3.5.1 Enabling Works

44) Enabling works would include fencing off working areas. This may consist of stock-proof post, wire fencing and higher 'heras' type fencing around compound areas. Access points as agreed with the landowner would be provided for crossing working widths using gates. Working areas would be topsoil stripped and drainage installed where required. Where unavoidable, trees would be felled and vegetation would be cleared. Compounds and laydown areas would be constructed and safe access and egress to and from the sites would be provided via the local road network.

3.5.2 Haulage Routes on the Public Highway

45) Significant amounts of construction materials would need to be transported by road to the compounds and laydown areas off the public highway. Accesses onto and off the public highway would be designed to highway authority engineering and safety standards. Where practicable, access points would make use of existing field gates, which would be improved or enlarged where necessary to meet appropriate highway safety requirements.

46) Surplus excavated material from tunnelling operations may need to be transported by road to final licensed destinations which can accept material of this nature.

47) Traffic management plans and potential highway improvements (e.g. temporary haul roads, passing places, etc.) would be developed in conjunction with highways authorities and local communities to minimise potential conflicts with other road users and enable the safe and timely movement of HGVs and other construction vehicles along local roads, prior to joining the strategic road network.

48) The decommissioning phase of the existing asset and the commissioning and operational phases of the new aqueduct would give rise to very low volumes of traffic. Further details surrounding approaches to the transport planning study are presented in Chapter 16.

3.5.3 Public Rights of Way

49) Public rights of way (PRoW) may need to be temporarily closed and where possible diverted to enable users to continue safely accessing footpaths, bridleways etc. Alternatively, and only when safe to do so, a banksman would be present to assist PRoW users in crossing the construction easement.

3.5.4 Temporary Access Tracks

50) Access tracks would be constructed from the public highway to laydown areas and construction compounds. Access tracks would normally be in the order of 3 m wide, and would be constructed along a soil-stripped and vegetation-cleared easement comprising a layer of crushed stone. Temporary drainage may need to be installed alongside or across the access tracks to maintain existing drainage lines, and the tracks would be aligned to minimise flood risk within the development envelopes or local watercourses.

51) Proposed points of access to and from the public highway are subject to further design development and would need to be agreed with the relevant highways authority. Accesses where the compound area is adjacent to the highway are not indicated on the plans but these too would need to be developed with the agreement of the highways authority.

3.5.5 Tunnel Boring Construction Option

Launch, Reception and Intermediate Tunnel Facilities

52) Tunnel sections would be constructed using tunnel boring machines (TBM); the type of TBM and the method of conveying material from the tunnel face to the surface would be varied to suit the expected ground conditions of the drives.

53) Tunnels would be driven from launch locations with above-ground temporary works to support the operation and maintenance of the TBMs. The above-ground activities may require 24 hours per day working. The temporary construction works areas would provide an area for plant, machinery, equipment, welfare, offices and vehicle movements. Surplus excavated material from the tunnelling works would be removed and treated as required at the launch location and tunnel segments and consumables would enter the tunnel at this location. Surplus material would be stored on site prior to removal off-site to a licenced facility.

54) Tunnels would be driven to a reception location where the TBM would be removed from the tunnel and dismantled prior to removal from site. Temporary construction works areas would be required to support this operation, but these would be of a smaller scale and reduced duration compared with the launch locations.

55) Launch and reception facilities would be required to access the tunnel for the launch and reception of the TBMs. Intermediate access points may be required along the Proposed Bowland Section for safety and construction logistics purposes. The size of these facilities would be determined as part of the ongoing design process.

56) If these facilities take the form of shafts, current indications are that these could be of 15 m to 20 m diameter with depths ranging from 15 m to 65 m. Launch and reception facilities can be constructed using a range of techniques and these will be confirmed as the design is developed.

57) Launch, reception and intermediate access points would have a cover slab fitted on completion of construction and be backfilled and covered for reinstatement. Surface features in these locations would be limited to access covers.

Surface Management of Tunnel Arisings

58) Arisings from tunnel construction would be brought to the surface and, according to the tunnelling technique, may require some form of processing such as dewatering within the construction areas. While tunnel arisings may be brought to the surface on a 24 hours per day basis, surplus materials would be taken off site within agreed hours to minimise effects on local communities. This approach is likely to require the temporary storage of material on-site. Additionally, processing of rock from the tunnel may take place within the indicative development envelopes.

59) Material may require disposal at a suitably licensed destination, such as a quarry undergoing restoration or an operational landfill. Work is presently underway to review options for the destinations of surplus material associated with tunnel construction. A surplus materials management strategy will be developed for the Proposed Bowland Section. The surplus materials strategy will need to strike a balance between technical, highways, commercial, environmental and community constraints; the weighting of these factors may differ between different sections.

3.5.6 Construction Compounds and Laydown Areas

60) Construction compounds are locations within which construction activities would be undertaken. The construction compounds would contain tunnel launch or reception facilities (e.g. vertical tunnel shafts), or intermediate access shafts, surplus materials storage areas and de-watering operations. Compounds would also contain generator sets, vehicle parking, site cabins and welfare facilities.

61) Laydown areas are temporary features where pipes and other construction materials are temporarily stored, allowing safe and efficient access to pipework prior to its installation. The locations of proposed indicative construction compounds and laydown areas are shown in Figure 3.1.

62) Temporary site cabins would be brought to site for offices, workshops and stores. The remainder of the compound would be used for construction-related activities such as car parking, plant and commercial vehicle storage, material storage areas and traffic circulation routes connecting and servicing these areas.

63) Power supply for the compounds would be via connection with the local electricity network where appropriate or via generators. Where required, generators would need to operate 24 hours a day. A water connection would be provided from the nearest suitable connection point or where necessary water bowsers would be provided.

64) Lighting would be required for safety reasons, and where 24-hour working is required. Lights would be located so as to minimise light spill towards adjacent properties and other sensitive locations, acknowledging that the AONB contains Dark Sky Discovery Sites.

3.5.7 Decommissioning of the Existing Asset

65) Following completion and commissioning of the new aqueduct, sections of 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 existing structures above the redundant sections and dealing with any flows arising from the decommissioned aqueduct. To deal with such flows, proposed existing discharge pipework would, where necessary, be supplemented/provided within locations identified within the development envelope boundary.

3.5.8 Above-Ground Installations and Permanent Infrastructure

66) This section describes the key elements of infrastructure which would be constructed to serve the operational aqueduct.

67) For the majority of the length of the replacement aqueduct there would be no permanent above-ground structures with much of the new sections of aqueduct being located deep below ground level. Stiles or access gates would be provided through field boundaries to enable personnel to undertake future inspections of the aqueduct route.

3.5.8.1 Valve House Buildings

68) At the end of each replacement section there is a transition from the existing single line sections to the multiple pipes for the siphon sections. These transition points are referred to as well structures. In most cases the existing valve house buildings (which house the well structures) would be reused, however in some locations this would not be possible and a new well structure would be required. The valve house buildings would be single storey and approximately 11 m wide and 12 m long. New valve house buildings would be similar in size and appearance to the existing structures. Photographs of existing valve house buildings in suburban and rural locations are shown in Figures 3.3 and 3.4 below:

Figure 3.3: Typical valve house building – suburban setting

Figure 3.4: Typical valve house building – rural setting

3.5.9 Land reinstatement

69) Land used for temporary compounds and open-cut pipeline construction would be reinstated after completion of construction works with temporary access roads being removed. Where launch and reception facilities (e.g. shafts) or intermediate access points are constructed these would be covered and reinstated at ground level.

3.5.10 Decommissioning of Existing Assets

70) Following completion and commissioning of the new aqueduct, sections of 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 will include protection of existing structures above the redundant sections and dealing with any flows arising from the decommissioned aqueduct. To deal with such flows, proposed existing discharge pipework would, where necessary, be supplemented/provided within locations identified within the development envelope boundary.

3.5.11 Easements

71) Operational access along the line of the new Haweswater Aqueduct would be similar to existing. Stiles or access gates would be provided at field boundaries to enable a walkover survey along the route of the aqueduct to take place.

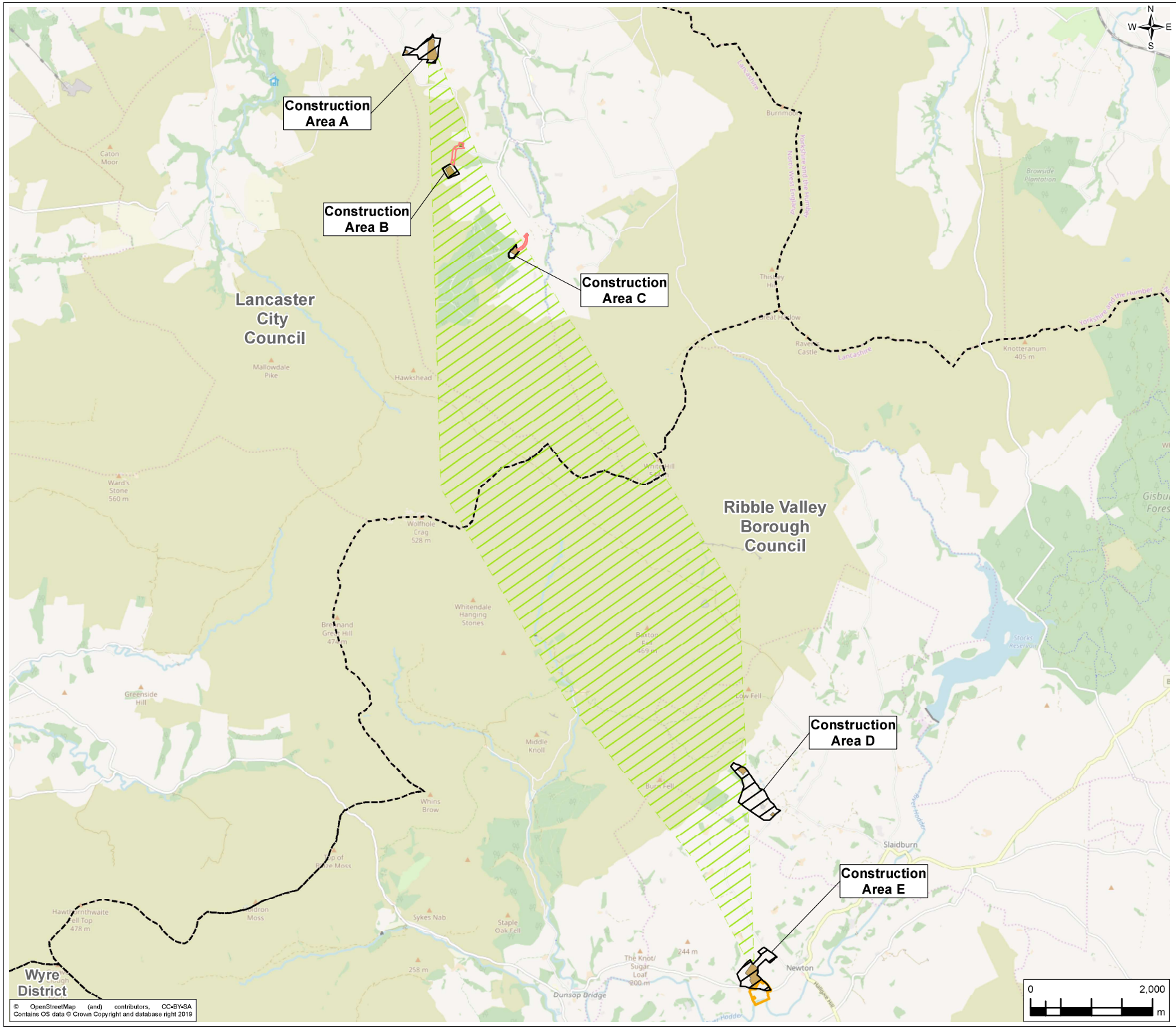
3.6 Construction and Commissioning Programme

72) An indicative construction programme is shown in Figure 3.5 below and presents a high level overview of when proposed construction works might be undertaken, subject to planning permission. Figure 3.5 shows that the Proposed Programme of Works could start in 2023 with enabling works, ultimately reaching completion and commissioning in 2029. The indicative programme provided does not include reinstatement works, which may continue for several years beyond the completion of construction. The dates and durations are indicative and will be developed further as the design progresses.

73) The construction programme would be phased so that some of the proposed new sections of aqueduct could start later and / or be completed earlier than others. Some could be completed prior to the overall indicative construction programme end date in 2028 (noting that decommissioning could extend into 2029).

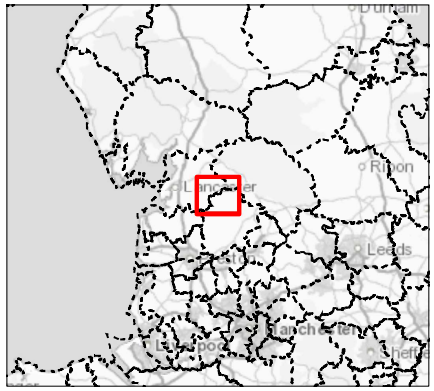
Figure 3.5: Indicative construction programme

FIGURE 3.1



Legend

- Proposed Tunnel Route - Indicative
- Proposed Construction Access - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area
- Proposed Discharge Pipe - Indicative
- Planning Authority Boundary



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Drawing Title: PROPOSED BOWLAND SECTION LANCASTER CITY COUNCIL AND RIBBLE VALLEY BOROUGH COUNCIL SHEET 1 OF 1

Drawing Status: FINAL

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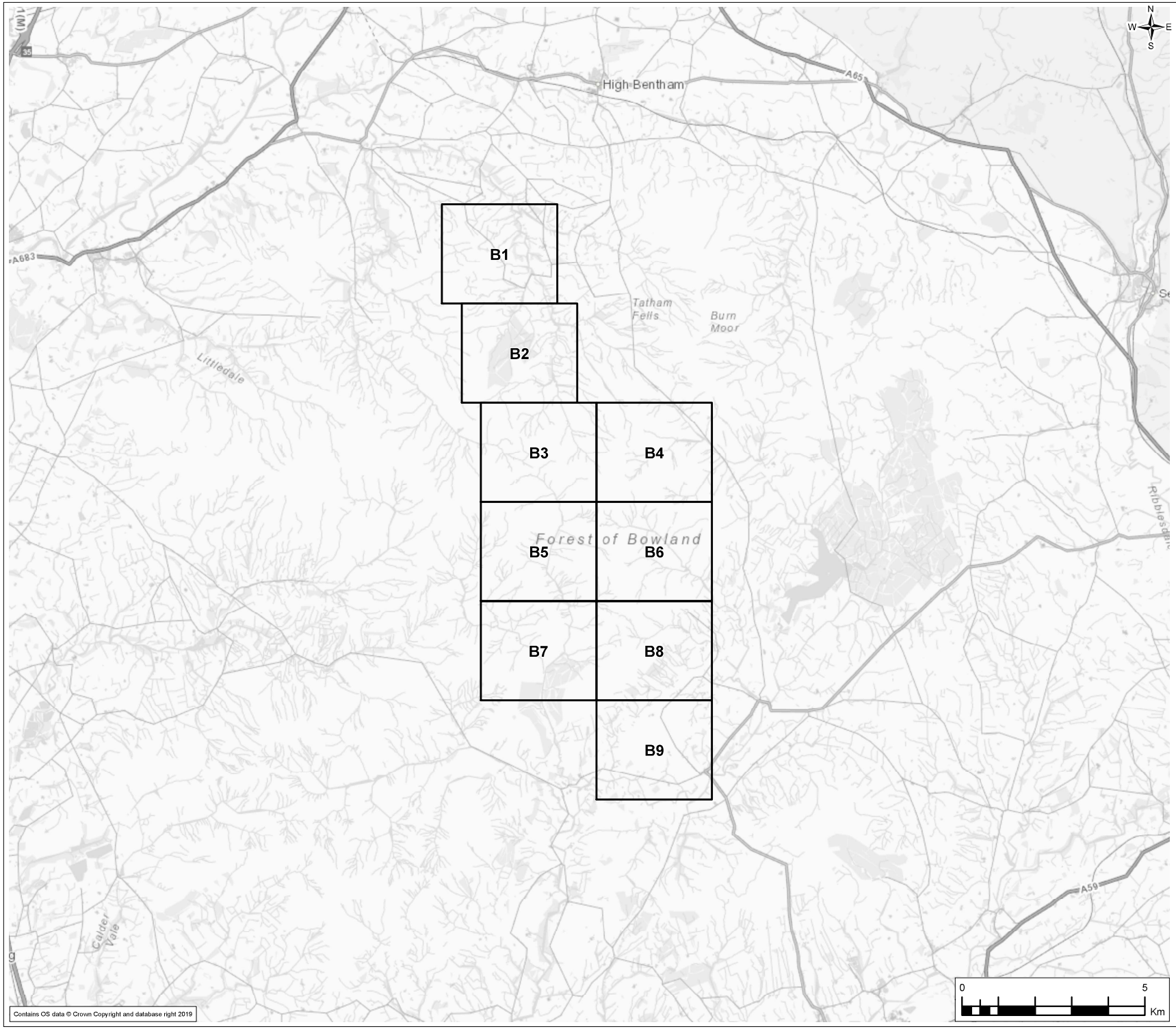
FIGURE 3.2



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Proposed Bowland Section Area Extent

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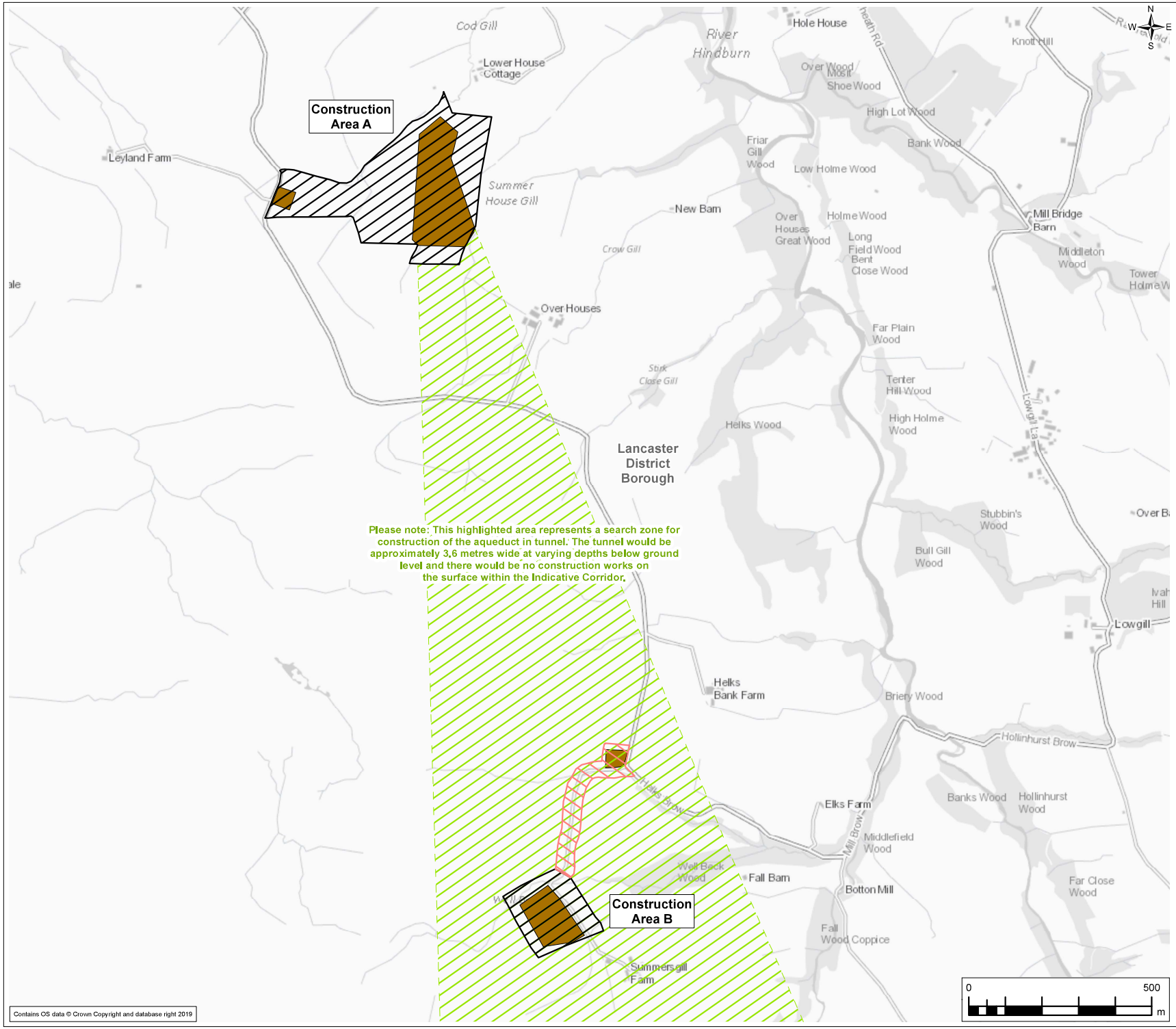
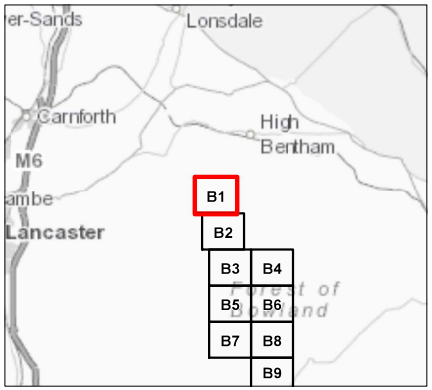


B1

Legend

- Proposed Tunnel Route - Indicative Corridor
- Proposed Construction Access - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area
- Planning Authority Boundary



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Drawing Title: INDICATIVE DEVELOPMENT ENVELOPE PROPOSED BOWLAND SECTION SHEET 1 OF 9

