Final Drought Plan

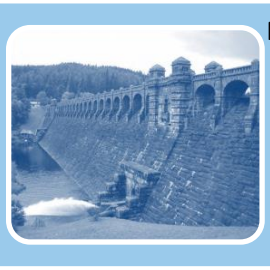
June 2018

Where to find topics of interest

West Cumbria

Windermere and Ullswater

Pennine areas



North Wales

Customer water use restrictions

Information for local authorities and emergency responders

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1 Executive summary

This drought plan outlines our approach in managing water supplies to make sure there's always enough water available for nearly seven million customers and 200,000 businesses across the North West, even during drought conditions.

Following a material change, this plan replaces our Final Drought Plan 2014. A draft of this drought plan went through public consultation during November and December 2016, following which a Statement of Response was published in January 2017.

The material change resulted from an updated environmental assessment report for our Crummock drought permit option in West Cumbria which showed a reduction to the amount of water available for abstraction from this reservoir. This change, along with the development of a new source of water (the South Egremont boreholes, to support Ennerdale in West Cumbria) resulted in a material change to our Final Drought Plan 2014.

This plan provides a summary of the actions that we will consider carrying out during drought conditions to protect essential water supplies to our customers and minimise environmental impact. The reliable supply of water is essential to our customers in their everyday lives.

Droughts do not follow any particular pattern and can occur at any time of year, showing different characteristics. Our plan therefore sets out a range of options available in the event of drought, and the processes and timescales required for their implementation. Our plan includes lessons learnt during the 1995/96 drought as well as more recent droughts in 2003 and 2010. The plan can be used for any drought condition, including those more severe than any previously recorded.

More than 90% of the water supplied by us to homes and businesses across the North West comes from rivers and reservoirs, with the rest from groundwater.

Our region is split into four water resource zones:

- Integrated Resource Zone – an integrated network serving South Cumbria, Lancashire, Greater Manchester, Merseyside and most of Cheshire, representing over 90% of total water supplied by us and the vast majority of our customers
- West Cumbria Resource Zone – serving the areas of Workington, Whitehaven, Wigton and Solway
- Carlisle Resource Zone – serving the Carlisle area
- North Eden Resource Zone – serving the rural, northern part of the Eden district of Cumbria.

The West Cumbria Resource Zone is the most sensitive to drought due to its short critical period of 2 to 3 months, that's the time taken for reservoirs to go from full to empty in the worst drought. Therefore decisions have to be taken quickly in this zone during a drought but equally, following rainfall, reservoirs can refill in a matter of days. West Cumbria also contains a number of environmentally sensitive sites which are designated under legislation and we are legally required to protect these.

In drought there is a fine balance between public water supply and environmental protection and we believe that this plan achieves this balance.

Executive summary

In order to provide a secure water supply to our customers, we use operating policies and control rules as well as carrying out frequent monitoring in conjunction with the Environment Agency. This data means that we can recognise drought conditions, identifying the need for, and timing of, any drought management measures. Many of our drought management actions are an integral part of our normal operational activities to get water to customers' taps.

Management of water supplies during drought conditions and the actions taken reflect the severity, geographical extent and speed of development of a drought. We would begin by taking actions that are under our own control and then only use specific legal powers and/or exceptional measures in serious drought conditions.

This plan presents four drought triggers for each resource zone, based on reservoir level or the proportion of annual abstraction licence that has been used. The triggers are decision points, to consider what measures are needed to address the current situation.

The plan includes a range of drought management actions (Figure 1), which are linked to the drought triggers, including:

- Operational actions
- Communication actions
- Demand side actions (water efficiency campaigns, campaign for voluntary water use restraint, Temporary Use Ban, drought order to ban non-essential use)
- Leakage control actions
- Supply side actions (non-commissioned sources; tankering)
- Drought permit/order actions.

Actions will only be taken if they are right for the particular drought situation. Drought actions may be applied either company wide, by resource zone or to target a specific geographic area depending on the nature of the drought event at that time.

Our plan is based on the current guidance and legislation including Defra's Drought Plan Guidance (Defra, December 2015) and the Water Industry Act 1991.

A separate Strategic Environmental Assessment and Habitats Regulations Assessment of the options included in this plan have been done. Options shown to have the potential to significantly affect designated sites (Special Areas of Conservation, Special Protection Areas and sites designated under the Ramsar Convention), are subject to a detailed Appropriate Assessment. A drought option that has an adverse effect on the integrity of a protected site can only be included in the plan subject to having no alternative solutions, and where the Secretary of State is satisfied that there are imperative reasons of overriding public interest for its inclusion and the adoption of suitable compensatory measures. This is the case for the Ennerdale Water drought order option included in this plan.

Applications for drought permits or orders would be made following the start of a campaign to encourage voluntary water use restraint. Our minimum level of service for water supply is for the implementation of Temporary Use Bans and drought permits or orders not more than once in every 20 years on average, with drought orders to restrict non-essential water use not more than once in every 35 years on average.

This drought plan does not include the use of rota cuts where water supplies are turned off for a period of time every day or standpipes to ration essential supplies (implemented through emergency drought

orders). This is consistent with the level of service in our Water Resources Management Plan (United Utilities, 2015) and is a balance between customer and environmental impacts. The level of service is reviewed as part of the Water Resources Management Plan process rather than this drought plan.

Our assessment of water supply security indicates that with a repeat of the worst drought on record our reservoirs will not empty but will reach very low levels. Before this happens, we would have to take action to conserve water supplies in case the drought is more severe than any previously recorded. Therefore, water use restrictions and drought permits or orders need to be introduced before reaching the very lowest reservoir levels to protect water supplies.

This document has been reviewed to assess the sensitivity of information from a national security perspective and it was not thought necessary to exclude any information. No commercially sensitive information has been excluded from this plan.

Drought plans are updated every five years (or earlier in the event of a material change), and we would expect this plan to be in place until 2022. Annual updates on the drought plan are provided as part of our annual Water Resources Review - these are available on our website (corporate.unitedutilities.com/waterresourcesplan).

Executive summary

Figure 1: Summary of drought triggers and associated actions

Status	Summary of normal activity	
Normal operation Above all drought triggers	On-going water efficiency programme to save 3 Ml/d each year	
	Leakage control to maintain leakage at the sustainable economic level	
	Optimise supply system to balance cost and manage risk of possible drought	
	Regular liaison with regulators[+] on water resources issues	
Status	**Summary of additional actions (if appropriate in specific drought)**	**Estimated time to implement**
Increased drought risk Below Trigger 1 for at least one source Likelihood of approx. 1 in 3 in any year Approx. 14 days to next trigger	Establish United Utilities' drought management structure	3 days
	Issue drought action plan to regulators[+] and discuss	1 week
	Enhanced water efficiency communications	1 week
	Fully optimise supply system to manage risk of possible drought	On-going
Possible drought Below Trigger 2 for at least one source Likelihood of approx. 1 in 5 in any year Approx. 7-14 days to next trigger	Further enhancements to water efficiency communications – link to dry weather. Press/radio adverts	1 week
	Establish regular stakeholder updates	3 days
	Enhance leakage control activities	1 week
	Start process of bringing supply side options into use	1-6 months
Drought alert Below Trigger 3 for at least one source Likelihood of approx. 1 in 12 year in any year Approx. 28 days to next trigger	Campaign for voluntary water use restraint	3 days
	Commence representation period for introduction of Temporary Use Ban	3 days to start; 2-4 weeks to complete
	Carry on process of bringing supply side options into use	1-5 months
	Apply for drought permits/orders	1 week
Drought Below Trigger 4 for at least one source Likelihood of approx. 1 in 20 in any year	Introduce Temporary Use Ban with extensive communications campaign	Soon after crossing the trigger
	Carry on process of bringing supply side options into use	3-6 months
	Implement powers granted under drought permits / orders	At time of crossing trigger or soon after
	Apply for and introduce drought order to restrict non-essential use	Dependent on level of customer demand for water

+ Environment Agency, Natural England and Natural Resources Wales, as appropriate

Note that the drought triggers and actions at Ennerdale Water in the West Cumbria Resource Zone differ from those set out above. A campaign for voluntary water use restraint will occur earlier at the 'possible drought' status (Trigger 2) to allow more time for this to take effect before applying for a drought order (Trigger 3) at this sensitive site and a period of 7 days exists between Triggers 2 and 3 to allow for this. A Temporary Use Ban will be implemented on reaching 'drought' status (Trigger 4) ahead of the need to implement a drought order at Ennerdale. In addition, tankering of treated water from the Integrated Resource Zone will commence at Trigger 3

2 Introduction

Key messages

- This drought plan replaces our Final Drought Plan 2014
- A draft of this drought plan was publicly consulted on in October and November 2016
- Due to changes in the West Cumbria Resource Zone (which we have decided constitute a material change) we have updated our 2014 plan
- The drought plan has a life of 5 years and sets out how we will deal with any drought situation

This drought plan has been produced by United Utilities Water Limited for the North West of England. Under Section 39B(7) of the Water Industry Act 1991, there is a statutory duty for water companies to agree publicly available drought plans following consultation.

This drought plan has been produced to provide a comprehensive statement of the actions that we will consider implementing during drought conditions to protect essential water supplies for our customers and to minimise environmental impact.

Following a review of the drought triggers in our West Cumbria Resource Zone we announced a material change on 26 January 2016. This resulted from an updated environmental assessment report for our Crummock Water drought permit option which showed a reduction to the amount of water available for abstraction from this reservoir. We believe that this change, along with the development of a new source of water (the South Egremont boreholes, to support Ennerdale Water in West Cumbria) results in a material change to our current published drought plan.

This plan updates our Final Drought Plan 2014. Details of how we've developed it, and the changes from our Final Drought Plan 2014, are set out in Appendix 1. Unless a material change is triggered, the drought plan has a life of 5 years. It should be noted that the long-term strategy to manage supply and demand over the next 25 years and beyond (for example, to consider further demand management or the development of new sources) is covered by the Water Resources Management Plan process (see Section 3.2).

This drought plan incorporates:

- Lessons learnt from the 2010 drought event
- Water use restriction legislation introduced by Government in 2010/11
- Defra's Drought Plan Guidance (Defra, December 2015).

Following direction from the Secretary of State, a draft of this drought plan (the Draft Drought Plan 2016) was published and went through a six week public consultation from 3 October to 14 November 2016. The Strategic Environmental Assessment (SEA) of the drought plan options was also consulted on alongside the main Draft Drought Plan 2016.

The public consultation on our Draft Drought Plan 2016 closed on 14 November 2016. We received 14 responses, identifying 90 issues for us to consider. On the 12 January 2017 (within 15 weeks from the start of the consultation on 3 October 2016) we published a Statement of Response setting out how we have dealt with each of the issues raised, and submitted a Revised Draft Drought Plan 2017 to the Secretary of State for Defra. The key changes to the plan arising from the consultation on the Draft Drought Plan 2016, as outlined in the Statement of Response, are:

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- The Swineshaw boreholes drought option has been confirmed as a drought order application due to the need to discharge the abstracted water to a watercourse. Following submission of our Draft Drought Plan 2016, we have undertaken an environmental assessment of this option and have fully involved the Environment Agency and Natural England in this process

- We have bought forward the planned review of the Environmental Assessment Report for our Lake Vyrnwy drought permit from 2020/21 to 2017 in response to comments raised by Natural Resources Wales in their response to our Draft Drought Plan 2016 consultation

- Trigger 4 at Ennerdale, representing the implementation of a Temporary Use Ban, has been moved up to make the time interval between Trigger 2 and Trigger 4 shorter. This also means that a Temporary Use Ban will be in place for longer before a drought order is required, although it will not be in place before the drought order application is submitted to Defra

- We have created a new Appendix 6 to bring together information on the drought scenario testing we have undertaken and have expanded on the information presented

- We have created a new Appendix 7 to show how we will make the case for an exceptional shortage of rain to support a drought permit/order application

- We have created a new Appendix 8 that sets out our decision making process for strategic pumping. This is in response to the issues raised by our stakeholders in Windermere in particular.

Following submission of our Revised Draft Drought Plan 2017 to Defra on 12 January 2017, they have asked for further considerations on a number of aspects. The Revised Draft Drought Plan 2017 submitted to Defra in July 2017 includes information to address these:

- The decision making process for strategic pumping has been amended and this plan includes an updated Appendix 8 which has been signed off by our Managing Director

- In May 2017 we appointed a consultant to review the conditions and operation of the Windermere abstraction licence. This review will include stakeholder meetings. We hope to complete the review in spring 2018

- Additional information on the predicted timings for crossing drought triggers in the scenarios is included in Appendix 6

- We have appointed a consultant to complete the mitigation study for the Windermere drought permit scenario 2 (involving a lake drawdown). This study is due to complete in autumn 2017. Information is included in the Windermere scenario 2 drought option form in Appendix 9.

We met with local stakeholders and the Environment Agency on 25 May 2017 to discuss these proposals and held the first quarterly review of strategic pumping on 9 October 2017. We held the first workshop of the Windermere abstraction licence review, facilitated by EA, in November 2017 and a dissemination seminar of the drought permit scenario 2 mitigation study in October 2017. The mitigation study concluded that dredging is technically feasible so we are progressing with a study to assess the environmental impact of dredging.

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Following an agreement with the Environment Agency to alter the operation of the South Egremont boreholes in the West Cumbria region due to issues with customer acceptability of the water, Defra asked for this to be incorporated into the drought plan. This Revised Draft Drought Plan incorporates these changes:

- Drought trigger 4 at Ennerdale has been moved down to ensure compliance with our stated level of service to customers of temporary use restrictions not more than 1 in 20 years on average[1]
- The frequency of crossing triggers at Ennerdale and Crummock have been updated in Section 4.3 and Appendix 5, and the drought scenarios for West Cumbria updated in Appendix 6.

The Section 20 agreement governing operation of the boreholes has not yet been revised and agreed with the Environment Agency, but it is not anticipated that this will alter the operation or affect the drought plan. If the revised section 20 agreement does materially alter the operation then the drought plan will be updated.

Following direction from the Secretary of State, this plan will become our new Final Drought Plan. Full details of our drought plan consultation can be found in Appendix 1.

To produce this plan we have worked with the Environment Agency to ensure consistency with their drought plans (Environment Agency, 2015). In addition, we liaised with Natural England, the Environment Agency, Natural Resources Wales, Cadw and Historic England regarding the environmental aspects of the plan.

The Environment Agency has recently revised some of our abstraction licences as part of their Review of Consents under the Conservation of Habitats and Species Regulations 2010 (as amended in 2011) (known as the Habitats Regulations). The Environment Agency's reviews have resulted in licence changes, such as increases to compensation or prescribed flow requirements and reductions to the volume of water we can abstract. These changes have been included in this plan.

This plan takes into account this legislation introduced during 2010/11, as summarised in the box below. It includes a campaign for voluntary water use restraint, followed by a representation period, prior to the implementation of a Temporary Use Ban. For all resource zones (except Carlisle where no drought permits/orders are proposed) applications for drought permits/orders would be made following the commencement of a campaign for voluntary water use restraint.

[1] Trigger 4 remains at a higher level than in the Final Drought Plan 2014

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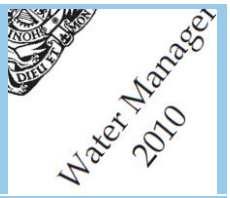
Water use restriction legislation explained

A summary of water use restrictions legislation is given below. Further information can be found in Section 5.3.2	
Flood and Water Management Act 2010	Introduced a new Section 76 within the Water Industry Act 1991 and allows water companies to temporarily restrict a range of water uses by customers – called 'Temporary Use Bans' in this plan. It allows companies to restrict a greater range of water uses than before (the powers under the original Section 76 were generally referred to as a 'hosepipe ban') and requires companies to publicly consult before such restrictions are imposed
Water Use (Temporary Bans) Order 2010	Provides definitions of words/phrases used in the Flood and Water Management Act 2010 as well as providing for exceptions to water use restrictions
Drought Direction 2011	Revokes the Drought Direction 1991 and sets out the range of water uses that can be restricted under an ordinary drought order (commonly known as a non-essential use ban)
Water Resources Act 1991	Emergency drought orders give the water company discretion on the uses of water to prohibit/limit and can also authorise the use of standpipes and rota cuts. Our plan does not include recourse to such emergency actions

In line with the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014):

- We have adopted a phased approach to demand restrictions with a campaign for voluntary water use restraint preceding Temporary Use Bans and drought orders to ban non-essential use
- We will implement demand restrictions on domestic customers before commercial customers.

This plan presents drought triggers for each resource zone. The triggers are decision points to consider the measures required to address the situation at the time. They represent a balance between the frequency of hitting them and the time interval between them to enact the required drought actions.

