United Utilities

# Water Framework Directive Assessment of the Draft Water Resources Management Plan 2019: Supplementary Information

## Draft Resilience Options

March 2018

Amec Foster Wheeler Environment
& Infrastructure UK Limited

## Report for

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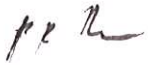

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# Executive summary

## Introduction

United Utilities (UU) is currently preparing its Water Resources Management Plan 2019 (WRMP19) that will set out the strategy for water resource and demand management to ensure supplies of safe, clean drinking water are maintained to customers throughout the company's region over the period 2020 to 2045 and beyond. As part of the preparation of WRMP19, UU is currently consulting on a Draft Water Resources Management Plan (Draft WRMP) in order that regulators, stakeholders and the public can comment on UU's proposed strategy and further contribute to the development of the plan.

UU has identified, and included in its Draft WRMP, five resilience solutions to address the resilience risks associated with the regional aqueduct system (which transfers water from the Lake District to supply the Manchester and Pennine areas including parts of Lancashire and South Cumbria). These solutions are made up of resilience options which can potentially be included in more than one of the overall solutions. At this stage, UU's preferred Manchester and Pennine Resilience solution has not been determined; this work is ongoing and will be informed by consultation responses to the Draft WRMP together with further assessment and appraisal.

This report presents the Water Framework Directive (WFD) assessment for the draft resilience options and, in-turn, the draft resilience solutions. The aim of the report is to demonstrate the potential level of WFD impact associated with each resilience option/solution and, if necessary, the level of further assessment that may be required in order to fully demonstrate WFD compliance. This assessment supplements the Draft Water Resources Management Plan 2019: Water Framework Directive Assessment Final Report ("WFD Assessment Report", available via UU's website).

The WFD sets a default objective for all rivers, lakes, estuaries, groundwater and coastal water bodies to achieve good status or potential by 2027 at the latest. Where it is not possible to achieve this (e.g. through disproportionate costs), alternative water body objectives can be set. The current (baseline) status (2015 classification), and the measures required to achieve the 2027 status objective, are set out for each water body in the relevant River Basin Management Plans (RBMPs), prepared by the Environment Agency (EA) every six years.

The final WRMP must be able to demonstrate that it would not cause a deterioration in respect of these baseline conditions. Furthermore, for those water bodies that are not currently attaining good status, the WRMP must be able to demonstrate that it would not preclude the delivery of measures to facilitate the improvements needed to attain good status.

## Approach to the WFD Assessment

The WFD assessment has considered the following key questions in respect of the construction and operational phase of each WRMP resilience option:

- At the water body scale, would the resilience option result in a deterioration of any of the WFD classification components from one status class to the next, (e.g. from good to moderate), irrespective of whether or not it results in the lowering of overall status?
- Would the resilience option prevent any water bodies from achieving good overall status or, where relevant, an alternate objective?

The possible future decommissioning of resilience options is beyond the scope of this assessment, but impacts arising from decommissioning are likely to be similar to those arising from construction.

### Resilience Options

The WFD assessment has been undertaken on 34 individual resilience options as provided by UU. The assessment for each resilience option was based on the engineering scope information provided by UU. In accordance with the WFD assessment of the feasible options contained in the Draft WRMP (as presented in the WFD Assessment Report), the assessment for each resilience option comprised two stages, a 'Level 1'

screening, followed by a more detailed 'Level 2' assessment for those resilience options that may be subject to medium or high impacts, as highlighted in the Level 1 assessment. The results of both levels of assessment are then combined to create a final impact assessment for all resilience options. Both levels of assessment use the definitions of impacts described in **Table 1**.

Table 1 Impact Classification Categories

| Level of impact | Description of impact |
|---|---|
| **No or minimal impacts** | No measurable change in the quality of the water environment or the ability for target WFD objectives to be achieved. |
| **Minor level of impact** | Impacts from the resilience option when taken on their own have the potential to lead to a minor localised, short-term and fully reversible effect on the quality of the water environment that would not result in the lowering of WFD status.<br><br>Impacts would be very unlikely to prevent any target WFD objectives from being achieved. |
| **Medium level of impact** | Impacts when taken on their own have the potential to lead to a widespread or prolonged effect on the quality of the water environment that may result in the temporary lowering of WFD status.<br><br>Impacts have the potential to prevent target WFD objectives from being achieved. |
| **High level of impact** | Impacts when taken on their own have the potential to lead to a significant effect and permanent deterioration of WFD status.<br><br>Impacts have a high risk of preventing target WFD objectives from being achieved. |

The assessments were based on available data and evidence as far as possible. However, due to the limited engineering and baseline information available, expert opinion and a number of assumptions have been employed in most cases (refer to **Section 2.3**). Where there was uncertainty over a resilience option (e.g. the exact route of a pipeline is not known), a worst case scenario approach has been used (e.g. the assessments have assumed that the pipeline has watercourse crossings rather than not).

A confidence rating has been given to the Level 2 assessments, according to the confidence categories in **Table 2**. The confidence rating assigned to each assessment is a reflection on:

- The amount of uncertainty in the resilience option design (e.g. uncertainty over the location and quantity of a new surface water abstraction would lower the level of confidence in the assessment); and
- The amount and quality of evidence upon which the impact level has been based (e.g. existing investigations into the impacts of abstractions on a river by UU and the EA increase the confidence level in the assessment).

All the resilience options that have only been subject to a Level 1 assessment are assigned a high confidence by default.

Table 2 Confidence Level Categories

| Confidence category | Description of confidence |
|---|---|
| **Low** | Very limited evidence, high risk activity or assessment solely based on expert judgement. |
| **Medium** | Reasonable levels of evidence for some aspects of the assessment. Some assumptions and expert opinion required. |
| **High** | Good level of evidence with minimal assumptions required or low risk activity. |

## Resilience Solutions

The results of the assessment have been presented for each individual option, and then for each solution. The results of the assessment for each solution are based on a consideration of the impacts for each of the

individual options within that solution, plus the results of initial screening of cumulative and protected area assessments.

# Results of the WFD Assessment

## Resilience Options

The results of the Level 1 and Level 2 assessments indicate that:

- 22 resilience options have a no or minimal level of potential impact;
- 7 resilience options have a minor level of potential impact; and
- 5 resilience options have a medium level of potential impact.

Further details on the results are summarised in **Table 4.1**, and described by solution in Sections 4.3 to 4.7.

The five resilience options that have been assigned a medium level of potential impact are:

- 37-38: Manchester and Pennine Aqueduct section T05 to T06;
- 37-42: Manchester and Pennine Aqueduct sections T01 to T06;
- 215: Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors);
- 296: T05 targeted repair 2025; and
- 297: T06 targeted repair 2025.

## Resilience Solutions

The five resilience options with a medium level of impact occur in four out of the five resilience solutions (**Table 3**) and pose a potential risk of widespread or prolonged impacts on the status of WFD water bodies.

Table 3 Summary of Resilience Option and Solutions Assessment

| | | Number of options (and water bodies in brackets) at each impact level | | | | | |
|---|---|---|---|---|---|---|---|
| **Solution** | **Total No. of Options** | **No or Minimal** | **Minor** | **Medium** | **High** | **Overall Impact** | **Confidence** |
| **A** | 6 | 3 | 1 | 2 (2) | 0 | Medium level of impact | Low |
| **B** | 16 | 15 | 0 | 1 (8) | 0 | Medium level of impact | Low |
| **C** | 8 | 4 | 4 | 0 | 0 | Minor level of impact | High |
| **D** | 2 | 1 | 0 | 1 (21) | 0 | Medium level of impact | Low |
| **E** | 6 | 1 | 3 | 2 (22) | 0 | Medium level of impact | Low |

Note:
Some resilience options are included in more than one resilience solution.
For options assigned a no or minimal or minor level of impact in the Level 1 screening, individual water bodies were not identified.

In such cases, further WFD assessment is required to be more conclusive in respect of requirements, or otherwise, for bespoke mitigation in order to ensure that WFD objectives are not compromised. In reality, on consideration of further information and future dialogue with the EA on proposed bespoke mitigation measures, these resilience options/solutions are unlikely to result in significant or long term potential impacts. Therefore, WFD compliance is unlikely to be an issue in respect of regulatory permitting once the further assessment provides the appropriate level of confidence for presentation to the regulator.

The assessments typically have a low or medium level of confidence, which reflects the high level nature of the WFD assessments undertaken at this time. The level of detail available on the resilience option designs

or environmental baseline information has necessitated a precautionary approach to the assessments, which relies on assumptions and results in a worst case level of impact. Further assessment and dialogue with the EA during the consultation and project stages is expected to result in a reduction of the level of impact, and an increase in the level of confidence.

Further detailed WFD assessment should be undertaken on the preferred solution (once identified) and any options within that solution that have been assigned a medium level of impact in the Level 2 assessment. The further assessment should include a full cumulative assessment (where multiple resilience options occur in a single waterbody or catchment), a full protected area assessment, consideration of more detailed design information, investigation of the water environment associated with each resilience option (in particular links between the groundwater and surface water environments), detailed impact assessments, and more detailed review of WFD objectives to ensure that the impacts highlighted in this report are appropriately accounted for.

## Statement of Compliance with the WFD

The assessments for the resilience options indicate that five of the 34 resilience options, which occur in four of the resilience solutions, could have a medium level of impact against WFD objectives. In such cases, further WFD assessment is required to be more conclusive in respect of requirements, or otherwise, for bespoke mitigation in order to ensure that WFD objectives are not compromised.

In reality, it is expected that these options are unlikely to result in significant or long term potential impacts, when further information and dialogue with the EA on proposed bespoke mitigation measures is accounted for. Therefore, WFD compliance is unlikely to be an issue in respect of regulatory permitting once the further assessment provides the appropriate level of confidence for presentation to the regulator.