Drawing Status: FINAL

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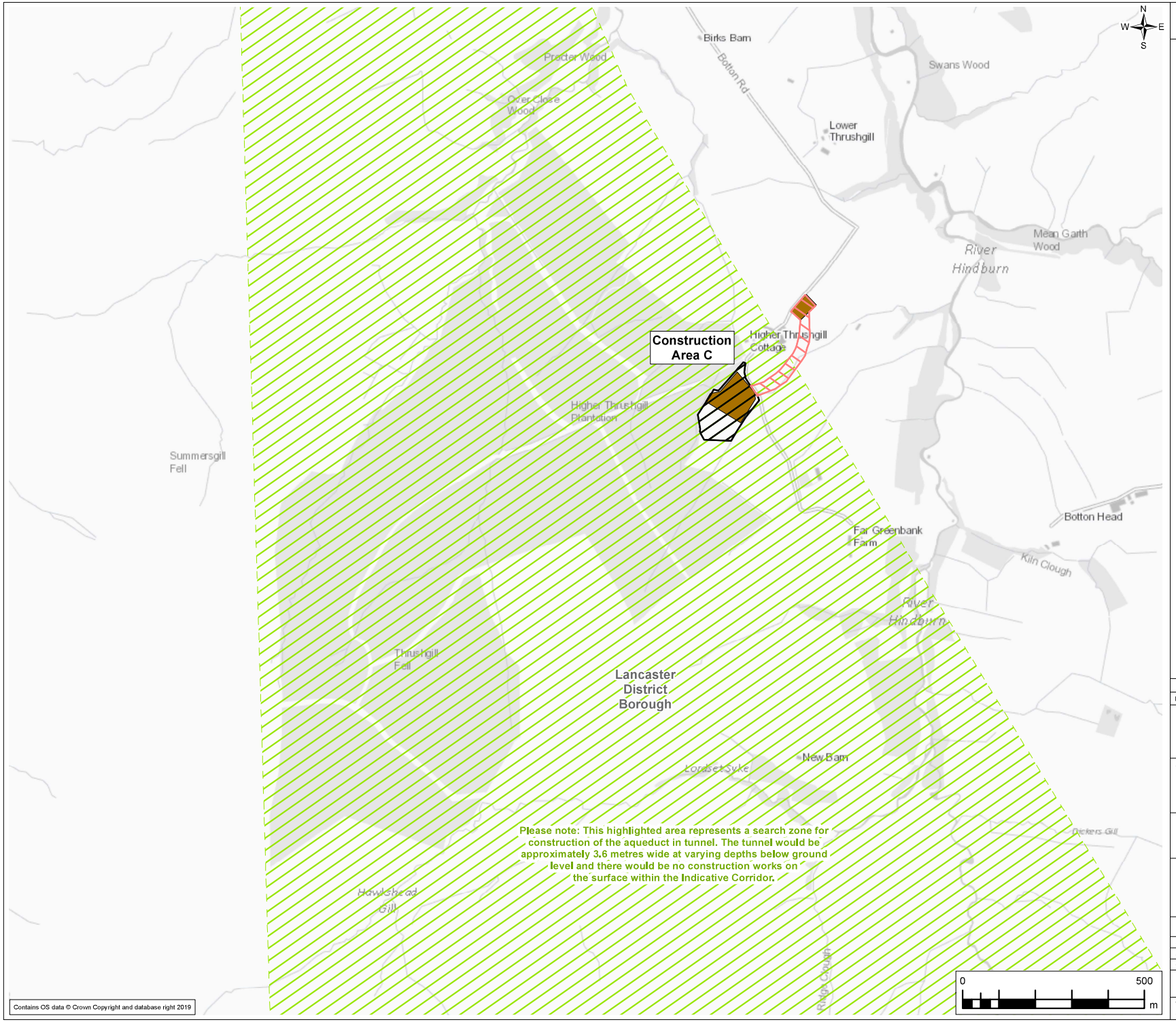
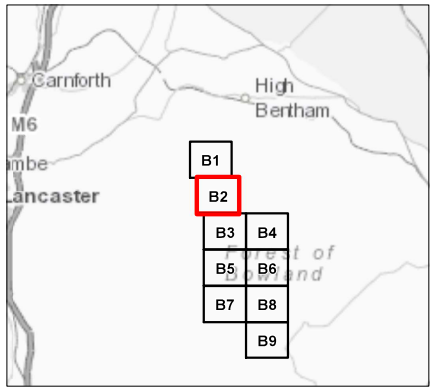


B2

Legend

- Proposed Tunnel Route - Indicative
- Proposed Construction Access - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area
- Planning Authority Boundary



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Drawing Title: INDICATIVE DEVELOPMENT ENVELOPE PROPOSED BOWLAND SECTION SHEET 2 OF 9

Drawing Status: FINAL

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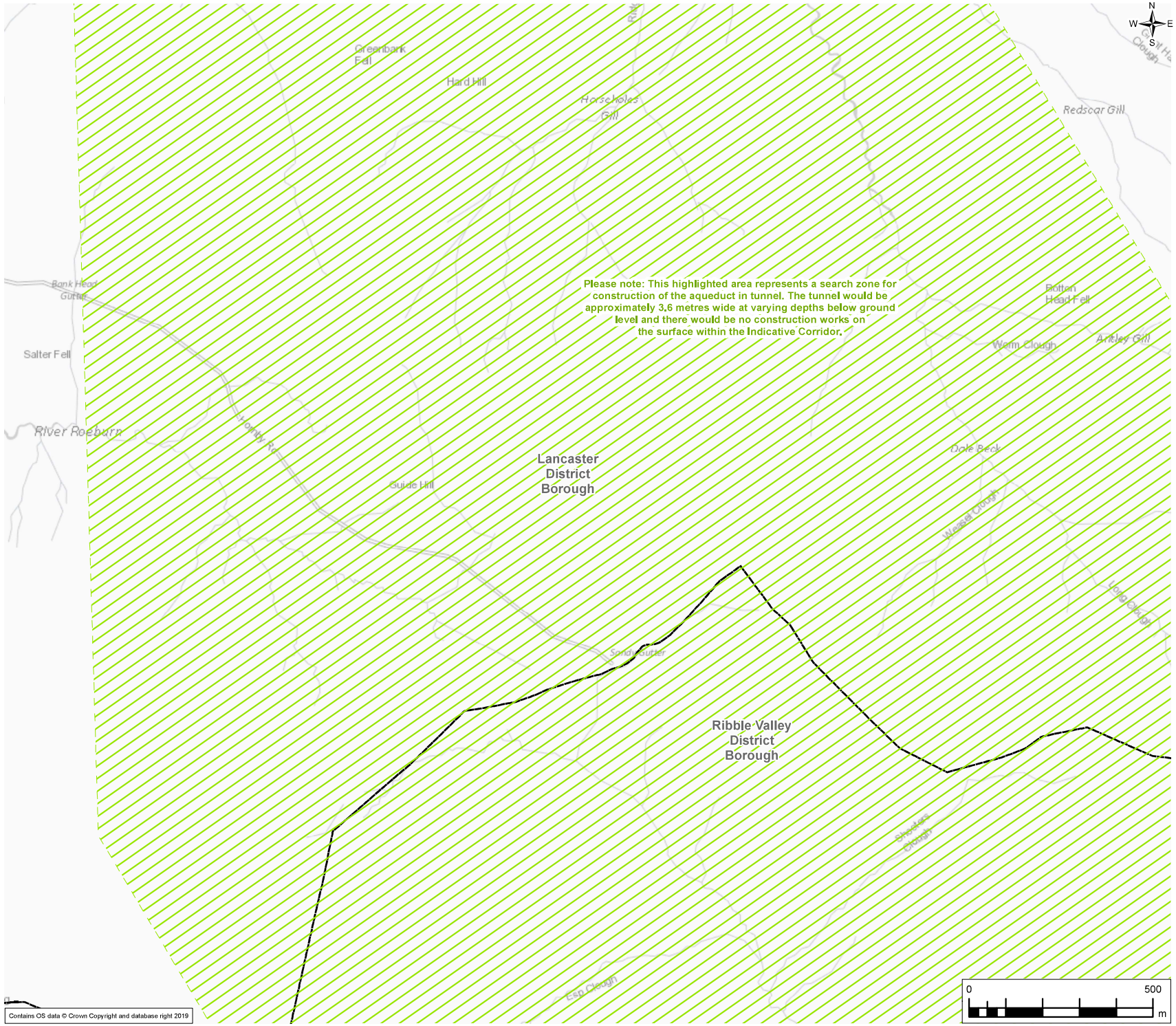
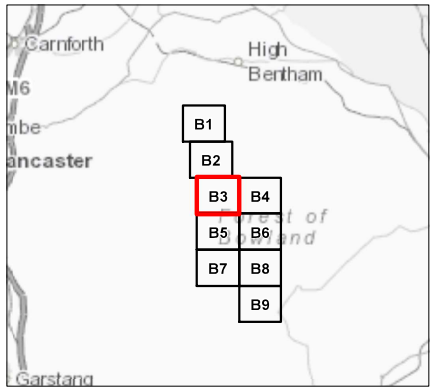


B3

Legend

- Proposed Tunnel Route - Indicative
- Planning Authority Boundary



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Drawing Status: FINAL

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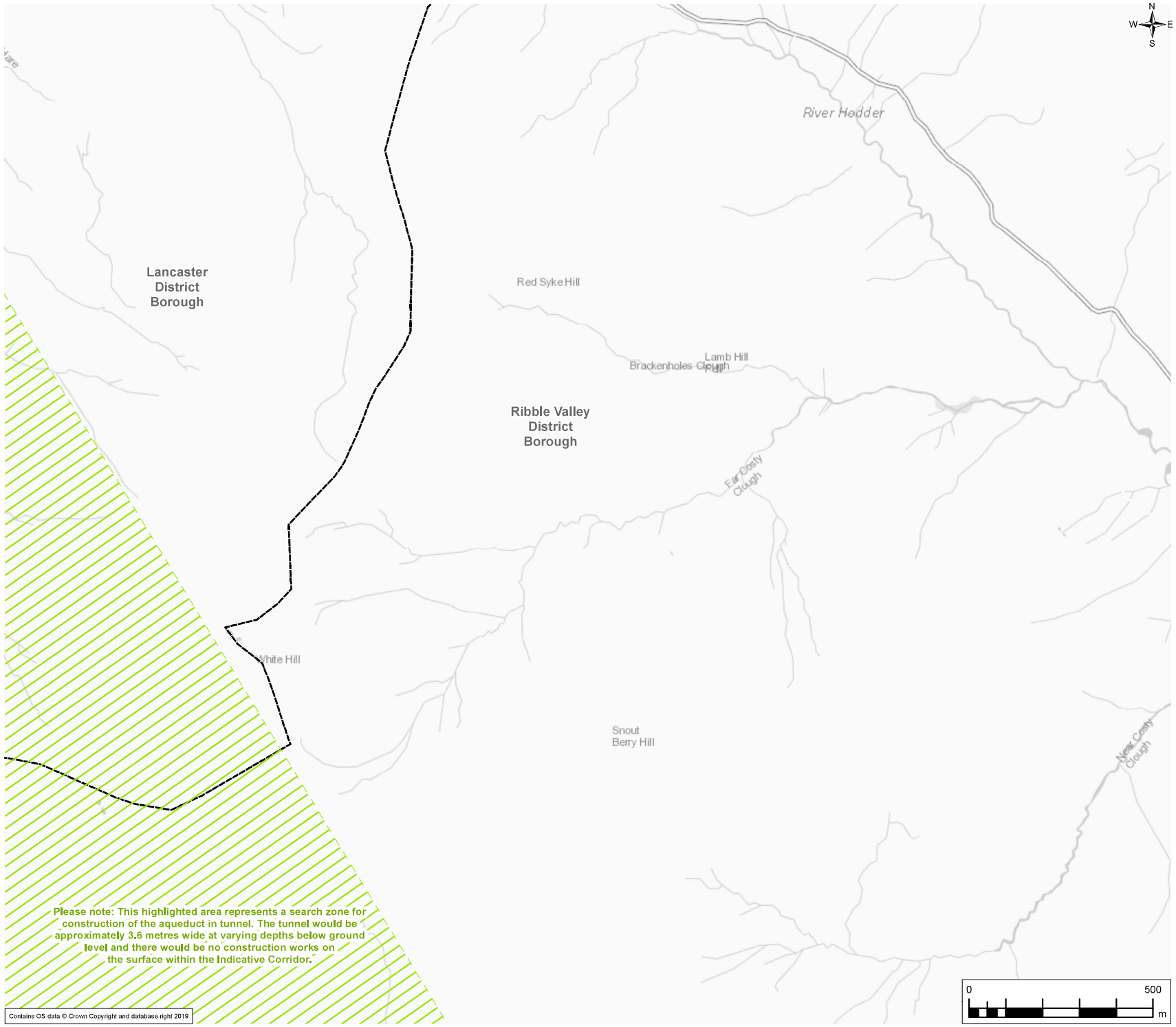
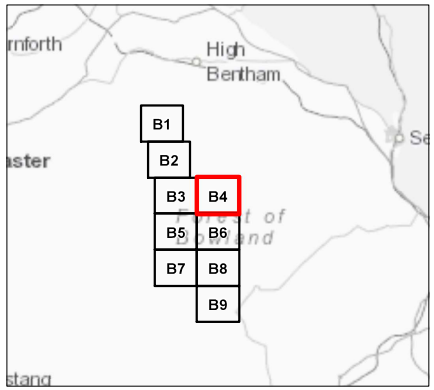


B4

Legend

- Proposed Tunnel Route - Indicative
- Planning Authority Boundary



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Project: HAWESWATER AQUEDUCT RESILIENCE PROGRAMME

Drawing Title: INDICATIVE DEVELOPMENT ENVELOPE
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SHEET 4 OF 9

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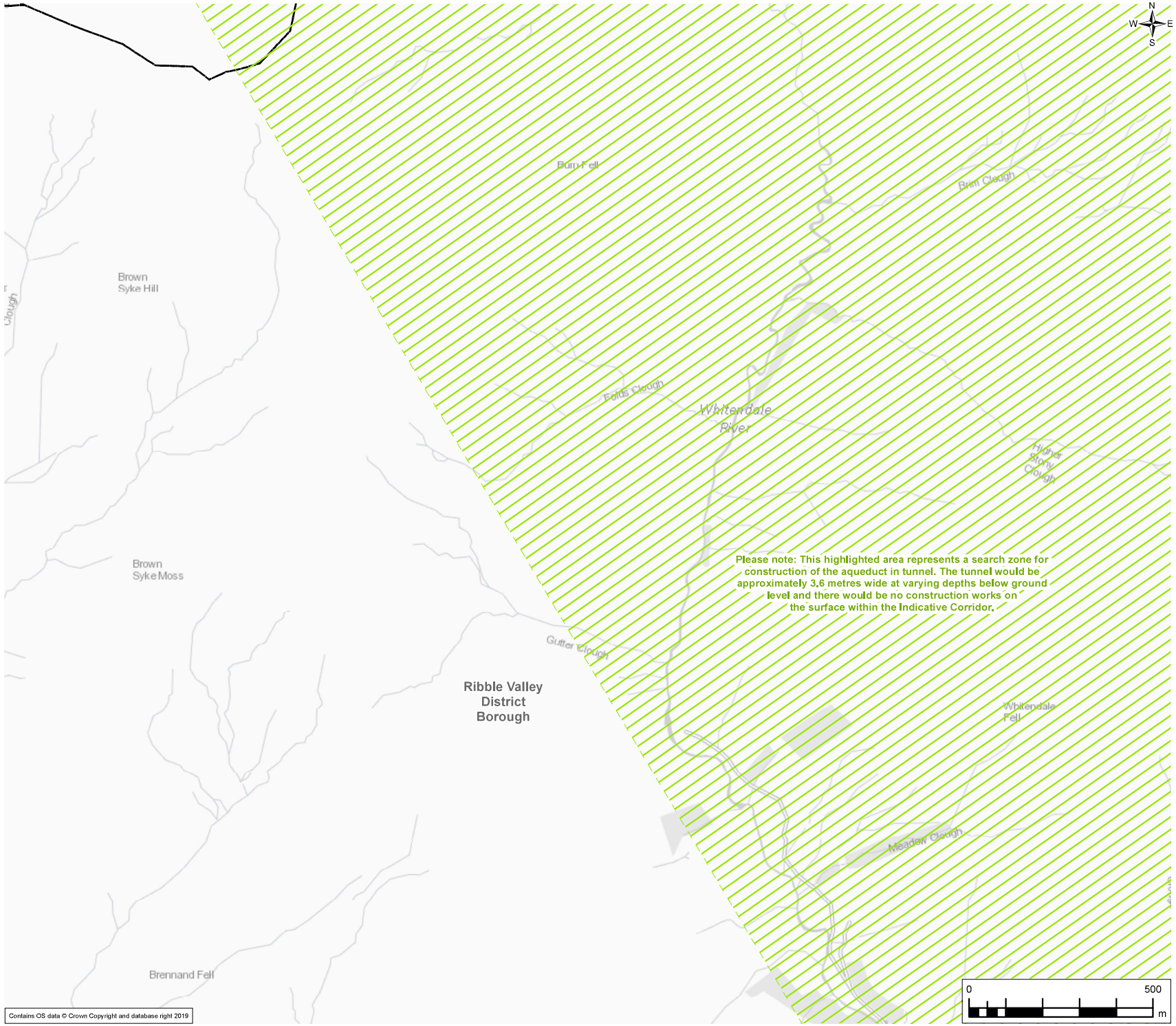
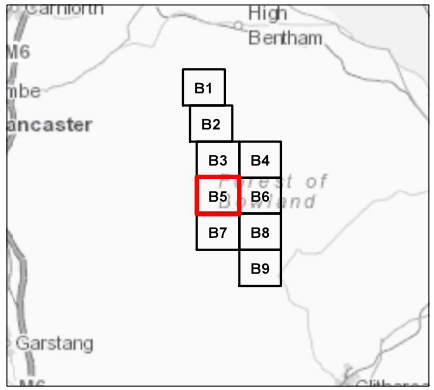
Client No.		
Drawing No.	B27070CG_ESR_03_02	



B5

Legend

- Proposed Tunnel Route - Indicative
- Planning Authority Boundary



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PROPOSED BOWLAND SECTION
SHEET 5 OF 9

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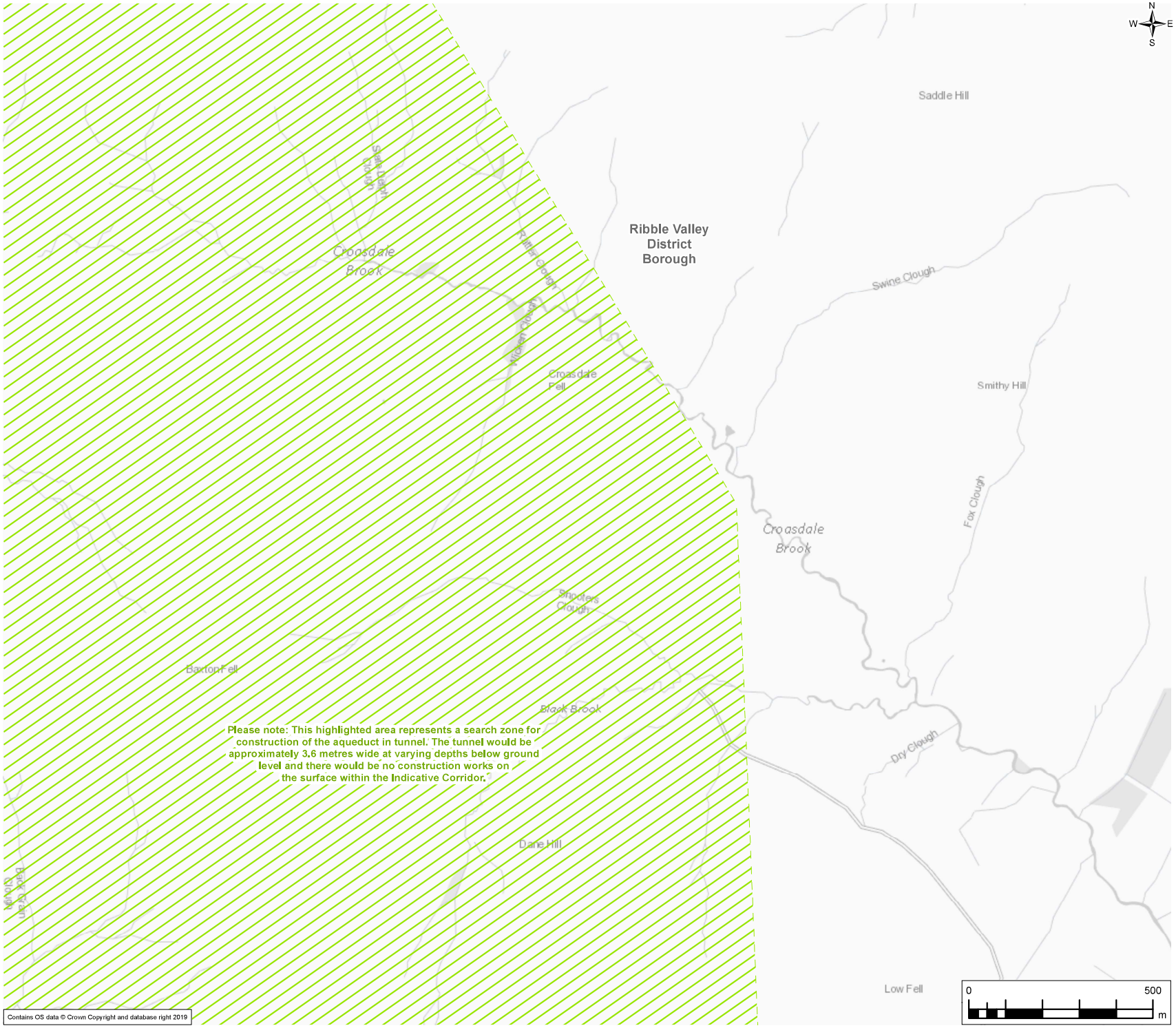
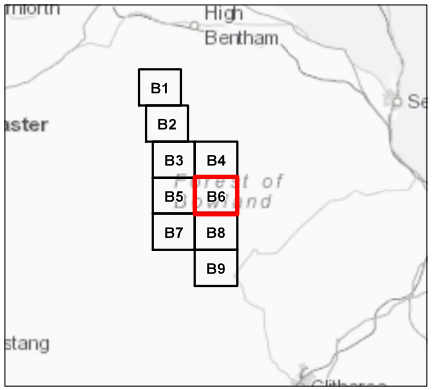


B6

Legend

- Proposed Tunnel Route - Indicative
- Planning Authority Boundary



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Drawing Title: INDICATIVE DEVELOPMENT ENVELOPE
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SHEET 6 OF 9

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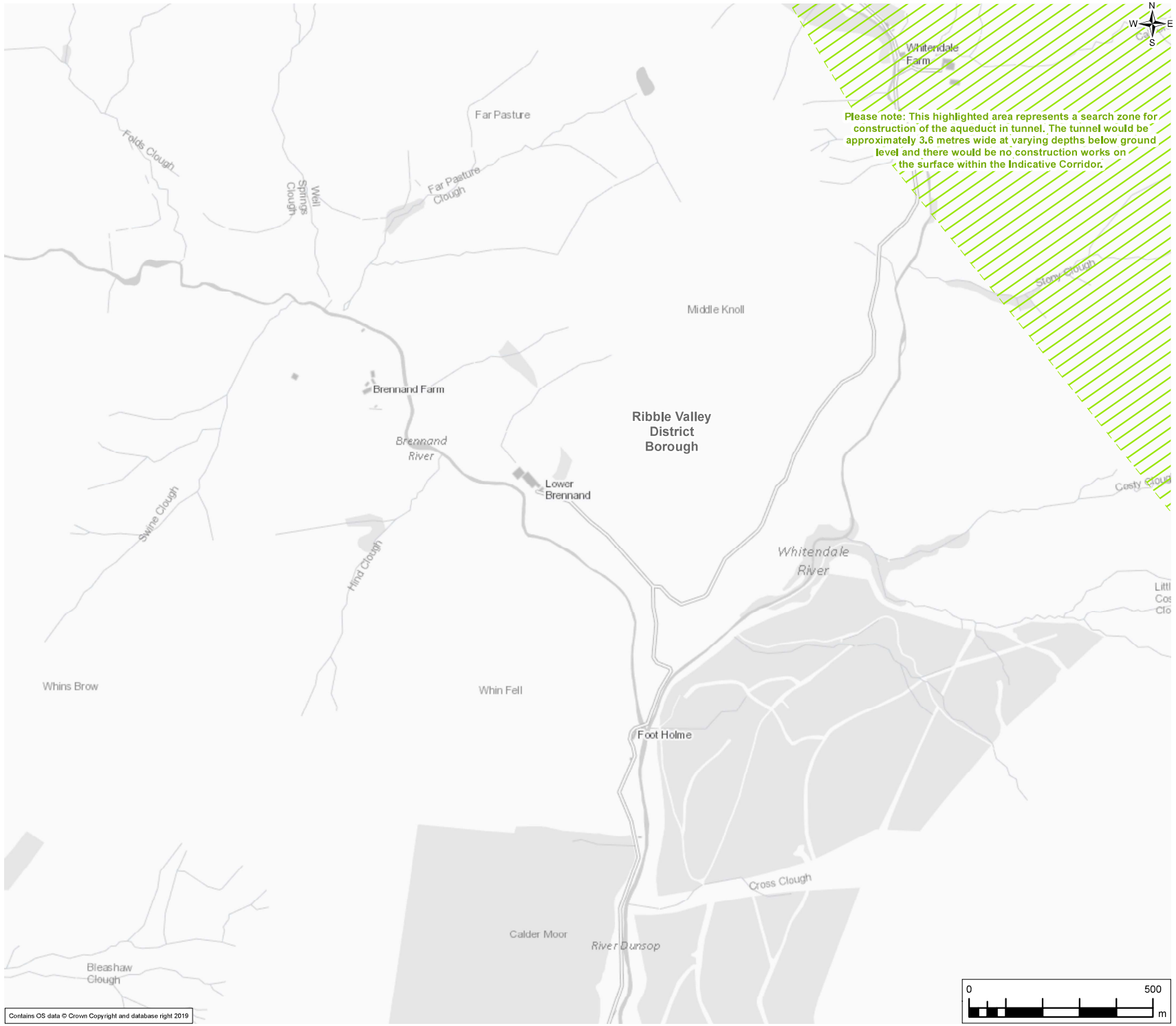
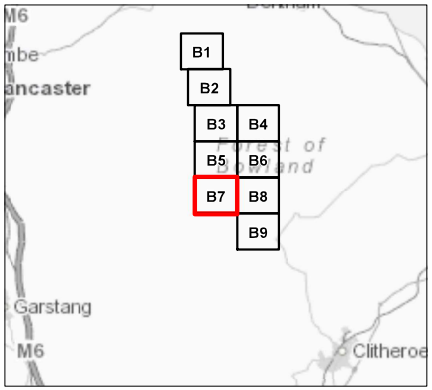


B7

Legend

- Proposed Tunnel Route - Indicative
- Planning Authority Boundary



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Drawing Status: FINAL

Scale @ A3	1:10,000	DO NOT SCALE
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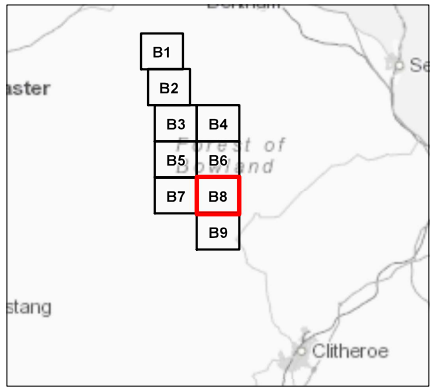
Client No.		