We supply water to some 6.9 million people and 200,000 business customers in Cumbria, Lancashire, Greater Manchester, Merseyside, most of Cheshire and a small portion of Derbyshire. We own and operate over 100 water supply reservoirs, various river and stream intakes, as well as lake abstractions and numerous groundwater sources. More than 90% of the water we supply comes from rivers and reservoirs, with the remainder from groundwater. This contrasts with the rest of England, where an average of only 60% is supplied from rivers and reservoirs. Abstracted water is treated at water treatment works before

being supplied to customers through an extensive network of aqueducts and water mains. Our region is split into four water resource zones (see Figure 2):

- Integrated Resource Zone, an integrated regional network serving south Cumbria, Lancashire, Greater Manchester, Merseyside and most of Cheshire, representing over 90% of total water supplied by us and the vast majority of our customers
- West Cumbria Resource Zone, serving the areas of Workington, Whitehaven, Wigton and Solway. There is some limited connectivity between the sources in this zone
- Carlisle Resource Zone, serving the Carlisle area
- North Eden Resource Zone, comprising solely of boreholes that serve the rural, northern part of the Eden district of Cumbria. The Alston area is supplied by a bulk water supply from Northumbrian Water.

The resource zones are used for both drought and water resources planning.

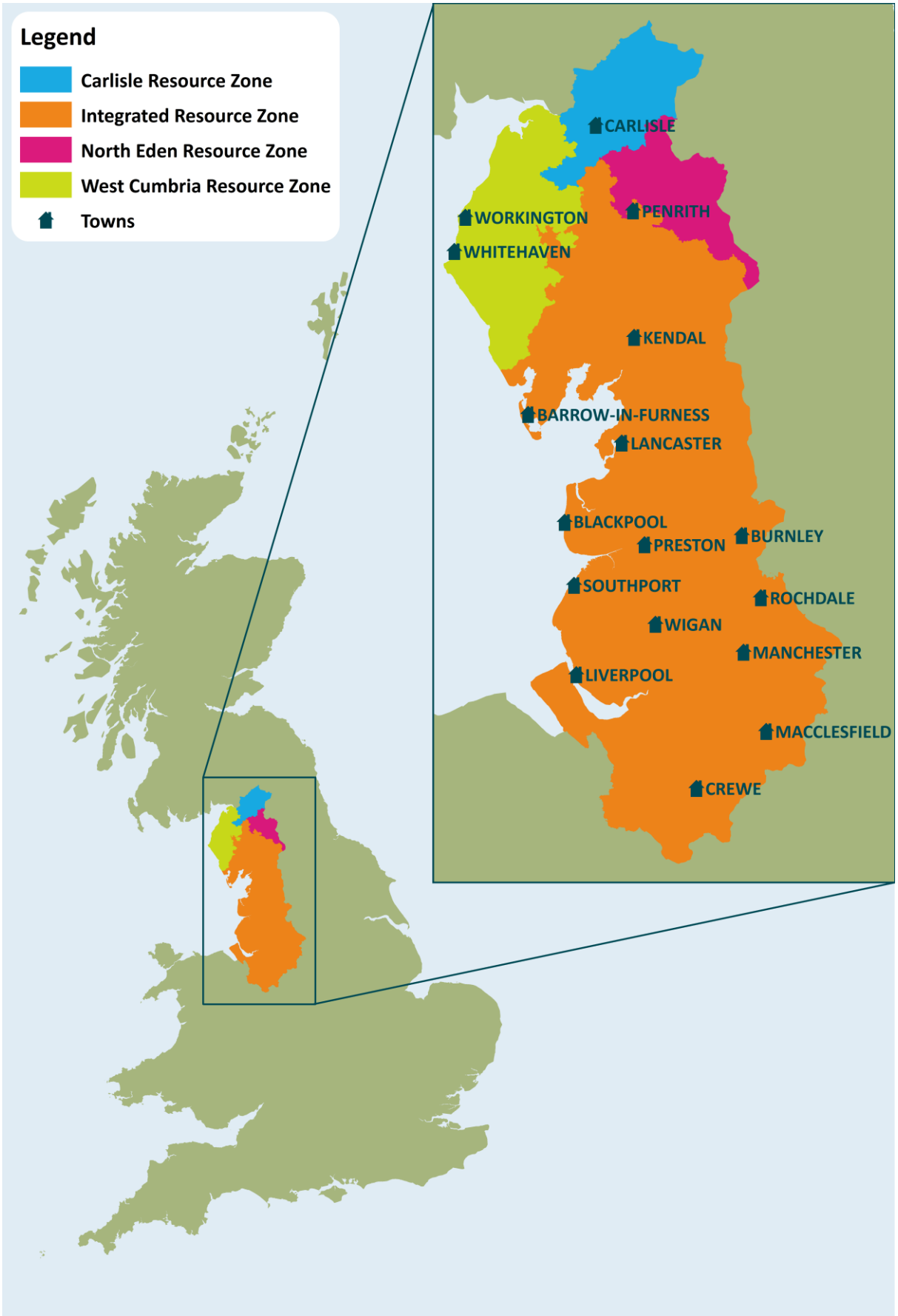
Our assessment of water supply security indicates that with a repeat of the worst drought on record, our reservoirs will not empty but will reach very low levels (with the remaining storage equivalent to a minimum of 30 days of supply). However, before reaching these very low levels, we need to take action to protect water supplies in case the drought is more severe than any previously recorded. Therefore water use restrictions and drought permits/orders need to be implemented before reaching the very lowest reservoir levels to protect water supplies.

The sensitivity tests we have done on our drought triggers indicate that with the benefits of the drought permits/orders and supply side options set out in this plan, the use of standpipes and rota-cuts would not be required under the plausible extreme drought scenarios tested. Therefore our drought plan does not include rota cuts or standpipes (implemented through emergency drought orders), even during extreme drought conditions – such actions would have serious public health implications and result in severe social and economic disruption.

In very extreme drought conditions, where actual water supply loss at customer taps was possible, we would engage with Local Resilience Forums under alternative supply plans agreed with them for emergency water distribution and sanitation arrangements under the Civil Contingencies Act (2004) and the Security and Emergency Measures Direction (1998). Our generic company incident management plan provides the structure for managing any incident at the appropriate level within the organisation. In 2016 it was completely revised to take account of incidents where comprehensive engagement with other agencies, under Local Resilience Forum arrangements, is needed. This would be especially relevant in an extreme drought situation. In the North West there are also multiagency plans for dealing with loss of water supplies which would apply in this type of scenario.

The following section provides further information on how we manage water resources.

Figure 2: United Utilities water supply area and resource zones



3 Water resources management

Key messages

- Our plan is for water use restrictions and drought permits/orders to occur no more than once in 20 years, on average
- We last imposed water use restrictions on customers in 2010
- We last implemented drought permits/orders in 1995/96
- As well as this drought plan, we also produce a Water Resources Management Plan (published March 2015) – the plans are consistent
- This plan includes changes made to our abstraction licences by the Environment Agency to ensure environmental protection. It does not include revocation of our Ennerdale abstraction licence as this isn't due until 2022
- We monitor the water resource situation continuously, using models to assess drought risk
- We have a management structure in place to deal with drought and implement lessons learnt from each drought event

3.1 Level of service

Our minimum level of service for water supply is for the implementation of Temporary Use Bans and drought permits/orders not to occur more than once in every 20 years on average, and drought orders to ban non-essential water use not more than once in every 35 years on average. This drought plan does not include rota cuts or standpipes to ration essential supplies. This is consistent with the level of service in our Water Resources Management Plan (United Utilities, 2015) and balances customer and environmental impacts. Customer research conducted for our Water Resources Management Plan (United Utilities, 2015), indicated that this level of service was acceptable to our customers. The level of service is reviewed as part of the Water Resources Management Plan process. To provide a higher level of service, i.e. less frequent restrictions or drought permits/orders, would require a greater investment in water supplies or more extensive demand management.

Our customer standards of service state that if a customers' water supply is cut off because of emergency drought restrictions, we will pay £10 for each day (or part day) that the supply is interrupted up to a maximum amount equal to the average household water bill for the previous year. This commitment does not refer to Temporary Use Bans or drought orders to ban non-essential use. The commitment refers to the need to implement emergency drought orders authorising the use of standpipes or rota cuts, and our plan does not include such measures.

3.2 Link to Water Resources Management Plan

We last published our Water Resources Management Plan in 2015 (covering the period 2015-2040) and it is updated every 5 years. The Water Resources Management Plan identifies if there will be a deficit in the future availability of water supplies compared to demand over a 25 year horizon, resulting in the need for new sources of water or demand measures. The assessment takes climate change into account, as well as any changes to our abstraction licences (e.g. the Environment Agency's review of our abstraction licences under the Habitats Regulations). The Water Resources Management Plan also makes allowances for parts of the water supply system being out of service for maintenance.

Our 2015 plan identified a future deficit in the West Cumbria Resource Zone following the Environment Agency's decision to revoke our Ennerdale Water abstraction licence. The Water Resources Management Plan 2015 sets out the preferred solution for dealing with the forecast deficit, which is to construct a new

pipeline from Thirlmere reservoir (in the Integrated Resource Zone) to West Cumbria. This is due to be in place in 2022 and will allow us to stop abstracting from Ennerdale Water, Crummock Water and the Quarry Hill sources. Ennerdale Water and Crummock Water are within Habitats Regulations sites, as are some of the sources that feed Quarry Hill water treatment works.

As part of our plan we will also undertake:

- Extensive leakage control in all resource zones
- Water efficiency research and water efficiency promotion, with free water savers packs offered to customers
- Free installation of water meters for those customers who wish to move to a measured tariff.

This drought plan is in line with our current Water Resources Management Plan[2]. As the pipeline link from Thirlmere won't be delivered until 2022 it is not included in this drought plan. It will be included in a future drought plan iteration. We expect to publish an updated draft Water Resources Management Plan by December 2017, as part of the 5 year review cycle and completed an extensive pre-consultation exercise in November 2016. Our next Water Resources Management Plan will include a number of new developments, in particular, even more sophisticated hydrological approaches to assess more severe, extreme and different characteristics of drought, along with the estimation of their likelihood of occurrence. Such developments will be able to inform development of future drought plans.

Should a significant or dry weather event occur, where there has been recourse to customer demand restrictions and/or applications for drought powers, we will examine the impact of this on the Water Resources Management Plan as soon as is reasonably practical following the event (e.g. once updated hydrological/inflow records are available etc.). This will allow us to understand if this brings about any change to the level of service and design events used within that plan. In the first instance we would seek to report this review through the Annual Water Resources Management Plan process, and consider if the event and subsequent lessons learnt, bring about a trigger for material change in the Water Resources Management Plan.

3.3 Agreements with other licensed water suppliers / water undertakers

At the time of writing this plan (January 2017), there are eight licensed water suppliers that supply customers within our geographical area through our supply system.

Within our area, Peel Water Networks Ltd operates as an Inset Appointee for the Media City development in Salford, Greater Manchester. During times of drought and water use restrictions, Peel Water Networks Ltd have agreed to mirror the same restrictions that we implement[3].

We also have a number of imports and exports of water with Northumbrian Water, Dee Valley Water, Yorkshire Water, Severn Trent Water and Dŵr Cymru Welsh Water. Shared water sources are:

[2] Or where relevant, updates reported upon in the annual review of the Water Resources Management Plan

[3] See www.peelutilities.co.uk/pwnl/domestic/droughtplan

- The River Dee
- Lake Vyrnwy
- Burnhope Reservoir.

We abstract water from the River Dee at various locations to supply both potable and non-potable customers. In addition to us, other abstractors from the River Dee include Dŵr Cymru Welsh Water, Dee Valley Water and the Canal and River Trust. The River Dee is managed by Natural Resources Wales through a regulation scheme. Our abstractions are governed by the River Dee General Directions (Natural Resources Wales, 2016) which set out rules for abstraction during drought conditions and are approved by the statutory Dee Consultative Committee. If storage in the River Dee regulation reservoirs falls to the drought action trigger level, a meeting of the Committee will take place to discuss the introduction of drought alleviation measures as enshrined in the Dee General Directions. To conserve water supplies and ensure efficiency of operation, we provide a weekly abstraction forecast to Natural Resources Wales to assist in calculating the required releases from the Dee system reservoirs.

Lake Vyrnwy is owned by Severn Trent Water. However, we have an abstraction licence allowing us to abstract water from the reservoir to supply customers in Merseyside and parts of Cheshire. Lake Vyrnwy is also used to regulate the River Severn, from which other water companies abstract including Severn Trent Water, South Staffordshire Water and Bristol Water. The Environment Agency and Natural Resources Wales, working with relevant water companies and stakeholders, manage the River Severn regulation system. The Environment Agency is responsible for applying for a River Severn drought order to reduce the prescribed flow at Bewdley to prolong storage in Llyn Clywedog Reservoir, enabling regulation to continue supporting the environment and public water supply needs for as long as possible during a severe drought. The Environment Agency and Natural Resources Wales reviewed the process for such applications in 2013, in consultation with all relevant water companies, stakeholders and the public. This ensures that water company drought plans and the Environment Agency's plans are aligned. During drought conditions, we will liaise with the Environment Agency to discuss potential management actions for the River Severn system.

We have the provision to provide Severn Trent Water with up to 16 Ml/d of treated water sourced from Lake Vyrnwy, for emergency use only up to a maximum period of 28 days in any instance.

We have a bulk supply agreement with Northumbrian Water who supply treated water to the Alston area of Cumbria (North Eden Resource Zone) from Burnhope Reservoir. The agreement is for Northumbrian Water to provide a bulk supply of non-fluoridated, potable water up to a maximum of 1.3 Ml/d. The maximum import volume provides sufficient headroom to meet demand in drought conditions. Discussions with Northumbrian Water have confirmed that the full import volume is reliably available under drought conditions.

Our drought plan consultation process has included licensed suppliers operating in our area, the inset appointee and water undertakers with whom we share imports/exports.

3.4 Abstraction licence changes

The Environment Agency's Review of Consents process, to ensure our abstraction licences comply with the Habitats Regulations, has resulted in changes to some of our abstraction licences. In addition, changes under the Environment Agency's Restoring Sustainable Abstraction programme and the Water Framework

Directive (WFD)[4] have/will also result in licence changes. The following table (Figure 3) sets out all the licence changes for environmental reasons which have an impact on our water abstraction ability, showing when they were/will be implemented and whether they are included within this drought plan (i.e. to derive drought triggers). The licence changes at Ennerdale and Overwater, due to take effect from 1 April 2022, have not been included in this drought plan which has a life of 5 years – these changes are related to our water resource scheme to provide a new water supply from Thirlmere Reservoir to West Cumbria, and when this comes in to operation it will trigger a review of the drought plan.

[4] The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Statutory Instrument 2003 No. 3242)

Figure 3: Abstraction Licence Changes for environmental protection[†]

Resource Zone	Source	Driver for change	Nature of change	Implementation date	Included in this plan?
Integrated	Cawdale (Haweswater)	Habitats Regulations	Increased prescribed flow from 1.27 to 5.5 Ml/d	1 April 2015	Yes
	Heltondale (Haweswater)	Habitats Regulations	Change to prescribed flow requirements to 7 Ml/d (Jan, Feb and Jun-Aug) and 10 Ml/d (Mar-May and Sep-Dec) plus a 500 Ml/yr water bank for spate releases	1 April 2015	Yes
	Swindale (Haweswater)	Habitats Regulations	Abstraction volume limits dependent on time of year and upstream river flow; increased prescribed flow of 14 Ml/d	30 September 2018[#]	Yes
	Thirlmere reservoir	Habitats Regulations	New prescribed flow of 3 Ml/d at Helvellyn Gill (offset against Thirlmere reservoir compensation flow release) and 973 Ml/yr water bank for spate releases	1 April 2015	Yes
	Lower Dee	Habitats Regulations	Cessation of abstraction at Dee Bridge. New hourly and instantaneous abstraction limits at remaining intakes. Reduced daily abstraction limit at Huntington of 380 Ml/d	1 April 2015	Yes
	Upper Dee	Habitats Regulations	New hourly and instantaneous abstraction limits	1 April 2015	Yes
	River Calder (Barnacre)	Water Framework Directive	New prescribed flow of 9.05 Ml/d	1 October 2018	Yes
	Brennand and Whitendale rivers and Footholme borehole (Fishmoor system)	Restoring Sustainable Abstraction (local issue)	Abstraction no longer allowed from 8 minor intakes; new prescribed flows of 5.4 Ml/d at Brennand main intake; 6.2 Ml/d at Whitendale main intake; 22.1 Ml/d for Footholme borehole; reduction in daily licence limit from 50 to 40 Ml/d	1 April 2013	Yes
	Tarnbrook Wyre river intakes, Lancaster	Water Framework Directive	New prescribed flows at the three main intakes	1 April 2020	Yes
	Cownwy and Marchnant, Lake Vyrnwy	Water Framework Directive	New prescribed flows at the two river intakes and abstraction limited to 75% of available flow above this	1 April 2020	Yes
	Holden Wood reservoir	Water Framework Directive	Increase to compensation flow provided to downstream river	25 October 2017	Yes
	Poaka Beck reservoir	Water Framework Directive	New compensation flow provided to downstream river	1 April 2020	Yes
	Readycon Dean reservoir	Water Framework Directive	New compensation flow provided to downstream river	1 April 2020	Yes

Resource Zone	Source	Driver for change	Nature of change	Implementation date	Included in this plan?
	Horse Coppice reservoir	Water Framework Directive	New compensation flow provided to downstream river	1 April 2020	Yes
West Cumbria	Ben Gill (Ennerdale Water)	Habitats Regulations	Revocation of abstraction licence	6 October 2014	Yes
	Ennerdale Water	Habitats Regulations	Changes to the impoundment and abstraction licences to increase the compensation flow release to the downstream River Ehen and reduce abstraction capacity	21 July 2015	Yes
	South Egremont boreholes	Habitats Regulations	New water source to offset the impact of increases to the compensation flow from Ennerdale Water made under the Habitats Regulations	2017	Yes
	Ennerdale Water	Habitats Regulations	Revocation of abstraction licence	16 December 2022	No
	Crummock Water	Habitats Regulations	Revocation of abstraction licence	16 December 2022	No
	Dash Beck (Quarry Hill)	Habitats Regulations	Increase in prescribed flow from 2.27 Ml/d (summer) and 4.54 Ml/d (winter) to 5 Ml/d (year round)	1 April 2015	Yes
	Overwater (Quarry Hill)	Restoring Sustainable Abstraction (local issue)	Abstraction not allowed if lake is lower than 1 m below weir crest	1 April 2022	No
	Overwater (Quarry Hill)	Habitats Regulations	Revocation of abstraction licence	16 December 2022	No
	Chapel House (Quarry Hill)	Habitats Regulations	Revocation of abstraction licence	16 December 2022	No
Carlisle	New Water (Castle Carrock reservoir)	Habitats Regulations	New prescribed flow of 3.5 Ml/d	1 April 2015	Yes
	Old Water, New Water and Geltsdale springs (Castle Carrock reservoir)	Habitats Regulations	Increased prescribed flow at Hynam Bridge from 6.8 to 14 Ml/d	1 April 2015	Yes
North Eden	No licence changes				

[#] We are hopeful that we will be able to implement the scheme at Swindale early

Note that other licence changes have been and will be made but because they do not result in a change to our ability to abstract they are not included in this table

3.5 Water banks

Some of our abstraction licences have flow release requirements to downstream rivers to benefit the aquatic environment, in particular spate releases with the aim of assisting fish migration. These requirements can be either legal requirements (set in the abstraction licence or an associated Section 20

legal agreement) or a voluntary agreement. There are water banks associated with the following water sources:

- Lake Windermere
- Lake Vyrnwy
- Thirlmere reservoir
- Stocks reservoir
- Heltondale (part of the Haweswater reservoir system)
- Wet Sleddale reservoir (part of the Haweswater reservoir system).