Based on the assessments in this report, **there is currently no requirement to implement Article 4.7 for the resilience options**. However, this is based on the assumptions detailed in this report, and the assumption that additional investigations and mitigation will be implemented for the preferred solution.

# Contents

# 1. Introduction

## 1.1 Overview

1.1.1 United Utilities (UU) is currently preparing its Water Resources Management Plan 2019 (WRMP19) that will set out the strategy for water resource and demand management to ensure supplies of safe, clean drinking water are maintained to customers throughout the company's region over the period 2020 to 2045 and beyond. As part of the preparation of WRMP19, UU is currently consulting on a Draft Water Resources Management Plan (Draft WRMP) in order that regulators, stakeholders and the public can comment on UU's proposed strategy and further contribute to the development of the plan.

1.1.2 UU has identified, and included in its Draft WRMP, five resilience solutions to address the resilience risks associated with the regional aqueduct system (which transfers water from the Lake District to supply the Manchester and Pennine areas including parts of Lancashire and South Cumbria). These solutions are made up of resilience options which can potentially be included in more than one of the overall solutions. At this stage, UU's preferred Manchester and Pennine Resilience solution has not been determined; this work is ongoing and will be informed by consultation responses to the Draft WRMP together with further assessment and appraisal.

1.1.3 In this context, and as part of the process of selecting the preferred Manchester and Pennine Resilience solution, Amec Foster Wheeler Environment and Infrastructure UK Ltd (Amec Foster Wheeler, now Wood) has been commissioned to undertake a Water Framework Directive (WFD) assessment of the five potential solutions identified by UU and their component resilience options. The WFD assessment is being undertaken to identify which resilience options and solutions pose a risk to the status of WFD water bodies. In doing so, it will help to inform the selection of the preferred Manchester and Pennine Resilience solution.

1.1.4 This document presents the WFD assessment of the draft Manchester and Pennine Resilience options and solutions. This assessment supplements the Draft Water Resources Management Plan 2019: Water Framework Directive Assessment Final Report[1] ("WFD Assessment Report", available via www.unitedutilities.com/wrmpconsultation), in a manner anticipated in the WFD Report. It should be read in conjunction with the WFD Report to provide consultees with an understanding of the likely significant effects of the resilience options that will make up the Manchester and Pennine Resilience solutions described in the Draft WRMP.

## 1.2 Purpose of this Report

1.2.1 This report has been produced for the purpose of presenting the WFD assessment of the resilience options included in the resilience solutions that have been considered for inclusion in WRMP19. The aim of the report is to demonstrate the potential level of WFD impact associated with each option and, if necessary, the level of further assessment that may be required in order to fully demonstrate WFD compliance.

1.2.2 In England and Wales, whilst the responsibility for ensuring that the WFD is implemented lies with the Secretary of State for Environment, Food and Rural Affairs, the Environment Agency (EA) and Natural Resources Wales (NRW), as well as other public bodies, have a duty to 'have regard' to the objectives of the WFD in exercising their functions. This includes water companies through their activities such as water resource management planning.

1.2.3 Failure to take account of WFD requirements could provide grounds for a challenge to regulatory decisions on any resilience options that progress into the final WRMP. Therefore, an early assessment of the relative levels of WFD compliance risk amongst the suite of potential resilience

[1] Amec Foster Wheeler (2018) *Draft Water Resources Management Plan 2019: Water Framework Directive Assessment – Final Report*.

options is a necessary part of WRMP optioneering that should help facilitate effective and efficient regulatory decision making.

## 1.3 Context

### United Utilities' Draft Water Resources Management Plan 2019

1.3.1 Along with all other water companies in England and Wales, there is a statutory requirement for UU to prepare, maintain and publish a WRMP that sets out how the balance between water supply and demand, and security of supply will be maintained over the coming 25 years in a way that is economically, socially and environmentally sustainable. These plans are reviewed on a rolling 5 year basis and UU is currently preparing its WRMP for the period 2020 to 2045 and beyond, which is due to be published in 2019. Once published, WRMP19 will replace the current 2015 WRMP.

1.3.2 The WRMP will present management options by water resource zone (WRZ). WRZs are defined in the Water Resources Planning Guideline[2] as "*an area within which the abstraction and distribution of supply to meet demand is largely self-contained (with the exception of agreed bulk transfers). Within a WRZ all parts of the supply system and demand centres (where water is needed) should be connected so that all customers in the WRZ should experience the same risk of supply failure and the same level of service for demand restrictions*".

1.3.3 UU's region is currently split into four WRZs:

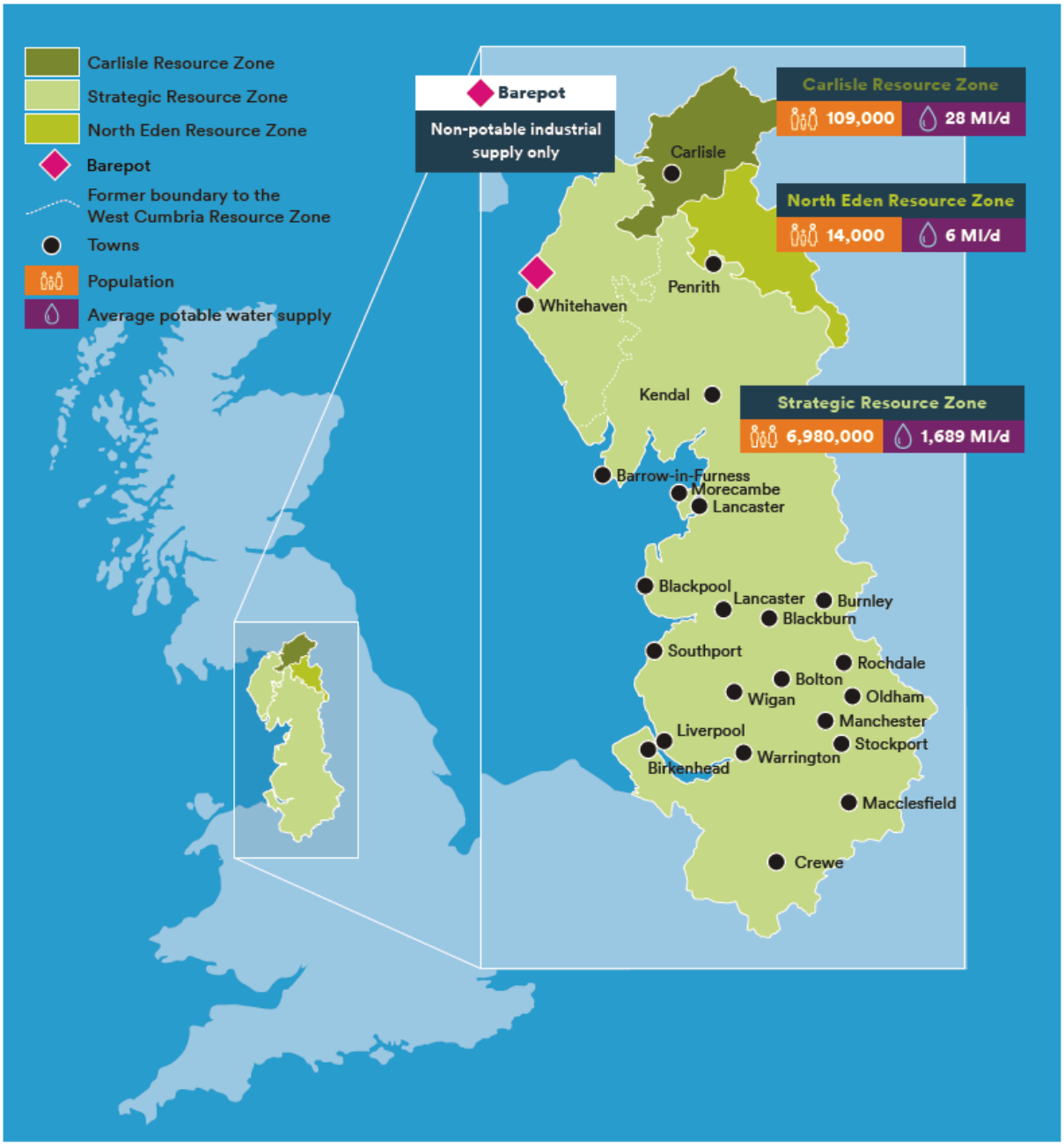
- The Integrated Water Resource Zone covering the major conurbations;
- North Eden;
- Carlisle; and
- West Cumbria.

1.3.4 As a long-term 25-year strategic view, WRMP19 is being developed to reflect the merging of the West Cumbria and Integrated Resource Zones in 2022 (following the implementation of the 2015 WRMP) and which together will form the Strategic Resource Zone. A new smaller resource zone, Barepot, has also been established to reflect supplies to commercial customers located in the West Cumbria area (these are not connected into the rest of the public water supply network). As a result, WRMP19 is being developed around the four WRZs that will exist from 2022, as shown in **Figure 1.1.** These are:

- The Strategic Resource Zone;
- The Carlisle Resource Zone;
- The North Eden Resource Zone; and
- Barepot non potable industrial supply zone.

[2] Environment Agency and Natural Resources Wales (2017) *Water Resources Planning Guideline: Interim Update*. Available at: https://naturalresources.wales/media/681612/interim-wrpg-update-final-april-2017.pdf [Accessed October 2017].

Figure 1.1 United Utilities' Resource Zones (from 2022 onwards)




1.3.5 In preparing the Draft WRMP, UU has forecast the future demand for water and available supply (the supply-demand balance) for the 25 year period to 2045 and has determined that there will be a surplus in all four of the company's WRZs in a dry year over the planning horizon of WRMP19. As there is forecast to be enough water to meet demand over the period of WRMP19, UU does not need to take any further action in this regard. However, consideration has been given to using the forecast surplus, with possible new source or demand management investment, to explore strategic choices for the WRMP.