Drawing No. B27070CG_ESR_03_02

B8

Legend

- Proposed Tunnel Route - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area
- Planning Authority Boundary



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Drawing Status: FINAL

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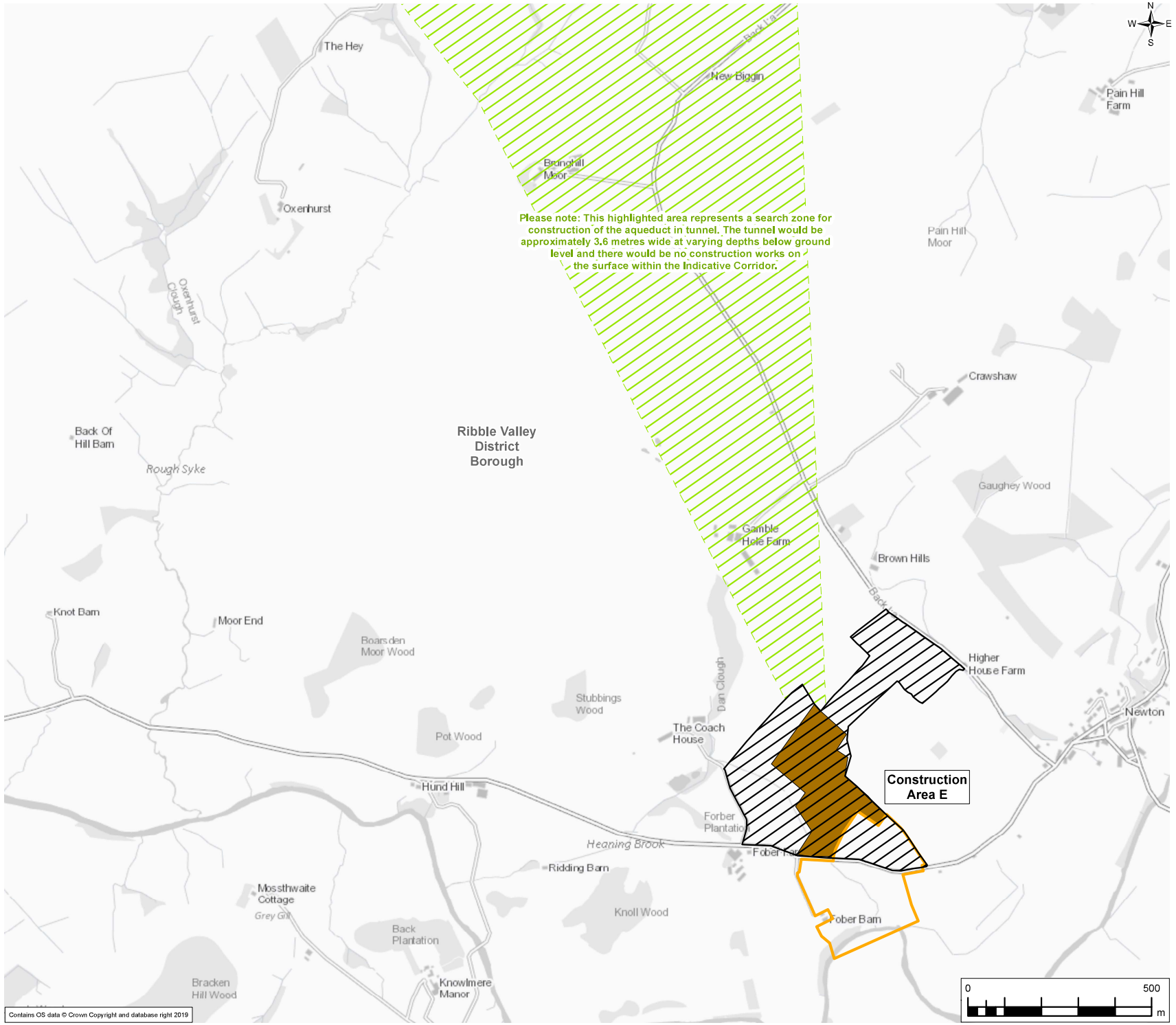
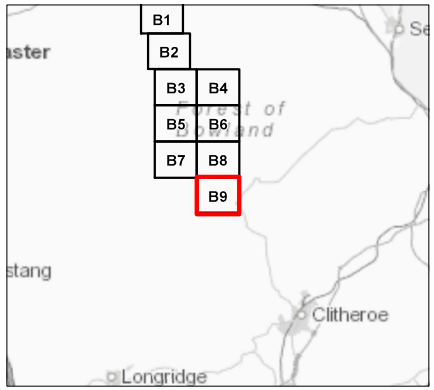


B9

Legend

- Proposed Tunnel Route - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area
- Proposed Discharge Pipe - Indicative
- Planning Authority Boundary



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Drawing Title: INDICATIVE DEVELOPMENT ENVELOPE PROPOSED BOWLAND SECTION SHEET 9 OF 9

Drawing Status: FINAL

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Client No.		

Drawing No.: B27070CG_ESR_03_02

4. Planning and Environmental Statement Strategy

4.1 Planning Application Strategy

74) Through legal advice and consultation with the planning authorities it has been determined that planning consents for the Proposed Programme of Works should be sought under the Town and Country Planning Act 1990 (*TCPA*). It has also been concluded that a single planning application for the Proposed Programme of Works covering all five sections is not appropriate because the five new sections straddle local planning authority boundaries and:

- Can be constructed and operated independently of each other. (Each of the replacement lines within the Programme of Works is intended to deliver an additional level of resilience to the Haweswater Aqueduct, meaning that United Utilities would propose to implement a consented section irrespective of whether planning permission was granted for any of the remaining sections related to the Proposed Programme of Works)
- Do not physically connect with each other, although their combined purpose and effect will be an improvement to the operation and resilience of the existing Haweswater Aqueduct.

75) This approach requires separate planning applications in support of each of the five replacement sections of aqueduct. A planning application for the Proposed Bowland Section will therefore be submitted to Lancaster City Council and Ribble Valley Borough Council independently of the planning applications for the other replacement sections of aqueduct.

76) It is intended that each application will be for planning permission in full, including above and below-ground elements of infrastructure and temporary accesses, construction compounds and ancillary working areas.

77) Assuming planning permission was granted for the Proposed Bowland Section, United Utilities may choose to implement it irrespective of whether permission was granted for the other four sections of replacement aqueduct. This is because the individual operational and resilience benefit of each of the five sections is not inter-dependent on the delivery of the remaining sections.

4.2 Environmental Statement Strategy

4.2.1 EIA Screening

78) United Utilities acknowledges that the Proposed Bowland Section constitutes EIA Development as defined in Schedule 2 of the EIA Regulations. United Utilities has therefore independently elected not to submit an EIA Screening Request to Lancaster City Council or Ribble Valley Borough Council. In turn, therefore, there is no EIA Screening Request associated with the Proposed Bowland Section. United Utilities has discussed and agreed this approach with Lancaster City Council and Ribble Valley Borough Council during EIA scoping consultations.

4.2.2 Robust Approach to EIA

79) Whilst the individual sections comprising the Proposed Programme of Works are considered by United Utilities to be standalone 'projects', for the purposes of the EIA Regulations and the assessment of likely significant environmental effects, a robust approach to assessment has been adopted. This approach is as follows:

- Assessment of each individual section alone (so in this case, the Proposed Bowland Section)
- Assessment of the Proposed Programme of Works combined (so in this case the Proposed Bowland Section with the other four sections of replacement aqueduct)
- The cumulative effects of the individual section (so in this case, the Proposed Bowland Section), with the Proposed Programme of Works combined and other committed developments, as agreed with the determining local planning authority).

80) As such, an ES will be produced for each of the five replacement aqueduct sections (so five ESs in total). Figure 4.1 summarises the distribution of ESs and planning applications for the five replacement aqueduct sections.

81) This approach to EIA has been adopted to ensure that each section as it relates to the Proposed Programme of Works combined has been assessed.

82) Each ES will also include a cumulative assessment of the other sections along the route of the Proposed Development. This would mean that the cumulative assessment within each ES would follow the approach described above and set out in more detail below.

83) This approach not only ensures that a robust EIA is undertaken but will also allow the LPAs as the individual decision-makers on the nine planning applications in their respective areas to understand the likely significant effects of the proposals - not only at a local level, but also the cumulative effects of the overall Proposed Programme of Works. It will also assist and inform proposed consultation arrangements and support local engagement. Figure 4.1 illustrates the proposed approach to production of ESs and planning application submissions to the seven planning authorities.

Figure 4.1: Approach to ES and planning application submissions

4.3 Consultation and Engagement Strategy

4.3.1 Local Planning Authorities and Statutory Consultees

84) United Utilities met the seven local planning authorities individually in early 2018, with follow-up meetings in 2019. These meetings outlined the intended planning and ES strategy, and there are ongoing discussions with the planning authorities concerning the adoption of the proposed planning approach.

85) It is intended to enter into planning performance agreements (PPA) with the determining authorities to cover the pre-application and determination stages but this arrangement may also extend through to the post-application stage. PPAs are useful in setting out an efficient and transparent process for determining large and/or complex planning applications. They help to secure required resources, encourage joint working between the applicant and the relevant planning authorities, and help to bring together other parties such as statutory consultees. A PPA is agreed voluntarily between the applicant and the local planning authority prior to the application being submitted, and can be a useful focus of pre-application discussions about the issues that will need to be addressed.

86) Pre-application advice agreements are in place with Cumbria County Council, Lancashire County Council, Natural England and the Environment Agency in connection with matters relating to their respective statutory functions, such as highways, flood risk and water resources.

87) Working group meetings to include representatives of all the main statutory consultees will be established at appropriate key points during the pre-application and determination phases. This will help to ensure cross-boundary consistency and will encourage knowledge sharing between officers dealing with the five separate sections of replacement.

4.3.2 Non-Statutory Consultees

88) The planning applications for each of the five sections of replacement aqueduct will be supported by a programme of community and stakeholder consultation. Consultations with local communities and non-statutory bodies will aim to:

- Enable early and effective opportunities to participate in the decision-making process
- Provide an opportunity express views about the EIA for Proposed Bowland Section and the contents of the ES
- Provide a platform for commenting on the engineering design and construction proposals
- Report back on how their views have been taken into account in design development.

5. Approach to Scoping

5.1 Purpose of Scoping

89) This Scoping Report has been prepared to accompany a request for a Scoping Opinion from Lancaster City Council and Ribble Valley Borough Council in connection with the Proposed Bowland Section. It aims to provide the information necessary to accompany such a request and inform both Lancaster City Council and Ribble Valley Borough Council in its formal consultations with statutory environmental bodies.

90) Scoping is an important initial stage of the EIA process. The EIA Regulations (Regulation 15 (2)) state that a Scoping Report should provide the following information:

- A plan sufficient to identify the land (refer to Figure 3.1)
- A brief description of the nature and purpose of the development, including its location and technical capacity (Chapters 2 and 3)
- An explanation of the likely significant effects of the development on the environment (provided in each of the technical chapters of the Scoping Report (Chapters 6-18))
- Such other information or representations as the person making the request may wish to provide or make (provided at points through the Scoping Report).

91) This Scoping Report identifies existing features along the Proposed Bowland Section, including important watercourses, residential areas and landscape features. Such features are referred to as the *baseline environment* or *baseline conditions*. Where baseline conditions may alter prior to construction or operation of the Proposed Bowland Section, for example where land use trends are affecting the status of a designated ecological site, this is highlighted within the relevant chapter. This Scoping Report then provides information on how the Proposed Bowland Section may interact with the baseline environment, and in particular identifies where the proposals may give rise to *likely significant environmental effects*.

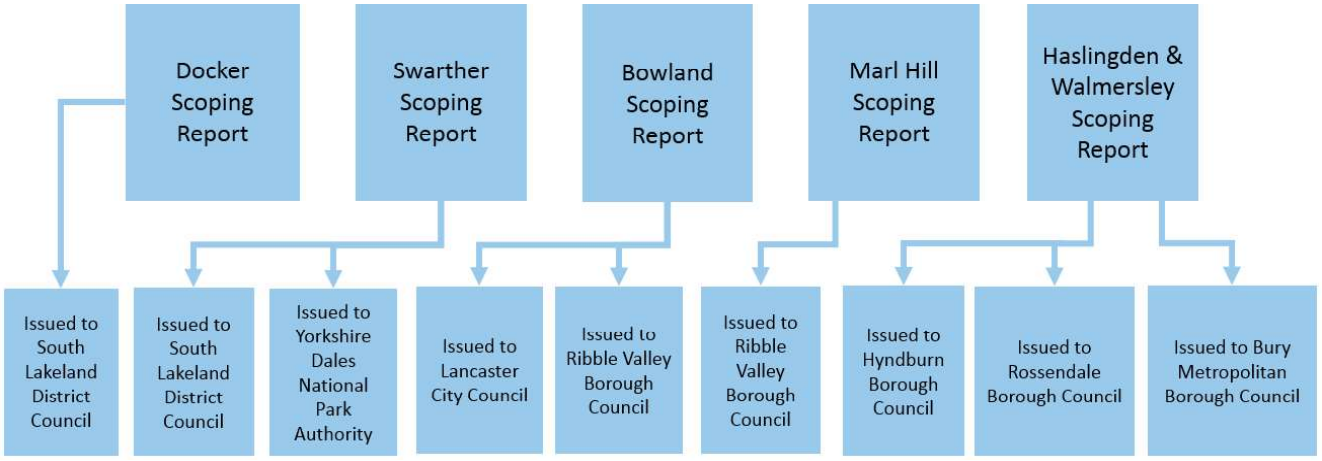
92) Where potential environmental effects are not considered to be significant, perhaps falling below an established threshold, they are generally discounted from the EIA process. This assists in promoting the principles of proportionate EIA, which aims to maintain a focus on likely significant effects only; this keeps the scope of EIA and the size of the subsequent ES to reasonable levels, with an emphasis on issues that are directly relevant to the decision-making process.

5.2 Approach to Scoping

93) The Proposed Programme of Works requires a bespoke approach to the scoping process. This is because of the complexity of dealing with a Proposed Programme of Works which comprises independent civil engineering projects delivered across seven planning authority areas. In addition, however, the ESs for each of the proposed sections will need to be linked with each other because, collectively they represent the Proposed Programme of Works along the aqueduct. The proposed approach to cumulative effects is described in Section 5.6.

94) Figure 5.1 below illustrates the proposed approach to the structure of the scoping reports across each of the five sections (the Proposed Docker Section, the Proposed Swarther Section, the Proposed Bowland Section, the Proposed Marl Hill Section and the Proposed Haslingden and Walmersley Section) comprising the Proposed Programme of Works together, and the distribution of the five Scoping Reports to each of the seven local planning authorities.

Figure 5.1: Approach to scoping report submissions to planning authorities



5.3 Topic-Specific Scoping

95) Topic-specific scoping has been undertaken by suitably qualified and experienced United Utilities and Jacobs personnel. This Scoping Report for the Proposed Bowland Section presents the outcomes of topic-specific scoping activities and confirms the nature and scope of assessment that will be undertaken in the EIA. Each technical section in this Scoping Report summarises the baseline conditions, methodology and deliverables relating to a particular topic.

5.4 Scoping Consultations

5.4.1 Planning Authorities and Statutory Consultees

96) Preliminary meetings with the determining local planning authorities have already taken place to introduce each of the proposed sections and how they relate to the Proposed Programme of Works, explain the need for each of the five sections and to explore options for how best to manage and co-ordinate pre-application activities for each of the planning applications. Further details are provided in Section 4.

5.4.2 Community and Non-statutory Stakeholder Engagement

97) The planning applications for the Proposed Bowland Section will be supported by a programme of community and stakeholder consultation. Consultation will aim to ensure that the statutory consultation bodies, non-statutory stakeholder organisations and the public are given timely and effective opportunities to participate in the decision-making process.

98) The timing of public consultation events, exhibitions and design freezes will be communicated after Lancaster City Council and Ribble Valley Borough Council have published their respective Scoping Opinions. The consultation exercise will consult on the preferred option for the Proposed Bowland Section and particularly the likely significant effects at a local level. The consultation exercises will also provide clear justification for discounting alternatives and seek views on the preferred option for the Proposed Bowland Section and potential mitigation. The consultation programme will allow for time to review and respond to issues raised during consultation, allowing for changes to be incorporated into the design and mitigation process for the Proposed Bowland Section, where practicable.

99) Scoping consultations for the Proposed Bowland Section have been undertaken with Lancaster City Council and Ribble Valley Borough Council and other statutory authorities and environmental regulators.

100) These initial consultations have taken the form of face-to-face meetings and briefing sessions with senior planning officers and members in South Lakeland District Council, in addition to telephone consultations with local authority officers and statutory bodies such as the Environment Agency, Natural England and Historic England. It is intended that local people, businesses and NGOs with a potential interest in the Proposed Bowland Section will be consulted and provided with the opportunity to provide feedback to support the EIA process, well in advance of the planning applications being submitted, as discussed in Section 4.

5.5 Assessment Criteria

101) As stated previously, the EIA process is directed towards the assessment of *likely significant effects*. This enables both the scoping process and the subsequent environmental assessment to focus on issues which will be relevant and material to the determination of the planning applications for the Proposed Bowland Section. It also supports the principles of proportionate EIA, which aims to reduce the volume of unnecessary scope or technical content in an ES; in doing so this assists in making the ES and planning application documents more accessible and legible to interested parties.

102) When considering whether likely environmental effects may be significant or not, assessment criteria are employed to assist in determining whether effects could be above or below defined thresholds. In some cases these thresholds are quantitative and are based on recognised numerical standards, for example, noise effects, while others are qualitative and subject to professional opinion, such as landscape effects. In some cases professional bodies have developed their own guidelines which their members are broadly expected to work to.

103) Within this scoping report, each topic confirms the assessment criteria that have been applied in determining whether potential environmental effects are significant or not. In support of this exercise, some topics have also considered the magnitude of an environmental effect against the value or sensitivity of each asset or resource that is being affected. The outcome of this exercise will be carried forward into the ES.

104) The sensitivity of a receptor is determined by, among other things, its level of designation or protection, its susceptibility to or ability to accommodate change, the availability and efficacy of mitigation measures, and professional judgement. Table 5.1 provides an illustration of how the significance of effects can be assessed by forecasting the magnitude of change and a receptor's sensitivity to that change.

Table 5.1: Forecasting the Significance of Effects

		Value / Sensitivity of Asset / Resource		
		Low	Medium	High
Magnitude of Effect	Very Low	Negligible	Negligible	Minor
	Low	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	High	Moderate	Major	Major

105) The threshold between insignificant and significant environmental effects is normally taken to be a 'moderate' effect. The combination of magnitude of effect and value / sensitivity combinations resulting in a potential significant effect are shaded in the table above.

106) Where possible, assessment criteria and the determination of 'significance' in the Scoping Report (and the ES to follow) will reflect nationally-accepted EIA procedures and methods including, but not limited to:

- Guidance for Ecological Impact Assessment (CIEEM 2018 as amended)
- Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (2013)
- ICOMOS guidelines for the assessment of cultural heritage assets
- Design Manual for Roads and Bridges (HA 208/07) (2013)
- British Standards relating to noise assessment, such as BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites*.

107) Once likely significant adverse effects – both adverse and positive – have been identified in the EIA process, mitigation proposals are developed in the ES to avoid, reduce or offset these likely significant effects. In selected cases adverse environmental effects falling below the 'significant' threshold may also be proposed. Approaches to mitigation are described in Section 5.7.

5.6 Cumulative Effects and Interaction of Effects

108) The EIA Regulations require an applicant to consider the cumulative effects of a proposed scheme with other, reasonably foreseeable, proposals whose environmental effects could act in combination with those described in the ES. For example, two separate developments could both give rise to increased flood risk in a river catchment which, when considered in combination, are more significant than when assessed as individual schemes.