In times of drought we would discuss the benefit of making water bank releases with the Environment Agency.

3.6 Normal monitoring arrangements

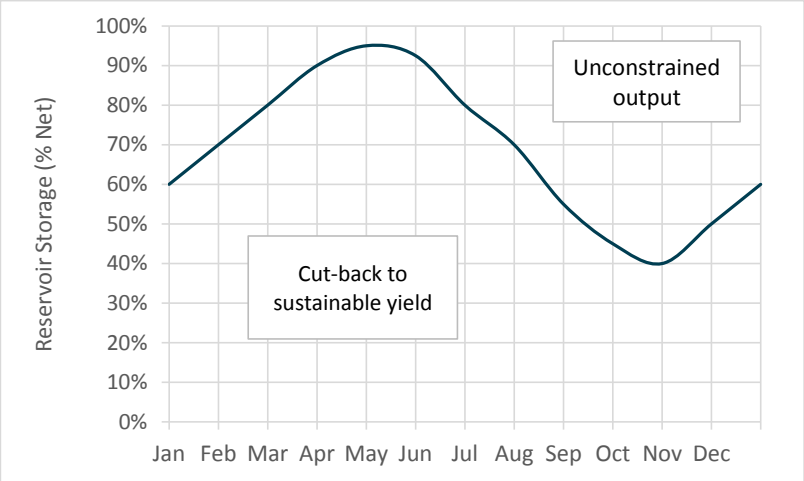
Data such as reservoir levels, groundwater levels, river flows, abstraction rates, compensation flow releases, leakage and water demand, are retrieved weekly from our company data management system. This data is used to produce a range of routine water resources reports. We provide information on the current water resources situation to the Environment Agency on a weekly basis, and also send information to the Centre for Ecology and Hydrology for national reporting. We discuss water resources issues with our environmental regulators at quarterly meetings. Information on the current water resource situation is published weekly on our website (www.unitedutilities.com/north-west-reservoir-levels).

Our water sources are managed in line with operating policies and control rules, such as pumping (covered in more detail within Appendix 8) from rivers or lakes when river flows are high enough and storing that water in reservoirs. We carry out frequent hydrological and hydrogeological monitoring, in conjunction with the Environment Agency. This data is used by us in water resource simulation models to ensure sources are operated sustainably and to identify any actions required to manage water supplies. These assessments provide the basis for recognising drought conditions at an early stage and identifying the need for, and timing of, any drought management measures.

Many of our reservoirs provide releases of water into rivers or streams to provide sufficient flows for the environment. These are called compensation flows and a minimum flow rate is usually required under abstraction licence conditions. Compensation flows are regularly checked for under or over releases.

Our normal assessments include comparison of actual reservoir storage or abstracted volumes against the drought triggers included in this plan. In addition we use reservoir control curves (Figure 4) to assess the sustainability of water abstractions during times of drought, and aid decisions to reduce or increase abstraction rates.

Figure 4: Example reservoir control curve



Under normal operation we balance abstraction across various reservoir, river and groundwater sources. This forms part of the normal weekly water resources risk management and production planning process. Should reservoir storage in local areas be lower than normal, then abstraction from these reservoirs is reduced and abstraction from other sources increased to balance overall supply and demand. This system optimisation can involve re-zoning of the water supply network.

3.7 Drought forecasting

We undertake regular assessments of the security of water supplies in discussion with the Environment Agency. These assessments provide the basis for recognising drought conditions at an early stage. Our assessments take account of a range of water resources indicators (Figure 5).

Figure 5: Water resources indicators, with resource zone specific detail, monitored weekly

Water resources indicator	Integrated Resource Zone	West Cumbria Resource Zone	Carlisle Resource Zone	North Eden Resource Zone
High probability of sources failing to meet demand or failing to refill sufficiently	High probability of sources failing to meet demand or failing to refill sufficiently	High probability of sources failing to meet demand or failing to refill sufficiently	High probability of sources failing to meet demand or failing to refill sufficiently	High probability of sources failing to meet demand or failing to refill sufficiently
Storage in reservoirs below control curve levels	Substantial numbers of local reservoir sources in the Pennines and south Lakes well below control curve for the time of year	Storage at Chapel House and Overwater reservoirs at or below 50% full and falling	Storage in Castle Carrock reservoir causing concern	N/A

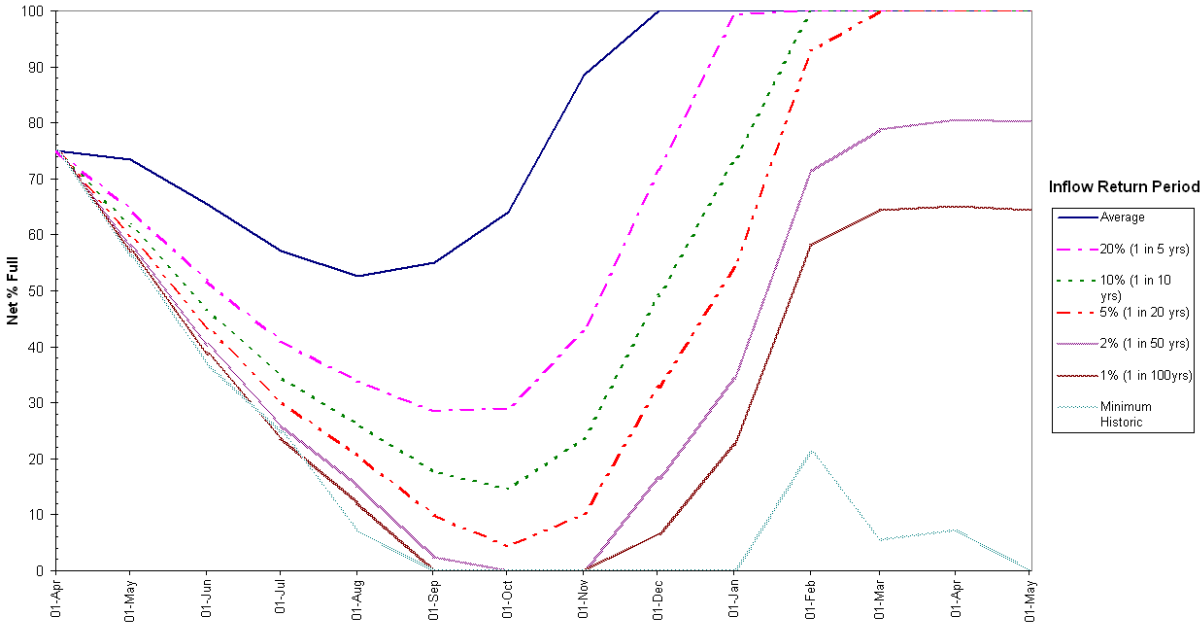
Water resources management

Water resources indicator	Integrated Resource Zone	West Cumbria Resource Zone	Carlisle Resource Zone	North Eden Resource Zone
Rapid weekly decline in storage (or slow recovery of storage during winter) in key reservoirs and/or reservoir groups	Rapid decline in storage (or slow rise in storage during winter) of key strategic reservoirs	Rapid decline in storage (or slow rise in storage during winter) of Chapel House and Overwater reservoirs, Ennerdale Water and Crummock Water	Rapid decline in storage (or slow rise in storage during winter) of Castle Carrock reservoir	N/A
Low, and declining, river flows at our river sources resulting in abstraction being limited	Prolonged low flow conditions on the River Lune, Eamont and Leven preventing abstraction from the River Lune, Ullswater and Windermere	River flows in Hause Gill, Dash Beck and River Ellen at low levels and continuing to decline	Low flows on the River Gelt and/or River Eden preventing, or severely limiting, abstraction	N/A
Significant reduction in the output from spring and/or groundwater sources, or significant decline in groundwater levels as measured at key observation boreholes in the major aquifers	Significant decline in groundwater levels as measured at key observation boreholes in the major aquifers (Fylde, Cheshire and Merseyside)	Scales boreholes operating at a high level of abstraction Low inflows from Aughertree Springs	Low inflows from Geltsdale Springs	Significant reduction in the output of groundwater sources Declining groundwater levels that could impact on resource availability
Magnitude and duration of “peak” customer demand for water significantly higher than normal for the time of year	Magnitude and duration of peak demands for water significantly higher than normal for the time of year	Magnitude and duration of peak demands for water significantly higher than normal for the time of year	Magnitude and duration of peak demands for water significantly higher than normal for the time of year	Magnitude and duration of peak demands for water significantly higher than normal for the time of year
Rainfall significantly below average, and/or soil moisture deficits significantly above average	Rainfall significantly below average and soil moisture deficits significantly above average for periods of 3 months and longer	Rainfall significantly below average and soil moisture deficits significantly above average for periods of 2 months and longer	Rainfall significantly below average and soil moisture deficits significantly above average for periods of 3 months and longer	Rainfall significantly below average and soil moisture deficits significantly above average for periods of 3 months and longer

We utilise a range of modelling tools in our water resource assessments. A tool called Droughtwatch is used on a weekly basis to assess a range of scenarios for individual reservoirs to assess their risk of failing to meet demand (Figure 6). In support of this, we also utilise the MISER supply system model for the larger, complex Integrated Resource Zone to guide regional level operating decisions and to assess risk across the whole water resource zone. We also use Aquator water resources models, which represent key components of our raw water system in greater detail. These tools simulate how reservoirs or the system would perform over the coming year, and beyond, under a range of scenarios. The results from these

assessments are used to assess the risks to reservoirs both in terms of drawdown and refill prospects. The interpretation of these results aids decisions on how the water supply system is managed and guide drought actions.

Figure 6: Example Droughtwatch plot, showing the reservoir emptying under minimum historic inflows (i.e. the worst drought on record), but recovering under average inflows



We have joint ownership of Droughtwatch with the Environment Agency and they have been consulted closely on the development of our Aquator water resources model. Water resources information, such as control curves, is shared between the organisations to ensure consistency. The Environment Agency update historic inflow series annually and these are then used to update our control curves and models including Droughtwatch, MISER and Aquator. For this drought plan the Environment Agency and Natural Resources Wales have provided inflow data up to the 31 December 2013 (up to 31 December 2014 for sources in the West Cumbria Resource Zone and Carlisle Resource Zone).

We also have river recession curves which allow estimates of the time that a river is predicted to remain available for abstraction i.e. until a set prescribed flow or hands-off flow is reached and abstraction is curtailed.

We continually strive for improvement and innovation in our approach to better understand and manage water supply and demand in drought and in our normal operations. An example of this is our work with the Met Office to develop demand forecasts that enable day-to-day water supply management decisions to be made with greater confidence, presenting greater opportunities to operate at lower risk (e.g. preparedness for peak demands). Advance warning of sudden increases in demand due to the weather can be planned for e.g. by gradually increasing network storage; scheduling pumping and treatment processes. Another example is our work with the Environment Agency on a research project, published in December 2015, to understand the performance of water supply systems during droughts – our Carlisle Resource Zone was one of the nine national case studies.

We will liaise fully with the Environment Agency to discuss water resource modelling data and modelling approaches to ensure that decisions are made using robust and jointly agreed approaches.

Our operational decision-making process, which guides the implementation of strategic pumping to balance reservoir storage across our regional water resources system, is discussed in more detail in Appendix 8.

3.8 Historic droughts

The following historic droughts were the most severe within our supply area:

- 1933/34: a two season drought event concentrated in the south of our region
- 1975/76: a two season drought event that particularly affected the south of our region
- 1984: a single season summer drought event that particularly affected the north of our region including the Pennines
- 1995/96: a two season drought event that affected the whole of our region.

Following customer experience of the drought event in 1995/96 we introduced an improved level of service for water supply, with implementation of Temporary Use Bans and drought permits/orders not more than once in every 20 years on average. This improved level of service was effective from the year 2000 onwards. Since then there have been no drought permits/orders implemented and one hosepipe ban implemented for eight weeks during summer 2010.

Two more recent drought events, in 2003 and 2010, were not as severe as those listed above. In both these years we implemented drought plans and applied for drought permits/orders, but the powers were never implemented because of subsequent rainfall. Figure 7 lists the drought permits and drought orders that have been granted since 2000. Further information on these can be found in Section 5.6 including an explanation of the difference.

Dry weather during the autumn of 2002 and into 2003, caused reservoirs to not refill sufficiently over the winter. This in turn led to low reservoir storage later in 2003 which resulted in the need for us to apply for three drought permits and one drought order at Windermere and Ullswater. These were granted just before Christmas 2003 following a 2-day Public Hearing. These powers were a contingency against continuing dry weather and allowed abstraction from Lake Windermere and Ullswater to continue at lower river flows than normally permitted. However due to rainfall in December 2003 and January 2004, none of the powers were implemented. The experience in 2003 shows that applications for drought permits/orders are often a precaution against continuing dry weather, but due to the length of time required for applications to be granted, applications are often made but are withdrawn or not actually implemented as weather conditions improve.

A dry spring and early summer in 2010 led to low reservoir storages in the West Cumbria and Integrated Resource Zones. A hosepipe ban was introduced on 9 July 2010 across the Integrated Resource Zone. The hosepipe ban was lifted on 19 August 2010 (note that following new legislation ‘hosepipe bans’ have now been replaced by Temporary Use Bans. See introduction for further detail). In addition, we applied for the following four drought permits as a precaution against continuing dry conditions:

- Ennerdale (West Cumbria Resource Zone). A drought permit application to allow abstraction down to a lake level of 1.7 m was made to the Environment Agency on 24 June 2010. Rainfall at the start of July resulted in Ennerdale refilling in approximately three days. We withdrew the application
- Windermere (Integrated Resource Zone). A drought permit application to reduce the hands-off flow to 95 Ml/d and to relax the rolling annual licence limit was made to the

Environment Agency on 7 July 2010. However an improvement in weather conditions meant that the permit was no longer required and we withdrew the application

- Rivington reservoirs (Integrated Resource Zone). A drought permit application to reduce compensation flows to Brinscall Brook and White Coppice to 2 Ml/d each was made to the Environment Agency on 7 July 2010. However it then rained, the associated reservoirs refilled quickly and we withdrew the application
- Longdendale reservoirs (Integrated Resource Zone). A drought permit application to reduce the compensation flow to 22.5 Ml/d was made to the Environment Agency on 7 July 2010. As the south of the region remained very dry, the application was not withdrawn. The Environment Agency granted the drought permit on 29 July 2010 (22 days after application), however, it was not implemented as the reservoirs never fell low enough.

The experiences in 2010 again show that applying for drought permit/orders is a precautionary approach, particularly in West Cumbria where the reservoirs are very flashy and can refill in a matter of days. Because of the time needed by the Environment Agency and Defra to determine applications for drought permits and drought orders, we need to make applications at reservoir storage levels higher than the point where the powers will be implemented. This means that we will apply for drought permits/orders more frequently than they will be used.