1.3.6 In this context, UU's Preferred Plan for WRMP19 seeks to deliver the following four 'strategic choices':

- Enhance leakage reduction by a total of 80 mega litres per day (Ml/d) over the planning period;
- Improve levels of service for drought permits and orders from 1 in 20 years to 1 in 40 years (moving from 5% to 2.5% annual risk);

- Increase resilience to others hazards, including through the Manchester and Pennine Resilience solution; and
- Commit to continue to explore national water trading.

1.3.7 The Preferred Plan comprises a combination of preferred resource management and demand management (including leakage reduction and network metering) options designed to achieve the four strategic choices outlined above and maintain and enhance the supply-demand balance. These preferred options are presented in the Draft WRMP for public consultation and have been selected following a process of options identification and appraisal. This process initially reviews as many potential solutions as possible (the 'unconstrained list' of options) to identify 'feasible' options. Following an initial round of screening (Primary Screening), the feasible options were then assessed in terms of their financial, environmental and social costs and ranked. Informed by this assessment, ongoing discussion with stakeholders, and the outcomes of the Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and WFD Assessment, plus some other assessments, this list was further refined through Secondary Screening to identify a list of constrained options, from which the Preferred Plan options were selected.

## Manchester and Pennine Resilience

1.3.8 As part of the Preferred Plan, UU will seek to enhance resilience to non-drought hazards; the largest resilience risk identified being that associated with the regional aqueduct system which supplies water from the Lake District to the Manchester and Pennine areas including parts of Lancashire and South Cumbria. UU has identified that the aqueduct condition is deteriorating over time and presents a risk in terms of both water quality and water supply to Greater Manchester and areas of the Pennines. This risk could, in the future, result in a widespread water quality incident (for example, advice to boil water for drinking purposes for over a million properties) or loss of supply to many thousands of properties for an extended period. UU has identified three indicative events to represent the overall baseline system risk over a future 10 year period:

- 65% probability that 1.2 million properties could be affected by water quality problems for 1 week;
- 35% probability that 120,000 properties could be affected by supply interruptions for up to 3 months; and
- 20% probability that 240,000 properties could be affected by supply interruptions for up to 2 weeks.

1.3.9 The development of solutions to address the risks of aqueduct deterioration (and its consequences) to the Strategic Resource Zone is collectively referred to as 'Manchester and Pennine Resilience'.

### Resilience Solutions

1.3.10 As noted in Section 1.1, five potential Manchester and Pennine Resilience solutions have been identified by UU. These solutions are listed below:

- **Solution A (FM20-SO4):** New sources and targeted repair of Tunnel 5 and Tunnel 6 (T05 and T06) of the existing aqueduct, supported by uprating the West East Link Main (WELM) and construction of a new associated break tank near Bolton in conjunction with a new abstraction from the River Irwell and an associated new water treatment works (WTW) (similar to water resources Option WR141).
- **Solution B (C29):** New tunnel sections T05 and T06 and partial UV and metals treatment at existing United Utilities facilities along the length of the existing Manchester and Pennine Aqueduct.
- **Solution C (FM15-SO4b):** Convert the Manchester and Pennine Aqueduct to raw water supply and build new WTWs at Bury and in the Ribble Valley.

- **Solution D (C11):** New tunnel sections T01, T02, T03, T04, T05 and T06.
- **Solution E (C17):** New tunnel sections as for Solution D, plus use of new and existing sources requiring WTW and associated pipelines varying in length from 100 m to over 8 km. The new sources are similar to water resources Options WR049a/b and WR141.

1.3.11 The five solutions offer varying degrees of risk reduction, are significantly different in terms of technical and geographical scope, and would potentially give rise to varying levels and types of environmental effects.

1.3.12 To support UUs decision making, and to ensure consistency between the assessment of the Manchester and Pennine Resilience solutions and the feasible options contained in the Draft WRMP, the component options that make up each solution as well as the solutions themselves have been subject to Environmental and Social (E&S) Costings, SEA, HRA and WFD Assessment.

1.3.13 The outcomes of these assessments, together with consultee's views on the Draft WRMP19, will be used to inform the selection of the preferred Manchester and Pennine Resilience solution.

### Resilience Options

1.3.14 Following initial screening in two distinct stages and ranking of over 300 options (consistent with the approach adopted to the identification of feasible (constrained) options for the Draft WRMP), United Utilities has identified a total of 34 resilience options, different combinations of which form the five potential Manchester and Pennine Resilience solutions. These resilience options are listed and described in **Appendix A** together with the respective solution(s) to which they relate.

## 1.4 The Legislative Context – Water Framework Directive

1.4.1 The WFD[3] came into force in 2000 in the European Union (EU), and was transposed into UK law in 2003 with the principal aims of protecting and improving the water environment and promoting the sustainable use of water. Environmental Quality Standards (EQSs) for priority substances have been set by so-called 'daughter' directives to the WFD, in the form of the EQS Directive[4] and subsequent amendments (EQSD)[5] and the Groundwater Directive (GWD)[6]. The environmental objectives of the WFD and its daughter directives are to:

- Prevent deterioration of aquatic ecosystems;
- Protect, enhance and restore water bodies to good status, which is based on ecology (with its supporting hydromorphological and physico-chemical factors) and chemical factors for surface water, and water quantity and chemical status for groundwater;
- Comply with water related standards and objectives for environmentally protected areas established under other EU legislation, e.g. The Habitats Directive 92/43/EEC; and
- Progressively reduce pollution from priority substances and cease or phase out discharges from priority hazardous substances; and

[3] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (the Water Framework Directive).
[4] Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council (the Priority Substances Directive).
[5] Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.
[6] Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration (the Groundwater Directive) including Commission Directive 2014/80/EU which amends Annex II of the original Directive 2006/118/EC

- Prevent or limit input of pollutants into groundwater and reverse any significant or sustained upward trends in the concentration of any groundwater pollutant.

1.4.2 The WFD sets a default objective for all rivers, lakes, estuaries, groundwater and coastal water bodies to achieve good status or potential by 2027 at the latest. Where it is not possible to achieve this (e.g. due to disproportionate costs), alternative water body objectives can be set. The current (baseline) status (e.g. 2015 classification), and the measures required to achieve the 2027 status objective, are set out for each water body in the relevant River Basin Management Plans (RBMPs), prepared by the EA every six years.

1.4.3 The resilience options/solutions assessed in this supplementary report are located within the RBMP for the North West River Basin District. The current RBMPs (known as the 'Cycle 2 plans') were published in February 2016 and they provide the baseline condition of the water environment for the assessment presented in this report.

1.4.4 The final WRMP must be able to demonstrate that it would not cause a deterioration in respect of these baseline conditions. Furthermore, for those water bodies that are not currently attaining good status, the WRMP must be able to demonstrate that it would not preclude the delivery of measures to facilitate the improvements needed to attain good status.

1.4.5 For more information on how the WFD is applied to surface water bodies, groundwater bodies and protected areas, and how this influences the WFD assessment of the resilience options, see Sections 1.5 to 1.7 in the main WFD Assessment Report.

## 1.5 Structure of this Report

1.5.1 The structure of the remainder of this report is as follows:

- **Section 2** outlines the methodology that has been adopted in order to undertake the WFD assessment of resilience options and solutions;
- **Section 3** presents an overview of the resilience options, and outlines how each type of option has been treated in the assessment process;
- **Section 4** presents the results of the assessment of the resilience options and solutions;
- **Section 5** provides the conclusions of the assessment including requirements for further work; and
- **Section 6** is the statement of compliance with the WFD.

# 2. Approach to the WFD Assessment of WRMP Resilience Options and Solutions

## 2.1 Overview of the Approach to the Assessment

2.1.1 The WFD assessment has considered the following key questions in respect of the construction and operational phase of each resilience option:

- At the water body scale, would the resilience option result in a deterioration of any of the WFD classification components from one status class to the next, (e.g. from good to moderate), irrespective of whether or not it results in the lowering of overall status?
- Would the resilience option prevent any water bodies from achieving good overall status or, where relevant, an alternate objective?

2.1.2 Once a decision on the preferred resilience solution has been made, an assessment will be made of the following for each of the resilience options that make up the preferred resilience solution:

- Would the cumulative effects of multiple resilience options impact on the objectives of individual WFD water bodies?
- Would the cumulative effects of multiple resilience options impact on the objectives of multiple water bodies that are hydrologically linked (i.e. operational catchments)?
- Would the cumulative effects of multiple resilience options affect protected areas and their associated objectives?

2.1.3 If the answer to all of the above five questions is 'no' then the resilience option and the preferred resilience solution can be considered to be WFD compliant. Note that at the time of writing, the WFD assessment has considered the options individually. However, an initial screening for the cumulative and protected area assessments has been undertaken, and once a preferred solution has been selected by UU, the full cumulative and protected area assessments will confirm the WFD compliance of the solution as a whole.

2.1.4 Whilst some guidance is available to help answer the above questions, the overall assignment of WFD impact was based on expert judgement. For further information on the guidance available see Section 3.1 in the main WFD Assessment Report.

2.1.5 The possible future decommissioning of resilience options is beyond the scope of this assessment, but impacts arising from decommissioning are likely to be similar to those arising from construction.

## 2.2 WFD Assessment Process

2.2.1 The WFD assessment has been undertaken on 34 resilience options identified by UU. The resilience option reference numbers and names are listed in **Appendix A**. The assessment steps are the same as those followed for the assessment of the feasible options contained in the Draft WRMP, and are as follows:

- All resilience options:
  - Step 1: Collation of resilience option data;
  - Step 2: Level 1 screening of resilience options; and

- Step 3: Level 2 detailed assessment of potential impacts on water bodies[7].

2.2.2 Further assessment of those options that comprise the preferred solution (when identified) will comprise:

- Step 4: Cumulative assessment; and
- Step 5: Protected areas assessment.

2.2.3 However, as noted above, an initial screening for the cumulative and protected area assessments has been undertaken and is presented in this supplementary report.