109) The interaction of effects considers different environmental effects associated with a proposed scheme (e.g. traffic, noise, air quality and community severance) acting at the same location or upon the same environmental resource. For example, a local community may experience increased noise levels, severance and traffic congestion during the construction phase of a project.

110) Therefore, and in consultation with stakeholders, the cumulative effects and the interaction of effects of the Proposed Bowland Section in conjunction with the other four sections relevant to the Proposed Programme of Works, as well as other committed schemes will be addressed in the ES.

111) In consultation with the determining local planning authorities and other stakeholders, United Utilities has developed an agreed approach to assessing cumulative effects and the interaction of effects arising from the Proposed Bowland Section in conjunction with the other sections comprised within the Proposed Programme of Works, which reflects the local and regional aspects of the proposals.

112) As explained elsewhere in this Scoping Report, the cumulative assessment will consider the likely significant effects of the Proposed Bowland Section with the Proposed Programme of Works combined, and then further in combination with other committed developments confirmed to United Utilities by the local planning authority.

5.7 Mitigation and Environmental Monitoring

113) The EIA Regulations allow for the consideration of available mitigation techniques during the scoping phase to discount likely significant effects which can be mitigated with proven techniques. Due to the early stage of engineering design development, including in relation to the construction, surplus material and road haulage strategies for the Proposed Bowland Section, it has not been possible (at this stage in the scoping process) to discount many potential likely significant effects from the EIA scope. As the design of the Proposed Bowland Section progresses, it may be possible to de-scope certain areas of work. Any deviation from the proposals in the Scoping Report would only take place in consultation with and with the agreement of Lancaster City Council and Ribble Valley Borough Council and the relevant statutory and stakeholders.

114) The ES for the Proposed Bowland Section will consider the likely significant adverse and beneficial environmental effects. Mitigation measures to avoid, reduce or eliminate any likely significant adverse effects will be presented in each technical chapter of the ES. Steps taken to avoid or reduce significant adverse effects through design revisions to the Proposed Bowland Section – known as embedded mitigation – will be recorded in the ES. The EIA Regulations require authorities to determine procedures for the monitoring of significant adverse effects on the environment, as identified in the ES.

115) The Environmental Statement will present an outline Environmental Management Plan (EMP). The EMP will present initial approaches to protecting the environment, respecting the amenity of local communities, and compliance with environmental legislation. It will also capture mitigation and monitoring commitments which have been presented in the ES. The EMP will comprise a series of volumes as illustrated in Figure 5.2.

Figure 5.2: ES Environmental Management Plan

116) The Environmental Masterplan will collate and map environmental commitments and mitigation proposals for some of the ES topics, such as ecology, landscape and visual, cultural heritage and water environment. The proposals will be mapped onto large scale base plans to indicate where and when (e.g. enabling works, construction phase, operation phase) mitigation proposals should be implemented.

117) The Construction Code of Practice will incorporate a series of documents. It will outline the general construction methodologies to be adopted by the contractor. Environmental control measures and other mitigation measures will be identified to avoid, reduce or offset likely significant effects. The documents making up the Construction Code of Practice will include outline methodologies and strategies along with some preliminary site-specific method statements. Examples could include construction strategies for:

- Pipe laying (open-cut, directional drill, and slip lining)
- Watercourse crossings
- Water quality monitoring methodology
- Tunnelling
- Sustainable soil stripping, storage and reinstatement
- Working in floodplain
- Biosecurity management plan
- Traffic management and diversions.

118) The purpose of the Code of Practice is to provide detailed guidance to enable the planning authority, regulators and the contractor to develop an appropriate system of work that would be employed for construction activities and documented in detailed Method Statements.

119) The information contained within these documents and the subsequent detailed Method Statements would be conveyed to all relevant third party stakeholders for consent/approval as required.

120) In tandem with the Construction Code of Practice and the Environmental Masterplan, the ES would present a schedule of mitigation detailing all of the mitigation proposals arising in each chapter. The schedule could act as a basis for forming planning conditions should the Proposed Bowland Section received planning consent.

121) Finally, a schedule of environmental monitoring would be developed to indicate the nature and scope of monitoring requirements that would be required to complement and support the mitigation programme. These monitoring requirements could be short-term (for example, water quality monitoring during construction adjacent to a watercourse), or extend well beyond the construction and reinstatement phase, for example in relation to the establishment of landscape planting schemes.

5.8 Programme

122) While it is currently too early to provide a detailed timeline for the Proposed Bowland Section and the other proposed sections, a provisional schedule has been prepared for inclusion in the Scoping Report (refer to Figure 3.5). If the Proposed Bowland Section receives planning consent from Lancaster City Council and Ribble Valley Borough Council in 2021, construction works could start on site in 2023 and take place over a period of more than five years, although reinstatement could extend beyond 2028. Commissioning of the Proposed Bowland Section in conjunction with other sections of the Proposed Programme of Works may then start in 2028 (at the earliest), with the entire Haweswater Aqueduct Resilience Programme being fully operational by 2029 (indicatively).

5.9 Scope of the Environmental Statement

123) There is no statutory provision surrounding the structure and presentation of an ES. However, it must contain the information specified in Part 2 of Schedule 4 of the EIA Regulations, and '*such of the relevant information* in Part 1 of Schedule 4 *as is reasonably required to assess the effects of the project and which the applicant can reasonably be required to compile'*. Schedule 4 of the EIA Regulations requires that an ES should contain the following information:

- A description of the development, including in particular:
  a. A description of the location of the development
  b. A description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases
  c. A description of the main characteristics of the operational phase of the development
  d. An estimate, by type and quantity, of expected residues and emissions
- A description of the reasonable alternatives, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects
- A description of the baseline, and potential changes in the future baseline
- A description of the likely significant effects of the development on:
  a. Population
  b. Human health
  c. Biodiversity[5]
  d. Land
  e. Soil resources and conservation
  f. Water environment
  g. Air quality
  h. Climate[6]
  i. Material assets
  j. Cultural heritage
  k. Landscape
- A description of the likely significant effects of the development on the environment resulting from the:
  a. Construction and operation phases of the development, including, where relevant, demolition and decommissioning works

[5] The term 'biodiversity' is used in the EIA Regulations. Chapter 9 of the Scoping Report has adopted the more commonly-used and recognised term 'ecology'.
[6] Climate change and climate resilience have been addressed in Chapter 18 – Air Quality – of the Scoping Report.

b. Use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources

c. Emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste

d. Risks to human health, cultural heritage or the environment (for example due to accidents or disasters)

e. Cumulation of effects with other existing and/or approved projects

f. Impact of the project on climate and the vulnerability of the project to climate change

g. Technologies and the substances used.

124) Schedule 4 of the EIA Regulations further explains that the ES should contain information on:

- Both direct significant effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development. (It is not envisaged that the Proposed Programme of Works would give rise to any transboundary effects and so this requirement of Schedule 4 will be descoped from the ES.)
- Additionally, the Regulations require a description of methodologies and technical assumptions, and a consideration of mitigation measures to avoid, reduce or offset any of the significant adverse effects identified during the EIA process. Mitigation measures should consider both the construction and operation phases of the proposed development
- A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of relevant major accidents and / or disasters. Where appropriate, this description should address measures to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.

125) Finally, the Regulations require a non-technical summary of the information provided in the ES, and a reference list detailing the sources used for the baseline descriptions and assessments.

126) The ES for the Proposed Bowland Section will include the above-mentioned requirements and technical scope where appropriate. The subsequent sections of this Scoping Report consider in more detail how each of the technical topics listed earlier in this section will be addressed in the ES.

6. Landscape and Arboriculture

6.1 Overview

127) This chapter presents the outcome of the scoping exercise in relation to the likely significant landscape and visual amenity effects of the Proposed Bowland Section. It also describes the proposed approach to surveying arboricultural resources – individual trees, tree groups, woodlands and hedgerows – within the indicative development envelopes.

128) The Landscape and Visual Impact Assessment (LVIA) will identify and assess the potential effects of the Proposed Bowland Section during the construction and operational stages on the landscape and visual resource within a defined assessment area.

129) The assessment of landscape effects will address the effects of change and development on the landscape as a resource (i.e. landscape receptors such as landscape character units and designated landscapes). The assessment will be primarily concerned with the extent to which the Proposed Bowland Section will affect the elements that make up the landscape, the aesthetic and perceptual aspects of the landscape and its distinctive character. Landscapes vary considerably in character and quality and constitute a key component of the distinctiveness of any local area.

130) The assessment of visual effects will address the effects of change and development on the views available to people and their visual amenity (i.e. visual receptors). It will be primarily concerned with how the surroundings of individuals or groups of people may be specifically affected by changes in the content and character of views as a result of the change or loss of existing elements in the landscape and / or the introduction of new elements.

131) The Guidelines for Landscape and Visual Impact Assessment (GLVIA)[7] promote landscape and visual impact assessment that is proportional to the scale and nature of the proposals and the likely landscape and visual effects.

6.2 Proposed LVIA Methodology

132) The assessment will be undertaken in accordance with GLVIA. It will also draw on previous experience of similar projects, professional judgement and knowledge of the local landscape within which the Proposed Bowland Section will be delivered.

133) Guidance is provided by GLVIA on the area of landscape that should be covered in assessing landscape effects i.e. the 'assessment area'. Paragraph 5.2 of GLVIA states that '*the assessment area should include the site itself and the full extent of the wider landscape around it which the proposed development may influence in a significant manner. This will usually be based on the extent of Landscape Character Areas likely to be significantly affected either directly or indirectly. However, it may also be based on the extent of the area from which the development is potentially visible, defined as the Zone of Theoretical Visibility, or a combination of the two.*'

134) The following activities will be undertaken in the assessment:

- Establish the assessment area
- Review and take account of relevant guidance and policy
- Establish baseline conditions within the assessment area
- Identify viewpoint locations
- Identify the potential effects
- Identify mitigation measures (including reinstatement measures) to reduce and minimise potential impacts on both landscape and visual receptors. Design and development of appropriate landscape mitigation proposals and contributions to a project-wide Environmental Masterplan

[7] Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA) produced by the Landscape Institute and the Institute of Environmental Management and Assessment.

- Undertake an assessment of likely significant effects on landscape receptors
- Undertake an assessment of likely significant effects on the visual amenity of receptors.

135) Further detail of these aspects of the assessment are discussed below.

6.2.1 Planning Policy and Guidance

136) The assessment, design proposals and mitigation measures will be guided by relevant National Planning Policy Framework policy and local planning policy. Planning policies and designations of relevance to the Proposed Bowland Section will be taken into consideration, for example in terms of assessing the value of receptors and identifying mitigation measures. The compliance of the proposed development in terms of planning policy will be dealt with under a separate planning statement supporting the planning applications.

6.2.2 Baseline Conditions

137) In establishing the existing baseline conditions, the assessment will include a description and analysis of the existing landscape character and visual quality of the assessment area. This will draw on available information considered during scoping and supplemented with field study to account for any environmental trends or new features.

138) Landscape character assessments will be based on published information from local landscape character assessments and Natural England's National Character Assessments (NCA).[8]

139) A winter baseline survey will be undertaken within the assessment area to verify landscape character areas and important viewpoints. Field notes and photographs will record the existing landscape and visual environment during the most visually exposed period. The winter survey findings will be recorded, against which comparisons can be drawn from a summer survey. Views of the Proposed Bowland Section from properties and communities within the assessment area will form the focus of the visual impact assessment. Visual receptors will also include locations associated with outdoor pursuits and activities, where a viewer's attention or interest is related to views and the landscape, and views which are incidental to a visitor's or user's day-to-day routine. These may include: residential properties; guests at hotels, hostels, camp sites; visitors to heritage or tourist attractions; and travellers through the landscape (e.g. motorists, cyclists, tourists, ramblers and outdoor workers).

140) The assessment of likely significant effects will take account of mitigation proposals developed as an integral part of the overall scheme design.

6.2.3 Viewpoints and Visualisations

141) The identification of impacts and effects will draw on information depicted in a series of representative photomontages and / or visualisations, which will be developed to assist in understanding how the Proposed Bowland Section interacts with the receiving landscape and affects visual amenity. The location of viewpoints will be identified and agreed with local authority officers and other key stakeholders as part of an agreed consultation process. This will consider the phase of work to be represented and the proposed locations.

142) All photography and visualisations will be prepared in accordance with the Landscape Institute's Photography and Photomontage Technical Guidance Note update – Interim Statement (November 2018)[9] with consideration of Technical Guidance Note 02/17 Visual Representation of Development Proposals (31 March 2017).[10]

6.3 Proposed LVIA Assessment Criteria

143) In accordance with GLVIA the assessment of sensitivity for both landscape and visual assessments will combine judgements on the value attributed to that receptor and the susceptibility of the receptor to the

[8] Natural England National Character Area profiles 2014 [Accessed August 2019] https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles
[9] Landscape Institute Photography and Photomontage Technical Guidance Note update – Interim Statement (November 2018) [Accessed August 2019] https://www.landscapeinstitute.org/visualisation/photography-and-photomontage/
[10] Landscape Institute Technical Guidance Note 02/17 Visual Representation of Development Proposals [Accessed August 2017] https://www.landscapeinstitute.org/visualisation/

specific type of development proposed. Sensitivity will be assessed on a three-point scale of High, Medium or Low.

6.3.1 Landscape Sensitivity Evaluation

144) Susceptibility is defined as the ability of the landscape to accommodate the proposed development without undue negative consequences. Susceptibility of landscape receptors to change will be assessed using the criteria detailed in Table 6.1 below.

Table 6.1: Landscape Susceptibility Criteria

Susceptibility	Criteria
High	Little ability to accommodate the proposed development without undue harm.
Medium	Some ability to accommodate the proposed development without undue harm.
Low	Substantial ability to accommodate the proposed development without undue harm.

145) GLVIA defines landscape value as '*the relative value that is attached to different landscapes by society*'. A review of existing designations (e.g. National Park, AONB, etc.) is usually the starting point in understanding value. Table 6.2 below sets out the relative importance of generic landscape designations and descriptions.

Table 6.2: Criteria for Assessing Value of Landscape Designations

Typical Designation	Description	Importance (Value)
World Heritage Site	Unique sites, features or areas of international importance with settings of very high quality.	International (High)
National Parks, AONBs, Registered Parks and Gardens of Special Historic Interest, Ancient Woodland, Scheduled Monuments, curtilage of Grade I, II and II* Listed Buildings	Sites, features or areas of national importance with settings of high quality.	National (High)
Conservation Areas	Sites, features or areas of regional importance with intact character.	Regional/County (High/ Medium)
Local Landscape Designations e.g. Green Belt, protecting setting of higher value landscape designations, Tree Preservation Orders (TPO)	Sites, features or areas of district importance.	District (Medium/Low)
Probably no designation, e.g. Public - Space or local footpath	General countryside area valued at the local level.	Local (Medium/ Low)

146) Table 6.3 outlines the criteria incorporating the above assessment of 'value' along with professional judgement that will be used in the evaluation of overall landscape sensitivity.

Table 6.3: Landscape Sensitivity Criteria

Sensitivity	Criteria
High	Landscape elements of particularly distinctive character, which are highly valued and considered susceptible to relatively small changes.
Medium	Landscape of moderately valued characteristics considered reasonably tolerant of change. Some ability to accommodate the proposed development without undue harm.
Low	Landscape of generally low valued characteristics considered potentially tolerant of substantial change.

6.3.2 Visual Sensitivity Evaluation

147) The susceptibility of different visual receptors to changes in views and visual amenity is mainly a function of:

- The occupation or activity of people experiencing the view at particular locations
- The extent to which their attention or interest may therefore be focused on the views and the visual amenity they experience at particular locations.

148) Table 6.4 below (based on generic guidance in GLVIA) will be used to help evaluate the susceptibility of different types of receptors.

Table 6.4: Visual Receptor Susceptibility to Change

Susceptibility	Receptor Type
High	• Residents • People engaged in outdoor recreation, including users of public rights of way, whose attention is likely to be focused on the landscape and on particular views • Visitors to heritage assets or other attractions where views of the surroundings are an important part of the experience • Communities where views contribute to the landscape setting and are enjoyed by residents • Transient users of scenic routes where awareness of views is likely to be particularly high.
Medium	• Transient users of road, rail or other transport routes where the appreciation of visual amenity is not the primary concern • Outdoor workers.
Low	• People engaged in outdoor sport or recreation, which does not involve appreciation of views • People at their place of work, education and worship whose attention may be focused on their activities and where the setting is not important.

149) The criteria in Table 6.5 below will be used, along with professional judgement, to help determine the value of the views in relation to designations and helps to equate sensitivity to other factors, for example, residential views.

Table 6.5: Value of Views

Value	Views from:
High	Viewpoints of national importance, or highly popular visitor attractions where the view forms an important part of the experience, or with important cultural associations. A view that may be identified in character area appraisals.
Medium	Viewpoints of regional / district importance or moderately popular visitor attractions where the view forms part of the experience, or with local cultural associations. A typical and / or representative view.
Low	Viewpoints with no designations, not particularly popular/ important as a viewpoint and with minimal or no cultural associations.

150) The sensitivity of visual receptors to changes in their views will be evaluated in accordance with the criteria provided in Table 6.6, based on the receptor susceptibility to change and the value of views.

Table 6.6: Visual Sensitivity Criteria

Sensitivity	Criteria
High	Receptors where the changed view is of high value and importance and / or where the receptor will notice any change to visual amenity by reason of the nature of use and their expectations. Receptors where the view is important to users will be of high sensitivity such as residential properties or PRoW.
Medium	Receptors where the changed view is incidental, but not critical to amenity and / or the nature of the view, is not a primary consideration of the users (receptors where users are likely to spend time outside or participation in an activity looking at the view and industrial receptors that have offices with windows that take advantage of views).
Low	Receptors where the changed view is unimportant and / or users are not sensitive to change (outdoor receptors where users are unlikely to consider the views an important element of their usage of the site will generally be assessed to be of low sensitivity).

6.3.3 Evaluation of Magnitude of Effects

Magnitude of Landscape Effects

151) The magnitude of landscape effect will be assessed in terms of its size or scale, the geographical extent of the area that would be influenced, its duration and reversibility.

152) This judgement on magnitude of change in the landscape takes into consideration the following factors:

- The extent / proportion of landscape elements lost or added
- The contribution of that element to landscape character and the degree to which aesthetic / perceptual aspects are altered
- Whether the change is likely to alter the key characteristics of the landscape, which are critical to its distinctive character.

153) The criteria used to assess the size, scale and geographic extents of landscape effects will be based upon the amount of change that would occur as a result of the scheme, as described in Table 6.7 below.

Table 6.7: Magnitude of Landscape Effects

Magnitude	Criteria
Major	Substantial adverse or beneficial impact where the scheme would cause a significant change in the landscape character e.g. notable change in landscape characteristics over an extensive area or very intensive change over a more limited area.
Moderate	Moderate adverse or beneficial impact where the scheme would cause a noticeable change in the landscape character e.g. minor changes in landscape characteristics over a wide area or notable changes in a more limited area.
Minor	Minor adverse or beneficial impact in landscape characteristics over a wide area ranging to notable changes in a more limited area.
Negligible	Barely discernible change in the existing landscape character e.g. minor imperceptible change in area or landscape components.
No Change	No noticeable change or alteration of character or features or elements.

154) In accordance with GLVIA, consideration will also be given to the duration and reversibility of landscape effects in the evaluation of magnitude.

Magnitude of Visual Effects

155) Evaluation of the magnitude of visual change affecting receptors will be carried out by considering the following:

- The scale of the change in the view with respect to the loss or addition of features and changes in its composition, including the proportion of the receptor's available view affected by the development
- The degree of contrast or integration of any new features or changes in the landscape with the existing landscape elements and characteristics
- The nature of the view of the proposed development, in terms of the relative amount of time over which it will be experienced and whether views will be full, partial or glimpsed
- The angle of view relative to the main activity of the receptor
- The distance of the viewpoint from the Proposed Bowland Section
- The extent of the area over which changes would be visible
- The duration and reversibility of changes.

156) The criteria used to help determine the magnitude of visual effects are shown in Table 6.8 below.

Table 6.8: Magnitude of Visual Effects

Magnitude	Criteria
Major	Substantial adverse or beneficial impact where the scheme would cause a significant change in the view e.g. the proposals dominate the view and fundamentally change its character and components.
Moderate	Moderate adverse or beneficial impact where the scheme would cause a noticeable change in the view e.g. the proposals are noticeable in the view, affecting its character and altering some of its components and features.
Minor	Minor adverse or beneficial impact where the scheme would be perceptible but not alter the overall balance of features and elements that comprise the existing view e.g. the proposals are noticeable in the view, but not affecting its character or altering its components and features.

Magnitude	Criteria
Negligible	Adverse or beneficial impact where the scheme would cause a small or virtually imperceptible change in the view e.g. the changes are only a minor element of the overall view that are likely to be missed by the casual observer.
No Change	Barely or no discernible change in the existing view e.g. the changes are scarcely appreciated.

157) Mitigation measures and standard construction and operational management practices will be incorporated into the design and will be considered in the determination of the magnitude of change.

6.3.4 Significance of Effects

158) The resulting determinations of sensitivity and magnitude will be applied together to assess the significance of effect through use of the matrix set out in Table 6.9. Effects will be qualified as 'adverse' or 'beneficial'. The significance of landscape and visual effects will be assessed on a five-point scale of very large, large, moderate, slight and neutral as set out below in Table 6.9, based on professional judgement and informed by GLVIA.

Table 6.9: Criteria to Assess the Significance of Effect for Landscape and Visual Resources

Category	Landscape	Visual
Very Large Beneficial Effect - Significant	The project would greatly enhance the character (including quality and value) of the landscape; create a high quality feature and / or series of elements; enable a sense of place to be created or greatly enhanced.	The project would create a new feature that would greatly enhance the view.
Large Beneficial Effect - Significant	The project would enhance the character (including quality and value) of the landscape; enable the restoration of characteristic features and elements lost as a result of changes from inappropriate management or development; enable a sense of place to be enhanced.	The project would lead to a major improvement in a view from a highly sensitive receptor.
Moderate Beneficial Effect - Significant	The project would improve the character (including quality and value) of the landscape; enable the restoration of characteristic features and elements partially lost or diminished as a result of changes from inappropriate management or development; enable a sense of place to be restored.	The proposals would cause obvious improvement to a view from a receptor of medium sensitivity or a perceptible improvement to a view from a more sensitive receptor.
Slight Beneficial Effect	The project would complement the character (including quality and value) of the landscape; maintain or enhance characteristic features and elements; enable some sense of place to be restored.	The project would cause limited improvement to a view from a receptor of medium sensitivity, or would cause greater improvement to a view from a receptor of low sensitivity.
Neutral Effect	The project would maintain the character (including quality and value) of the landscape; blend in with characteristic features and elements; enable a sense of place to be retained.	No perceptible change in the view.
Slight Adverse Effect	The project would not quite fit the character (including quality and value) of the landscape;	The project would cause limited deterioration to a view from a

Category	Landscape	Visual
	be at variance with characteristic features and elements; detract from a sense of place.	receptor of medium sensitivity or cause greater deterioration to a view from a receptor of low sensitivity.
Moderate Adverse Effect - Significant	The project would conflict with the character (including quality and value) of the landscape; have an adverse impact on characteristic features or elements; diminish a sense of place.	The project would cause obvious deterioration to a view from a receptor of medium sensitivity or perceptible damage to a view from a more sensitive receptor.
Large Adverse Effect - Significant	The project would be at considerable variance with the character (including quality and value) of the landscape; degrade or diminish the integrity of a range of characteristic features and elements; damage a sense of place.	The project would cause major deterioration to a view from a highly sensitive receptor, and would constitute a major discordant element in the view.
Very Large Adverse Effect - Significant	The project would be at complete variance with the character (including quality and value) of the landscape; cause the integrity of characteristic features, elements and sense of place to be lost.	The project would cause the loss of view from a highly sensitive receptor, and would constitute a dominant discordant feature in the view.