Figure 7: Drought permit/orders we have been granted since 2000

Date granted	Location and type	Order or permit	Details	Implemented?
22 Dec 2003	Ullswater	Order	Temporary weir on River Eamont up to 145.12 m AOD, subject to maintaining a flow of 91 Ml/d. No powers sought to lower lake level	Not implemented
12 Dec 2003	Ullswater	Permit	Disregard rolling 12 month abstraction limit of 45,633 Ml a year	Not implemented
12 Dec 2003	Ullswater	Permit	Reduce prescribed flow in the River Eamont to 169 Ml/d in Dec 2003 and Jan 2004	Not implemented
12 Dec 2003	Windermere	Permit	Disregard rolling 12 month abstraction limit of 36,505 Ml a year. Abstract up to 205 Ml/d providing flow to River Leven is at least 91 Ml/d. No powers sought to lower lake level	Not implemented
29 July 2010	Longdendale	Permit	Reduce compensation water from Bottoms Lodge Reservoir into the River Etherow to 22.5 Ml/d	Not implemented

There is a history of drought orders for Ennerdale Water, particularly in the 1970s and 1980s. A change in the abstraction licence in the early 1990s, and a substantial decrease in industrial demand for water in the area, has reduced the need for drought powers in recent years. No drought permits/orders have been implemented at Crummock Water.

3.9 Lessons learnt from previous droughts

As each drought has different characteristics, such as the area affected and the water sources at risk, different lessons are learnt from each drought event that has been experienced.

Water resources management

Following the 2010 drought event, we completed a joint lessons learnt exercise with the Environment Agency to identify improvements in the areas of governance and resilience; communications, communities and partners; environment; drought plans, drought permits, drought orders and hearings.

The key lessons learnt were:

- Our weekly multi-agency drought communication telephone conference call and weekly update reports were very successful
- Closer working relationships needed between ourselves, the Environment Agency, Natural England, Canal and River Trust, National Farmers Union and other partners at all levels
- The need for earlier proactive communication with customers about the evolving water resources situation
- A process for managing compensation-only reservoirs during drought is needed
- Develop further the sensitivity analysis for bringing non-commissioned sources online (e.g. time, volume, quality, treatment needs etc.)
- Environmental monitoring arrangements for drought, especially for drought permits and orders, need to be clear and up to date
- Biennial drought exercises to test the drought plan and drought readiness checks.

As explained below, where appropriate, these lessons and the resulting actions have been incorporated into this drought plan.

In 2014 it was agreed that the Environment Agency will be responsible for making drought order applications for compensation-only reservoirs. These are reservoirs from which we do not abstract and whose purpose is to release water to a downstream watercourse. They include:

- Hollingworth Lake
- Worthington system
- Belmont
- Walverden
- Dubbs
- Borrans
- Meadley
- Swineshaw (Glossop)
- Blackmoss (Upper and Lower)
- Teggs Nose and Bottoms (Langley).

Drought option forms are included in this plan for non-commissioned sources. These forms document the requirements to bring each source back into use and the expected timescales to do so. The detail in these forms comes from work completed by engineering specialists.

To ensure we are 'drought ready' we have collated information for all drought permit/order sites included in this plan and we have agreed Environmental Monitoring Plans for all drought permit/order sites with the Environment Agency, Natural England and Natural Resources Wales (as appropriate). Further information on our drought permit/order readiness is set out in Section 5.6.

The Environment Agency held a drought exercise in March 2017, attended by our Water Resources Manager, to provide a water company perspective. We held our first company drought exercise on 22 March 2016 at which the Environment Agency and Natural Resources Wales were also present.

3.10 Standing down drought measures

This plan outlines drought triggers and other indicators for assessing the onset and progression of drought in each of our resource zones. Specific triggers for defining the exiting or end of drought have not been developed as the end of drought depends upon the level of risk of re-crossing triggers at a later date. These risks and actions need to be considered at a resource zone level. Instead, a range of indicators will be assessed to identify the end of drought status, including:

- Level of storage compared to drought triggers in key reservoirs
- Relative storage position across the resource zone
- Current levels of demand compared to normal levels
- Rainfall and weather forecasts for the next 7-30 days
- Previous rainfall against average and an assessment of whether soil moisture deficits have returned to normal for the time of year
- Status of groundwater sources and/or levels at observation boreholes
- Availability of pumping from lakes/rivers to assist further recovery of reservoir storage.

Continual assessments of supply security will form the basis of our decisions relating to the standing-down of drought measures. As with the implementation of drought measures, the standing-down of drought measures will be fully discussed with the Environment Agency and Natural Resources Wales (as appropriate). The rate at which measures are relaxed will depend upon an assessment of supply security. In general, those measures that have the greatest adverse effect on customers and the environment will be relaxed first.

Communications with customers, the Environment Agency, Natural Resources Wales, Natural England, Ofwat, the Consumer Council for Water and other interested parties will continue during the period of water resource recovery to explain our actions and to thank customers for their help in conserving water.

3.11 Post-drought actions

Following a drought event, we will review the drought management process jointly with the Environment Agency and Natural Resources Wales to highlight lessons learnt. If appropriate, discussions will be held with other stakeholders (see Figure A3.5 in Appendix 3) to review lessons learnt. Any issues arising will be implemented as soon as practical and will be incorporated into the next update of our drought plan. We regularly review our drought plan, in consultation with the Environment Agency, and the full plan is revised every 5 years, or earlier in the event of a material change, and undergoes a public consultation.

Following the 2010 drought we and the Environment Agency jointly reviewed the drought event and produced a joint lessons learnt paper (see Section 3.9). This covered the following key areas: governance and resilience; communications, communities and partners; environment; drought plans, drought permits, drought orders and hearings. For each lesson, specific actions, a responsible person and completion dates were identified and progress was reviewed regularly.

Following a drought event (defined as crossing Trigger 4), we will review the drought management process. A "lessons learnt" report will be produced within 3-6 months of conditions returning to normal. The report will review the drought, actions taken, drought planning, communications, environmental impacts, the effectiveness of drought options that were adopted, and alternative strategies that could be adopted in future droughts. The lesson learnt report will be informed through joint discussions with regulators (Environment Agency, Natural Resources Wales and Natural England) as well as external stakeholders (as appropriate) and a range of internal stakeholders involved in various aspects of drought management.

3.12 Drought management structure

In the event of drought, we will determine the most appropriate management structure to deal with the developing situation considering its severity and extent. Figure 8 shows a typical management structure which may be adopted within our company. Any drought event will be managed in line with our company incident management procedure. Our drought groups have a clear role/remit, and will seek to make decisions through consensus; if that is not possible, issues will be escalated as appropriate for decision.

Decisions on all drought management actions will be taken by us at a regional level. Actions will be introduced in those areas where they are considered appropriate and this will depend on the measure under consideration and the current circumstances.

Figure 8: Our drought management structure

Responsibility	Group
Overall responsibility for drought policy and management decisions (including decisions on water use restrictions and applications for drought permits/orders)	United Utilities Water Limited board
Responsibility for implementing drought management strategy This group will be established at Drought Trigger 1 and typically meet weekly below Drought Trigger 2	Executive Drought Management Group, comprising: • Managing Director (Chair) • Corporate Affairs Director • Domestic Retail Director • Director of Water and Scientific Services • Asset Management Director (link to United Utilities/Environment Agency Executive Liaison Group) • Head of Water Network+ Strategy (link to Drought Coordination Group, United Utilities/Environment Agency Drought Liaison Group and the Environment Agency Multi-Agency Drought Group)
Day-to-day responsibility for managing and implementing the drought plan This group will be established at Drought Trigger 1 and meet more frequently than the Executive Drought Management Group	Drought Coordination Group, comprising leaders from the following business areas: • Head of Water Network+ Strategy (link to Executive Drought Management Group, United Utilities/Environment Agency Drought Liaison Group and the Environment Agency Multi-Agency Drought Group) • Head of Water Resources • Corporate Affairs • Domestic Retail • Water and Scientific Services • Water Network Operations • Resilience team • Production Planning team A Drought Manager will be appointed (in line with our incident management procedure) and will be the Chair of the Drought Coordination Group Specialist task teams will be established as required

The following section outlines the drought triggers that have been developed for each of our four water resources zones. Drought management actions are linked to these drought triggers.

4 Drought triggers

Key messages

- Drought triggers are decision points, to consider which drought management actions are required to address the current situation
- We have drought triggers on key sources in each of our four resource zones
- Our drought triggers have been developed in consultation with the Environment Agency
- Drought trigger positioning is a balance between ensuring sufficient time between triggers, to undertake the required actions, and the frequency with which the triggers are reached
- We have tested the drought triggers under a range of drought situations to ensure we have confidence in them

4.1 Overview

This section presents the drought triggers for each resource zone, based on reservoir (or lake) storage (or level) or the proportion of annual abstraction licence that has been used. These triggers have been developed in consultation with the Environment Agency, using experience from past drought events and water resources modelling to test robustness.

As well as the drought triggers, we consider a range of other water resources indicators when considering drought management actions (see Figure 5). The management of water supply and demand during drought conditions represents a progression of actions that reflect the severity, geographical extent and speed of development of the drought.

Drought triggers are decision points, to consider which drought management actions are required to address the current situation. It does not automatically follow that all associated actions will be implemented immediately after crossing the trigger. At the time of an actual drought event a Drought Action Plan will be produced to detail the drought management actions required to deal with that specific event.

This plan includes a range of actions which are linked to the drought triggers, summarised in Figure 1 and explained in Section 5. Drought triggers are positioned to make an appropriate balance between:

- Sufficient time between triggers to take the required actions (see Appendix 1)
- The likelihood of implementing the actions.

We have used water resources modelling to derive and test the proposed drought triggers. These models simulate the operation of the current supply system under a range of historic and simulated droughts. This includes the “dry weather” demand for water which may occur over the 5 years of this plan. It means that modelled reservoir storage is greater than in actual historic droughts due to lower demands than historically seen and improvements to the supply system (e.g. the West East link commissioned in 2012). Further detail on how we have derived drought triggers and the testing we have done on them, in conjunction with the drought actions that we would apply, is given in Appendix 6. This has included stress testing the drought plan interventions against more severe or extreme droughts than historically experienced.

4.2 Integrated Resource Zone

Drought triggers have been developed for two sources in the Integrated Resource Zone, Haweswater Reservoir and the River Dee system. The drought triggers for Haweswater Reservoir and the River Dee system in our Final Drought Plan 2014 have been revisited for this plan to include the Environment Agency’s Review of Consents licence changes and updated inflow series to the end of 2013. For the Dee,

the Final Drought Plan 2014 triggers were found to remain valid and have not been altered for this drought plan. For Haweswater, whilst overall the triggers remained valid, we have chosen to shift the Final Drought Plan 2014 triggers to provide more protection, i.e. more time between the triggers, in the early part of the calendar year in the event that significant drawdowns occur prior to the end of the winter refill period. This has been informed by our drought scenario testing (Appendix 6).

There are no drought triggers for the Pennines reservoir group, which comprises over 100 reservoirs, as this could mask local issues; however we use operational control curves and monitor storage in these reservoirs each week as part of our normal water resources management process.

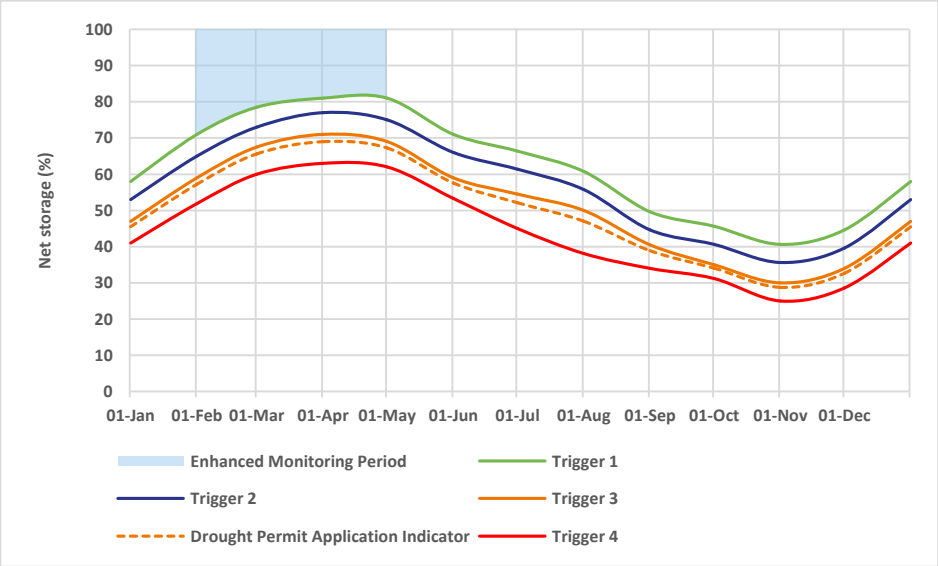
4.2.1 Haweswater Reservoir drought triggers

The Haweswater Reservoir drought triggers vary from month to month reflecting differing seasonal hydrological drought patterns. We have completed modelling, using the Integrated Resource Zone Aquator model, to derive the triggers, using a range of historic drought events.

The Haweswater Reservoir drought triggers from the Final Drought Plan 2014 were found to be effective. Scenario modelling highlighted a risk (albeit very low) of a drawdown starting earlier in the year, e.g. a winter event similar to 1963, followed by an extended “dry” summer. This type of scenario testing is explored further in Appendix 6. Modelling was done to revise the Haweswater Reservoir triggers and propose new triggers to mitigate this risk. We have refined the triggers slightly to ensure additional protection against earlier drawdowns prior to the start of the summer period. This ensures more time to consider appropriate action in the event of drawdowns early in the calendar year, to protect against the eventuality of this being followed by a “dry” summer. The new Haweswater Reservoir drought triggers are shown in Figure 9. The change is subtle and constitutes minor refinements, to “shift” Triggers 1, 2 and 3 in the early part of the year.

Drought triggers

Figure 9: Haweswater drought triggers[5]



The triggers include an enhanced monitoring period between February and May to reflect the enhanced attention to the water resources situation during this period when the drought triggers are at their highest, and the need to ensure adequate storage is achieved before the summer period.

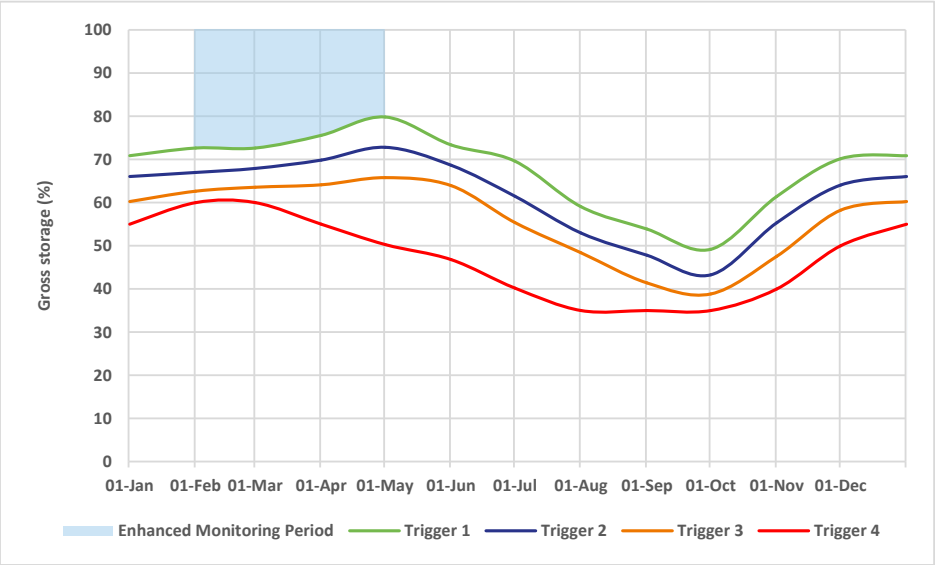
4.2.2 River Dee system drought triggers

The Dee system drought triggers are shown in Figure 10. As with Haweswater Reservoir, the triggers vary from month to month reflecting differing seasonal hydrological drought patterns. Again, we have completed modelling using the Integrated Resource Zone Aquator model to derive the trigger curves using a range of historic drought events.

[5] Note that the drought triggers show the indicative point of commencing drought permit/order applications approximately one week after Trigger 3 is reached

Drought triggers

Figure 10: River Dee system drought triggers



The triggers include an enhanced monitoring period between February and May to reflect the enhanced attention to the water resources situation during this period when the drought triggers are at their highest.

Our River Dee system drought triggers comply with the Dee General Directions. The background to these can be found in Section 3.3. We manage our abstraction from the River Dee in line with these directions, including reducing abstraction according to the various drought stages in the Dee General Directions. We operate our abstractions from the River Dee in an integrated manner with other supplies in the Integrated Resource Zone. This requires us to take action earlier than specified in the Dee General Directions and, therefore, our River Dee system drought triggers are set at higher storage levels than the three stages specified in the Dee General Directions. We have undertaken modelling using the Aquator water resources modelling package (the River Dee system components were developed in conjunction with Natural Resources Wales). By positioning our drought triggers at higher levels than Stages 1 to 3 of the Dee General Directions, modelling has shown that storage would not fall below Stage 3 with a repeat of any of the drought events over the modelled record period (commencing 1927).