## Step 1: Collation of Option Data

2.2.4 The WFD assessments for each resilience option were based on the engineering scope information provided by UU. Information was provided on likely resilience option 'activities' (e.g. new surface water abstraction, new pumping stations etc.) as well as GIS files of the geographical location of new infrastructure. The engineering scopes are typically high level documents, to enable desk top assessment, and do not contain detailed information on construction methods or designs of the new infrastructure.

## Step 2: Level 1 Screening of Resilience Options

2.2.5 Each resilience option was broken down into its main constituent parts ('activities') based on construction and operational phases. This included activities such as:

- **Construction phase**; trenching and laying of pipe lines, building new abstraction infrastructure (e.g. river intakes, pumping stations), refurbishment of current infrastructure; and
- **Operational phase**: abstractions, discharges, maintenance of pipe lines.

2.2.6 Each resilience option was considered against each activity which would occur as part of the resilience option, and the likely impact assigned based on the definitions of impacts described in **Table 2.1**. In this step, the assessment was undertaken at the resilience option level and individual WFD water bodies were not identified[8].

Table 2.1 Impact Classification Categories

| Level of impact | Description of impact |
|---|---|
| **No or minimal impact** | No measurable change in the quality of the water environment or the ability for target WFD objectives to be achieved. |
| **Minor level of impact** | Impacts from the resilience option when taken on their own have the potential to lead to a minor localised, short-term and fully reversible effect on the quality of the water environment that would not result in the lowering of WFD status.<br><br>Impacts would be very unlikely to prevent any target WFD objectives from being achieved. |
| **Medium level of impact** | Impacts when taken on their own have the potential to lead to a widespread or prolonged effect on the quality of the water environment that may result in the temporary lowering of WFD status.<br><br>Impacts have the potential to prevent target WFD objectives from being achieved. |
| **High level of impact** | Impacts when taken on their own have the potential to lead to a significant effect and permanent deterioration of WFD status.<br><br>Impacts have a high risk of preventing target WFD objectives from being achieved. |

[7] Only undertaken on resilience options which are categorised as having a medium or high level of impact in the Level 1 screening.

[8] Note that this is a slightly difference approach to that used for the assessment of the main WRMP options where the Level 1 screening was undertaken at the water body level.

2.2.7 Some activities (e.g. pipe line construction) are highly unlikely to have more than a minor level of impact on a water body, no matter what the status of the water body is. This is because the activities are limited in spatial extent, will occur for a short duration in time, and/or have limited scope for interaction with the water environment. It should also be noted that the Level 1 screening assessment has assumed that all construction activities will be undertaken in line with best practice construction and pollution control measures, and that all relevant consents would be secured and complied with (refer to **Section 2.3**). Where the Level 1 screening has identified that a resilience option would only result in a minimal or minor level of impact, from one or more activities, the resilience option has been screened out from the Level 2 detailed assessment and is considered to be WFD compliant.

2.2.8 Other activities have the potential for a medium or high level of impact on the WFD status of a water body. These include activities that could have long term impact on water resources (e.g. a new surface water abstraction), or involve large scale sub-surface construction of new structures in a groundwater body (e.g. tunnels). Where the Level 1 screening has identified that a resilience option could result in a medium or high level of impact from one or more activities, the resilience option was screened in for Level 2 detailed assessment.

2.2.9 **Table 2.2** summarises the Level 1 screening impacts from the activities that make up the resilience options.

Table 2.2 Level 1 Screening Impacts from Option Activities

| Level of impact | Construction activities | Operation activities | Level 1 screening result |
|---|---|---|---|
| **No or minimal impact** | ▶ Trenching and laying of pipe lines within the interfluves of a catchment (no watercourse crossings);<br>▶ Modification of an existing water treatment works;<br>▶ Construction of a new water treatment (set back from a watercourse). | ▶ Maintenance of pipe lines;<br>▶ Maintenance and use of pumping stations and water treatment works;<br>▶ Maintenance and use of river intakes/outfalls. | Screened out of Level 2 detailed assessment |
| **Minor level of impact** | ▶ Trenching and laying of pipe lines involving watercourse crossings;<br>▶ Construction or modification of a new pumping station and/or river intake. | ▶ No minor impact operation activities in the resilience options. | Screened out of Level 2 detailed assessment |
| **Medium level of impact** | ▶ Construction/repair of new tunnels and conduits. | ▶ New or increased surface water abstraction;<br>▶ Presence of new underground structures such as tunnels and shafts. | Screened in for Level 2 detailed assessment |
| **High level of impact** | ▶ No high level impact construction or operation activities in the resilience options. | | |

## Step 3: Level 2 Detailed Assessment of Potential Impacts

2.2.10 Where the Level 1 screening of resilience options indicated that an activity may have a medium or high level of impact, further assessment of the potential impacts was undertaken. This was recorded in an impact assessment worksheet for each water body that may be subject to a medium or high level of impact.

2.2.11 All relevant water bodies that the resilience option could impact on were identified by comparing the engineering pro forma to the spatial extent of WFD water bodies obtained from the EA's

Catchment Data Explorer website[9]. This website was also used to collate baseline WFD data for each water body for the Level 2 assessments. The Level 1 and Level 2 assessments were based on the 2015 classifications, in line with the 2015 Cycle 2 RBMPs. Additional baseline data for the Level 2 assessments was collected from the EA's Abstraction Licensing Strategies (ALS)[10].

2.2.12 For the Level 2 screening, each resilience option was broken down into its main constituent activities. Each activity was considered separately against each WFD element and the WFD baseline that has been collated. However, where feasible, assessments against elements were grouped if the scale and level of impacts were expected to be similar.

2.2.13 The assessments were based on available data and evidence as far as possible. However, due to the limited engineering and baseline information available, expert opinion has been employed in most cases. Where there was uncertainty over a resilience option (e.g. the exact route of a pipe line is not known), a worst case scenario approach has been used (e.g. the assessments have assumed that the pipe line has watercourse crossings rather than not).

2.2.14 The same level of impact categories were used as in the Level 1 screening (**Table 2.1**). The final impact category identified for each part of a resilience option assumes that generic construction best practice and pollution prevention measures would be put in place (see **Section 2.3**).

2.2.15 A confidence rating has been given to the Level 2 assessments, according to the confidence categories in **Table 2.3**. The confidence rating assigned to each assessment is a reflection on the amount of uncertainty in the resilience option design, and the amount and quality of evidence upon which the impact level has been based. All the assessments that have only been subject to a Level 1 assessment are assigned a high confidence by default.

Table 2.3 Confidence Level Categories

| Confidence category | Description of confidence |
|---|---|
| **Low** | Very limited evidence, high risk activity or assessment solely based on expert judgement. |
| **Medium** | Reasonable levels of evidence for some aspects of the assessment. Some assumptions and expert opinion required. |
| **High** | Good level of evidence with minimal assumptions required or low risk activity. |

2.2.16 The overall WFD impact of the resilience options was based on the 'one out, all out' methodology used for the WFD. For example, this would mean that if the construction phase of an resilience option has a final level of impact of 'no or minimal' but the operational phase has a level of impact of 'medium', the overall impact to WFD objectives from the resilience option would be identified as 'medium level of impact'.

## Step 4 and Step 5: Cumulative and Protected Area Assessments Screening

2.2.17 As set out above, initial screening for the cumulative and protected area assessments has been undertaken to inform the UU's selection of its preferred resilience solution for WRMP19.

2.2.18 For the cumulative assessment, this has included identifying which waterbodies and operational catchments are affected by more than one option, and therefore which solutions will require a full cumulative assessment if selected. Once the preferred solution has been selected, any cumulative impact in-combination with the Draft WRMP as a whole will also be considered.

2.2.19 For the protected area assessment, this has included identifying those waterbodies that are affected by one or more options and which are linked to a protected area designated for habitat and species protection. This is based on data from the EA Catchment Data Explorer website, and

[9] EA Catchment data explorer, available at: http://environment.data.gov.uk/catchment-planning/
[10] Abstraction Licencing Strategies, accessed October 2017: https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process.

no further analysis has been undertaken at this stage. This would form part of the full protected area assessment on the preferred solution (once identified).

## 2.3 Assumptions

2.3.1 The WFD assessment has been based on available data, primarily spatial data on the EA's Catchment Data Explorer website, and the engineering scopes provided for each resilience option by UU. However, in all cases the information had insufficient detail and so the use of assumptions in the assessment was required. The assumptions used were as follows:

- Construction best practice will be used at all construction sites. As no detailed plans or construction methods were available for the assessments, they are based on the assumption that measures will be implemented that are consistent with the suite of Guidance for Pollution Prevention[11], and that all relevant consents would be secured and complied with. This is especially crucial in respect of in-channel works and works that take place in proximity to river channels (e.g. within 8 metres);
- All new transfer pipe line river watercourse crossings would be installed via trenchless techniques or via a trench and cover technique within a dry working area. Trench and cover techniques would require temporary over pumping of water or temporary diversion of the river channel, and a reinstatement of bed and bank material, and flow, once works are complete. Such works would require consent from the EA or Lead Local Flood Authority, which would ensure WFD compliance;
- Ground investigations would be undertaken prior to construction activities. These will identify any contaminated land, historical coal workings, and mitigation that may be required;
- Extensions, modifications, or new pumping stations, water treatment works, etc. would be consented either via permitted development rights, or via planning consent from the relevant Local Planning Authority. Construction of these components would involve a relatively small footprint in the context of any WFD water body catchment, would not be laterally extensive (compared to, for example, a new transfer main), and would not involve the requirement for in-channel works. Where planning consent is required, such developments would need to demonstrate that they are compliant with the objectives of the WFD in order to gain planning consent;
- Dewatering of shallow excavations would not require a permit from the EA. Dewatering and a corresponding discharge from shallow excavations of sufficient magnitude, duration, or sensitivity to require a permit may have a greater impact than assessed. However it is assumed that the dewatering permit would limit any impacts to a minor level (localised and temporary). Dewatering would be of uncontaminated water, and water would be discharged within the same water body. This assumption does not include dewatering activities associated with the new tunnel and tunnel refurbishment resilience options, which would require further detailed assessment to establish the risks posed by dewatering; and
- The relatively shallow and localised excavations associated with laying new transfer pipe lines, and constructing new pumping stations, water treatment works etc. would not present a risk to the overall WFD status of groundwater bodies.