6.4 Proposed Arboricultural Assessment Methodology

6.4.1 Preamble

159) The landscape associated with the Proposed Bowland Section takes its character from a combination of elements. Landscape elements can vary considerably in character and quality, with trees – defined as individual trees, groups of trees and woodlands – contributing to the distinctiveness of a local area.

160) The following section describes the proposed approach to surveying and assessing arboricultural interests potentially affected by the Proposed Bowland Section. To date there have been no site-specific appraisals undertaken and so this section considers only the broad principles of how arboricultural assets will be addressed within the EIA process. In addition to desk study and fieldwork, consultations with key stakeholders will form an important element of work.

161) Trees and woodlands play a crucial role in improving and maintaining the environment by protecting against flooding, improving water quality and providing habitats for wildlife. Woodlands also provide the backdrop for recreation and tourism facilities that attract people to the countryside and urban areas, whilst also contributing to the mental and physical wellbeing of residents and visitors.

162) A preliminary assessment area focused on the Proposed Bowland Section was adopted to inform the scoping of potential effects on trees. The assessment area falls within Lancashire, parts of which are recognised for their scenic beauty and high quality landscapes. The tree populations of these areas have evolved over a long period of time, and have been influenced by geology, climate and, to a large extent, human intervention.

6.4.2 Potential Effects

163) Trees are complex organisms that can be affected by direct or indirect damage during construction; scoping therefore identified potential short- and long-term effects which could occur on trees as a result of construction activities. These construction effects would potentially occur because of both tree removal and direct damage to branches and roots, with minor damage potentially affecting tree growth and their ability to take up water, oxygen and nutrients.

164) Additional effects can include ground compaction, altered drainage and the potential effects of wind-throw on retained trees which, depending on the magnitude of the change, can affect a tree's ability to recover and increase its susceptibility to disease and decay.

165) Short-term effects could be associated with tree felling within the indicative development envelopes (but not along the indicative tunnel sections where no above-ground working would take place). Tree felling or disturbance could also take place along access routes from the public highway, while loss of or disturbance to hedgerows and hedgerow trees is also a potential risk. It should be noted that much of the Proposed Bowland Section comprises tunnelling at varying depths below ground level and, at locations where this construction technique is employed, there would be no direct or indirect effects on trees, hedgerows or woodlands at ground level. While construction activities at ground level (for example, construction compound/laydown areas and soil storage) could potentially impact tree resources, the indicative development envelopes are generally sufficiently sized to enable a high degree of avoidance through embedded design.

166) Long-term effects would principally be associated with the unavoidable loss of any trees required in connection with enabling works and site preparation, and the prevention of replanting along easements where, for operational reasons, it is not permissible to introduce tree root zones above pipework.

6.4.3 Proposed Scope, Methodology and Criteria

167) A tree assessment for the Proposed Bowland Section will be undertaken in accordance with British Standard 5837:2012 '*Trees in relation to design, demolition and construction – Recommendations*', and in line with nationally-accepted guidelines for the visual assessment of trees from ground level.

168) An assessment will be undertaken along the route of the Proposed Bowland Section, concentrating on those indicative development envelopes where activities would take place at ground level, such as proposed access routes, compounds and laydown areas. Where construction activities are proposed below ground level, specifically tunnel boring, surveys and assessment will be discounted. Where appropriate, the survey area may extend a short distance beyond indicative development envelopes to account for indirect effects, for example, compaction of root zones, or in cases where there are particularly sensitive arboricultural assets. Potential wind-throw resulting from the removal of existing trees will also be considered where appropriate.

169) Information will be obtained from stakeholders and published sources including: aerial photography; local authorities (protected trees); Natural England (ancient woodland); landowners and the Forestry Commission (woodland management and grant status).

170) The survey will generally encompass trees with a stem diameter of 75 mm or greater measured at a height of 1.5 m). Individual trees, groups of trees and woodlands will be assessed for their quality and benefits, with each tree or tree group recorded by allocating it to one of four categories:

- A) Trees of high quality with an estimated remaining life expectancy of at least 40 years
- B) Trees of moderate quality with an estimated remaining life expectancy of at least 20 years
- C) Trees of low quality with an estimated remaining life expectancy of at least ten years, or young trees with a stem diameter below 150 mm
- U) Trees in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than ten years.

171) Trees growing as groups or woodland will be identified and assessed as such, where appropriate. An assessment of individuals within any group will still be undertaken in order to highlight significant variation in attributes (including physiological or structural condition).

172) The significance of tree loss will be expressed in the ES in relation to the number of trees affected. Mitigation measures will be developed in consultation with statutory and non-statutory bodies. The effects of tree removal, tree loss and tree decline are factors that will also be considered in the ecological and landscape assessments. Additionally, opportunities to avoid the loss of trees through embedded mitigation and avoidance will be described.

6.5 Existing Conditions

173) This report will summarise the landscape and visual amenity baseline for the assessment area and identify receptors where there is potential for significant effects to arise. A brief description of the existing conditions is also included.

174) The process of scoping commenced with the definition of a preliminary assessment area within which both existing landscape character and visual amenity could be evaluated to assist in the identification of potential effects.

6.5.1 Assessment Area

175) The assessment area includes the tunnelling compounds of Construction Areas A, B, C, D and E and the surrounding local landscape. The five tunnelling compounds could be operational for a period of up to five years, while some may be only intermittently active over this period. Soils would be stripped, and the site would be laid with a temporary surface. The compounds would be located on the rising valley sides or in valley bottoms from which the soil strip would be highly visible within the surrounding elevated land and valleys. Gantry cranes would be used at shaft locations and these would be highly visible in the local area.

176) Plant and machinery movements along haul roads (which would be constructed to provide access from the local road network) would cause visual disturbance. Haulage routes would use defined routes within the minor road network, passing through local settlements and past local properties and would be visually intrusive.

177) The landscape and visual amenity assessment area is shown in Figure 6.1. This assessment area will be refined through the assessment process based upon desk-study data and field survey verification, influence from stakeholder engagement, scoping opinion response and will be refined throughout the development of the design of the Proposed Bowland Section.

178) The assessment area is located within the central and northern area of the Forest of Bowland Area of Outstanding Natural Beauty (AONB). The local Landscape Character Assessment describes the AONB as '*designated as a landscape of national significance due to the grandeur and isolation of the upland core; the steep escarpments of the Moorland Hills; the undulating lowlands; the visual contrasts between each element of the overall landscape; the serenity and tranquillity of the area; the distinctive pattern of settlements; and the landscape's historic and cultural associations*'.[11]

179) The landscape of the assessment area is characterised by undulating lowland, wooded valleys, moorland and rolling upland with occasional rocky outcrops. Topography ranges from approximately 150 m above Ordnance Datum (AOD) to elevations of 400 m - 540 m AOD at the tops of the Bowland Fells. The undulating lowland comprises a rich patchwork of farmland pastures, mixed farm woodlands, copses and winding lanes lined with hedgerows. At a higher level within the moorland fringe, dry stone walls and scattered farmsteads with stone out-barns are typical. Wooded valleys, surrounded by the moorland fringe, are deeply incised, with wooded valley sides providing a strong sense of enclosure. The moorlands encircle the moorland fringe and rolling upland at lower elevations and are characterised by distinct hill profiles. Distinctive features include large enclosures, mostly delineated by gritstone walls, and small, isolated stone hamlets and farmsteads.

180) The upland farmland comprises gentle landscape of soft rolling hills, cloaked with moorland grasses in the higher parts, and lush green pastures and herb rich meadows on the lower slopes. Stands of beech trees are a distinctive feature, growing on rocky slopes and outcrops, and often enclosed by circular walls. Small clustered stone villages occur on south facing slopes and there are also some small linear settlements.

181) Drystone walls form the majority of field boundaries at higher elevations, creating strong patterns in the landscape, and reflecting the underlying geology. From elevated locations there is a feeling of openness and remoteness with dramatic, unimpeded long distance views across wide valleys and surrounding lowlands.

182) Settlements are few within the assessment area; Slaidburn is the largest to the east of the assessment area. Small settlements in the assessment area include Newton-in-Bowland, Lowgill and Easington. These consist

[11] Lancashire County Council, Forest of Bowland AONB Landscape Character Assessment (2009) [Accessed August 2019] https://www.forestofbowland.com/landscape-character-assessment

of stone houses and cottages, and churches which provide landmarks in the landscape. Farmsteads are isolated throughout the area, often located along tracks following the contour of the hills. The network of PRoWs and Open Access Land provide opportunities for recreation. The local road network provides links between villages and isolated properties.

183) There is a strong sense of tranquillity across the assessment area with the most tranquil areas within the higher areas. The remoteness, vast skies, extensive panoramic views give a strong sense of wildness and isolation. Within the high fells there is little sign of human activity and night skies are almost completely dark. Dark sky events occur throughout the year and there are five designated Dark Sky Discovery Sites[12] within the AONB.

6.5.2 Information Sources

184) The following desk-based sources have been used to inform this scoping chapter:

- Adopted Local Plans:
  - Ribble Valley Borough Council's Core Strategy[13]
  - Lancaster City Council's:
    - Local Plan[14]
    - Core Strategy[15]
    - Development Management DPD[16]
- Natural England's National Character Areas (NCA)[17]
- Local Landscape Character Assessments:
  - A Landscape Strategy for Lancashire Landscape Character Assessment[18]
  - Forest of Bowland AONB Landscape Character Assessment[19]
- The Forest of Bowland AONB Management Plan[20]
- Multi Agency Geographic Information for the Countryside (MAGIC) website.[21]

185) Emerging local plans and policies that have not been formally adopted have not been considered as part of this chapter at the scoping stage. However, consideration will be given to any emerging planning documents as part of a future assessment.

6.5.3 Landscape Designations

186) The Forest of Bowland AONB is designated for its distinctive character and natural beauty, unspoiled and richly diverse landscapes, and its wildlife and heritage. The Forest of Bowland Joint Advisory Committee have produced the AONB Management Plans which are statutory plans. They provide a framework for

[12] Forest of Bowland Area of Outstanding Natural Beauty, Star Gazing https://forestofbowland.com/star-gazing

[13] Ribble Valley Borough Council Core Strategy 2008-2028 A Local Plan for Ribble Valley Adopted Version [Accessed August 2019] https://www.ribblevalley.gov.uk/download/downloads/id/10010/adopted_core_strategy.pdf

[14] Lancaster City Council (2008). Lancaster District Local Plan Strike-Through Edition. [Accessed August 2019] http://www.lancaster.gov.uk/planning/planning-policy/about-the-local-plan

[15] Lancaster City Council (2008). Core Strategy (2003-2021). [Accessed August 2019] http://www.lancaster.gov.uk/planning/planning-policy/about-the-local-plan

[16] Lancaster City Council (2014). A Local Plan for Lancaster District 2011-2031 Development Management DPD. [Accessed August 2019] http://www.lancaster.gov.uk/planning/planning-policy/about-the-local-plan

[17] Natural England. National Character Area Profiles (2014) [Accessed August 2019] https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles#ncas-in-north-west-england

[18] Lancashire County Council (2000) A Landscape Strategy for Lancashire. Preston, Lancashire County Council. [Accessed August 2019] https://www.lancashire.gov.uk/media/152746/characterassesment.pdf

[19] Lancashire County Council Forest of Bowland AONB Landscape Character Assessment (2009) [Accessed August 2019] https://www.forestofbowland.com/landscape-character-assessment

[20] Joint Advisory Committee Forest of Bowland AONB Management Plan (20191-20240 [Accessed August 2019] https://www.forestofbowland.com/Management-Plan

[21] Magic Maps [Accessed August 2019] https://magic.defra.gov.uk/MagicMap.aspx

ensuring delivery of the statutory purpose for AONBs, conserving and enhancing the natural beauty of the landscape.

187) The nearest National Park is the Yorkshire Dales National Park, which is located approximately 10.5 km to the north-east.

188) At a local level, there are a large number of Grade II listed structures within the assessment area, many of which are clustered within the village of Newton-in-Bowland and the town of Slaidburn. There are also many individual listed structures scattered within the assessment area. These heritage features provide a sense of time depth and reflect human influence within the predominantly rural landscape. (Refer to Chapter 10 Cultural Heritage for further information.)

189) Ancient woodland is generally rare throughout the AONB, although River Hindburn and River Hodder valleys within the assessment area contain many ancient woodland areas. Tree Preservation Order data have not to date been obtained but will be during the EIA.

190) There is a substantial area of Open Access Land and large areas of Registered Common Land, designated under the CRoW Act, that fall within the assessment area. There are several footpaths providing access within the surrounding area. There are no national trails within the assessment area. National Cycle Network route 90 (North Lancashire Loop)[22] follows a route east of the assessment area, approximately 1.2 km east of Construction Area A at its nearest point.

6.5.4 Landscape Character

191) At a national scale the assessment areas fall within National Character Area (NCA)[23] 34 Bowland Fells.

192) At the local scale, the Landscape Strategy for Lancashire[24] undertaken by Lancashire County Council, provides a more specific description of the landscape through the identification of LCAs and LCTs.

- LCA Moorland Hills 2b Central Bowland Fells
- LCA Moorland Fringe 4d Bowland Gritstone Fringes
- LCA Undulating Lowland Farmland 5j West Bowland Fringes
- LCA Wooded Rural Valleys 10b North Bowland Valleys
- LCA Moorland Hills 2b Central Bowland Fells
- LCA Moorland Fringe 4e Bowland Limestone Fringes
- LCA Undulating Moorland Farmland 5a Upper Hodder Valley
- LCA Rolling Upland Farmland 14a Slaidburn-Giggleswick.

193) Forest of Bowland AONB has also carried out a landscape character assessment[25] which provides greater detail for the AONB. LCAs that fall within the assessment areas include:

- LCA Moorland Fringe D5: Beatrix to Collyholme
- LCA Undulating Lowland Farmland with Parkland G3 Upper Hodder
- LCA Unenclosed Moorland Hills B9: Goodber Common
- LCA Moorland Fringe D2 Tatham
- LCA Moorland Fringe D13: Park House
- LCA Wooded Rural Valleys I3: Hindburndale.

[22] National Cycle Network and Open Road Open Skies[Accessed August 2019] https://www.openroadopenskies.co.uk/self-guided-cycling-holidays/route-90-north-lancashire-loop
[23]Repeated Refer to citation 30
[24]Repeated Refer to citation 31
[25]Repeated Refer to citation 32

194) The Landscape Institute's Technical Information Note (TIN) 01/2017[26] identifies tranquillity as a perceptual aspect of landscape and will be considered as part of the landscape character assessment, which will form the baseline against which the landscape effects of the Proposed Bowland Section will be assessed.

6.5.5 Key Visual Receptors

195) Key visual receptors within the assessment area include:

- Residents within Slaidburn, Low Bentham; the villages of Newton-in-Bowland, Lowgill and the various farmsteads and individual properties (Refer to Figure 6.1)
- Users of the PRoW network, Open Access Land and Registered Common Land, and the NCN route 90, particularly those in close proximity to the area of works, and the surrounding hills
- Users of roads throughout the area including the B6478 Slaidburn Road, the B6480 Hornby Road and minor roads.

6.6 Potential Effects

196) Effects on landscape character are likely to derive from modifications to the physical landscape and how this is experienced, whereas effects on visual amenity are likely to arise from modification to the composition of existing views and how people perceive and respond to this.

197) Potential likely significant temporary construction effects of the Proposed Bowland Section to be considered in the assessment are as follows:

- Effects on landscape components and character - associated with construction work including vegetation clearance or disturbance along working corridors; topsoil stripping and the temporary stockpiling of materials (including soils); areas of excavation and tunnelling
- Effects on visual amenity - associated with focused construction activities and vehicle movements along working corridors, vehicle movements along the local road network, visual awareness of compounds, particularly when lit, vegetation removal, excavation of areas for the new pipeline and tunnel, and with changes in the outlook from temporarily diverted rights of way.

198) Potential permanent changes to the landscape character as a result of construction will also be considered as a result of the removal of hedgerows and trees/woodland.

199) Potential operational effects of the Proposed Bowland Section to be considered in the assessment are as follows:

- Effects on landscape components and character - associated with the loss of vegetation and agricultural land, the introduction of new valve house buildings, and modifications to existing highways from the creation of temporary/permanent access arrangements
- Effects on visual amenity - associated with working corridor, compound areas for tunnel access facilities (e.g. shafts) and access tracks from a range of visual receptor types including public rights of way users.

200) The scoping exercise highlighted that there may also be changes to the landscape setting of heritage assets within the assessment area, and from potential changes landscape resulting from the new tunnel and associated aqueduct. Effects on heritage assets are described in Chapter 10.

[26] Landscape Institute, Tranquillity, an Overview. Technical Information Note 1/2017 (2017) [Accessed August 2017] Technical https://www.landscapeinstitute.org/technical-resource/tranquillity/

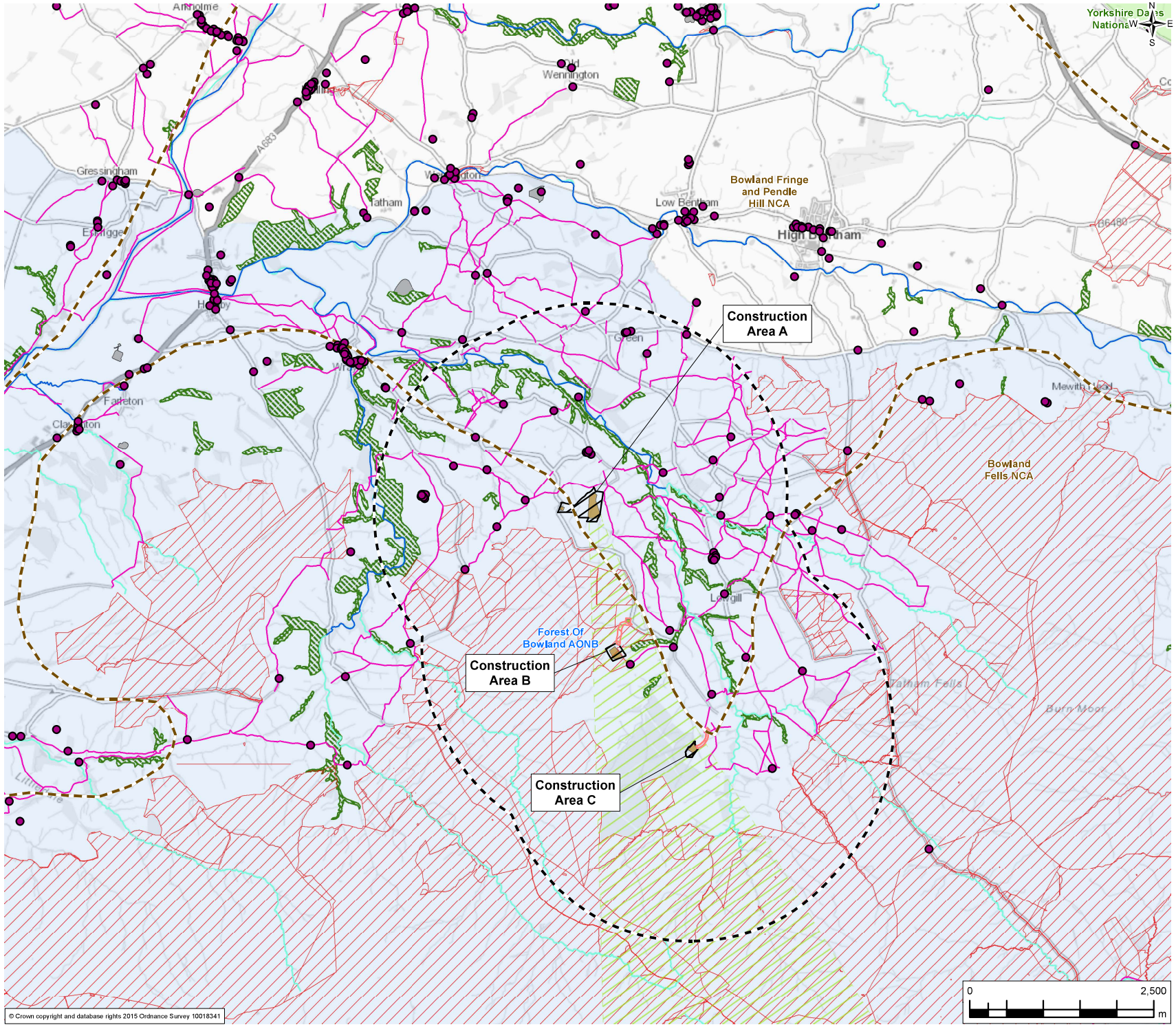
6.7 Summary Scope for the EIA

201) A summary of the scope is detailed in Table 6.10.

Table 6.10: Matters of significance for landscape and visual effects

Receptor group	Matter / potential effects	Location within assessment area	Comments
National Character Areas: 33. Bowland Fringe and Pendle Hill, and 34. Bowland Fells.	Landscape effects	Construction Area A falls within NCA33 and Construction Area B, C, D and E falls within NCA 34.	Scoped in The NCA comprises of strategies and guidance to help inform design and mitigation proposals.
A Landscape Strategy for Lancashire Landscape Character Assessment.	Landscape effects	Construction Areas A, B and C – LCA Moorland Hills 2b Central Bowland Fells, LCA Moorland Fringe 4d Bowland Gritstone Fringes, LCA Undulating Lowland Farmland 5j West Bowland Fringes, LCA Wooded Rural Valleys 10b North Bowland Valleys. Construction Areas D, E - LCA Moorland Hills 2b Central Bowland Fells, LCA Moorland Fringe 4e Bowland Limestone Fringes, LCA Undulating Moorland Farmland 5a Upper Hodder Valley, LCA Rolling Upland Farmland 14a Slaidburn-Giggleswick.	Scoped in Provides an assessment of landscape effects proportional to the scale and nature of the Proposed Bowland Section and the likely effects, which would largely be of a temporary nature. Assessment would allow development of landscape reinstatement mitigation.
Forest of Bowland Landscape Character Assessment.	Landscape effects	Construction Areas A, B, C – LCA Moorland Fringe D5: Beatrix to Collyholme, LCA Undulating Lowland Farmland with Parkland G3 Upper Hodder. Construction Areas D, E – LCA Unenclosed Moorland Hills B9: Goodber Common LCA Moorland Fringe D2 Tatham, LCA Moorland Fringe D13: Park House, LCA Wooded Rural Valleys I3: Hindburndale.	Scoped in Provides an assessment of landscape effects proportional to the scale and nature of the Proposed Bowland Section and the likely effects, which would largely be of a temporary nature. Assessment would allow development of landscape reinstatement mitigation.
Residents, users of PRoW and other outdoor recreation, users of places of worship, educational and community facilities, and places of work, transient receptors.	Visual amenity effects	Slaidburn, Low Bentham, Newton-in-Bowland, Lowgill and surrounding rural properties Local PRoW network and areas of Open Access Land, the NCN route 90. Schools, churches and places of work. Major arterial transport routes and local roads.	Scoped in Construction activities have the potential to be visually intrusive and cause temporary changes to visual amenity. Permanent features and removed features, such as vegetation, have the potential to permanently alter the landscape surrounding these settlements and properties.