The relationship between our four River Dee system triggers and the three Dee General Direction stages is:

- Our Drought Trigger 1 is positioned above the Stage 1 Dee General Directions curve in order to conserve storage in the River Dee system during a potential drought event. The average difference is 9% of gross storage
- Our Drought Triggers 2 and 3 are positioned above the Stage 2 Dee General Directions curve. Trigger 3 would see us consider implementing a campaign for voluntary water use restraint and the average difference between our Drought Trigger 2 and the Stage 2 Dee General Directions curve is 4% of gross storage
- Our Drought Trigger 4 is the trigger where a Temporary Use Ban would be considered. Water use restrictions might not be imposed if regulation releases were not required from the Dee reservoirs to support abstraction as there would be no benefit from imposing water use restrictions. However if there were wider zonal benefits, or a forecast that River Dee regulation may be imposed, we would consider implementing water use restrictions. Our Drought Trigger 4 is positioned above the Stage 3 Dee General Directions curve which

requires water companies to impose water use restrictions and a drought order to ban non-essential use. The average difference is 6% of gross storage.

4.2.3 Drought trigger testing

In line with Environment Agency guidance, a wide range of drought events have been used to test the robustness of the drought triggers in the Integrated Resource Zone Aquator model. This modelling exercise covers the period 1927 to 2013 and includes a wide range of historic drought events including the single season 1984 and 2010 events, as well as a range of two-season events in 1933/34, 1975/76 and 1995/96. In terms of criticality, both the 1995/96 and 1984 events are considered to be the most severe historic droughts for the Integrated Resource Zone water supply system.

Figure 11 shows the estimated frequency of crossing the Haweswater Reservoir and River Dee system drought triggers based on the 87 year record (1927 to 2013).

Figure 11: Estimated likelihood of crossing Haweswater Reservoir and River Dee system drought triggers in any one year

Trigger	Haweswater Reservoir†	River Dee System
Trigger 1	1 in 5	1 in 7
Trigger 2	1 in 15	1 in 15
Trigger 3	1 in 36	1 in 29
Trigger 4	1 in 65	1 in 44

† The likelihoods presented for Haweswater Reservoir are based on an average for two Aquator runs

The likelihood of crossing drought triggers is considered to be an acceptable balance to allow sufficient time for actions during severe drought events. Our current minimum level of service of 1 in 20 (as in the Water Resources Management Plan 2015[6]) is met for crossing Trigger 4 when a Temporary Use Ban is expected to be imposed.

Although the crossing of Trigger 1 is relatively likely, at this point we will not be experiencing widespread drought conditions. At this stage it simply means that there is a heightened risk of drought. Trigger 1 is the time to start taking actions as a precaution against the risk of continued dry weather.

Example outputs comparing modelled storage to the drought triggers for key historic drought events are shown for Haweswater Reservoir (Figure 12) and the River Dee system (Figure 13) below. We have also tested the system against more severe and extreme droughts (Appendix 6), which has shown our plan to be resilient to a range of plausible future drought events.

[6] This is tested using the maximum sustainable level of output possible from the system or resource zone (called "Deployable Output") through the historic hydrological record, in line with Water Resources Management Plan supply-demand appraisal

Drought triggers

Figure 12: Haweswater Reservoir drawdown for 1976, 1984 and 1995/96 scenarios against drought triggers

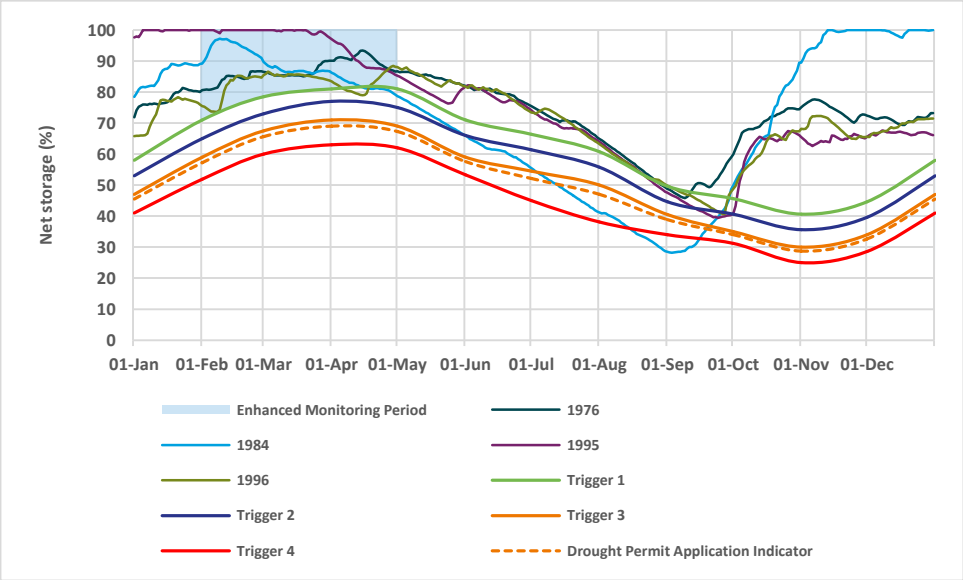
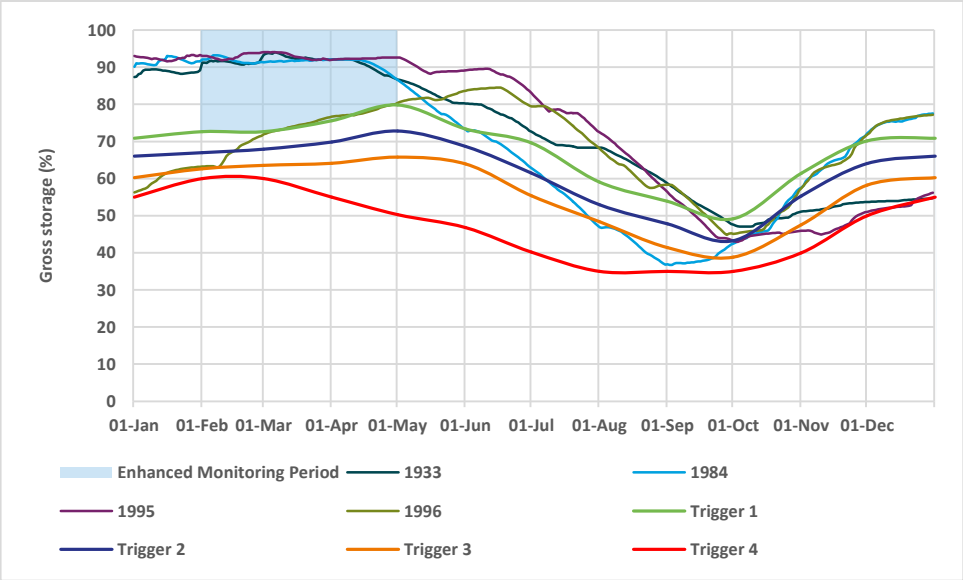


Figure 13: River Dee system drawdown for 1933, 1984 and 1995/96 scenarios against drought triggers



4.3 West Cumbria Resource Zone

Drought triggers have been developed for three sources in the West Cumbria Resource Zone: Crummock Water, Ennerdale Water and Scales boreholes. The drought triggers in our Final Drought Plan 2014 have been reviewed for this drought plan to include the Environment Agency's Review of Consents licence changes and updated inflow series to the end of 2014 (the most recent data available from the Environment Agency). For the draft version of this plan we altered the drought triggers for Crummock Water, but for Ennerdale Water and Scales boreholes the same triggers were retained as presented in our Final Drought Plan 2014. Following consultation feedback, we have now also revised the Ennerdale Water triggers to reduce the time it takes to implement a Temporary Use Ban based on storage at this source.

Given the short critical periods at Crummock Water and Ennerdale Water, winter droughts are an equal risk as summer droughts. Therefore, flat trigger levels throughout the year are appropriate. The triggers include an enhanced monitoring period above Trigger 1 to reflect the need to closely monitor the water resources situation at all times given the rapid response of these sources to drought.

Chapel House reservoir is a balancing reservoir as it does not have its own catchment area but is supplied by abstractions from nearby sources that are transferred into the reservoir. Abstractions from Hause Gill, Dash Beck, the River Ellen, Longlands mine adit and Overwater reservoir all feed into Chapel House reservoir. These sources, together with abstraction from Aughertree Springs and Scales boreholes, supply the Quarry Hill water treatment works. Maximum storage in Chapel House reservoir is equal to less than 10 days supply of water and so it is inappropriate to devise drought triggers for the Quarry Hill sources based on Chapel House reservoir storage. Instead, drought triggers based on actual abstraction compared to the annual licence limit of 365 Ml/yr at Scales boreholes are used.

4.3.1 Crummock Water drought triggers

The Crummock Water drought triggers are shown in Figure 14 including a comparison with the Final Drought Plan 2014 triggers. This comparison shows the changes made to the triggers following the material change resulting in Trigger 4 moving from 1.1 m below weir crest to 0.97 m below weir crest. Trigger 4 at Crummock Water is set at 0.97 m below weir crest level, which is the lake level at which the ability to release the compensation flow to the River Cocker by gravity is lost according to updated assessments. Below 0.97 m, the compensation flow release has to be pumped which requires a drought permit to be in place and the solution developed also requires pumping of the abstracted water at the same time. Due to the change to Trigger 4, the other triggers also needed to move up to preserve the time intervals between them.

Figure 14: Crummock Water drought triggers

Trigger	Crummock Water level (m below weir crest)	
	Final Drought Plan 2014	Final Drought Plan 2018
Trigger 1	0.26	0.13
Trigger 2	0.44	0.31
Trigger 3	0.63	0.50
Trigger 4†	1.1	0.97

† Note that to abstract below Trigger 4 at Crummock Water would require a drought permit to be in force. The change to drought Trigger 4 resulted in a material change to our Final Drought Plan 2014

4.3.2 Ennerdale Water drought triggers

The Ennerdale Water drought triggers are shown in Figure 15, including a comparison with the Final Drought Plan 2014 triggers, showing that only Trigger 4 has been altered. The Ennerdale Water triggers take account of the recently issued impoundment licence (issued on 21 July 2015), which requires higher compensation flows to the downstream River Ehen and allows abstraction down to 1.7 m below the weir crest (see Section 5.8 for further information). For this version of the drought plan, Trigger 4 for Ennerdale Water has been positioned so that a Temporary Use Ban in implemented as early as possible whilst still remaining compliant with our levels of service for Temporary Use Bans of once in 20 years.

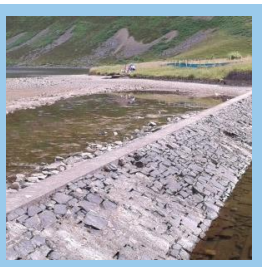
Figure 15: Ennerdale Water drought triggers

Trigger	Ennerdale Water level (m below weir crest)	
	Final Drought Plan 2014	Final Drought Plan 2018
Trigger 1	0.55	0.55
Trigger 2	0.92	0.92
Trigger 3	1.05	1.05
Trigger 4†	1.65	1.47

† Note that to abstract below 1.7 m at Ennerdale Water would require a drought order to be in force

Position of Ennerdale triggers explained

In our Draft Drought Plan 2016 we kept the Ennerdale triggers at the same positions as in the Final Drought Plan 2014 despite developing the new South Egremont boreholes and making changes to allow us to supply more of West Cumbria from Crummock Water - meaning we now abstract less water from Ennerdale Water, resulting in more time before we need to implement a drought order at 1.7m below weir crest.



Following a consultation response from the Environment Agency we have reconsidered the position of Trigger 4 at Ennerdale Water. Trigger 4 at Ennerdale indicates when a Temporary Use Ban may be implemented; it is only when a lake level of 1.7m below weir crest is reached that the drought order is implemented along with more tankering of water. In this plan we have moved Trigger 4 up as high as it can go whilst still meeting our level of service for Temporary Use Bans of once in 20 years. This means that a Temporary Use Ban will be in place for longer before a drought order is implemented, giving more opportunity for demand reductions to take place.

4.3.3 Scales boreholes drought triggers

The Scales boreholes drought triggers are shown in Figure 16 including a comparison with the Final Drought Plan 2014 triggers. The triggers from the Final Drought Plan 2014 have been reviewed for this plan to include recent abstraction data, but have not been altered.

Figure 16: Scales boreholes drought triggers (cumulative annual abstraction in Ml)

Trigger	Scales boreholes cumulative annual abstraction (1 April – 31 March period)	
	Final Drought Plan 2014	Final Drought Plan 2018
Trigger 1	265 Ml	265 Ml
Trigger 2	287 Ml	287 Ml
Trigger 3	309 Ml	309 Ml
Trigger 4[†]	365 Ml	365 Ml

[†] Note that to abstract beyond Trigger 4 would require a drought permit to increase the annual licence volume

4.3.4 Drought trigger testing

The intervals between the Ennerdale Water and Crummock Water triggers are shown in Figure 17. The intervals with both average and worst case drawdown rates are given to show the impact that drought severity can have on the time available to implement actions. At Ennerdale Water, there is significant additional time estimated between the triggers compared to the 2014 Drought Plan on a like for like basis. This reflects in particular the benefits of South Egremont boreholes. However, as we have now moved Trigger 4 up to reduce the time to implement a Temporary Use Ban, the increased time available is now mostly reflected in the significantly greater period between Trigger 4 and the point of implementing a drought order at 1.7m below weir crest. For example, the 2014 Drought Plan had an estimated minimum time of 2 days between these points, whereas this has now increased to 15 days worst-case, or 24 days on average.

Figure 17: Ennerdale Water and Crummock Water drought trigger intervals

Trigger	Ennerdale Water		Crummock Water	
	Average number of days	Worst case days	Average number of days	Worst case days
Trigger 1 to 2	17	13	18	13
Trigger 2 to 3	7	5	18	18
Trigger 3 to 4	19	19	82[+]	38[+]
Trigger 4 to drought order implementation at 1.7 m below weir crest	14[+]	9[+]	N/A	N/A

[+] The Aquator model shows that Ennerdale Water and Crummock Water never reach 1.7m below weir crest or Trigger 4 for these two sites respectively. The time interval from the previous trigger point is therefore estimated using drawdown rates. The "average" drawdown rate is the drawdown rate in the 28 days before reaching the minimum modelled lake level for all the years on record (1961 to 2014), averaged. The "worst case" drawdown rate is the fastest drawdown rate seen over the same 28 day period, in all the years on record

In line with Environment Agency guidance, a wide range of drought events have been used to test the robustness of the drought triggers in the West Cumbria Resource Zone Aquator model. This modelling exercise covers a 54 year period from 1961 to 2014 and includes a wide range of historic drought events including 1963, 1978, 1980, 1983, 1995 and 2010. Given the "flashy" nature of the resource zone, these are all single season events. The 1978 drought event is the most severe event for Ennerdale Water, closely followed by 1963, 1976 and 1984. For Crummock Water, the 1995/96 drought event is the most severe, with the 1983 and 1989 drought events close behind.

As with the 2014 Drought Plan, these tests showed that Crummock Water is more resilient to drought, although the frequency of trigger crossing has increased relative to that plan. This reflects the changes to the drought trigger positions (i.e. moved up) and the additional demand in West Cumbria that is now being

met by Crummock Water in order to reduce abstraction from Ennerdale Water. Crummock Water would still require an event significantly longer in duration than historically experienced to reach Trigger 4. Ennerdale Water is sensitive to both a longer duration drought and a more intense drawdown rate, however, compared to the Final Drought Plan 2014, drawdowns are less severe given interventions to reduce abstraction from the source, including the South Egremont boreholes.

Our drought scenario testing for the West Cumbria Resource Zone is summarised in Appendix 6.

Figure 18: shows the estimated frequency of crossing the Ennerdale Water and Crummock Water drought triggers based on the 54 year record (1961 to 2014).