[11] http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

# 3. Overview of the Resilience Options

## 3.1 Introduction

3.1.1 The 34 resilience options have been assessed to identify if they present a risk to the delivery of WFD objectives. The following sub-sections describe the activity categories associated with the resilience options and outline how each activity has been dealt with during the Level 1 screening and the Level 2 detailed assessment.

## 3.2 Construction Phase Activities

### In-channel Construction Activities

3.2.1 Eight resilience options include the need for the construction of in-channel structures (e.g. new surface water abstractions requiring the construction of intake structures), or the construction of pipe lines with watercourse crossings. In-channel construction may have the following impacts on surface water bodies:

- Reduction in the chemical status due to deterioration in water quality as a result of disturbance of soils and sediments, particularly if contaminated;
- Reduction in the chemical status due to deterioration in water quality as a result of accidental spillage or leakage of fuels, oils and other chemicals associated with construction machinery;
- Reduction in the ecological status due to deterioration in chemical status;
- Reduction in the ecological status due to smothering of habitats or reduction in light as a result of release of sediments; and
- Reduction in the ecological status due to changes in hydrological regime, river continuity or morphological conditions as a result of impoundments or changes to the structure of the channel.

3.2.2 For the purposes of the WFD assessment, it has been assumed that construction best practice would be used, including pollution prevention measures (see **Section 2.3**). As such, any effects that do occur would be temporary and localised. In channel construction has therefore been flagged as a minor impact in the Level 1 screening and is not subject to a detailed Level 2 assessment.

### Near Surface Catchment Construction Activities

3.2.3 A total of 31 resilience options include the construction or modification of raw water transfer pipe lines, water treatment works, and other infrastructure in the near surface environment, but away from watercourse channels.

3.2.4 These structures typically have a very small footprint compared to the WFD water bodies as a whole, and only involve relatively shallow excavations. Assuming that construction best practice is implemented (see **Section 2.3**), these activities are unlikely to have a negative impact on the status of the water bodies. As such, construction activities away from watercourses have been assigned a no or minimal impact in the Level 1 screening and are not subject to a detailed Level 2 assessment.

### Construction or Repair of Tunnels and Conduits

3.2.5 Two resilience options include the construction of new tunnels and conduits, and two include the repair of existing tunnels and conduits that make up the Manchester and Pennine Aqueduct.

These four resilience options also include the drilling of temporary and permanent access shafts to the new or existing tunnels. The potential impacts of these activities include:

- Reductions in the quantitative status of a groundwater body due to dewatering of shafts and tunnels;
- Changes to groundwater levels and flow patterns due to dewatering of shafts and tunnels, or through the creation or disruption of groundwater flow pathways due to subsurface excavation and construction. These changes could result in a reduction in the quantitative status of a groundwater body. Depending on the nature of the surface geology and the degree of connectivity between the groundwater and surface water environment, there may also be an impact on the hydrological regime of overlying surface water bodies or protected areas;
- Reductions in chemical status of groundwater bodies. This could be caused by migration of contaminated groundwater from shallow contaminated land or abandoned coal workings to unaffected areas of the groundwater body, or by leakages from construction machinery;
- Reduction in the chemical status of surface water bodies due to deterioration in water quality arising from disturbance of soils and sediments at the surface, particularly if contaminated, or due to accidental spillage or leakage of fuels, oils and other chemicals associated with construction machinery;
- Reduction in the ecological status of surface water bodies due to smothering of habitats or reduction in light as a result of the release of sediments from construction activities; and
- Reduction in the ecological status of surface water bodies resulting from a deterioration in chemical status.

3.2.6 The length of the tunnels (up to 52 km of new tunnels), the number of access shafts that need to be constructed (estimated at every 3 km), and the scale of the excavation and construction activities means that there is the potential for significant impacts on the WFD status of water bodies. As a result, resilience options that include tunnels have been assigned a medium level of impact in the Level 1 screening and are subject to a Level 2 detailed assessment.

## 3.3 Operation Phase Activities

### New Abstractions

3.3.1 Two resilience options include a new surface water abstraction. The impact of this activity may include:

- Reduction in the ecological status of the surface water body due to changes in the hydrological regime failing to support good status of biological elements such as fish or benthic invertebrates;
- Reduction in the chemical status of the surface water body due to reduction of dilution of specific pollutants, priority substances or priority hazardous substances;
- Reduction in the ecological status of the surface water body due to changes in the chemical status failing to support good status of biological elements such as fish or benthic invertebrates; and
- Reduction in the quantitative water balance of a groundwater body due to changes to the quantity and patterns of leakage of surface water to groundwater.

3.3.2 Changes to abstractions may have a widespread or prolonged effect on the WFD status of surface water bodies, so water bodies in which a new abstraction is located have been screened in for Level 2 detailed assessment.

## Presence of New Tunnels and Conduits

3.3.3 Two resilience options include the construction of new tunnels and conduits. These resilience options also include the construction of permanent access shafts to the new or existing tunnels. The potential impacts of these resilience options include:

- Changes to groundwater levels and flow patterns due to the presence of a new subsurface impermeable structure. Where the diameter of the tunnel is small in comparison to the saturated thickness of the aquifer, and the tunnel is well below the water table, impacts are likely to be minor. However, where the diameter of the tunnel is large relative to the saturated thickness of the aquifer, and the tunnel is close to the water table and active zone of groundwater flow, greater impacts may occur, particularly if the tunnel is perpendicular to the direction of groundwater flow. These changes may cause a reduction in the quantitative status of the groundwater body, and may also impact on the hydrological regime of overlying surface water bodies or protected areas (depending on the degree of connection between the groundwater and surface water environment). Changes to groundwater levels and flow patterns may also occur if altered or preferential flow paths are created in the strata immediately surrounding the tunnels and shafts; and
- Changes to the chemical status of groundwater bodies due to leakages from the aqueduct. However, it is assumed that the potable standard raw water would be free from hazardous and priority hazardous substances and other pollutants, and would therefore not have a significant negative effect on the chemical status of the groundwater body.

3.3.4 The presence of large (up to 52 km long tunnels) impermeable structures in the subsurface has the potential to result in permanent changes to the groundwater environment which may impact on both groundwater and surface water bodies. As a result, resilience options which include tunnels have been assigned a medium level of impact in the Level 1 screening and have been subject to a Level 2 assessment.

# 4. Results of the WFD Assessment of Resilience Options and Solutions

## 4.1 Introduction

4.1.1 The results of the Level 1 and Level 2 assessments for each resilience option are summarised in **Table 4.1**, and described by solution in Sections 4.3 to 4.7.

4.1.2 For each of the five resilience solutions, the impact level of all the individual resilience options within that solution have been considered, and initial screening level cumulative and protected area assessments have been undertaken. Further cumulative and protected area assessments will be required for the preferred resilience solution once this has been identified by UU.

## 4.2 Resilience Options

4.2.1 **Table 4.1** presents a summary of the resilience options assessment. This assessment indicates that, in total:

- 22 resilience options have a no or minimal level of impact;
- 7 resilience options have a minor level of impact; and
- 5 resilience options have a medium level of impact.

Table 4.1 Summary of Resilience Option Assessment

| Option Number | Solution | Option Description | WFD Impact Level | Confidence Rating |
|---|---|---|---|---|
| **3** | C | Manchester and Pennine Aqueduct to Raw: 2 Stage filtration (Bury) | No or minimal impact | High |
| **37-38** | B | Manchester and Pennine Aqueduct section T05 to T06 | Medium level of impact | Low |
| **37-42** | D, E | Manchester and Pennine Aqueduct sections T01 to T06 | Medium level of impact | Low |
| **46** | A, E | WELM Uprate to 150Ml/day | No or minimal impact | High |
| **112** | B, D | Manchester and Pennine Aqueduct Outage (4 weeks) for installation of connections | No or minimal impact | High |
| **212** | C | Manchester and Pennine Aqueduct to Raw (Newton-in-Bowland) | No or minimal impact | High |
| **213** | C | Manchester and Pennine Aqueduct to Raw (Clayton-le-Moors) | No or minimal impact | High |
| **214** | C | Manchester and Pennine Aqueduct to Raw (Haslingden) | No or minimal impact | High |
| **215** | E | Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors) | Medium level of impact | Medium |
| **216** | A, E | Alternative Supply: Raw water abstraction and WTW (Haslingden) | Minor level of impact | Medium |
| **217** | E | Alternative Supply: Raw water transfer and WTW (Newton-in-Bowland) | Minor level of impact | High |
| **218** | E | Alternative Supply: Raw water transfer and WTW (Preston) | Minor level of impact | High |

| Option Number | Solution | Option Description | WFD Impact Level | Confidence Rating |
|---|---|---|---|---|
| **238** | B | Metals & UV treatment of BSPs: Bury | No or minimal impact | High |
| **260** | A | Ribblesdale South Well Isolation | No or minimal impact | High |
| **261** | A | Haslingden Well Isolation | No or minimal impact | High |
| **296** | A | T05 targeted repair 2025 | Medium level of impact | Low |
| **297** | A | T06 targeted repair 2025 | Medium level of impact | Low |
| **301** | C | Lunesdale Siphon BSPs North | Minor level of impact | High |
| **303** | C | Lunesdale Siphon BSPs South | Minor level of impact | High |
| **306** | C | Ribblesdale Siphon BSPs North | Minor level of impact | High |
| **348** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (1) | No or minimal impact | High |
| **349** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (2) | No or minimal impact | High |
| **350** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (3) | No or minimal impact | High |
| **351** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (4) | No or minimal impact | High |
| **352** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (5) | No or minimal impact | High |
| **353** | B | Metals & UV Treatment of BSPs: Lunesdale Siphon (6) | No or minimal impact | High |
| **354** | B | Metals & UV Treatment of BSPs: Hodder Siphon | No or minimal impact | High |
| **355** | B | Metals & UV Treatment of BSPs: Ribblesdale Siphon (1) | No or minimal impact | High |
| **356** | B | Metals & UV Treatment of BSPs: Ribblesdale Siphon (2) | No or minimal impact | High |
| **357** | B | Metals & UV Treatment of BSPs: Ribblesdale Siphon (3) | No or minimal impact | High |
| **358** | B | Metals & UV Treatment of BSPs: Ribblesdale Siphon (4) | No or minimal impact | High |
| **359** | B | Metals & UV Treatment of BSPs: Ribblesdale Siphon (5) | No or minimal impact | High |
| **360** | B | Metals & UV Treatment of BSPs: Haslingden | No or minimal impact | High |
| **382** | C | Manchester and Pennine Aqueduct to Raw: WTW reduced flow | Minor level of impact | High |