FIGURE 6.1



Legend

- 2.5km Assessment Area
- Proposed Tunnel Route - Indicative Corridor
- Proposed Construction Access - Indicative
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Indicative Construction Compound / Laydown Area

Constraints

- Listed Building
- Public Right of Way
- Main River
- Canal network
- National Character Area (NCA)
- CRoW Act 2000 - Access Land
- Area of Outstanding Natural Beauty
- Ancient Woodland
- Scheduled Monument
- National Park

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	OCT 19	Initial Issue	LT	JM	TA	SH

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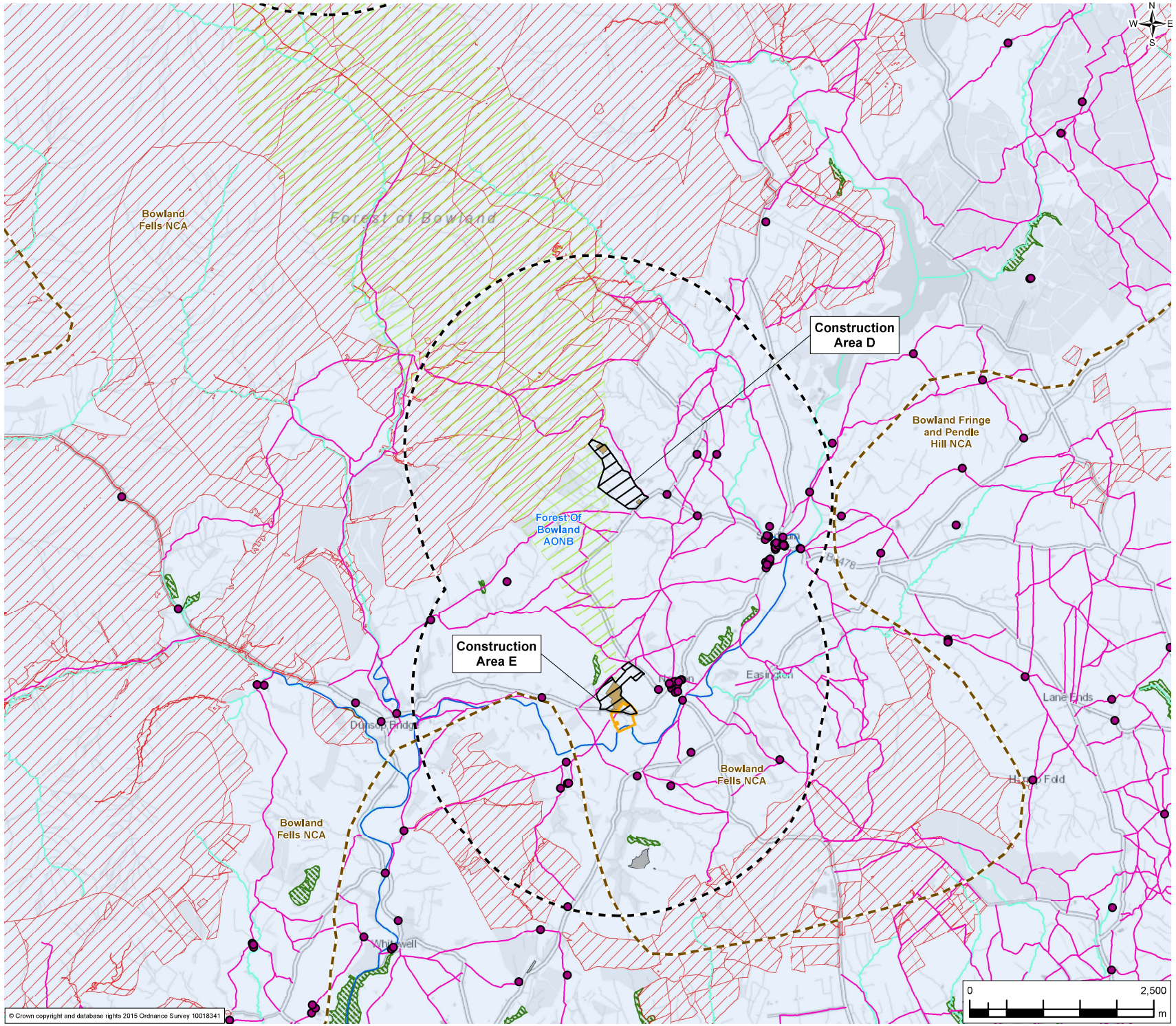
Drawing Status: FINAL

Scale @ A3	1:50,000	DO NOT SCALE
Jacobs No.	B27070CG	
Client No.		

Drawing No. B27070CG_ESR_06_01

FIGURE 6.1



Legend

- 2.5km Assessment Area
- Proposed Tunnel Route - Indicative Corridor
- Proposed Construction Compound / Laydown Area - Indicative Development Envelope
- Proposed Discharge Pipe - Indicative Corridor
- Proposed Indicative Construction Compound / Laydown Area

Constraints

- Listed Building
- Public Right of Way
- Main River
- Canal network
- National Character Area (NCA)
- CRoW Act 2000 - Access Land
- Area of Outstanding Natural Beauty
- Ancient Woodland
- Scheduled Monument

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	OCT 19	Initial Issue	LT	JM	TA	SH

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Project: HAWESWATER AQUEDUCT RESILIENCE PROGRAMME

Drawing Title: LANDSCAPE CONSTRAINTS PLAN PROPOSED BOWLAND SECTION SHEET 2 OF 2

Drawing Status: FINAL

Scale @ A3	1:50,000	DO NOT SCALE
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Client No.		
Drawing No.	B27070CG_ESR_06_01	

7. Water Environment

7.1 Overview

202) This chapter presents the outcome of the scoping exercise in relation to potential effects upon the water environment. The water environment is characterised by surface water hydrology (i.e. water quantity and flow), fluvial geomorphology, surface water quality, groundwater (including quantity and quality) and water resources. The assessment also considers aspects relating to the use of water (as a resource) during construction and operation.

203) This chapter also identifies Water Framework Directive (WFD) water bodies within the assessment area. Assessment of the potential effects upon these will be considered in the Preliminary WFD Assessment, which will be carried out in conjunction with the EIA. Flood risk issues and aquatic ecology are addressed separately in Chapters 8 and 9 respectively. The groundwater topic has close alignment to other subject areas, including geology and soils and contaminated land presented in Chapter 11 and ecology contained within Chapter 9.

7.2 Key Legislation and Policy

204) The following section provides a summary of the key legislation and policy of relevance to this chapter.

7.2.1 Legislation

- European Union Water Framework Directive (WFD) (Directive 2000/60/EC)
- Water Environment (WFD) (England and Wales) Regulations 2017
- Water Resources Act 1991
- Environment Act 1995
- Groundwater (England and Wales) Regulations 2009
- Control of Pollution (Applications, Appeals and Registers) Regulations 1996 (SI1996/2971)
- Environmental Protection Act 1990
- Water Supply (Water Quality) Regulations 2016
- Water Act 2003
- Environmental Permitting (England & Wales) Regulations 2016.

7.2.2 Local Policy

- Ribble Valley Borough Council Core Strategy 2008-2028[27]
- Local Plan for Lancaster District 2011-2031, Local Development Scheme.[28]

7.2.3 Additional Policy

- The Environment Agency's approach to groundwater protection (Version 1.2, February 2018).

7.3 Proposed Methodology and Criteria

7.3.1 Scoping Methodology

205) A description of the proposed scoping assessment methodology is given below, with the assessment criteria presented in Appendix 7.1. There are no published technical guidance criteria for assessing and evaluating effects on the water environment for projects of this nature. The assessment will therefore be based on general EIA methodology and criteria developed through professional experience and as used on previous EIAs of a similar nature. For assessing impacts upon water quality, water quantity (excluding flood risk

[27] Ribble Valley Borough Council Core Strategy 2008 – 2028 A Local Plan for Ribble Valley Adoption Version
[28] Local Plan for Lancaster District 2011-2031, Local Development Scheme http://www.lancaster.gov.uk/planning/planning-policy/about-the-local-plan

covered in Chapter 8 and water resources where applicable the criteria from the Design Manual for Roads and Bridges (DMRB) HD45/09 Road Drainage and the Water Environment (hereafter referred to as HD45/09) has been used. The methodology has been based upon discussion with the regulatory bodies during the scoping stage as described in Chapter 5.

7.3.2 Assessment Criteria

206) Features were initially identified by developing an understanding of the catchments from baseline data and an understanding of the Proposed Bowland Section. Features were then valued based on the criteria outlined in Appendix 7.1 accounting for their rarity, importance, attributes/processes and sensitivity. The greater the importance or sensitivity the higher the value of feature.

207) Likely significant effects were then identified based upon the nature and extent of the Proposed Bowland Section. The magnitude of impact is established using either a quantitative or qualitative assessment based upon professional judgement, the criteria for which are outlined in Appendix 7.1. The magnitude of an impact is not dependent upon the value of a feature.

208) Considering the value of the feature and the potential magnitude of impact, the significance of the effect is based on the combination of the value of the feature and the magnitude of impact using the matrix in Table 7.1.

Table 7.1: Significance of effect

		Magnitude of impact			
		Negligible	**Minor**	**Moderate**	**Major**
Importance / value of feature	**Low**	Neutral	Neutral	Slight	Slight/Moderate
	Medium	Neutral	Slight	Moderate	Large
	High	Neutral	Slight/Moderate	Moderate/Large	Large/Very Large
	Very High	Neutral	Moderate/Large	Large/Very Large	Very Large

209) For the purposes of the water environment appraisal those residual effects described as having a Moderate, Large or Very Large effect are significant in terms of the EIA Regulations. The use of the terms 'neutral' or 'slight' are used to acknowledge that there will be some change from the baseline conditions but that these effects are not significant.

7.3.3 Environmental Statement Methodology

210) For those water resources scoped in for further assessment the following section outlines the proposed methodology for undertaking the EIA.

Surface Water Hydrology, Fluvial Geomorphology and Water Quality

211) The methodology described below sets out a list of criteria for evaluating the environmental effects on fluvial geomorphology, as follows:

- The importance (value) of the resource under consideration on a scale of sensitivity (i.e. high, medium, low or negligible)
- The magnitude of the effect in relation to the resource that has been evaluated, quantified using the scale large, medium, small, or negligible
- The significance of the effect using the scale major, moderate, minor and negligible. For significant effects (moderate and major), additional mitigation may be required to reduce the significance of the effect.

212) An effect may be significant if, in the professional opinion of the expert undertaking the assessment, it would meet at least one of the following criteria:

- It could lead to an exceedance of defined guidelines or widely-recognised levels of acceptable change (e.g. exceedance of an EQS of a water quality parameter)
- 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 threatens or enhances the viability or integrity of an asset or resource group of interest
- It is likely to be material to the ultimate decision about whether the planning applications should be approved.

213) To aid the determination of significance, the assessment of effects will take the following stepped approach:

- Determine the relevant assets and resources
- Derive their value (importance) based on the criteria set out in tables below
- Identify and consider the effects from each activity
- Determine the magnitude of change likely as a result of the effects, as set out in the tables below
- Present the environmentally and ecologically significant effects and then consider how additional mitigation may reduce negative effects.

214) Consultation will be undertaken with the regulators and local authorities to support the assessment and development of mitigation.

215) A Water Framework Directive Assessment will be undertaken to support the ES.

Groundwater

216) The assessment of potential effects described above will be based on an interpretation of data from the scheduled ground investigation. This will characterise the groundwater environment intercepted by the Proposed Bowland Section, and confirm groundwater levels (i.e. groundwater pressures above the tunnelled sections, areas of shallow groundwater conditions, geological settings and groundwater quality). Based on this information, a generic dewatering assessment will be carried out to determine an order of magnitude for temporary groundwater volumes expected to be extracted during shaft and tunnel construction through the geological and hydrogeological conditions present in the area. These dewatering assessments will also consider the wider attributes and potential impacts on groundwater abstractions (licensed and unlicensed), GWDTEs and baseflow contributions to surface waters. The ground investigation will also support the assessment of potential groundwater flow disturbances as a result of the proposed decommissioning strategy.

217) GWDTEs will be identified following UK Technical Advisory Group (UKTAG) guidance (UKTAG, 2009). Where GWDTEs are identified, Conceptual Site Models will be developed bringing together available geological and hydrogeological baseline data, together with a view to determine the degree of groundwater dependency and assess any potential impacts. Information used for this assessment will include Groundwater Flooding Susceptibility maps.

218) Potential impacts on groundwater flooding aspects are captured in Chapter 8 Flood Risk.

219) Consultations with Lancaster City Council, Ribble Valley Borough Council and land owners will take place to identify Private Water Supplies in addition to licenced abstractions which will be requested from the Environment Agency.

220) The ground investigations will also support the review of groundwater quality to determine whether additional measures should be implemented.

7.4 Existing Conditions

7.4.1 Assessment Area

221) The Groundwater Assessment Area is defined as the indicative development envelope with a 1 km buffer in all directions around the proposed development area, the proposed tunnel option. This buffer allows for the identification of groundwater features which could be impacted beyond the indicative potential construction areas. Impacts could arise from activities such as a change in groundwater levels caused by dewatering, or disturbance in flow and / or quality of groundwater, which may support features such as groundwater dependent terrestrial ecosystems (GWDTEs) or provide baseflow to local watercourses. The size of the groundwater assessment area is based on professional judgement regarding the maximum potential extent of effects likely on groundwater features in the type of aquifers present, and uncertainties associated with the degree of heterogeneity of these aquifers.

222) For the other aspects of the water environment (i.e. water quality, quantity, fluvial geomorphology and water resources) the assessment area is defined as the indicative development of the Proposed Bowland Section with a 500 m buffer in all directions as shown in Figures 7.1 and 7.2. This buffer allows for the consideration of impacts of the Proposed Bowland Section on surface water features outside the design envelope, such as surface water flow paths or sediment transportation systems. Where significant downstream impacts are anticipated the buffer is increased to 2 km. The size of the assessment area is based on professional judgement and has been used to identify the relevant features for the assessment; should aspects of the Proposed Bowland Section change the assessment area will be reconsidered.

7.4.2 Information Sources

223) The following desk-based sources have been used to inform this scoping chapter:

- Multi-Agency Geographical Information for the Countryside (MAGIC) website http://www.magic.gov.uk/ (accessed July 2019)
- The Environment Agency's Catchment Data Explorer website http://environment.data.gov.uk/catchment-planning/ (accessed July 2019)
- British Geological Survey (BGS) data accessed via http://www.bgs.ac.uk/data/mapViewers/home.html (accessed July 2019)
- Historical maps (http://maps.nls.uk/geo/explore/side-by-side/#, accessed July 2019)
- Aerial imagery (http://www.magic.gov.uk/, access July 2019).

224) A groundwater desk study has been undertaken that comprises the analysis of maps, geological information and publicly available data, originating from the EA and external organisations such as the BGS. No site walkovers or ground investigations have presently been undertaken, however a large-scale ground investigation is currently underway. The following lists the key information and data used to inform the desk study.

- Ordnance Survey (OS) 1: 10,000, 1: 25,000 and 1: 50,000 scale maps. The 1:25,000 OS map has been used to identify where the most significant spring features are likely to occur (that is, springs marked on this scale map). These significant spring discharges are shown in Figure 7.3
- Environment Agency Aquifer Designation Maps (available from DEFRA's MAGIC Map application), which designate aquifers as described in the glossary
- Environment Agency groundwater source protection zones (SPZs). Data on SPZs have been used to assess potential for impacts on public water supplies and groundwater abstractions used for food or drink production. For each source, three zones are defined as described in the glossary, Zone 1 is the most sensitive
- BGS 1: 50,000 scale geological maps (obtained from the BGS Web Map Service)
- BGS geological/lithological information from:
  - Technical Report: Geological notes for the Silurian strata and their Quaternary cover on 1:10k sheets SD48NW, SD58NE (Old Hutton) and SD58NW IR/06/129

- Technical Report: Geology of the area between Lindale and Witherslack IR/06/079

- BGS baseline groundwater quality information for:
  - The Pennine Coal Measures Group (Technical Report: OR/07/039)
  - The Millstone Grit of Northern England (Technical Report: CR/05/015N)
- Hydrogeological information from:
  - BGS Technical Report: The physical properties of minor aquifers in England and Wales WD/00/04
  - BGS Technical Report: The Carboniferous Limestone of Northern England CR/05/076N
  - Hydrogeological Impact Assessment Report
  - BGS Carboniferous Bowland Shale gas study
- Cross sections made available by United Utilities used to determine the depth of the existing aqueduct.

7.4.3 Baseline information

Surface Water Hydrology

225) Within the assessment area there are several water features, which include:

- Main Rivers (i.e. those defined in Section 113 of the Water Resources Act (as amended) and maintained by the Environment Agency in terms of flood risk)
- Ordinary Watercourses (i.e. all watercourses that are not designated as Main Rivers and maintained by owners in accordance with the Land Drainage Act 1991 (as amended 1994))
- Water features such as reservoirs and ponds (man-made and natural).

226) Some of the larger watercourses are also classified under the WFD and these have been identified within this assessment.

227) Watercourses are presented in Figure 7.1. The River Hindburn and River Hodder are classed as Main Rivers within the assessment area and these have been valued as High. At this stage, over 250 Ordinary Watercourses have been identified within the assessment area from OS mapping. They are largely unnamed with the exception of:

- Cod Gill
- Crow Gill
- Summer House Gill
- Stirk Close Gill
- Redscar Gill
- Dickers Gill
- Dale Beck
- Horsehole Gill
- Lordset Syke
- Hawkshead Gill
- Antley Gill
- Bankhead Gutter
- Ranteryhall Syke
- Sandy Gutter
- Brown Syke
- Black Brook

- Dunsop Brook
- Davison's Syke
- Eller Beck.

228) Of the watercourses within the assessment area, approximately 160 have been identified as being located within the development envelope or immediately adjacent to it, of which 110 are also located within the Bowland Fells SPA. These watercourses may be directly impacted by the Proposed Bowland Section. While these watercourses fall within the indicative construction areas, including the tunnel, they have been included at the scoping stage pending further decisions on the likelihood of there being any relationship between tunnel construction and surface water features. Except for the Main Rivers identified above, all other watercourses are likely to be valued as Low or Medium.

229) There are also eight ponds located within the assessment area these are valued as low. Further identification of ponds will be undertaken at the EIA stage.

Fluvial Geomorphology

230) The Ordinary Watercourses are generally either land drains or first order streams and exhibit largely straight planforms, and there is little evidence of significant geomorphological features or processes. All Ordinary Watercourses are likely to be of Medium or Low geomorphological value.

231) Ponds within the assessment area do not appear to have any significant geomorphological features and are likely to be of Low geomorphological value.

232) Baseline descriptions of the Main Rivers and WFD Watercourses are presented in Table 7.2.

Table 7.2: Fluvial geomorphology baselines for Main River and WFD watercourses

Name	Interaction with Proposed Bowland Section	Baseline	Value
River Hindburn (Main River and WFD Watercourse)	Crossed by indicative tunnel corridor.	The River Hindburn is one of the major tributaries of the River Wenning. The River Hindburn has its source within the assessment area at the confluence of the Dale Beck and Lordset Syke. The channel has a sinuous planform throughout its catchment. Continuous, dense coverage of mature riparian vegetation from the headwaters of the River Hindburn to the settlement of Wray (approximately 2.5 km north east of the assessment area) obscure much of the channel, making it difficult to assess the geomorphological value of the channel based on aerial imagery. Where the channel is visible on aerial imagery, side bars and riffles are present. These features, combined with a largely uninterrupted riparian zone, suggest the watercourse is likely to be largely uninfluenced by human activities and is likely to function in a near-natural state. The geomorphological value is therefore likely to be very high; this would need to be validated with a site visit.	Very High

Name	Interaction with Proposed Bowland Section	Baseline	Value
River Hodder (Main River and WFD Watercourse)	Discharge from Hodder North Well	The River Hodder is a tributary of the River Ribble. The rivers headwaters are located approximately 1 km east of the assessment area. The river passes into the assessment area approximately 15 km downstream of its source. Approximately 7 km upstream of the assessment area, the River Hodder passes into Stocks Reservoir, which regulates the flows downstream. Upon issuing from the reservoir, the River Hodder has a largely straight planform, with a largely continuous vegetated riparian zone. Some riffles and elongated pools are visible on aerial imagery suggesting low sediment input from the upstream catchment. Within the assessment area, the channel planform is slightly more sinuous than the upstream reach, with riffles, side bars and bank erosion evident on aerial imagery, suggesting increased geomorphological activity and adjustment to upstream modifications. A lack of mature vegetation along much of the reach likely contributes to increased incidence of erosion, with the vegetated riparian zone largely dominated by grasses. The wider floodplain is used for either pastoral or arable agriculture. The River Hodder is crossed by the existing Haweswater Aqueduct within the assessment area, at which point both banks are heavily engineered to support a pipe bridge.	Medium
Roeburn (WFD watercourse)	Crossed by indicative tunnel corridor.	A tributary of the River Hindburn, the headwaters of the Roeburn are located within the assessment area on Guide Hill. The channel has a sinuous planform with a number of tight meander bends. Some geomorphological features such as bars and pools were observed on aerial imagery, as was evidence of a historical hillslope failure at the downstream end of the reach. The vegetated riparian zone largely consists of wild grasses/heathland.	High

Name	Interaction with Proposed Bowland Section	Baseline	Value
Whitendale River (WFD watercourse)	Crossed by indicative tunnel corridor.	A tributary of the River Dunsop, the headwaters of the Whitendale River are located within the assessment area. The channel is largely confined to what appears to be a narrow, steep sided valley, although has a sinuous planform where the valley floor broadens. Historical maps show that the channel position has adjusted significantly where the valley floor widens, suggesting that the Whitendale River is a high energy watercourse. What appear to be cascades and step-pool sequences were observed on aerial imagery, with bars present on the inside of the meander bends in more sinuous reaches. A small dam has been constructed across the channel. Historical maps call this Whitendale Intake, and is an active United Utilities abstraction location. The presence of this infrastructure and abstraction activities are likely to influence the flow regime downstream. The vegetated riparian zone largely consists of wild grasses/heathland.	High
Croasdale Beck (WFD watercourse)	Crossed by indicative tunnel corridor.	A tributary of the River Hodder, the headwaters of the Croasdale Beck are located within the assessment area. The channel has a sinuous planform with multiple tortuous meanders. Bank erosion/hillslope failure was observed on aerial imagery, with mid-channel bars, riffles and side bars present throughout the reach. The vegetated riparian zone consists of wild grasses/heathland and shrub-like plants. The channel is crossed by a single ford but otherwise appears to be unmodified through the assessment area.	Very High

Surface Water Quality

233) There are seven WFD water bodies within the assessment area; the baseline WFD data is outlined below in Table 7.3. The WFD data provides an indication of water quality as the overall classification comprises of physico-chemical elements which contribute to the ecological status and chemical water quality elements. Further assessment of these WFD water bodies will be carried out as part of the Preliminary WFD Assessment as the EIA develops.