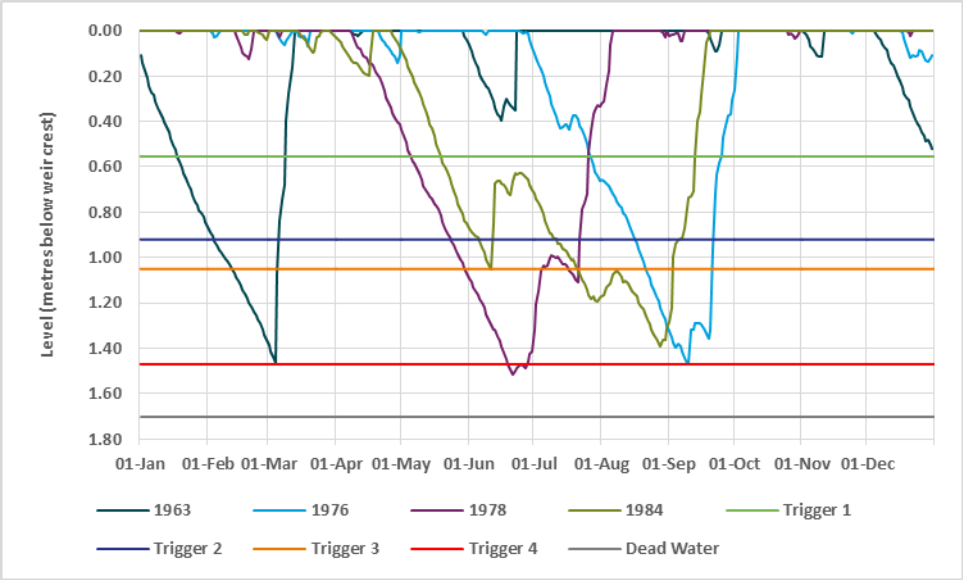
Figure 18: Estimated likelihood of crossing Ennerdale Water and Crummock Water drought triggers in any one year

Trigger	Ennerdale Water	Crummock Water
Trigger 1	1 in 1.6	1 in 2.7
Trigger 2	1 in 3.4	1 in 6.0
Trigger 3	1 in 3.9	1 in 54
Trigger 4	1 in 54[+]	less than 1 in 54

[+] Over the duration of record available, this is the closest frequency of crossing Trigger 4 that can be modelled without breaching our stated Levels of Service for Temporary Use Bans of once in 20 years. This is based on one event over the 54 year record, as the next two events are equally severe and would result in a Level of Service of once every 18 years

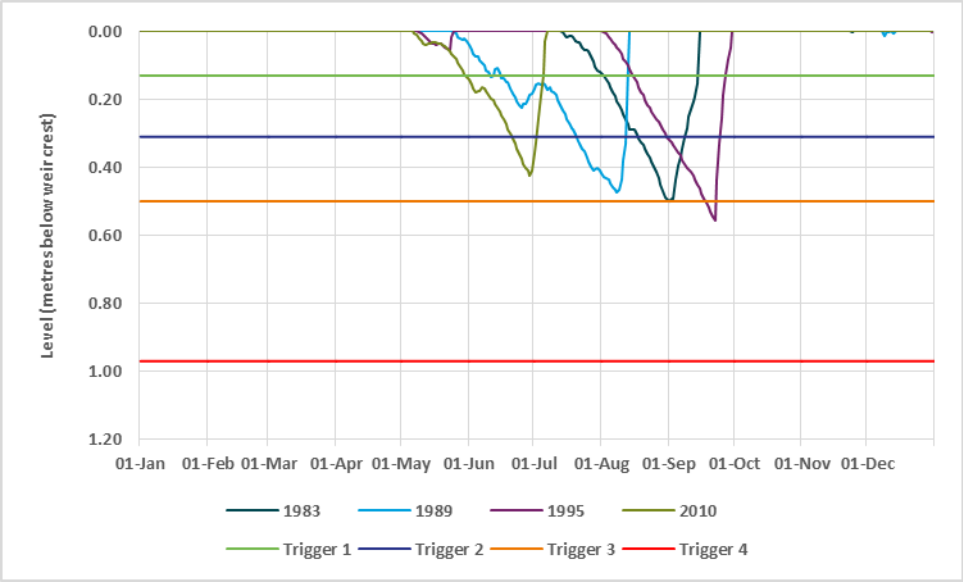
The likelihood of crossing drought triggers is considered to be an acceptable balance to allow sufficient time for actions during severe drought events. The results show that our level of service of 1 in 20 is met for crossing Trigger 4 when a Temporary Use Ban is expected to be imposed. Outputs comparing modelled storage to the drought triggers for key historic drought events are shown for Ennerdale Water (Figure 19) and Crummock Water (Figure 20).

Figure 19: Ennerdale Water drawdown scenarios for key drought events against drought triggers



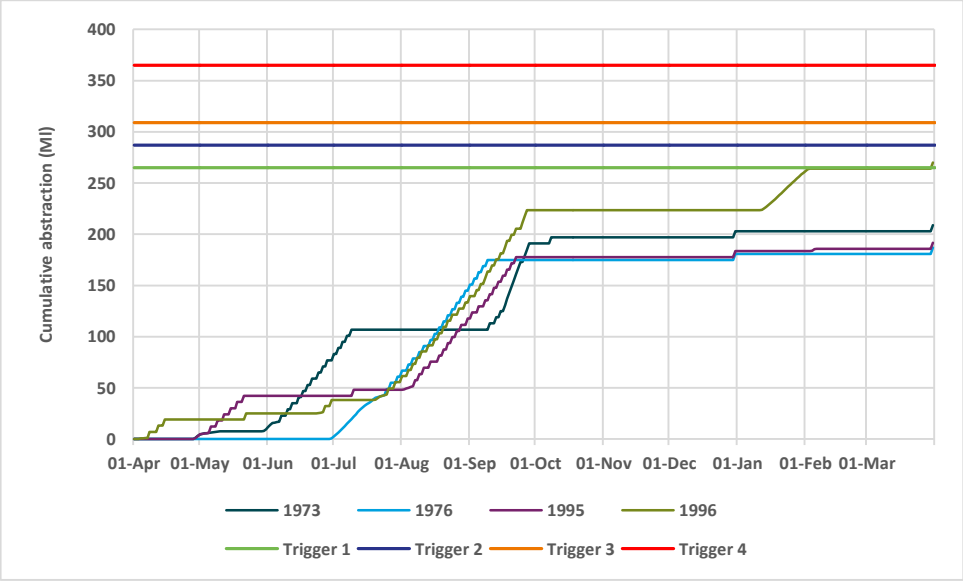
Drought triggers

Figure 20: Crummock Water drawdown scenarios for key drought events against drought triggers



As with the Ennerdale Water and Crummock Water drought triggers, Aquator modelling was used initially to undertake an assessment of the frequency with which the drought triggers are crossed for the Scales boreholes (Figure 21). In this modelling, the lower triggers were not crossed. Therefore, a further assessment was carried out using historic abstraction volumes, which confirmed that the trigger spacing was appropriate. The frequency with which drought powers would be implemented is expected to be less than once in 20 years.

Figure 21: Scales boreholes modelled abstraction scenarios for key drought events against drought triggers



4.4 Carlisle Resource Zone

Drought triggers have been developed for Castle Carrock Reservoir in the Carlisle Resource Zone. This section covers the development and testing of those drought triggers.

4.4.1 Castle Carrock Reservoir drought triggers

The Castle Carrock Reservoir drought triggers have been refined from those previously presented in the Final Drought Plan 2014. Following implementation of new abstraction licences in 2015 on the River Gelt (to meet Habitats Regulations obligations) the water resource position in the Carlisle Resource Zone is more finely balanced.

The Carlisle Resource Zone has a relatively short "critical period", given the hydrologically "flashy" catchments (river flows may recede and in turn recover rapidly following rainfall) and relatively small volumes of reservoir storage available. Therefore, winter droughts may hypothetically pose a risk to supplies as much as summer droughts, therefore flat trigger levels throughout the year are appropriate.

In developing the Final Drought Plan 2014 drought triggers, we considered that pumping from the River Eden to Castle Carrock Reservoir would only likely take place from Trigger 3 due to water quality risks. Whilst we considered that in certain conditions pumping might have occurred prior to Trigger 3 we were not confident this would be available during higher levels of river water turbidity. We have since completed modifications to the assets at Castle Carrock Reservoir which mitigates these risks and allows pumping from the River Eden to Castle Carrock from Trigger 1 to protect against reservoir drawdown. For this drought plan we have reassessed the drought triggers for the Carlisle Resource Zone to take this change in operation into account as shown in Figure 22. We have also updated on this latest operational capability within the 2015/16 annual Water Resources Management Plan review.

Due to the high environmental protection given to the River Eden and River Gelt (part of the River Eden and Tributaries SAC), we are not proposing any drought permit/order applications to alter our existing abstraction licences from these rivers.

Changes to our River Eden at Cumwhinton abstraction licence in 2003 and improvements to the supply system in the zone mean that extensive drought management actions, including drought permit/order applications, are unlikely to be required (even under the most extreme drought on record). The drought actions included in this plan for the Carlisle Resource Zone include use of dead water[7] in Castle Carrock Reservoir and demand management actions. Dead water comprises a significant portion of additional storage, 170.7 Ml, equivalent to 26% of the normal reservoir volume available for supply.

[7] Dead water is water that lies below our normal intake from the reservoir and so cannot normally be abstracted. In a drought we would seek to install pumps to allow this water to be used

Drought triggers

Figure 22: Castle Carrock drought triggers[8]

	Net storage in Castle Carrock reservoir (%)	
Trigger	Final Drought Plan 2014	Final Drought Plan 2018
Trigger 1	77.6%	73.9%
Trigger 2	56.4%	63.7%
Trigger 3	41.5%	53.6%
Trigger 4	33.3%	33.3%

4.4.2 Drought trigger testing

In line with Environment Agency guidance, a wide range of drought events have been used to test the robustness of the drought triggers in the Carlisle Resource Zone Aquator model. This modelling exercise covers the period 1961 to 2014 (the most recent inflow data available) and includes a wide range of historic drought events including 1976, 1995, 1996 and 2003. Given the nature of the resource zone these are all single season events. The Carlisle Resource Zone is particularly susceptible to shorter-duration droughts given the hydrologically "flashy" catchments (river flows may recede and in turn recover rapidly following rainfall) and relatively small volumes of reservoir storage available. In terms of criticality, the 1976 and 2003 events are considered to be the most severe droughts for the Carlisle Resource Zone supply system. Drought scenario testing (Appendix 6) has also demonstrated that single season events are most representative of the drought risks in Carlisle, upon which the triggers are based.

Figure 23 shows the estimated likelihood of crossing the Castle Carrock Reservoir drought triggers, based on the 54 year record.

Figure 23: Estimated likelihood of crossing Castle Carrock drought triggers in any one year

Trigger	Castle Carrock
Trigger 1	1 in 2
Trigger 2	1 in 8
Trigger 3	1 in 27
Trigger 4	less than 1 in 54

There is a marginally increased likelihood of crossing Triggers 1, 2 and 3 compared to the Final Drought Plan 2014, which reflects the net impact of using the latest water resources models and revisions to upper trigger positions (to account for pumping availability and to ensure adequate spacing between Triggers 3 and 4). As with modelling in other zones, demands are also at the upper end of the plausible range on a precautionary basis for trigger derivation.

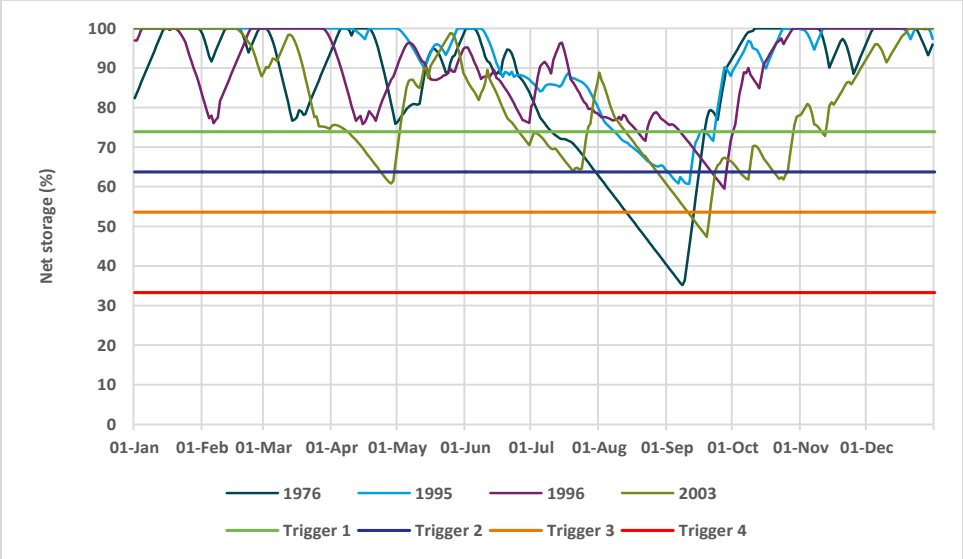
Therefore, the frequency of crossing drought triggers is considered to be an acceptable balance to allow sufficient time for actions during severe drought events. Whilst crossing the upper triggers is relatively likely, the likelihood of reaching the lower triggers is very low, and less than our level of service for

[8] In the Final Drought Plan 2014 the Castle Carrock triggers were presented as gross storage in megalitres and have been converted to the equivalent net % storage for this plan

Drought triggers

Temporary Use Bans defined by Trigger 4. Figure 24 compares modelled storage to the drought triggers for Castle Carrock Reservoir for key drought years.

Figure 24: Castle Carrock drawdown scenario against drought triggers



4.5 North Eden Resource Zone

Drought triggers have been developed for the boreholes (Bowscar, Cliburn, Edenhall, Gamblesby, and Tarnwood) in the North Eden Resource Zone. This section covers the development and testing of those drought triggers.

4.5.1 North Eden boreholes drought triggers

The need for drought options in the North Eden Resource Zone is highly unlikely due to the current surplus of water supplies over demand during drought conditions. Therefore, this drought plan details the options available to deal with localised problems that may occur and how customers' water supplies can be maintained throughout drought periods.

The potential drought permit applications for the North Eden Resource Zone relate to the relaxation of the annual abstraction licence limits (see Appendix 9.7 for details), thereby permitting abstraction to continue at a higher rate. The need to make these applications would not be based on specific groundwater level triggers but instead would relate to a prolonged period of dry weather and associated high demands for water, which would in turn necessitate an increase to the annual abstraction licence limit.

The drought triggers for the North Eden boreholes are based on percentages of the cumulative annual abstraction licence total for all the boreholes. Using this approach, drought triggers are only at risk of being crossed towards the end of a year. Figure 25 sets out the North Eden boreholes drought triggers. The triggers presented in the Final Drought Plan 2014 have not been altered for this plan.

Drought triggers

Figure 25: North Eden boreholes drought triggers

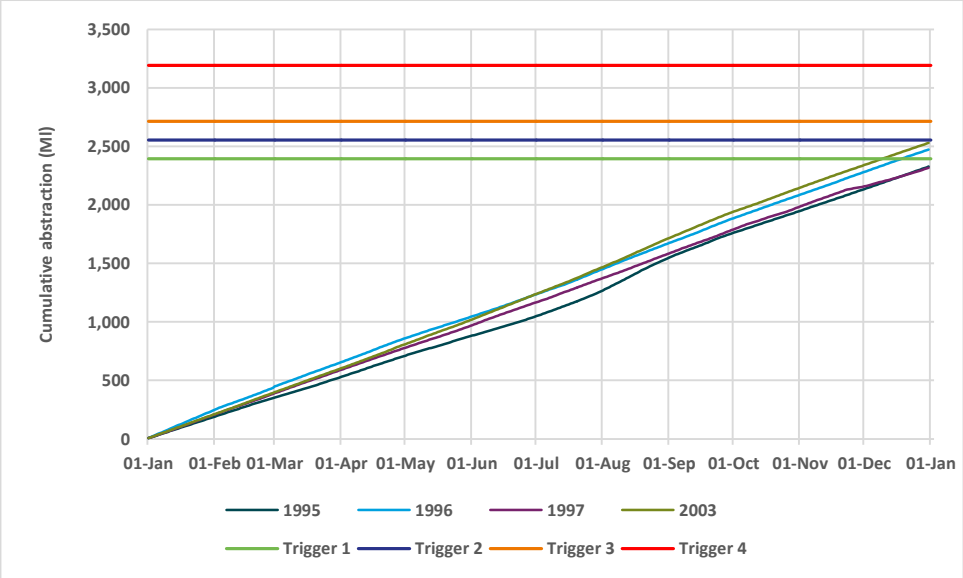
Trigger	Cumulative annual abstraction from 1 January
Trigger 1	2,394 Ml
Trigger 2	2,554 Ml
Trigger 3	2,714 Ml
Trigger 4†	3,192 Ml

† Note that to abstract beyond Trigger 4, we would require a drought permit to increase the annual licence volume

4.5.2 Drought trigger testing

Figure 26 shows the combined cumulative actual abstractions for the North Eden boreholes, for the four most severe years between 1995 and 2015, against the drought triggers.

Figure 26: North Eden boreholes actual abstraction against drought triggers



Drought Trigger 1 has been crossed on only two occasions (December 1996 and December 2003) whereas Trigger 2 has never been crossed. In 2003, the cumulative abstraction for the year was 2,530 Ml, just below the Trigger 2 level of 2,554 Ml. Since 2003, demands in the North Eden Resource Zone have declined. Drought triggers are only crossed late in the calendar year, avoiding abortive work applying for drought permits early in the year. Given the surplus of supply over demand for this resource zone, this is an acceptable level of risk. The triggers have also been tested using theoretical scenarios with higher rates of abstraction than we have seen historically. Trigger 4 was crossed only under a very worst case scenario, with the maximum daily abstraction figure from the whole of the abstraction record (9.7 Ml/d in August 1995) occurring each day of the year.

Our drought scenario testing for North Eden Resource Zone is summarised in Appendix 6.

5 Drought management actions

Key messages

- For each drought trigger there are associated actions that escalate as a drought develops. Actions can include:
  - Moving water around our system to balance risk
  - Enhancing customer communications
  - Increasing leak detection and water efficiency activities
  - Demand restrictions on customers
  - Drought permits/orders to alter our abstraction licence conditions (e.g. reduce releases to rivers from our reservoirs, allow us to abstract at lower river flows etc.)
  - Bringing supply side options online
- Some actions have to follow a legal process set out in legislation

5.1 Introduction

This section outlines the drought management actions that we would consider implementing during a drought event. These include:

- Operational actions
- Communication actions
- Demand side actions
- Leakage actions
- Supply side actions (non-commissioned sources; tankering)
- Drought permit/order actions.