## 4.3 Solution A (FM20-SO4)

4.3.1 Solution A includes six resilience options involving new sources and targeted repair of Tunnel 5 and Tunnel 6 (T05 and T06), centred around uprating the West East Link Main (WELM), construction of a new associated break tank near Bolton and new abstraction from the River Irwell with treatment.

4.3.2 Three resilience options in this solution have been assessed at no or minimal impact with a high level of confidence in the Level 1 screening assessment:

- 46: WELM Uprate to 150Ml/day;
- 260: Ribblesdale South Well Isolation; and

- 261: Haslingden Well Isolation.

4.3.3 Option 216 (Alternative Supply: Raw water abstraction and WTW (Haslingden) was assigned a medium level of impact in the Level 1 screening assessment as it includes a new surface water abstraction, but following the Level 2 assessment, the impact was lowered to minor with a medium confidence due to the relatively small size of the abstraction and the availability of water in the surface water body.

4.3.4 Two resilience options (296: T05 targeted repair 2025, and 297: T06 targeted repair 2025) were assigned a medium level of impact in the Level 1 screening, and this was confirmed in the Level 2 detailed assessment, but with a low level of confidence. These resilience options involve the repair of the existing Manchester and Pennine Aqueduct tunnels and conduits, including new access shafts. Medium impacts could occur in the groundwater bodies as a result of water quality impacts from drilling shafts through mine workings, or spillages from construction machinery in the subsurface environment. The assessment results have been assigned a low level of confidence due to the lack of design detail at this stage, and the high level of the WFD assessment (i.e. no detailed baseline data has been collected).

4.3.5 Cumulative assessments have not been undertaken at this time. Initial screening indicates that for most water bodies or operational catchments affected by more than one resilience option, the impact level would not be raised above the highest impact level assigned to the individual options. However, the Croal and Irwell catchment will be affected by both of the tunnel repair options (296 and 297) plus the new abstraction under Option 216. If this solution is selected as the preferred solution, further cumulative assessment would therefore be required.

4.3.6 No waterbodies affected by the options that comprise this solution are linked to a protected area, so a protected area assessment would not be required if this solution is selected as the preferred solution.

## 4.4 Solution B (C29)

4.4.1 Solution B includes sixteen resilience options related to new tunnel sections T05 and 06 and partial UV and metals treatment at existing UU facilities along the length of the existing Manchester and Pennine Aqueduct.

4.4.2 Fifteen of the sixteen resilience options have been assessed as no or minimal impact with a high level of confidence in the Level 1 screening. This includes resilience options 112 (HA Outage (4 weeks) for installation of connections), 238 and 348 to 360 (metals and UV treatment of bulk supply points).

4.4.3 Option 37 – 38 (Manchester and Pennine Aqueduct section T05 to T06) was assigned a medium level of impact in the Level 1 screening, and this was confirmed in the Level 2 detailed assessment, but with a low level of confidence. This resilience option involves the construction of 19.2 km of new tunnel and conduit, along with associated temporary and permanent access shafts, and connections into the existing Manchester and Pennine Aqueduct.

4.4.4 Medium impacts could occur in the construction phase due to dewatering of the tunnel and shafts, and due to water quality impacts from drilling shafts through mine workings, or spillages from construction machinery in the subsurface environment. Medium impacts could also occur in the operation phase due to permanent changes in the groundwater flow regime, impacting both groundwater and surface water bodies.

4.4.5 A detailed study of the geology of the tunnel route has not been undertaken at this time, and good connections between the groundwater and surface water environment have been assumed. Further study may indicate that lower permeability strata (e.g. mudstones) and superficial deposits (e.g. glacial till) may protect surface water bodies from impacts arising from changes in the groundwater regime. Due to this uncertainty, the general high level nature of the WFD assessments, and the lack of design detail at this stage, the results have been assigned a low level of confidence.

4.4.6 Cumulative assessments have not been undertaken at this time. Initial screening indicates that no waterbody that is affected by this solution is affected by more than one option. Several individual waterbodies in the Croal and Irwell catchment and the Calder catchment are affected by Option 37-38 and in consequence, a cumulative assessment would be required should this solution be taken forward as the preferred solution, although it is unlikely that the impact on the surface watercourses would be raised above the current medium level of impact.

4.4.7 No waterbodies affected by the options that comprise this solution are linked to a protected area that is designated for protection of habitats and species, so a protected area assessment would not be required if this solution is selected as the preferred solution.

## 4.5 Solution C (FM15-SO4b)

4.5.1 This solution includes eight resilience options for converting the Manchester and Pennine Aqueduct to raw water supply and building WTWs.

4.5.2 All eight of the resilience options that make up this solution have been assessed as no or minimal or minor level of impact with a high level of confidence in the Level 1 screening. These resilience options would include new pipelines and/or new WTWs but with suitable construction best practice and pollution control measures in place, they would not have a prolonged or widespread impact on the WFD status of water bodies.

4.5.3 Cumulative assessments have not been undertaken at this time. As no options in this solution would have greater than a minimal level of impact, a cumulative assessment would not be required if this solution is selected as the preferred solution.

4.5.4 No waterbodies affected by options in this solution are linked to a protected area, so a protected area assessment would not be required if this solution is selected as the preferred solution.

## 4.6 Solution D (C11)

4.6.1 Solution D includes two resilience options associated with new tunnel sections T01, 02, 03, 04, 05 and 06.

4.6.2 Option 112 (HA Outage (4 weeks) for installation of connections) has been assessed as no or minimal impact with a high level of confidence in the Level 1 screening because there is no new infrastructure and no construction works proposed as part of this resilience option.

4.6.3 Option 37 – 42 (Manchester and Pennine Aqueduct sections T01 to T06) was assigned a medium level of impact in the Level 1 screening, and this was confirmed in the Level 2 detailed assessment, although with a low level of confidence. This resilience option involves the construction of 51.8 km of new tunnel and conduit, along with associated temporary and permanent access shafts, and connections into the existing Manchester and Pennine Aqueduct.

4.6.4 Medium impacts could occur in the construction phase of this resilience option due to dewatering of the tunnel and shafts, and due to water quality impacts from drilling shafts through mine workings, or spillages from construction machinery in the subsurface environment. Medium impacts could also occur in the operation phase due to permanent changes in the groundwater flow regime, impacting both groundwater and surface water bodies.

4.6.5 A detailed study of the geology of the tunnel route has not been undertaken at this time, and good connections between the groundwater and surface water environment have been assumed. Further study may indicate that lower permeability strata (e.g. mudstones) and superficial deposits (e.g. glacial till) may protect surface water bodies from impacts arising from changes in the groundwater regime. Due to this uncertainty, the general high level nature of the WFD assessments, and the lack of design detail at this stage, the results have been assigned a low level of confidence.

4.6.6 Cumulative assessments have not been undertaken at this time. An initial screening indicates that no waterbody that is affected by this solution is affected by more than one option. Several individual waterbodies in the Croal and Irwell catchment, the Calder catchment, the Kent catchment, the Bela catchment and the Hodder and Loud catchment are affected by Option 37-42. If this solution is selected as the preferred solution, a cumulative assessment would therefore be required; however, it is unlikely that the impact on the surface watercourses would be raised above the current medium level of impact.

4.6.7 Six waterbodies affected by options under this solution are linked to protected areas that are designated for protection of habitats and species (The Bowland Fells, Morcambe Bay Pavements and the River Kent). In consequence, a protected area assessment would be required if this solution is selected as the preferred solution.

## 4.7 Solution E (C17)

4.7.1 This solution includes six resilience options, comprising new tunnel sections as for Solution D, plus new sources requiring WTWs and associated pipelines.

4.7.2 Three of the six resilience options have been assessed as no or minimal impact, or minor level of impact with a high level of confidence in the Level 1 screening because they involve relatively small scale in catchment or in channel construction works. These are resilience options:

- 46: WELM Uprate to 150 Ml/day;
- 217: Alternative Supply: Raw water transfer and WTW (Newton-in-Bowland); and
- 218: Alternative Supply: Raw water transfer and WTW (Preston).

4.7.3 Options 215 (Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors) and 216 (Alternative Supply: Raw water abstraction and WTW (Haslingden) are both related to new surface water abstractions, and were assigned a medium level of impact in the Level 1 screening assessment. The Level 2 detailed assessment lowered the impact of Option 216 to a minor level of impact due to the relatively small size of the proposed abstraction and the availability of water in the surface water body in which the new abstraction is located. The impact of Option 215 has remained at medium in the Level 2 detailed assessment due to the large size of the abstraction.