Table 7.3: WFD Surface Water Bodies within assessment area

	Brennand	Croasdale Beck	Whitendale river	Hodder - headwaters to Stocks Reservoir
Water body ID	GB112071065400	GB112071065410	GB112071065420	GB112071065430
Catchment size	10.9 km^2	20.4 km^2	13.6 km^2	22.9 km^2
Hydromorphological designation	Not designated artificial or heavily modified.	Not designated artificial or heavily modified.	Not designated artificial or heavily modified.	Heavily modified.
Overall status	Good	Good	Good	Good
Ecological status	Good	Good	Good	Good
Chemical status	Good	Good	Good	Good
	Roeburn	**Hindburn**	**Hodder – confluence with Easington Beck to confluence with Ribble**	
Water body ID	GB112072066020	GB112072066050	GB112071065560	
Catchment size	34.7 km^2	49.1 km^2	69.3 km^2	
Hydromorphological designation	Not designated artificial or heavily modified.	Heavily modified.	Not designated artificial or heavily modified.	
Overall status	Good	Moderate	Good	
Ecological status	Good	Moderate	Good	
Chemical status	Good	Good	Good	

234) The WFD waterbodies are all classified as Good for chemical water quality and are therefore valued as High. All other watercourses not classified under WFD are considered to be of Low to Medium value.

235) The assessment area does not lie within a Nitrate Vulnerable Zone (NVZ) or a Drinking Water Safeguard Zone.

Groundwater

236) The aqueduct is centred about 175 m above Ordnance Datum (AOD) along the Proposed Bowland Section which equates to a maximum of 365 m bgl.

Groundwater Resource

237) Table 7.4 and Table 7.5 provide descriptions of the lithology of each geological unit present, the aquifer designations for these deposits, and descriptions of the likely hydrogeological characteristics of the strata. Each bedrock formation may comprise several individual members and beds, but for this stage of the assessment, the bedrock stratigraphic units are discussed at the formation level only.

238) Table 7.4 and Table 7.5 also describe the location of the proposed indicative development envelope (including the proposed tunnel route indicative corridor), in relation to the bedrock formations and superficial deposits present, i.e. whether they are directly crossed by the proposed route option, or whether they lie within the wider groundwater assessment area. The aquifer designation maps are shown in Figure 7.1 and Figure 7.2 for the bedrock and superficial deposits respectively.

Table 7.4: Bedrock Aquifer Information

Hydrogeological Unit	Description	Aquifer Designation	Hydrogeology	Relation to Route Proposal
Millstone Grit Group	Fine to very coarse-grained sandstones, interbedded with siltstones and mudstones, with subordinate shaley mudstone, claystone, coals and seat earths.	Secondary A	Forms an important local aquifer that provides water for both potable and industrial use. Multi-layered aquifer, in which thick, massive sandstone horizons form discrete aquifers, separated by mudstones and shales (perched water tables). Mainly fracture flow, as the sandstones are well cemented, with low porosity. Flow in the aquifer tends to decrease rapidly with depth. Artesian conditions occur in places, and there are abundant springs located at the base of the sandstone layers, and at junctions between the shale and sandstone horizons, some of which are used for public supply.	Crossed by the proposed development envelope
Chatburn Limestone Formation	Well-bedded packstone limestones, with chert lenses and subordinate thin beds of shaley mudstone and siltstone.	Secondary A	Greatest yields are supported by fracture flow along bedding planes, solution enlarged fractures, and joints. The matrix of the limestones has a very low porosity and permeability, making a negligible contributes to total groundwater flow. There is potential for karstification in places, and thus larger conduits. The unit has been proven to operate in discrete blocks[29] due to extensive faulting. This forms an important local aquifer (multi-layered), providing water for potable and industrial use. Where boreholes have been tested in this formation, yields range from 240m^3/day to 1,920m^3/day.[30]	Crossed by the proposed development envelope
Hodder Mudstone Formation	Mudstone, with subordinate detrital limestone, siltstone and sandstone. Mudmound reef limestones, limestone boulder conglomerates and breccias near the base.	Secondary A	Argillaceous strata dominate, acting as aquitards or aquicludes, isolating the occasional sandstone horizons which act as separate aquifers. This is where most of the groundwater storage / movement occurs as both intergranular and fracture flow. Faulting has split the once continuous sandstone horizons into discrete blocks, to which no direct recharge can occur.	Crossed by the proposed development envelope

[29] http://planningregister.lancashire.gov.uk/DisplayImage.aspx?doc=cmVjb3JkX251bWJlcj02MTY2JmZpbGVuYW1lPVxcYWQubGFuY3NjYy5uZXRcQ29ycG9yYXRlXERhdGF3cmlnaHRcUGxhbm5pbmdcMDMtMTItMDk0MFxlYW5zb24gTGFuZWhlYWQgU2VwdCAyMDEyIEhJQSBSZXAgcjYucGRmJmItYWdlX251bWJlcj0xMiZpbWFnZV90eXBlPXBsYW5uaW5nJmxhc3RfbW9kaWZpZWRfZnJvbV9kaXNrPTA4LzEwLzIwMTIgMTI6NTA6NTA=

[30] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290922/scho0207blyt-e-e.pdf

Hydrogeological Unit	Description	Aquifer Designation	Hydrogeology	Relation to Route Proposal
Clitheroe Limestone Formation	Packstones, wackestones and subordinate grainstones and mudstones with reef limestones.	Secondary A	Similar hydrogeological characteristics to the Chatburn Limestone Formation.	Crossed by the proposed development envelope.
Pendleside Limestone Formation	Fine to coarse-grained, bioclastic, commonly graded, cherty packstones, interbedded with wackestone, sporadic limestone conglomerate, and mudstone in the lower part.	Secondary A	Similar hydrogeological characteristics to the Chatburn Limestone Formation.	Crossed by the proposed development envelope.
Pendleton Formation Silsden Formation	Fine to very coarse-grained pebbly sandstone, interbedded with siltstone and mudstone and subordinate shales, thin coals and seatearths.	Secondary A	Lies stratigraphically within the Millstone Grit Group. Multi-layered aquifer system in which the thick sandstone horizons act as separate aquifers, with the intervening mudstones and shales acting as aquicludes or aquitards.	Crossed by the proposed development envelope.
Bowland Shale Formation	Mainly fissile and blocky mudstone, with subordinate sequences of interbedded limestone and sandstone.	Secondary Undifferentiated.	Consists mainly of mudstone with low hydraulic conductivity which inhibits vertical hydraulic continuity. Predominantly an aquitard in this area.	Crossed by the proposed development envelope.

Table 7.5: Superficial Aquifer Information

Hydrogeological Unit	Description	Aquifer Designation	Hydrogeology	Relation to Route Proposal
Till (diamicton)	Variable lithology, typically sandy, silty clay, with pebbles, but can contain gravel-rich, or laminated sand layers.	Secondary Undifferentiated.	Typically mixed flow with varying permeability. Usually acts as an aquitard or aquiclude but can locally comprise productive sand and gravel horizons, which may yield limited amounts of groundwater, although groundwater abstraction is unlikely.	Crossed by the proposed development envelope.
Head	Comprises sand and gravel, locally with lenses of silt, clay or peat and organic material.	Secondary Undifferentiated.	Typically mixed flow with varying permeability. The extent and thickness of these deposits limits the available groundwater yield contained within the more productive sand and gravel horizons and groundwater abstraction is therefore unlikely. The unit may contain multiple perched water tables above discontinuous clay/peat lenses.	Crossed by the proposed development envelope.
Alluvium	Typically soft to firm, consolidated, compressible silty clay, that can contain layers of silt, sand, peat, basal gravel, and a desiccated surface zone.	Secondary A	Typically intergranular flow with varying permeability. Where sand/gravel layers are thick and continuous, groundwater yields will be high, making local groundwater abstraction possible, although the dominance of clay in this unit may limit it's potential as an aquifer.	Crossed by the proposed development envelope.
Alluvial fan deposits	Alluvium, with a low-angle cone form.	Secondary A	Typically intergranular flow with high permeability. Similar hydrogeological characteristics to alluvium.	Crossed by the proposed development envelope.
Peat	An accumulation of wet, dark brown, partially decomposed vegetation, or an organic rich clay.	Unproductive strata.	Typically mixed flow with low permeability. Usually comprises 90% water and acts as an aquitard, limiting groundwater discharge. Permeability varies with the degree of decomposition and soil compression and often reduces with depth.	Crossed by the proposed development envelope.

Hydrogeological Unit	Description	Aquifer Designation	Hydrogeology	Relation to Route Proposal
River terrace deposits	Sand and gravel, locally with lenses of silt, clay or peat.	Secondary A.	Typically intergranular flow with high permeability. Sand and gravel deposits will typically comprise high porosity and high permeability and can locally yield significant groundwater volumes, if clay lenses are infrequent and sand/gravel deposits are of sufficient thickness. Local groundwater abstraction possible.	Crossed by the proposed development envelope.
Talus	Clast-supported accumulation of angular rock fragments.	Secondary A.	Typically intergranular flow with high permeability. The extent and thickness of these deposits limits the available groundwater yield, and groundwater abstraction is therefore unlikely.	Crossed by the proposed development envelope.
Glaciofluvial sheet deposits	Sand and gravel, locally with lenses of silt, clay or organic material.	Secondary A	Typically intergranular flow with high permeability. Sand and gravel constituents may locally yield significant groundwater volumes where deposits are of sufficient thickness. The aquifer may contain perched water tables above discontinuous clay lenses. Local groundwater abstraction possible	Lies within the wider groundwater assessment area.

239) The western part of the indicative development envelope of the proposed development and wider Groundwater Assessment Area encroach upon both an SPZ2 and SPZ3). Although there is currently no information available relating to this licensed groundwater abstraction, it is likely that the SPZs relate to a more productive sandstone horizon within the Pendleton Formation, that is, the Pendle Grit member, which acts as a separate sandstone aquifer, isolated between mudstone aquitards or aquicludes. In this general area, borehole yields between 432 m^3/d to 864 m^3/d can be expected within the Millstone Grit, but with significantly higher yields of up to 4,320 m^3/d in the Pendle Grit Member.[31]

240) The sandstone, siltstone, and limestone formations that comprise the Secondary A bedrock aquifers could also provide groundwater sources for industrial users, or for agriculture and leisure activities (such as golf courses). The presence and / or locations of these potential abstractions are also currently unknown.

241) There is also no information available at this stage regarding Private Water Supplies within the Groundwater Assessment Area, and this information will be gathered at the following stage through consultation with Local Authorities and land owners.

242) No groundwater level data is currently available, but it is anticipated that groundwater levels are shallowest in watercourse valleys (where present). Multiple springs are shown on Ordnance Survey mapping within the Groundwater Assessment Area (see Figure 7.3). Given that the development is below ground level, throughout its length, it is assumed that groundwater would be encountered at varying depths. The scheduled large-scale GI will provide a baseline characterisation of the groundwater environment.

243) In terms of WFD groundwater bodies, the northern half of the groundwater assessment area for the Proposed Bowland Section lies within the Lune and Wyre Carboniferous Aquifers groundwater body

[31] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290918/scho0207blyp-e-e.pdf

(GB41202G102700). The southern extent of the groundwater assessment area crosses the Ribble Carboniferous Aquifers groundwater body (GB41202G103000). Further details of the WFD groundwater bodies are provided in Table 7.6.

Table 7.6: WFD Groundwater Bodies within assessment area

	Ribble Carboniferous Aquifers	Lune and Wyre Carboniferous Aquifers
Water body ID	GB41202G103000	GB41202G102700
Catchment size	828.6 km^2	1,396.9 km^2
Overall status	Good	Good
Quantitative status	Good	Good
Chemical status	Good	Good

244) Further assessment of these WFD water bodies will be carried out as part of the Preliminary WFD Assessment as the EIA develops.

Groundwater Quality

245) Where carbonate cements are present in the Millstone Grit aquifer, the baseline groundwater chemistry is largely controlled by carbonate dissolution reactions.[32] However, some groundwaters have relatively low pH and alkalinity, and probably therefore originate from areas dominated by sandstone, where silicate dissolution controls the groundwater signatures. Variations in the spatial distribution of impermeable superficial deposits and variations in aquifer transmissivity, due to the occurrence of mudstone units in the bedrock, have led to a complex distribution of redox conditions in the groundwater. Where reducing environments are present, the baseline chemistry is influenced by high levels of naturally occurring iron and manganese. Overall, the aquifers are characterised by the widespread occurrence of calcium sulphate type waters, due to the process of pyrite oxidation and calcite dissolution.

246) The baseline chemistry of the groundwaters in the Carboniferous Limestone aquifers is predominantly controlled by carbonate dissolution reactions.[33] Dolomite and silicate dissolution can also affect the groundwater signatures but are generally only important in areas where dolomitisation and / or chertification of the bedrock has occurred. Similar to the Millstone Grit Group, there is a complex distribution of redox conditions in the groundwater, and high levels of naturally occurring iron and manganese are present where reducing environments are encountered. In some locations, bedrock mineralisation has also led to locally high levels of fluorine and barium.

247) Importantly, the high groundwater flow rates associated with the presence of large interconnected conduit systems in areas of karst, which if/where present, make the aquifer highly vulnerable to pollution, especially where windows in the overlying superficial deposits occur. Overall, the aquifers are considered to comprise of sodium-bicarbonate type waters, due to the process of ion exchange and mixing of deeper saline groundwater.

248) There is limited information available relating to the baseline groundwater chemistry of the Hodder Mudstone Formation or the Bowland Shale Formation. Previous studies have focussed on shale gas production of the aquifers, and quote high Total Organic Carbon (TOC) contents (up to 10 %)[34] in both formations.

249) The scheduled large scale GI will provide baseline groundwater quality information along the Proposed Bowland Section.

Groundwater Dependent Terrestrial Ecosystems

250) An initial scoping list of nature conservation sites to be assessed is provided in Chapter 9 Ecology. It is possible that these sites or some of them could support potential GWDTEs in the groundwater assessment

[32] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290918/scho0207blyp-e-e.pdf
[33] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290922/scho0207blyt-e-e.pdf
[34] https://www.northyorks.gov.uk/sites/default/files/fileroot/About%20the%20council/Partnerships/Carboniferous_Bowland_shale_gas_study_-_geology_and_resource_estimation_%282013%29.pdf

area for the Proposed Bowland Section The criteria to assess potential impacts on GWDTEs are provided in Appendix 7.1.

Water Resources

251) At this stage a search of the Environment Agency's online Public Register for Environmental permits, which includes discharges to surface and groundwaters has not been undertaken. There are likely to be existing environmental permits within the assessment area which will be obtained during the assessment stage. The existence of environmental permits for discharges to waters does not affect the identification or valuation of water environment features but is useful to identify constraints to inform the design.

252) Data relating to abstraction licences have not been obtained at this stage and will be considered at the ES stage. Private water supplies will also be considered and identified at the ES stage.

253) Pollution incident data have not been obtained and they are not considered to be relevant for informing the assessment and will not be considered further.

7.4.4 Key Features

254) To summarise the key features include:

- The River Hindburn and River Hodder are designated as Main Rivers and WFD watercourses
- Roeburn, Whitendale River and Croasdale Beck which are classified as WFD watercourses
- The Lune and Wyre Carboniferous Aquifers and Ribble Carboniferous Aquifers groundwater bodies within the assessment area as classified under the WFD
- The Secondary A aquifers of the Millstone Grit Group, Chatburn Limestone Formation, Hodder Mudstone Formation, Clitheroe Limestone Formation, Pendleside Limestone Formation, Pendleton Formation and Silsden Formation
- The Secondary A aquifers of the Superficial deposits of Alluvium, Alluvial fan deposits, River terrace deposits, Talus and Glaciofluvial sheet deposits.

255) Following the proposed survey for GWDTE, those identified could also become key features for assessment.

7.5 Potential Effects

256) A range of key activities are potentially associated with effects on the water environment. Likely potential effects are set out below for construction, operation and decommissioning activities, including any long-term effects from these activities.

7.5.1 Construction Effects

257) Potential likely significant short-term construction effects of the Proposed Bowland Section to be considered in the assessment are as follows:

Surface Water Hydrology

- In channel working, as a result of open-cut and access road crossings could lead to changes to the typical flow regime locally and downstream. De watering activities can result in less flow within the dewatered sections and potential for high velocities in other part of the river channel. This impact is **Scoped in** for all watercourses crossed by above ground construction activities i.e. access roads
- Localised loss of riparian vegetation as a result of vegetation clearance for pipe/road crossings and use of fords across watercourses, leading to an increase in local runoff from bare unvegetated banks. This impact is **Scoped in** for all watercourses crossed by above ground construction activities i.e. access roads
- Temporary crossing structures, such as culverts for haul roads and access tracks, can cause changes in flow depth and velocity under high flow conditions if the flow is constrained by structures. Bridges and culverts can also restrict flows locally with the channel increasing velocities This impact is **Scoped in** for all watercourses crossed by above ground construction activities i.e. access roads

- Site compounds and materials storage- Change in local runoff patterns and rates associated with compounds, storage areas, stockpiles and temporary drainage; leading to changes in stream flow. This impact is **Scoped in** for watercourses are that could interact with development areas
- Soil compaction (associated with trackways, earthworks etc.) can affect local runoff by increasing runoff rates during rainfall events leading to increased stream flow and velocity **– Scoped in**.

Fluvial Geomorphology

258) The following elements are scoped into the EIA pending further investigation, and in cases where watercourses are crossed by above-ground activities.

- Changes in sediment load leading to the adjustment of sediment processes, depositional features and the potential smothering of the channel bed substrate (with subsequent impacts on species and habitats)
- Changes to the flow regime in receiving watercourses, altering the flow processes, capacity of the channel to adjust (due to changes in the energy of the channel) and changes in erosion and deposition, potentially effecting the stability of the channel
- Diversion of watercourses to accommodate construction compounds and pipe/road crossings, effecting the form of the channel, gradient (altering flow processes) and morphological processes. Diversions and crossings could be in place for up to five years
- Localised loss of riparian vegetation as a result of vegetation clearance for pipe/road crossings, leading to bank instability
- Input of fine sediment from local runoff or via existing and temporary field drainage leading to localised changes in sediment load and the bed substrate
- In-channel working leading to the damage and disturbance of morphological features, e.g. channel banks, depositional features and compaction of bed materials
- Temporary crossing structures, such as culverts for haul roads and access tracks, altering bank stability, removing riparian vegetation and altering geomorphological features
- Disruption of groundwater flow pathways could impact on baseflows in the watercourses crossed, particularly in an ephemeral/winterbourne watercourse such as the higher order tributaries of Mill Beck, River Hindburn, Davison's Syke and Eller Beck, there could be changes to the geomorphological processes and features within the channel.

Surface Water Quality

259) With any construction work undertaken within or close to a watercourse there is an inherent risk of surface water contamination which can impact upon water quality.

- There would be an increased pollution risk from elevated suspended solids and nutrients, caused by the mobilisation of fine sediments which could potentially impact on the physical, chemical and microbiological water quality characteristics of receiving watercourses. The mobilisation of sediments could occur because of activities including dewatering, earthworks, the movement of heavy plant and runoff from stockpiles. **Scoped in** for all watercourses that could interact with above ground construction activities. **Scoped out** for all watercourses crossed by tunnel section, as above ground construction activities along the tunnel corridor are likely to be negligible
- There could be a risk of localised contamination as a result of using polluting substances in the construction process for example cement, oils, lubricants, and tunnel slurry. The pollutants could directly enter watercourses or via runoff with a higher risk of this occurring during storm events. Construction plant may also generate a diffuse source of hydrocarbons and to a lesser extent heavy metals that could enter watercourses directly or leach into the subsoil and find their way into watercourses. **Scoped in** for all watercourses
- There is a risk of accidental spillage of polluting substances or leakage from general equipment use and the movement of plant around the site (e.g. storage tanks, leaking valves, refuelling, concreting activities and inadequate storage facilities). **Scoped in** for all watercourses that could interact with above ground construction activities.

Groundwater

260) Construction processes have the potential to impact on both groundwater flow and groundwater quality in different ways.

261) General construction effects on groundwater include:

- Changes to groundwater recharge rates due to temporary changes in ground cover, such as working platforms, laydown areas, temporary access roads, and the removal of vegetation and / or shallow soils. This in turn could impact on groundwater levels and flows. The working area for construction is likely to be relatively small in comparison to the scale of the aquifer(s) being crossed. Any effects, if they were to occur, would therefore likely be negligible, and as such, this effect is **Scoped out** of the assessment, except for where sensitive groundwater environment attributes are present, for e.g. where the proposed development passes through a GWDTE
- Changes to groundwater quality from leaks and spills of chemicals, bentonite, fuels and oils from construction plant or materials used. This includes the storage of such materials, including fuel storage areas in construction compounds. **Scoped in** for areas overlying or directly interacting with highly sensitive aquifers, and / or where sensitive groundwater environment attributes (such as abstractions or GWDTEs) are intercepted by the proposed development
- Changes to groundwater quality due to the use of cementitious materials, which has the potential to change groundwater' pH value by making it more alkaline and affecting major ion concentrations. This would most likely occur when wet concrete is used in fractured bedrock and these sensitive fractured aquifers will be **Scoped in**
- Changes to groundwater quality due to mobilisation of soil and rock particles (suspended solids) which can migrate through the aquifer(s). Due to the filtering effect of the unsaturated zone and aquifer material, suspended solids would not migrate to any significant extent in intergranular aquifers or Unproductive strata. However, for aquifers with fracture flow, particularly for flow in karstic features, suspended solids can migrate significant distances and rapidly. This effect is therefore **Scoped out,** except for areas overlying or interacting with sensitive fractured flow dominated aquifers and in particular aquifers with the potential for karst development
- Changes to groundwater quality from the removal of vegetation and disturbance of ground. This could lead to exposed soils which in turn could lead to greater leaching of natural substances in the soils. The working area for construction is likely to be small in comparison to the scale of the aquifer(s) being crossed. Rainfall would naturally percolate through the soils (albeit it at a likely lower rate), leading to leaching of natural substances. Therefore, any effects that occur would likely be negligible, and as such, this effect is **Scoped out** of the assessment.

262) Specific construction impacts also need to be examined for tunnelling and the development of shafts.