Actions will only be pursued if they are right for the current drought situation, and the plan for dealing with a specific drought event is likely to comprise actions from all of the above areas. Drought actions may be applied either company wide, by resource zone or to target a specific geographic area depending on the nature of the drought event at that time.

The drought triggers outlined in the previous sections are designed to provide sufficient time between them to allow these actions to be instigated. The triggers are decision points to review possible actions and determine the appropriate course of action in the particular drought event. Different actions will take different timescales to implement following the decision to commence. The spacing of drought triggers has been derived to ensure a balance between:

- Sufficient time between triggers to take the required actions
- The likelihood of implementing the actions.

The target intervals between the drought triggers, to ensure drought actions can be implemented, are explained in Appendix 1. If appropriate, following Trigger 3, we would implement a campaign for voluntary water use restraint (Trigger 2 at Ennerdale Water) and commence the representation period for a Temporary Use Ban. Following Trigger 4 we would implement the Temporary Use Ban, if appropriate. For all resource zones where drought permit/order applications are proposed, these would be submitted approximately 7 days after a campaign for voluntary water use restraint has commenced.

During preparation of our 2014 drought plan, the drought actions and triggers at Ennerdale Water (West Cumbria Resource Zone) were reviewed through discussion with Defra. Section 5.8 explains the timing and intervals between drought triggers at Ennerdale and the associated actions. The main differences are that at Ennerdale, a campaign for voluntary water use restraint would occur earlier, at Trigger 2, and the drought options include tankering of treated water. These differences to the drought triggers and actions at Ennerdale Water compared to other sources should be kept in mind when reading this plan. The fine

balance between public water supply and environmental impacts in West Cumbria means that very careful consideration of the drought options is required and these are discussed in Section 5.8.

5.2 Operational actions

Figure 27 outlines operational actions that we would consider on reaching each drought trigger for each resource zone.

In our drought scenario testing (Appendix 6), we have identified the timing and order of implementation of supply-side options for each of the drought scenarios tested. However, this is indicative only; in practice the timing and sequence of operational actions will depend on the characteristics of any future drought and the prevailing operational circumstances at that time.

Drought management actions

Figure 27: Operational drought management actions

Trigger	Integrated Resource Zone	West Cumbria Resource Zone	Carlisle Resource Zone	North Eden Resource Zone
Trigger 1	Continuously monitor the water resource situation and reduce outputs from local reservoir sources to sustainable levels where appropriate Issue internal reminder to closely control compensation and prescribed flows Rezone to meet demand including increasing water supplies from regional strategic sources where appropriate Increase pumping from Windermere, Ullswater, River Lune and boreholes across the region (where appropriate) dependant on licence conditions and demand levels. We will utilise all practicable opportunities to help support storage in Haweswater reservoir in line with this drought plan, by pumping from Windermere and/or Ullswater and/or utilising the West-East link depending on the resource availability Review use of West-East Link and Rivington Aqueduct links to balance risk across the resource zone	Continuously monitor the water resource situation, with increased frequency of checking water levels at Crummock and Ennerdale Issue internal reminder to closely control compensation and prescribed flows Rezone to meet demand and balance zonal risk including adjusting the outputs from Ennerdale, Crummock and Quarry Hill sources where appropriate If appropriate increase abstraction from Scales boreholes within licence limits	Continuously monitor the water resource situation to ensure sustainable source use and balance of risk across the zone Issue internal reminder to closely control prescribed flows Review and adjust abstraction rates from Castle Carrock and the River Eden Commence pumping of raw water from the River Eden (subject to licence and water quality constraints) to augment storage in Castle Carrock reservoir. Monitor Eden catchment rainfall, weather forecasts and water quality (particularly turbidity); balance resource and water quality risks as appropriate	Continuously monitor the water resource situation to ensure sustainable source use and balance of risk across the zone Increase abstraction from borehole sources within the constraints imposed by the annual abstraction licence limits to meet increases in demand Increase import of water from Northumbrian Water to Alston if necessary within the agreed maximum volume Close monitoring of abstraction compared to the drought triggers
Trigger 2	Continue with Trigger 1 drought actions; continue to balance regional system to ensure risk is balanced across the resource zone Review the use of normal dry weather water sources (different to non-commissioned sources) in order to optimise resource use and ensure sustainable abstractions from local reservoir sources Assess the potential use of Trigger 2 non-commissioned sources where appropriate Initiate discussions with Environment Agency to review the use of water banks (where appropriate)	Continue with Trigger 1 drought actions; continue to balance risk across the zone where possible Continue to rezone in order to balance resource zone risk by implementing temporary changes to the distribution system operation whilst maintaining sufficient water pressure to customers (for example, the use of Hayborough pumps to support the Quarry Hill zone from Crummock if appropriate) All viable options to limit the drawdown of Ennerdale Water, and hence avoid the need for a drought order, will be considered and adopted if proved feasible including increasing abstraction from South Egremont boreholes When water level in Crummock reaches 0.63 m below weir crest commence plans to implement pumping of compensation/abstraction flows (4 weeks ahead of 0.97 m below top water level being reached at worst drought drawdown rate)	Continue with Trigger 1 drought actions; continue to balance risk across the zone where possible Consider distribution network changes including temporary pipelines or pumping stations to provide alternative water supplies or temporary changes to the distribution system operation to maintain sufficient water pressure to customers	Continue with Trigger 1 drought actions; continue to balance risk across the zone where possible Consider distribution network changes including temporary pipelines or pumping stations to provide alternative water supplies or temporary changes to the distribution system operation to maintain sufficient water pressure to customers

Drought management actions

Trigger	Integrated Resource Zone	West Cumbria Resource Zone	Carlisle Resource Zone	North Eden Resource Zone
Trigger 3	Continue with Trigger 1 and 2 drought actions; continue to balance the regional system to ensure risk is balanced across the resource zone Where necessary, augment declining gravity flows from reservoirs to water treatment works with temporary pumps (e.g. Piethorne reservoir) Consider temporary pipelines and pumping stations within the supply system to provide alternative water supplies Implement any actions agreed with the Environment Agency in relation to the use of water banks and the Windermere fishery sluices Assess the potential use of Trigger 3 non-commissioned sources where appropriate	Continue with Trigger 1 and 2 drought actions; continue to balance risk across the zone where practical Commence tankering of treated water to the service reservoirs associated with Ennerdale Water (approximately 0.6 Ml/d which will require 24 tanker deliveries a day)	Continue with Trigger 1 and 2 drought actions; continue to balance risk across the zone where possible	Continue with Trigger 1 and 2 drought actions; continue to balance risk across the zone where possible
Trigger 4	Continue with Trigger 1, 2 and 3 drought actions; continue to balance the regional system to ensure risk is balanced across the resource zone Assess potential use of Trigger 4 non-commissioned sources where appropriate	Continue with Trigger 1, 2 and 3 drought actions; continue to balance risk across the zone where possible On implementation of a drought order at Ennerdale (at 1.7 m below weir crest) increase tankering of treated water to the service reservoirs associated with Ennerdale Water (approximately 2 Ml/d which will require 76 tanker deliveries a day)	Continue with Trigger 1, 2 and 3 drought actions; continue to balance risk across the zone where possible Consider use of dead water in Castle Carrock reservoir	Continue with Trigger 1, 2 and 3 drought actions; continue to balance risk across the zone where possible

5.3 Demand side actions

5.3.1 Water efficiency actions

As part of our normal operation we take an active role in promoting the efficient use of water to all types of household and non-household customers. A range of measures are undertaken including many publicity, education and advisory activities. These activities are estimated to save 3 Ml/d each year during 2015-20.

We promote and distribute shower regulators and promote 'Save-a-Flush' cistern displacement devices to all of our customers. Approximately 30,000 shower regulators will be distributed each year. The devices, along with other water saving ideas, are promoted in the billing leaflet which is sent to all customers. We also promote these on our website, through advertisements in local council magazines, local press, at community events and through road show activities.

These devices are provided alongside a household water audit and guide to using water wisely in the home, to reinforce water saving behaviour, and are provided free of charge to our customers via our customer call centre and website. We offer a home audit service, where skilled technicians carry out an audit of water use in the property and install water efficient products, where appropriate. We also undertake a programme of installing water meters for those customers who wish to benefit from a measured tariff. We estimate that an average of 54,000 properties each year will be metered in this way during 2015-20. Water efficiency devices are also promoted to customers who are requesting a free water meter.

We regularly update the Corporate Responsibility information on our website (corporate.unitedutilities.com/corporate-responsibility) including our activities to support local communities, the environment, our customers and employees. It also includes information on our company performance such as the Dow Jones sustainability index (in 2014/15 we were an industry leader with world class status).

We continue to deliver our water efficiency education programme for primary schools in the North West region (unitedutilities.com/educational-talks). The programme includes topics such as the water cycle, where your water comes from, water safety, what not to flush and water efficiency. In 2015/16, over 8,500 Key Stage 2 pupils have taken part in the programme. As well as expert teaching, over two classroom visits, each child receives a booklet reiterating the important messages, a set of water efficiency trump cards and a toothy timer to encourage them to turn off the tap when brushing their teeth.

We maintain partnerships with external bodies to promote water conservation including the Environment Agency, local councils, local environmental groups and water efficient product manufacturers.

While extensive water efficiency promotion is undertaken every year, during a drought event, we will enhance this publicity, for example the placing of adverts in newspapers or on local radio. Enhancements to water efficiency promotion will start following the crossing of Trigger 1, when the heightened risk of drought is first identified. The water efficiency promotion will escalate as appropriate to the situation. The nature of this promotion during a drought event will vary depending on aspects of the drought such as its geographical extent, the population centres affected and the time of year. For example, during the spring and summer months, water conservation messages will focus on garden watering. However, during the winter months when garden watering is minimal, it will be more appropriate to issue customer communications relating to the need to lag pipes to prevent bursts, particularly during the Christmas holiday period when businesses and homes may be left unoccupied for some time. The following list shows the range of possible water efficiency actions that could be employed during a drought event:

- General use water wisely messages
- Use water wisely in the garden messages
- Use water wisely in the household messages
- Free issue of water saving devices for use in toilet cisterns
- Free issue of water savers packs
- Promotion of water efficiency and provision of water efficiency devices at superstores and attendance at local events such as flower shows
- Joint initiatives with other organisations to promote water efficiency (e.g. Environment Agency)
- Information on billing leaflets
- Targeted mailshots to areas particularly affected
- Issue of press releases to the local press
- Adverts in the local press
- Use of social media posts including YouTube videos
- Local radio adverts
- Messages on the need to lag pipes.

Water efficiency promotion will be closely linked to wider customer communication in a drought, and this is discussed further in Section 5.7.2.

5.3.2 Water use restrictions

This section outlines our plans for introducing water use restriction measures allowed for under legislation. Further detail can be found in Appendix 2 and Appendix 9.

The management of customer demand plays an important role in assisting the assurance of security of supply, particularly during times of drought. Companies must demonstrate that they have implemented appropriate demand side restrictions to support drought permit/order applications.

This plan takes into account legislation passed by Government in 2010/11 including the Flood and Water Management Act 2010, Water Use (Temporary Bans) Order 2010 and the Drought Direction 2011.

We are a signatory to the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) and we will act in line with its four principles:

- Ensure a consistent and transparent approach
- Ensure that water use restrictions are proportionate
- Communicate clearly with customers and the wider public/users
- Consider representations in a fair way.

Drought management actions

Water use restrictions explained

There are three types of water use restrictions in this plan:

- Campaign for voluntary water use restraint
- Temporary Use Bans
- Ordinary drought orders to ban non-essential use.

In line with the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014):

- We have adopted a phased approach to demand restrictions with voluntary measures preceding Temporary Use Bans and drought orders to ban non-essential use
- We will implement demand restrictions on domestic customers before commercial customers.

On reaching Trigger 3 (Trigger 2 at Ennerdale) we would ask customers to use water wisely and initiate a campaign for voluntary water use restraint to ask customers to restrain their use of hosepipes connected to the mains water supply. We would also announce our intention to introduce a Temporary Use Ban and would commence a period for representations on this proposal. On reaching Trigger 4 we would consider imposing a Temporary Use Ban. Following this, if the situation continued to worsen, we would consider applying to the Secretary of State for a drought order to impose a non-essential use ban as set out in the Government's Drought Direction 2011

Campaign for voluntary water use restraint	Customers asked not to use hosepipes connected to the mains water supply to wash cars or water their gardens. This is entirely voluntary and we appreciate that some customers are more able than others to do this
Temporary Use Ban	Temporary Use Bans primarily target domestic customers Customers must not use hosepipes connected to the mains water supply to water gardens, wash cars, fill a domestic swimming pool and similar uses. Exceptions will be offered including blue badge holders, affected businesses and use for reasons of health and safety. We will apply **all** the discretionary concessional exceptions included in the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014)
Drought order to ban non-essential use	Drought orders to ban non-essential uses primarily target commercial customers The Drought Direction 2011 sets out the uses than can be banned including the use of mechanical vehicle washers, filling non-domestic swimming pools (exclusions include public pools) and using hosepipes to clean the exterior (including windows) of non-domestic buildings We will apply **all** the discretionary concessional exceptions included in the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014)

More information can be found in Appendix 2 and Appendix 9

Drought management actions

Following the 2010 drought and the new legislation passed by Government in 2010/11, we commissioned a survey in 2011 looking at customer views of water use restrictions. We also undertook further customer research in 2014 in West Cumbria due to the different drought actions and their frequency in this zone. The results of the 2011 and 2014 surveys have been used to develop our water restrictions implementation process (Figure 28) which takes account of the need to maximise the amount of water saved during times of drought, the need to meet legislative requirements and to align to the four principles in the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014).

Figure 28: Process for implementation of water use restrictions

Trigger	Action
Trigger 3 (Trigger 2 at Ennerdale)	Initiate campaign for voluntary water use restraint and commence the representation period (3 weeks but may be shorter at Ennerdale) for a Temporary Use Ban
	Consider Temporary Use Ban representations
Trigger 4	Implement Temporary Use Ban and continue to consider representations
After Trigger 4	Consider need for ordinary drought order to ban non-essential uses; apply for and implement if appropriate

In order to encourage reduction in demand we will start a campaign for voluntary water use restraint at Trigger 3 (Trigger 2 at Ennerdale), commensurate with the start of the representation period for a Temporary Use Ban. This will help avoid short-term increases in demand before a Temporary Use Ban takes effect. The message will be conveyed through the use of press releases and coverage on our website, as well as through the formal legal notice. Enforcement of the Temporary Use Ban will occur following the end of the representation period and should be in place around the time Trigger 4 is reached.

Additional information on demand management actions during drought can be found in Appendix 9. Information on our water use restrictions process, and outputs from our 2011 and 2014 customer surveys, can be found in Appendix 2.

5.4 Leakage actions

Leakage control is a key activity in managing the balance between water supply and water demand. Our long-term programme for leakage reduction is outlined in our business plan in line with the Water Resources Management Plan 2015. This ensures that we manage leakage at a sustainable and economic level and achieve our target set by Ofwat. Whilst leakage control is a long-term activity, during a drought situation we will make every effort to further reduce leakage beyond our Ofwat target through additional leakage detection and repair over and above our normal efforts. The extent to which, during a drought, our intensive efforts can further reduce leakage will depend on leakage levels and weather conditions at the time.

Reductions in leakage below the sustainable economic level are not required to prevent reservoirs emptying even in a repeat of the worst drought on record, even when the forecast effects of climate change are taken into account. However, our customers expect us to control leakage, and particularly so during a drought. Therefore, it is essential that we explain to our customers the actions that we are taking to control leakage during a drought event. This reflects the enhanced value of water during such times and the need to complement water savings measures by our customers.

Drought management actions

In a possible drought event (below Trigger 2), additional detection and repair resources will be implemented. As the drought event intensifies and the drought triggers are reached, the priority of leak detection and repair alters. Where demand savings can be made, we will seek to engage additional leakage resources during a drought.

Based on our experience of the 2010 drought, there could be a potential saving of up to 5 Ml/d per month (during the summer period) in total across the region. The magnitude of the saving will, however, depend on the area affected by drought, as potential leakage savings may vary substantially across our region and would not be sustainable in the longer term as the easiest to detect leaks are found first and other activities would need to be attended to over the longer term. If leakage is already at historically low levels, or there is severe break out of new leaks, there may be limited scope for further leakage reduction even in the short-term. Droughts can increase leak breakout rates as there is a link between soil-moisture deficit and increasing leakage levels, for example, due to increased subsidence of soils. In this event, additional resources are needed to simply hold leakage steady and the benefit of a significant increase to our leakage control activities would be to minimise increases in leakage which might otherwise occur.

In a drought lasting three months or more, which affects the North West but not other regions of the UK, we would look to acquire skilled leak detection resource on contract from other regions. This means that any leakage reduction achieved by short-term activities might be maintained over the longer term. If a drought affects other regions of the country we may find it difficult to acquire additional skilled leak detection resources due to the demand for such skills.