4.7.4 As with Solution D, Option 37 – 42 (Manchester and Pennine Aqueduct sections T01 to T06 was assigned a medium level of impact in the Level 1 screening, and this was confirmed in the Level 2 detailed assessment, but with a low level of confidence. This resilience options involves the construction of 51.8 km of new tunnel and conduit, along with associated temporary and permanent access shafts, and connections into the existing Manchester and Pennine Aqueduct.

4.7.5 Medium impacts could occur in the construction phase of this option due to dewatering of the tunnel and shafts, and due to water quality impacts from drilling shafts through mine workings, or spillages from construction machinery in the subsurface environment. Medium impacts could also occur in the operation phase due to permanent changes in the groundwater flow regime, impacting both groundwater and surface water bodies.

4.7.6 A detailed study of the geology of the tunnel route has not been undertaken at this time, and good connections between the groundwater and surface water environment have been assumed. Further study may indicate that lower permeability strata (e.g. mudstones) and superficial deposits (e.g. glacial till) may protect surface water bodies from impacts arising from changes in the groundwater regime. Due to this uncertainty, the general high level nature of the WFD assessments, and the lack of design detail at this stage, the results have been assigned a low level of confidence.

4.7.7 Cumulative assessments have not been undertaken at this time. An initial screening indicates that for most water bodies or operational catchments affected by more than one option, the impact level would not be raised above the highest impact level assigned to the individual options. However, the three waterbodies will be affected the tunnel options (37-42) plus a new abstraction (option 215

or 216). If this solution is selected as the preferred solution, further cumulative assessment would therefore be required.

4.7.8 Six waterbodies affected by options in this solution are linked to protected areas that are designated for protection of habitats and species (The Bowland Fells, the River Kent, and Morecambe Bay Pavements), so a protected area assessment would be required if this solution is selected as the preferred solution.

# 5. Summary and Conclusions

## 5.1 Summary of Resilience Options Assessment

5.1.1 A WFD assessment has been undertaken of the 34 resilience options identified by UU to inform the development of WRMP19 and the selection of the preferred resolution solution. Each resilience option was initially subject to a Level 1 screening exercise. Resilience options that were identified as being subject to a medium or high level of impact in the Level 1 screening were then subject to a Level 2 detailed assessment at a waterbody scale.

5.1.2 The results of the screening and detailed assessments were collated to produce a combined assessment result for all resilience options, which are described in **Section 4**, and summarised by solution in **Table 5.1**.

5.1.3 It is important to note that full cumulative and protected area assessments have not been undertaken for any resilience options as a preferred solution has not yet been selected by UU. However, given the linear nature of the resilience options that typically have the highest potential impacts (new tunnels and tunnel repairs), it is considered unlikely that the cumulative assessment would result in a higher than medium level of impact for a single water body or catchment. The results of the protected area assessment are more difficult to anticipate, but based on the findings of the protected area assessment of the preferred WRMP19 resource management options (as assessed in the WFD Assessment Report), it is again considered unlikely that a higher than medium level of impact would be predicted.

Table 5.1 Summary of Resilience Option Assessment

| | | Number of options (and water bodies in brackets) at each impact level | | | | | |
|---|---|---|---|---|---|---|---|
| **Solution** | **Total No. of Options** | **No or Minimal** | **Minor** | **Medium** | **High** | **Overall Impact** | **Confidence** |
| **A** | 6 | 3 | 1 | 2 (2) | 0 | Medium level of impact | Low |
| **B** | 16 | 15 | 0 | 1 (8) | 0 | Medium level of impact | Low |
| **C** | 8 | 4 | 4 | 0 | 0 | Minor level of impact | High |
| **D** | 2 | 1 | 0 | 1 (21) | 0 | Medium level of impact | Low |
| **E** | 6 | 1 | 3 | 2 (22) | 0 | Medium level of impact | Low |

Note:
Some resilience options are included in more than one resilience solution.
For options assigned a no or minimal or minor level of impact in the Level 1 screening, individual water bodies were not identified.

## 5.2 Resilience Options Requiring Further Assessment

### The Reality of Moderate Potential Impact: A Regulatory Perspective

5.2.1 Five of the 34 resilience options have been assigned a medium level of potential impact. These occur in four out of the five resilience solutions. These options pose a potential risk of widespread or prolonged impacts on the status of WFD water bodies.

5.2.2 In such cases, further WFD assessment is required to be more conclusive in respect of requirements, or otherwise, for bespoke mitigation in order to ensure that WFD objectives are not compromised. In reality, on consideration of further information and dialogue with the EA on proposed bespoke mitigation measures, these resilience options are unlikely to result in significant

or long term potential impacts. Therefore, WFD compliance is unlikely to be an issue in respect of regulatory permitting once the further assessment provides the appropriate level of confidence for presentation to the regulator.

5.2.3 The assessments typically have a low level of confidence, which reflects the high level nature of the WFD assessments undertaken at this time. The lack of detailed design or environmental baseline information has necessitated a precautionary approach to the assessments, which relies on assumptions and results in a worst case level of impact. Further assessment and dialogue with the EA would likely result in a reduction of the level of impact, and an increase in the level of confidence.

## Resilience Options Requiring Further Assessment

5.2.4 Further detailed WFD assessment should be undertaken on the preferred solution and any composite options that have been assigned a medium level of impact in the Level 2 assessment. These include:

- 37-38: Manchester and Pennine Aqueduct section T05 to T06 (Solution B);
- 37-42: Manchester and Pennine Aqueduct sections T01 to T06 (Solutions D and E);
- 215: Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors) (Solution E);
- 296 T05 targeted repair 2025 (Solution A); and
- 297 T06 targeted repair 2025 (Solution A).

5.2.5 Further assessment should include a full cumulative assessment (where multiple options occur in a single waterbody or catchment), a full protected area assessment, consideration of more detailed design information, investigation of the water environment associated with each option (in particular links between the groundwater and surface water environments), detailed impact assessments, and more detailed review of WFD objectives to ensure that the impacts highlighted in this report are appropriately accounted for.

# 6. Statement of Compliance with the WFD

## 6.1 WFD Compliance of Resilience Options

6.1.1 The assessments of the resilience options for WRMP19 indicate that five of the 34 options, which occur in four of the resilience solutions, could have a medium level of impact against WFD objectives. In such cases, further WFD assessment is required to be more conclusive in respect of requirements, or otherwise, for bespoke mitigation in order to ensure that WFD objectives are not compromised.

6.1.2 In reality, on consideration of further information and dialogue with the EA on proposed bespoke mitigation measures during the consultation and project stages, these options are unlikely to result in significant or long term potential impacts. Therefore, WFD compliance is unlikely to be an issue in respect of regulatory permitting once the further assessment provides the appropriate level of confidence for presentation to the regulator.

## 6.2 Article 4.7 Requirements

6.2.1 If the impact assessment for a resilience option concluded that there was a high risk that the option would not be compliant with WFD requirements after mitigation (i.e. there would be a deterioration in WFD status of one or more water bodies), documentation would be required to justify permitting of the resilience option under the provisions of Article 4.7 of the WFD. Article 4.7 states that the option would not be in breach of the WFD if the following conditions were met:

- All practicable mitigation has been incorporated;
- There are no significantly better environmental options;
- The option is of overriding public interest and/or the benefits of the option outweigh the benefits of WFD compliance; and
- The reasons for the modifications to the water body are flagged to the EA for reporting in the next RBMP.

6.2.2 The Planning Inspectorate and the EA would be responsible for deciding whether the Article 4.7 conditions have been met with respect to any option.

6.2.3 Based on the assessments in this report, there is currently no requirement to implement Article 4.7 for the resilience options. However, this is based on the assumptions detailed in this report including that additional investigations and mitigation will be implemented for the preferred solution.

# Appendix A
# Resilience Options

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **3** | Manchester and Pennine Aqueduct to Raw: 2 Stage filtration (Bury) | This option would involve the development of a new 2 stage filtration Water Treatment Works (WTW) at an existing site in the Bury area in order to provide increased resilience. In conjunction with Options 212, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>In addition to the new WTW, the scheme would require new abstraction/ pumping from a Bulk Supply Point (BSP) to the new WTW, pumping from the new WTW to existing treated water storage, and the demolition of the existing connection mains. | ▶ Solution C |
| **37-38** | Manchester and Pennine Aqueduct section T05 to T06 | This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water.<br><br>This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 19.3km, and new connection chambers and isolating penstocks. | ▶ Solution B |
| **37-42** | Manchester and Pennine Aqueduct sections T01 to T06 | This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water.<br><br>This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 51.9km, and new connection chambers and isolating penstocks. | ▶ Solution D<br>▶ Solution E |
| **46** | WELM Uprate to 150Ml/day | This option would provide additional connectivity for treated water. It would involve the construction of a 3.1Ml break tank and intermediate pumping facilities to enable the transfer of 150 Ml/d. | ▶ Solution A<br>▶ Solution E |
| **112** | Manchester and Pennine Aqueduct Outage (4 weeks) for installation of connections | This option would involve implementing Manchester and Pennine Aqueduct outage for a period of 4 weeks to facilitate the installation of connections. There would be no new development associated with this option. | ▶ Solution B<br>▶ Solution D |
| **212** | Manchester and Pennine Aqueduct to Raw (Newton-in-Bowland) | Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Newton-in-Bowland area. In conjunction with Options 3, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Aqueduct to the WTW and pumped supply to an existing aqueduct. The new WTW is expected to treat an average of 41 Ml/d, with a maximum treatment capacity of 60 Ml/d. | ▶ Solution C |