- As tunnelling progresses, the lining will be constructed with pre-cast concrete segments. However, changes to groundwater levels and groundwater flow directions may be caused by temporary groundwater dewatering. **Scoped in**
- Shaft construction has therefore the potential to disturb local groundwater flow and levels. Some degree of dewatering may still be expected and could be significant, especially if the shaft is located in the vicinity of sensitive attributes. **Scoped in**
- Dewatering effects, whether it is caused by tunnelling or shaft construction have the potential to mobilise pre-existing pollution by reversing the natural groundwater flow gradient or re-enforcing the existing one. Little is known at the time of writing on pre-existing in-situ groundwater quality and the potential historical contaminated land areas are identified in Chapter 11. Some geological units are also expected to have a pre-existing contamination signature. As a consequence, mobilisation of pre-existing contamination is **Scoped in**
- The discharge of potentially contaminated dewatered groundwater could also be problematic, whether discharged to surface waters or, where no suitable watercourses are present discharged to ground. The use of mitigation measures, such as settlement lagoons or other appropriate treatment would remove silt and suspended solids, however in the absence of understanding of potential pre-existing contamination with groundwater, potential chemical significant impacts cannot be ruled out at this stage **– Scoped in**

- The potential recharge of abstracted groundwater from dewatering could also cause the groundwater level to rise and the groundwater flow direction to change. This could then lead to new local groundwater flooding developing or enhancing existing ones (discussed further in Chapter 8) **– Scoped in**
- The construction of shafts and trenchless crossing areas if proposed could also create vertical pathways for contaminated groundwater to migrate between aquifers currently unconnected **– Scoped in**

Water Resources

- Potential for any works which leads to a change in water quality and flows to affect downstream abstraction licences from surface waters, including those for private water supplies **– Scoped in**

7.5.2 Operational

Surface Water Hydrology

- At drain down locations the same volumes of water will be discharged as per existing arrangement. Therefore changes in flows from drain down locations have been **Scoped out** of further assessment
- New infrastructure associated with the aqueduct such as valve houses will have an inconsequential effect on water resources **– Scoped out**
- Discharge pipes outfall to local watercourses as emergency discharges and during routine maintenance. Discharge pipes are existing features, the replacement of which is not being considered at this stage of the EIA. If new or modified discharge pipes/discharges are required, these would be assessed in the Environmental Statement. It is assumed that the operation of the aqueduct and the requirements for emergency discharges and maintenance will be similar to existing requirements and therefore has been **Scoped out**
- The decommissioned aqueduct may experience groundwater ingress. This water would be discharged via the existing discharge pipes to local watercourses. The extent of change at each location cannot be quantified at this time and will be **Scoped in**
- Decommissioning works could lead to a change in local runoff and infiltration patterns and rates; leading to changes in stream flow. This cannot be determined until the method of decommissioning is known therefore **Scoped in**.

Fluvial Geomorphology

263) The following outlines some of the potential effects during operation that could affect the fluvial geomorphology features and have been **Scoped in**:

- It has been assumed that no new outfalls would be required. However, an increase in discharge volume from the decommissioned section of the aqueduct could lead to changes in the sediment and flow processes
- During a discharge event there could be a localised increase in flow, disrupting sediment and flow processes. This could also exacerbate any scouring of the channel already experienced by the presence of the outfall(s)
- Localised removal of lateral connectivity between a watercourse and its floodplain by structures crossing the channel and aqueduct infrastructure (e.g. pipe bridges), including the removal of riparian vegetation
- Disruption of geomorphological features and disruption of processes whilst carrying out routine or emergency maintenance on the aqueduct.

Surface Water Quality

- Groundwater may flow into the decommissioned tunnel. This water would be discharged via existing pipes to local watercourses. This could impact upon water quality in receiving watercourses. Ground investigation is programmed for the Proposed Bowland Section which will include water quality testing of the groundwater to identify any potential pollutants and the chemistry of the water (i.e. pH). Until this information is available the impact upon surface waters cannot be established and this will be **Scoped in**

- At present chlorine is added to the treated drinking water prior to entering the aqueduct. Consequently, de-chlorination could be required prior to discharging of potable water into watercourses.

Groundwater

- Changes to groundwater flow direction or levels due to the below ground aqueduct and other below ground structures. The portion of aquifer(s) lost would likely be small in comparison to the overall volume of aquifer storage available and groundwater flow would be expected to adjust around the aqueduct – **Scoped out**
- The new sections of aqueduct will be more 'water tight' than the neighbouring sections of the existing Haweswater Aqueduct that require replacement. Groundwater ingress into the new aqueduct would therefore be restricted. There is potential therefore, for groundwater to rebound, i.e. for groundwater levels to rise. This could result in localised groundwater flooding (discussed further in Chapter 8). It could also lead to groundwater discharges to areas where groundwater is currently not discharging **– Scoped in.**

264) The interpretation of ground investigation data and development of Conceptual Site Models developed for the construction phase will also be the basis to assess impacts during the operational changes.

Water Resources

265) No effects upon water resources are anticipated, other than the main objective of the Proposed Bowland Section which is to improve resilience for public water supplies which is a major beneficial significant effect.

Potential Decommissioning Effects (Including Decommissioning of Existing Haweswater Aqueduct)

266) Decommissioning impacts related to hydrology, fluvial geomorphology, water quality and use of water resources would be similar to those identified for the construction stage of the project.

267) Potential groundwater rebound as a result of the existing aqueduct being decommissioned and the new aqueduct being more "water tight" is already captured in the potential operational effects above. Other effects specific to the decommissioning phase for groundwater aspects include:

- Changes to groundwater levels and flows if 'open' sections of aqueduct are abandoned. If the aqueduct is not permanently filled with grout or cement then the structure itself could act as a preferential pathway for groundwater migration. This could then lead to groundwater being drained from one area, leading to a reduction in groundwater levels, or changes to groundwater discharge points elsewhere. There is also potential for the aqueduct to collapse, leading to ground settlement, which could cause significant effects to overlying or nearby groundwater environment attributes. This potential effect **will be considered in the next stage of assessment**
- If the entire length of the abandoned aqueduct is permanently grouted, with for e.g. concrete or a bentonite slurry, and open ends and connections are sufficiently sealed, then groundwater ingress into the aqueduct would be prevented. The aqueduct could therefore provide a barrier to groundwater flow, which similar to the new aqueduct, could lead to changes in groundwater levels. There would then be the potential for changes to groundwater discharge points. The aqueduct would, however, likely be small compared to the overall thickness of the aquifer unit(s), except where the aqueduct is shallow and at proximity of a sensitivity attribute such as a GWDTE or in areas where groundwater is already shallow. On this basis, this effect is **scoped out** of the assessment, except for where sensitive groundwater environment attributes are located, or in areas with existing groundwater flooding issues.

7.6 Design and Mitigation

268) Additional mitigation will depend on the issues identified through the assessment and may include but are not limited to:

- Developing the design to avoid sensitive water environment features such as those watercourses identified as High value, such as the Rivers Hindburn and Hodder and GWDTEs. Whilst it may not be possible to change the general route of the aqueduct due to the gradients required for the gravity feed it may be possible to avoid impacts from shafts, site compounds, access roads and other infrastructure associated with the Proposed Bowland Section through careful sighting within the development envelopes

- Embedding the outcome of the ground investigation and developed Conceptual Site Models into the developing design to remove or minimise effects
- Embed in the routing and design development to avoid impact on sensitive attributes such as licensed abstractions and GWDTE with national or international designations or GWDTEs with local or no designations that have high or moderate groundwater dependency
- Groundwater breaks incorporated into the design at discrete intervals to prevent continuous groundwater flowpaths in the material surrounding the aqueduct. This would prevent groundwater from being drained in one location and groundwater discharge points being created elsewhere
- Additional measures to prevent vertical migration of pollution in between aquifers
- Reinstatement of the channel cross-section and vegetated riparian corridor following open-cut and access road crossings should be designed and undertaken in a manner that ensures restoration of the natural flow and sediment dynamics of the watercourses affected. This will be key to ensuring there are no significant effects on the fluvial geomorphology following construction.

7.7 Summary Scope for the EIA

269) A summary of the scoping assessment for the water environment is presented below in Table 7.7.

Table 7.7: Matters of significance for Water Environment

Feature group	Matter / potential effects	Location within assessment area	Comments
Construction			
Surface Water Hydrology	In channel working and de-watering leading to changes to the typical flow regime locally and downstream.	All watercourses within the development envelope for above ground construction activities.	Scoped in for all watercourses, as working technique and duration are currently unknown. An assessment on a case-by-case basis for each watercourse will need to be made to determine potential impacts.
	Increase in runoff due to riparian vegetation clearance for road crossings and use of fords across watercourses.	All watercourses within the development envelope for above ground construction activities.	Scoped in for all watercourses crossed by above ground construction activities.
	Restriction of flows (i.e. from culverts, bridges, crossings etc.) leading to changes in flow depth and velocity under high flow.	All watercourses within the development envelope for above ground construction activities.	Scoped in for all watercourses, as working technique and duration are currently unknown. An assessment on a case-by-case basis for each watercourse will need to be made to determine potential impacts.
	Site compounds and materials storage - change in local runoff patterns and rates associated with compounds, storage areas, stockpiles and temporary drainage; leading to changes in stream flow.	Throughout and specifically within development areas.	Scoped in for all watercourses that could interact with development areas.

Feature group	Matter / potential effects	Location within assessment area	Comments
	Increase in runoff rates due to soil compaction (associated with trackways, earthworks etc.).	All watercourses within the development envelope.	Scoped out for all watercourses assuming the CEMP includes mitigation for managing surface water runoff.
Surface Water Quality	Increased pollution risk from the mobilisation of sediments which could potentially impact on the physical, chemical and microbiological water quality of receiving watercourses.	Throughout.	Scoped in for all watercourses that could interact with above ground construction activities. Scoped out where watercourses are crossed by tunnel corridor as impact likely to be negligible.
	Increased pollution risk as a result of using polluting substances in the construction process for example cement, oils, lubricants, and tunnel slurry.	Throughout.	Scoped in for all watercourses.
	There is a risk of accidental spillage of polluting substances or leakage from general equipment use and the movement of plant around the site	Throughout.	Scoped in for all watercourses that could interact with above ground construction activities.
Water Resources	Potential change in water quality and flows to affect downstream abstraction licences from surface waters	Throughout.	Scoped in for all watercourses, as abstraction locations and duration are currently unknown. An assessment on a case-by-case basis for each watercourse will need to be made to determine potential impacts.
Fluvial Geomorphology	Changes to geomorphological processes and features as a result of construction compounds. Loss/modification of riparian vegetation as a consequence of site clearance.	Throughout.	Scoped in for Very High and High value features due to sensitive nature of the channel and potential for the works to destabilise the channel bed and lead to erosion. Scoped out for Medium and Low value features as the works would be localised and short-term and it is assumed the channel would be reinstated to pre-work conditions.
	Changes to geomorphological processes and features, and the loss/modification of riparian vegetation as a result of access road crossings.	Various watercourses.	Scoped in for all watercourses, as crossing technique and duration are currently unknown. An assessment on a case-by-case basis for each watercourse will need to be made to determine potential impacts.

Feature group	Matter / potential effects	Location within assessment area	Comments
	Changes to geomorphological processes and features as a consequence of tunnel-crossings.	Throughout, including three WFD Watercourses.	Scoped in for Very High and High value features due to potential changes in flow processes from drawdown in groundwater. Scoped out for Medium and Low value features, unless identified to be an ephemeral watercourse, due to limited potential for changes to flow processes.
Groundwater	Changes to groundwater recharge rates due to temporary changes in ground cover	Throughout.	Scoped out except where aqueduct is shallow and in vicinity of a GWDTE or running through shallow groundwater conditions
	Changes to groundwater quality from leaks and spills of chemicals, fuels and oils from construction plant or materials used.	Throughout.	Scoped in for areas overlying or directly interacting with highly sensitive aquifers, and / or where sensitive groundwater environment attributes (such as abstractions or GWDTEs) are intercepted by the proposed development.
	Changes to groundwater quality due to the use of cementitious materials.	Throughout.	Scoped out except where the proposed development interacts with sensitive fractured aquifers.
	Changes to groundwater quality from the removal of vegetation and disturbance of ground.	Throughout.	Scoped out.
	Temporary tunnel dewatering.	Throughout.	Scoped in.
	Temporary shaft dewatering	In the location of proposed shafts.	Scoped in.
	Potential recharge of abstracted groundwater from dewatering could also cause the groundwater level to rise.	Throughout.	Scoped in.
	Creation of vertical pathways by shafts.	In the location of proposed shafts.	Scoped in.
Operation			
Surface Water Hydrology	Discharges from the aqueduct at existing drain down locations.	At drain down locations – receiving watercourses.	Scoped out - the same volumes of water will be discharged, and the washout locations will remain as per existing.

Feature group	Matter / potential effects	Location within assessment area	Comments
	New infrastructure associated with the aqueduct have the potential to increase the amount of impermeable area and thus increase flows to watercourses.	All locations where new infrastructure proposed.	Scoped out as will have an inconsequential effect.
	Discharge pipes outfall to local watercourses as emergency discharges and during routine maintenance.	All locations where discharge pipes outfall to watercourses.	Scoped Out - the operation of the aqueduct and the requirements for emergency discharges and maintenance will be similar to existing requirements and therefore has been scoped out of further assessment.
	The existing aqueduct which will be abandoned will over time fill with groundwater. This water will be directed via the existing discharge pipes and will result in new constant discharges to surface waters.	All locations where discharge pipes outfall to watercourses.	Scoped in - the extent of change at each location cannot be quantified at this time and will be assessed at the next stage.
	Decommissioning works could lead to a change in local runoff and infiltration patterns and rates; leading to changes in stream flow.	Throughout.	Scoped in - this cannot be determined until the method of decommissioning is known.
Surface Water Quality	During operation groundwater ingress into the abandoned sections of the existing tunnel would occur. This water would most likely be discharged via pipes to surface watercourses and may impact upon surface water quality in receiving watercourses.	Throughout.	Scoped in - an extensive GI is programmed for the project which will include water quality testing of the groundwater to identify any potential pollutants and the chemistry of the water (i.e. pH). Until this information is available the impact upon surface waters cannot be established and this will require further assessment.
Fluvial Geomorphology	Discharges from drain down locations into channel effecting flow and sediment processes.	Various watercourses and water features including two Main River.	Scoped in for all watercourses due to potential for changes in flow and sediment processes.
Groundwater	Changes to groundwater flow direction or levels due to the below ground aqueduct and other below ground structures	Throughout.	Scoped out except where the aqueduct is shallow and in vicinity of a GWDTE or running through shallow groundwater conditions
	Water-tight new aqueduct may result in groundwater rebound.	Throughout.	Scoped in.

Feature group	Matter / potential effects	Location within assessment area	Comments
	Decommissioning: the aqueduct is not permanently filled with grout or cement	Throughout.	Scoped in.
	Decommissioning: the aqueduct is permanently filled with grout or cement.	Throughout.	Scoped out except for where sensitive groundwater environment attributes are located, or in areas with existing groundwater flooding issues.

Appendix 7.1 Detailed Water Environment Assessment Methodology and Significance Criteria

A.1 Introduction

270) There are no standard methods for evaluating likely effects on the water environment for projects of this nature. To fulfil the requirements of the EIA Regulations the methodology used for undertaking the assessment to determine any significant effects as a result of the Proposed Bowland Section is based upon that prescribed in the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 10: HD45/09, Road Drainage and the Water Environment, professional judgement and past EIA experience. The methodology sets out a list of criteria for evaluating the environmental effects, as follows:

- The importance (value) of the resource under consideration on a scale of sensitivity (i.e. very high, high, medium or low) as shown in Table A7.1A
- The magnitude of the effect in relation to the resource that has been evaluated, quantified using the scale very high, high, medium or low as shown in Table A7.1B
- The significance of the effect using the scale major, moderate, minor and negligible using the diagram as shown in Table A7.1C. This is based on the value of the resource under consideration and the magnitude of the effect.

271) The criteria defined for GWDTEs follows the UK Technical Advisory Group (UKTAG) guidance (UKTAG, 2009) to identify, prioritise and assess potential impacts on these attributes.

A.2 Proposed Assessment Criteria

A.2.1 Value of Receptors

272) Establishing the baseline environment allows water environment receptors to be identified. Following this a value is assigned to each receptor based on the criteria in Table A7.1A below.

273) The value of resources are derived to reflect the importance of features outlined in key policy documents and legislation.

Table A7.1A: Estimating the Importance/Value of Water Environment Attributes

Importance/ Value	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on regional or national scale	**Surface Water Hydrology and Quality** Main Rivers EC Designated Salmonid/Cyprinid fishery* Water Framework Directive (WFD) Class 'High' for overall status Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, Water Protection Zone (WPZ), Ramsar site, salmonid water)/ Supports water-dependent species protected by EC legislation Supports major surface water abstraction for potable supply.
		Fluvial Geomorphology A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. Morphological features and processes would be highly sensitive to change as a result of temporary or permanent works.
		Groundwater

Importance/ Value	Criteria	Typical Examples
		Principal bedrock and superficial aquifers. Groundwater flow and yield associated with licensed groundwater abstractions. Groundwater quality associated with SPZ1 (Inner Protection Zone) associated with licensed abstractions. Buildings of regional or national importance, such as scheduled monuments, hospitals, power stations and industrial buildings. Water feeding GWDTEs with a high or moderate groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs).
High	Attribute has a high quality and rarity on local scale	**Surface Water Hydrology and Quality** Main River WFD Class 'Good' for overall status or Moderate overall status with good chemical quality and good physico-chemical elements. Major Cyprinid Fishery* Species protected under EC or UK habitat legislation Supports licensed small scale substitutable abstraction for potable supply or extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates).
		Fluvial Geomorphology A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. Morphological features and processes would be sensitive to change as a result of temporary or permanent works.
		Groundwater Secondary A aquifers. Groundwater flow and yield and quality associated with extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates). Groundwater quality associated with SPZ2 (Outer Protection Zone) associated with licensed abstractions. Residential and commercial properties. Water feeding GWDTEs of low groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately GWDTE with a national non-statutory UK Biodiversity Action Plan (BAP) priority.
Medium	Attribute has a medium quality and rarity on local scale	**Surface Hydrology and Water Quality** Main River or Ordinary watercourse WFD Class 'Moderate' overall with Moderate or poor chemical quality and moderate or poor physico-chemical elements. WFD Class 'Poor' overall status. Supports water dependent BAP habitats or local sites of importance for nature conservation Supports limited non-licensed abstraction for non-potable supply.
		Fluvial Geomorphology

Importance/ Value	Criteria	Typical Examples
		A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. Morphological features and processes could be sensitive to change as a result of temporary or permanent works.
		Groundwater Secondary B and Secondary Undifferentiated aquifers. Groundwater flow and yield and quality associated with small scale private water abstractions (i.e. feeding fewer than ten properties). Groundwater quality associated with SPZ3 (Source Catchment Protection Zone) associated with licensed abstractions and with licensed abstractions for which no SPZ is defined. Vacant residential properties and buildings. Water feeding GWDTEs of low groundwater dependence with a national non-statutory UK BAP priority; or water feeding highly or moderately groundwater dependent GWDTE sites with no conservation designation.
Low	Attribute has a low quality and rarity on local scale	**Surface Water Hydrology and Quality** Ordinary watercourse (note – man-made drains that serve purely a drainage function or man-made features such as SuDS ponds can be included in this category or excluded from assessment based upon the nature of the Proposed Bowland Section). Non - WFD designated watercourses. WFD water body status of Poor and failing to achieve chemical quality. Habitats dependent upon fluvial or pluvial water sources not designated (i.e. wetlands etc.). No surface water abstractions.
		Fluvial Geomorphology A highly modified watercourse that exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes. Has likely been significantly affected by anthropogenic factors which may include modification of flow regime, resulting in a dry channel during prolonged dry periods. Morphological features and processes would be unlikely to be sensitive to temporary or permanent works.
		Groundwater Very poor groundwater quality and / or very low permeability make exploitation of groundwater unfeasible. No active groundwater supply. Industrial buildings that are currently not utilised, all derelict buildings and infrastructure that serves a single dwelling. Water feeding GWDTEs of low groundwater dependence with no designation or groundwater that supports a wetland not classified as a GWDTE, although may receive some minor contribution from groundwater.

274) It should be noted that the values assigned to various SPZs are to acknowledge the differing sensitivities between the three categories and are based on assessment criteria that have been widely used and accepted for other development projects. It should be noted that although the criteria distinguish between the different SPZ categories, this does not detract from the need for the assessment to identify appropriate mitigation measures for aquifer and source protection.

A.2.2 Magnitude of Impacts

275) Impacts are then identified based upon the nature and extent of the Proposed Bowland Section. The magnitude of impacts is established using either quantitative or qualitative assessment based upon professional judgement. The magnitude of change is a measure of the scale or extent of the change in the baseline condition, irrespective of the value of the resource(s) affected. In determining magnitude, the extent of the physical change would be considered in the context of other factors such as the likelihood of effect, existing long-term trends, the timescale over which the effect occurs and whether the effect is temporary or permanent. The magnitude of potential impacts may be beneficial or adverse.

276) Estimating the magnitude of adverse impacts is based on the criteria presented in Table A7.1B. The nature, duration (i.e. long term, short term) and characteristics of impacts are identified to enable their magnitude to be determined.

277) Whilst beneficial impacts may result from the Proposed Bowland Section it is not intended to qualitatively or quantitatively determine the magnitude of these and therefore these will be noted in the assessment as appropriate but not assigned a magnitude or significance. It is highly unlikely a project would achieve any significant beneficial effects unless the project was purely for improving the water environment.

Table A7.1B: Scale for recording the magnitude of adverse predicted effect.

Importance/ Value	Criteria	Typical Examples
Major Adverse	Results in loss of attribute and / or quality and integrity of the attribute.	**Surface water hydrology and quality** Loss or extensive change to a Nature Conservation Site or Fishery Total loss of water environment receptor Reduces resource availability resulting in change to assessment point status. Reduction in major potable abstraction (quantity or quality). Derogates existing water quality (e.g. exceedance of an EQS of a water quality parameter) or impacts on ability of the water body to achieve WFD objective.
		Fluvial Geomorphology Loss or extensive damage to habitat due to extensive modification of natural channel planform, and / or sediment and flow processes. Replacement of a large extent of the natural bed and / or banks with artificial material.
		Groundwater Major or irreversible change to groundwater aquifer(s) flow, water level, quality or available yield which endangers the resources currently available. Groundwater resource use / abstraction is irreparably impacted upon, with a major or total loss of an existing supply or supplies. Changes to water table level or quality would result in a major or total change in, or loss of, a groundwater dependent area, where the value of a site would be severely affected. Changes to groundwater aquifer(s) flow, water level and quality would result in major changes to groundwater baseflow contributions to surface water and / or alterations in surface water quality, resulting in a major shift away from baseline conditions such as change to WFD status. Dewatering effects create significant differential settlement effects on existing infrastructure and buildings leading to extensive repairs required.
Moderate Adverse	Results in effect on integrity of attribute, or	**Surface water hydrology and quality** Partial loss in productivity of fishery Impacts on WFD measure(s) ability to deliver benefits but not on achievement of objectives.