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **213** | Manchester and Pennine Aqueduct to Raw (Clayton-le-Moors) | Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Clayton-le-Moors area. In conjunction with Options 3, 212, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Manchester and Pennine Aqueduct to the WTW inlet, a pumping station and circa 2.8km pipeline from the WTW to two BSPs. | ▶ Solution C |
| **214** | Manchester and Pennine Aqueduct to Raw (Haslingden) | Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Haslingden area. In conjunction with Options 3, 212, 213, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would involve the construction of a new 2 stage filtration WTW together with new connections from the Manchester and Pennine Aqueduct to the WTW inlet and from the WTW to an existing pumping station. | ▶ Solution C |
| **215** | Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors) | This option would provide additional raw water from the River Ribble (under a new abstraction licence) and additional water treatment capacity in the Clayton-le-Moors area. The option, in conjunction with Options 216, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E.<br><br>The option would require a new abstraction point, circa 9.1km of 800m main to a new 3 stage WTW and a pumping station. | ▶ Solution E |
| **216** | Alternative Supply: Raw water abstraction and WTW (Haslingden) | This option would provide additional raw water from the River Irwell (under a new abstraction licence) and additional water treatment capacity in the Haslingden area. The option, in conjunction with Options 215, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E.<br><br>The option would require a new abstraction point and pumping station, circa 1.0km of 450mm main to a new 3 stage WTW and a new connection from the WTW to an existing BSP. | ▶ Solution A<br>▶ Solution E |
| **217** | Alternative Supply: Raw water transfer and WTW (Newton-in-Bowland) | This option would provide additional raw water from an aqueduct and additional water treatment capacity in the Newton-in-Bowland area. The option, in conjunction with Options 215, 216 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E.<br><br>The option would require a new connection to the raw water aqueduct, circa 5.3km of 700mm diameter pipeline to transfer water from the connection point and a new 3 stage WTW and pumping station. | ▶ Solution E |

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **218** | Alternative Supply: Raw water transfer and WTW (Preston) | This option would redirect raw water from the River Wyre to additional water treatment capacity in the Preston area. The option, in conjunction with Options 215, 216 and 217, would provide additional abstraction/treatment facilities to facilitate Solution E.<br><br>The option would require a connection to the raw water feed from the River Wyre and pumping from the connection point via circa 8.5km of 800mm main to a new 3 stage WTW. A new pumping station would also be constructed at the WTW site to feed water from the WTW into an existing aqueduct via circa 4.4km of 700mm pipeline. | ▶ Solution E |
| **238** | Metals & UV treatment of BSPs: Bury | This option seeks to provide treatment of metals, cryptosporidium and/or E.Coli to the treated water which is being siphoned off the Manchester and Pennine Aqueduct. The option would require the construction of a new 2 stage WTW in the Bury area. | ▶ Solution B |
| **260** | Ribblesdale South Well Isolation | This option would enable the isolation of the downstream section T05 for rehabilitation. It would require a new valve chamber constructed around existing siphon pipes in the Clitheroe area and a new valve house over the chamber. The option would also require a new access road. | ▶ Solution A |
| **261** | Haslingden Well Isolation | This option would enable the isolation of the downstream section T06 for rehabilitation. It would require a new 12.5mID shaft on an existing 2.59mID conduit in the Haslingden area with two isolating penstocks and provision for downstream tunnel access. The option would also require a new control kiosk and access road. | ▶ Solution A |
| **296** | T05 targeted repair 2025 | This option would target section T05 for remedial works (tunnel lining) in order to provide greater structural support to the wider water distribution network.<br><br>Under the option, approximately 100m of section T05 would undergo tunnel lining which would involve the installation of steel liner. The installation of two new access shafts (5m diameter/110m deep) would be required to facilitate the proposed works. It should be noted that the installation of tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation. | ▶ Solution A |
| **297** | T06 targeted repair 2025 | This option would target section T06 for remedial works (tunnel lining and conduit lining) in order to provide greater structural support to the wider water distribution network.<br><br>It is proposed that an approximate 200m of section T06 would undergo conduit lining which would involve the installation of steel reinforcement cages sprayed with concrete lining whilst 200m of the tunnel would receive tunnel lining. The installation of four new access shaft/chambers (5m diameter/110m deep) would be required. Additionally, there is a risk that it may be necessary to rebuild a cracked conduit bridge (approx 30m) in addition to implementing a new settled conduit configuration as additional ancillary works. It should be noted that the installation of conduit/tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation. | ▶ Solution A |

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **301** | Lunesdale Siphon BSPs North | This option seeks to provide additional connectivity for treated water via existing pipework to treated water storage in the Kendal area and onwards to the north end of the Lunesdale Siphon where it would be intercepted by a proposed new pipeline connecting to existing BSPs. In conjunction with Options 3, 212, 213, 214, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would require pipelines from the treated water storage facility to the Manchester and Pennine Aqueduct in the vicinity of the BSPs in the Kirkby Lonsdale area in addition to increased storage provision at the existing treated water storage facility (from 0.75Ml to 9.0Ml). | ▶ Solution C |
| **303** | Lunesdale Siphon BSPs South | This option would increase connectivity for treated water through Manchester and Pennine Aqueduct outage on a permanent basis. In conjunction with Options 3, 212, 213, 214, 301, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The options would require new sections of pipeline between BSPs in the Bentham area. The option would also require: a new pumping station in the Bentham area; additional 9Ml storage at an existing treated water storage facility near Lancaster; modification to a pumping station in the Morecambe area to accommodate permanent usage; and the abandonment of existing facilities. | ▶ Solution C |
| **306** | Ribblesdale Siphon BSPs North | This option would adapt the connectivity of the treated water network with BSPs in the Clitheroe area being permanently supplied via an existing aqueduct and pumping stations using existing network infrastructure. In conjunction with Options 3, 212, 213, 214, 301, 303 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would require a new circa 2.9km reinforcing pipe (250mm diameter) to support the new configuration between the BSPs and the aqueduct. Some existing pipelines would be abandoned. | ▶ Solution C |
| **348** | Metals & UV Treatment of BSPs: Lunesdale Siphon (1) | This option would involve the construction of a new WTW with second stage rapid gravity filters (RGF) for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.48 Ml/d. | ▶ Solution B |
| **349** | Metals & UV Treatment of BSPs: Lunesdale Siphon (2) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.9 Ml/d. | ▶ Solution B |
| **350** | Metals & UV Treatment of BSPs: Lunesdale Siphon (3) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.36 Ml/d, with a maximum treatment capacity of 0.57 Ml/d. | ▶ Solution B |

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **351** | Metals & UV Treatment of BSPs: Lunesdale Siphon (4) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Wrayton area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.59 Ml/d, with a maximum treatment capacity of 6.04 Ml/d. | ▶ Solution B |
| **352** | Metals & UV Treatment of BSPs: Lunesdale Siphon (5) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d. | ▶ Solution B |
| **353** | Metals & UV Treatment of BSPs: Lunesdale Siphon (6) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d. | ▶ Solution B |
| **354** | Metals & UV Treatment of BSPs: Hodder Siphon | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Newton-in-Bowland area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 40.86 Ml/d, with a maximum treatment capacity of 45.28 Ml/d. | ▶ Solution B |
| **355** | Metals & UV Treatment of BSPs: Ribblesdale Siphon (1) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.02 Ml/d, with a maximum treatment capacity of 0.03 Ml/d. | ▶ Solution B |
| **356** | Metals & UV Treatment of BSPs: Ribblesdale Siphon (2) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 4.09 Ml/d, with a maximum treatment capacity of 5.05 Ml/d. | ▶ Solution B |
| **357** | Metals & UV Treatment of BSPs: Ribblesdale Siphon (3) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 2.10 Ml/d, with a maximum treatment capacity of 2.17 Ml/d. | ▶ Solution B |
| **358** | Metals & UV Treatment of BSPs: Ribblesdale Siphon (4) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clayton-le-Moors area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 33.51 Ml/d, with a maximum treatment capacity of 43.05 Ml/d. | ▶ Solution B |

| Ref | Option | Description | Solution(s) |
|---|---|---|---|
| **359** | Metals & UV Treatment of BSPs: Ribblesdale Siphon (5) | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Accrington area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.23 Ml/d, with a maximum treatment capacity of 6.83 Ml/d. | ▶ Solution B |
| **360** | Metals & UV Treatment of BSPs: Haslingden | This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Haslingden area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 8.97 Ml/d, with a maximum treatment capacity of 9.96 Ml/d. | ▶ Solution B |
| **382** | Manchester and Pennine Aqueduct to Raw: WTW reduced flow | This option would reduce the flow of a WTW in the Kendal area from 570 Ml/d to 80 Ml/d whilst continuing to provide treated water to existing BSPs. In conjunction with Options 3, 212, 213, 214, 301, 303 and 306, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct.<br><br>The option would require: modifications and refurbishment of the existing WTW to maintain the existing process but at a reduced flow of 80 Ml/d; new connections to a new inlet tank (total length circa 8km); new UV disinfection process; new final water chemical dosing and storage in bunded area – replaced existing due to new outlet position; sodium bisulphite dosing and storage for de-chlorination of start up to waste line and pre UV disinfection (prevention of fouling); dual process streaming of works to minimise plant shut-downs and ensure 50% of max flow can be maintained at all times; and a new valve chamber and new twin outlet pipelines from the WTW to supply existing BSPs. | ▶ Solution C |

**Abbreviation**s:
BSP: Bulk Supply Point
DMA: District Metered Area
WTW: Water Treatment Works

**Solutions:**

- Solution A (FM20-SO4): New sources and targeted repair of Tunnel 5 and Tunnel 6 (T05 and T06), centred around uprating the West East Link Main (WELM) and construction of a new associated break tank near Bolton and new abstraction from the River Irwell with treatment;
- Solution B (C29): New tunnel sections T05 and 06 and partial UV and metals treatment at existing UU facilities along the length of the existing Manchester and Pennine Aqueduct;
- Solution C (FM15-SO4b): Convert Manchester and Pennine Aqueduct to raw water supply and build new water treatment works (WTWs);
- Solution D (C11): New tunnel sections T01, 02, 03, 04, 05 and 06;
- Solution E (C17): New tunnel sections as for Solution D, plus new sources requiring WTW and associated pipelines varying in length from 100 m to over 8 km.

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