In order to achieve the savings indicated by using an enhanced workforce, a number of different additional working practices would be deployed. These would vary as appropriate to the location and extent of the drought. These may include:

- Increasing management focus on leakage including increased frequency of our leakage board meetings, and coordination through our drought management structure (Section 3.12)
- Increasing detection and repair resources, with initial focus on reducing our repair workbank
- Working with our alliance partners to allow for a quicker turnaround of repairs (move to next day repair, increase priority of jobs raised)
- Liaison with councils and Highways Agency to reduce notice periods required before a repair can be carried out in the highway
- Increasing publicity of our free ‘Leakline’ telephone service and website form for customer reporting of leaks
- Promoting pipe lagging (according to season of drought) and encourage customers to repair leaks on their own pipes
- Promoting the private leak repair scheme offering free repairs (subject to conditions) to domestic customers for leaks on their supply pipes
- Increasing frequency of surveys of aqueduct systems and the local distribution network
- Increasing frequency of service reservoir inspections
- Increasing use of advanced acoustic leak detection on aqueducts
- Contacting landowners with large mains crossing their property to request them to report suspect leaks
- Issuing more Defective Fitting notices to customers

- Considering use of legislation, for example by enforcing urgent work notices where appropriate
- Increasing the use of more disruptive leak control methods e.g. step tests and pressure zone tests by night staff
- Optimising existing pressure management schemes and increasing deployment of flow modulated control devices where appropriate.

In summary, additional leakage control will be deployed as part of our reaction to a drought event. This will mean a significant additional use of resources and the adoption of more disruptive working practices. The actions that we would take to reduce leakage during a drought would depend upon the situation in other regions of the country, the location and severity of the drought, the timescale for implementation of the action, together with a consideration of the potential water savings that could be achieved. Enhanced leakage detection and repair during a drought event could potentially give a benefit of several Ml/d during a drought lasting several months, but this may be at the detriment of other performance measures such as lower pressure water supplies to customers and increased disruption to highways.

Additional information on leakage actions during drought can be found in Appendix 9.

5.5 Supply side actions

Actions relating to our operational asset base are discussed in Section 5.2, but there are also a number of additional water sources that may be used in the event of a severe drought. These include tankering and use of reservoir dead water, as well as bringing currently non-operational water sources in to use (these are called non-commissioned sources in this drought plan) – together these are called supply side options. These sources are not required to prevent reservoirs emptying in a repeat of the worst drought on record, even when the forecast effects of climate change are taken into account. However, we may take action to bring supply side sources in to use as a precaution against the risk of a more severe drought occurring.

A substantial amount of work is required to bring a non-commissioned source in to operation. This includes the need for water quality testing and associated risk assessments plus the need to provide new equipment such as pumps and treatment plants. This can extend the timescales for implementation in some cases.

Drinking water quality needs to be maintained even during drought conditions. We are required by legislation to provide drinking water that meets the statutory water quality standards and this would continue to be the case during drought conditions. Non-commissioned water sources will always be fully tested prior to being used in line with the sampling provisions set out in Section 15 of The Water Supply (Water Quality) Regulations 2000 (as amended) to ensure we are able to treat the water to the required potable standards. In some cases, the source may not comply with these regulations resulting in it being unavailable for use. Water quality sampling can take several weeks to complete before the source can be brought in to operation. All non-commissioned drought sources will be risk assessed through our drinking water safety plan approach and included within the relevant Regulation 28 report. If a source is not included in the relevant report, a risk assessment needs to be completed and a three month period elapsed before the source can be used, and a revised report sent to the Drinking Water Inspectorate.

In some cases, for example when a reservoir source is changed for a groundwater source, customers may notice a change in the type of water, e.g. from soft to hard water. In these cases, we will carry out local publicity through press releases and direct contact with local businesses that would be sensitive to such a change. In the event of any concerns about drinking water quality arising from drought conditions, we would liaise closely with Public Health England, Local Authorities and the Drinking Water Inspectorate.

Drought management actions

A complete review of all of our licensed and unlicensed water sources was completed for our Final Drought Plan 2014, identifying those sources which are used in normal operation each year from those which could only be used after substantial work (e.g. to provide additional contingency during periods of drought). This review incorporated lessons learnt from the 2010 drought (Section 3.9). Utilisation of such sources will assist by taking demand off the regional or local water supply system, or both, and therefore represent an important drought management action. In this plan these potential sources of water are termed non-commissioned sources. They are not part of our normal operational asset base and most have not been used since the 1995/96 drought event due to falling demand for water and significant reductions in leakage. However they still have abstraction licences in place. It should be remembered that all normal water sources that are available and which could assist with the current drought situation would be in operation.

The regular maintenance regime for operational and non-commissioned water sources and their associated water treatment works differs. We have standard operating procedures for the different asset types, for example aqueducts, pumps and components of our water treatment works. These in turn generate requirements for proactive maintenance scheduled tasks carried out on a cyclical and routine basis. This is the Company's Master Asset Management System. Scheduled tasks may also generate reactive maintenance requirements and a proactive work order will be required to resolve the problem. Unplanned failures also occur and these are fixed as required.

For those water sources that form part of our normal day to day supply system, we carry out the scheduled and reactive tasks as described above. For non-commissioned sources, we carry out operational and security checks on a routine basis but the majority of scheduled tasks are not required. During a drought, the maintenance schedules as per operational sources will occur.

As part of our preparation for this current plan, a range of engineering specialists including mechanical, electrical and civil disciplines have completed a thorough review of the non-commissioned sources contained in our Final Drought Plan 2014 and identified the requirements needed to bring each source back into operation. Alongside this work, we have also sought to better understand the specific benefits of bringing each source back into use by examining our water resource models alongside risks, for example associated with water quality compliance to our customers. We have discussed this in further detail in Appendix 1.5 and Appendix 6.

The results of this work has led to a refinement of the supply side options presented in this plan, resulting in 12 options being identified. Some of the previous options in the Final Drought Plan 2014 are now in operational use and so are no longer included as non-commissioned drought options in this plan. For the remainder, we have concluded that they offer no additional benefit of any significance during a severe drought, alongside our other drought options. Therefore, we have decided to remove them from the drought plan and we will consider their future potential use in our next water resources management plan. The Swineshaw boreholes drought option has now been confirmed to be a drought order.

Drought option forms for each supply side option have been prepared (see Appendix 9). For each, details on the source, the estimated benefit, any potential environmental risks and the mitigation measures that would need to be considered are provided.

Figure 29 presents details of the 12 supply side options including their deployable output. This is the volume of water expected to be produced from the source when it becomes available for public water supply. Deployable output figures are available for all of these potential sources of water and have been used to understand the relative benefit of utilising a given source during drought periods. Each source is

allocated to its water resource zone and to the specific area it would supply. This was to facilitate targeting of additional resources to the most vulnerable areas and to ensure that maximum benefits are realised. The nature and extent of the drought determines which of these sources we would seek to utilise at any particular time. Crossing through a particular drought trigger would not automatically mean that action would be taken to instigate the use of all the sources associated with that trigger as a source would only be considered for use if it would aid the current drought situation.

The supply side options have been separated into the four resource zones:

- Integrated Resource Zone: 10 of the 12 supply side options are located in this zone. They are all groundwater sources. Two sources are linked to Haweswater Trigger 2, four sources are linked to Haweswater Trigger 3 and four sources are linked to Haweswater Trigger 4
- West Cumbria Resource Zone: There is one supply side option for this zone which involves tankering treated water from the Integrated Resource Zone to the West Cumbria Resource Zone to help support Ennerdale during a drought. We have no unused water sources in the West Cumbria Resource Zone that would be of benefit during a drought; therefore this zone is more reliant on the need for other options as discussed in Section 5.8
- Carlisle Resource Zone: There is one supply side option for this zone, Castle Carrock Reservoir. This option seeks to utilise water stored in the reservoir below the normal operational level (commonly called dead water) at Trigger 4. It is considered unlikely that we would need to utilise this option as the drought trigger modelling showed that Trigger 4 is not crossed based on the historic record (see Section 4.4.2). Consequently, this option has been linked to Trigger 4
- North Eden Resource Zone: There are no supply side options detailed for this zone. It is considered unlikely that we would seek to apply for a drought permit given the supply/demand surplus with the resource zone.

Drought management actions

Figure 29: List of supply side options

Source	Deployable Output (Ml/d)		Estimated time to implement	Water resources benefit
	In Water Resources Management Plan	Estimated in drought[1]		
Trigger 2				
Belle Vale boreholes	0	4.0	1 month	Integrated Resource Zone, with local support to Widnes area
Stocks Well boreholes	0	8.0	6 months	Integrated Resource Zone, with local support to Widnes area
Trigger 3				
Netherley boreholes	0	11.4	3 months	Integrated Resource Zone, with local support to Widnes area
Pex Hill boreholes	0	5.8	3 months	Integrated Resource Zone, with local support to Widnes area
Worsthorne borehole	0.5	2.0	3 months	Integrated Resource Zone, with local support to Burnley area
Walton boreholes	0	3.9	5 months	Integrated Resource Zone, with local support to Warrington area
Tankering to Ennerdale[2]	0	0.6	2 weeks	West Cumbria Resource Zone, with local support to the Ennerdale supply area
Trigger 4				
Castle Carrock reservoir, dead-water storage	0	6.0	1 month	Carlisle Resource Zone
Daresbury borehole	0	4.5	6 months	Integrated Resource Zone, with local support to Warrington area
Water Lane boreholes	0	6.5	4 months	Integrated Resource Zone, with local support to Widnes area
Landside borehole	0	4.8	3 months	Integrated Resource Zone, with local support to Wigan area
Croft boreholes	0	6.0	6 months	Integrated Resource Zone, with local support to Wigan area

Note 1 Individual source deployable output figures and daily licensed quantities where these are considered more representative for drought planning (see Appendix 9). These do not account for conjunctive use benefit to the resource zone as a whole

Note 2 Tankering of treated water from the Integrated Resource Zone to help support Ennerdale (West Cumbria Resource Zone) in times of drought commences at Trigger 3; the volume transferred will increase to approximately 2 Ml/d if a drought order is implemented at Ennerdale. Note that this is not "new" water but a transfer of water between zones

5.6 Drought permits/orders

Drought permits/orders are required as a precaution against the risk of a drought occurring that is worse than the worst historic drought that has been experienced. Applications must be made early enough to allow sufficient time for the powers to be granted in advance of existing licence constraints being reached and therefore protect the availability of water supplies for customers. The drought permit/orders included in this plan cover a range of actions including:

- Reducing compensation flow releases from reservoirs to downstream rivers to conserve storage in the reservoirs for future abstraction (for both public water supply and for release to the rivers)
- Allowing abstraction by pumping as well as gravity
- Relaxing abstraction licence limits such as annual volumes of water that can be abstracted or flow limits below which abstraction cannot occur
- Allowing increased drawdown of lakes and reservoirs to enable water to continue to be abstracted to provide both public water supplies and flow releases to the downstream rivers.

In their consultation response to the Draft Drought Plan 2016, the Environment Agency clarified that only the Ennerdale drought option should be considered to be a drought order application. We have subsequently confirmed that the Swineshaw option is also a drought order. The Ennerdale option is a drought order due to its potential impact on the downstream River Ehen SAC. The Swineshaw boreholes option is a drought order, because it includes release of abstracted water to a watercourse, and drought permits do not and cannot include provisions relating to discharges of water whereas a drought order can. All other options are likely to be drought permits.

There is the potential to need a drought permit/order at any of our abstractions across the region, however it is very unlikely at most locations. In Figure 30 we have identified the locations where we consider there is a reasonable chance that we may apply for a drought permit/order. In order to maintain flexibility within our drought planning, this list is not exhaustive and there could be other locations that may require a drought permit/order application; in this event we would liaise closely with the Environment Agency and other relevant stakeholders.

Drought management actions

Drought permits and orders explained

Legislation allows water companies to apply for both drought permits and drought orders to manage a drought situation. Only the Ennerdale and Swineshaw boreholes options in this plan are likely to be drought orders 	
Drought Permits: Environment Act 1995	The Environment Act 1995 introduced drought permits – prior to this only drought orders existed. Drought permit applications are determined by the Environment Agency. They can alter an abstraction licence e.g. to allow abstraction by pumping or increase the volume of water allowed to be abstracted. The Environment Agency can hold a local public hearing to discuss the application if it deems one is necessary. A drought permit lasts for a maximum of 6 months but can be extended by a further 6 months if necessary
Drought Orders: Water Resources Act 1991	Drought order applications are determined by Defra and they have the same powers as drought permits but can also authorise the water company to enter/occupy land to carry out necessary works and discharge water. Defra expect water companies to apply for orders rather than permits for applications that could affect Habitats Regulations sites e.g. Ennerdale. Defra can hold a local public hearing or public inquiry to discuss an application if it deems one is necessary. A drought order lasts for a maximum of 6 months but can be extended by a further 6 months if necessary (note that water companies can also apply for drought orders to restrict the non-essential use of water – see box in Section 2 for details)

Figure 30 lists our potential drought permit/order sites, together with details of the change that would be sought in a drought event. For several sites there is more than one possible option for the drought permit. This is because the actual powers sought depend on the severity of the drought event and the current situation at that time. For example, in the 1995/96 drought event, an initial drought permit to reduce the compensation flow at Longdendale to 22.5 Ml/d was applied for. However, as the drought intensified a subsequent application was made to reduce the compensation flow further to 15 Ml/d. There are no drought permit/order sites for the Carlisle Resource Zone. Not all of the actions would necessarily be implemented to the full extent shown, and some actions may not be required. Depending on the nature and extent of the drought, further drought permits/orders not included in Figure 30 may be required.

With the exception of the River Lune and the Swineshaw boreholes (which has only recently been identified as being a drought order), drought permits/orders were granted and implemented at all the sites in the 1995/96 drought with no reported long-term environmental impacts. However, there is no guarantee that any of the potential drought permits/orders would be granted in a future drought. Each application would need to be assessed by the Environment Agency/Defra taking account of current conditions in a specific drought situation.

Appendix 7 sets out how we would assess an exceptional shortage of rain to support any drought permit/order application.

Drought management actions

The need for drought permits/orders would be considered when Trigger 2 is reached and the required information to support an application would be prepared. We will discuss any plans for drought permits/orders with the environmental regulators (Environment Agency, Natural England and Natural Resources Wales) and Defra as appropriate. We expect to apply for initial drought permits/orders on reaching Trigger 3, with implementation from Trigger 4 onwards. There is around 14 days between Triggers 2 and 3 (7 days at Ennerdale) and during this time we would be preparing any potential drought permit/order applications. Over recent years we have completed a lot of work to ensure we are prepared for drought permit/order applications and are able to produce the information required in a timely manner. This has included collating the following information for each drought permit/order site (this was a key lesson learnt from the 2010 drought experience):

1	Application for the drought permit/order
2	Draft of the drought permit/order
3	Draft statement in support of the drought permit/order application
4	Location map
5	Draft notice of application for the drought permit/order
6	Draft notices to relevant parties, and details of those on whom notice would be served
7	Abstraction/impoundment licence
8	Relevant Act(s) of Parliament
9	Environmental report
10	Draft of press notice, and details of local newspapers for published notices
11	Local venues suitable for the public to view a copy of the application

In accordance with the Environment Agency's guidance (November 2016) we have:

- Completed environmental assessments (see Section 6.2) for all our drought permit/order sites and regularly review these. For the Ennerdale drought order option this includes an Appropriate Assessment. In a drought event we will update the relevant environmental assessment reports, if necessary, to include recent data and to suit the specific conditions of the drought being experienced. The Environmental Assessment Report will also include our proposals for monitoring, both during implementation of the drought permit/order and post drought – our Environmental Monitoring Plans have been agreed with the environmental regulators and are updated annually

- Identified and undertaken baseline monitoring required to support our drought permit/order applications

- Discussed our drought permits/orders with stakeholders. For each of our drought permit/order environmental assessments we establish a Project Steering Group comprising the environmental regulators. We also establish a Stakeholder Group, which ensures we are aware of the impacts and risk our drought permits/orders may have on others and are prepared for the implementation of mitigation measures if needed

- Identified the advertising arrangements for each of our drought permit/orders including local newspapers and venues for displaying the application documents

- Identified potential venues for public hearings

- Set out the process we will follow to demonstrate an exceptional shortage of rain (see Appendix 7)
- Prepared a draft of each of our drought permits/orders.

Our supporting statement, to accompany a drought permit/order application, will also include:

- An assessment of the benefit of the drought permit/order and the risks to the water supply situation if the application is not granted
- Proof that a serious deficiency of water supplies exists or is threatened due to an exceptional shortage of rain
- A justification for the order of drought permit/order use to show why this is the most appropriate action
- Details of the actions we have taken to manage the water resources situation and conserve supplies including demand management actions (e.g. leakage control, Temporary Use Ban, water efficiency), operational actions (e.g. strategic pumping), communication actions (e.g. publicity, press releases).

Further details on each drought permit/order site are included in the appendices to this plan (Appendices 9.2, 9.4 and 9.7). Drought permit/order options for this drought plan have been assessed using the Habitats Regulations Assessment (HRA) process to establish whether there are any potential adverse impacts on designated sites. The outcomes of this assessment are discussed further in Section 6.3.

Figure 30: Potential drought permit/order sites

Integrated Resource Zone	Drought permit/order conditions
Delph reservoir	Reduce compensation flow from 3.7 to 1.0 Ml/d
Dovestone reservoir	Reduce compensation flow from 15.9 to 10.0 or 5.0 Ml/d
Jumbles reservoir	Reduce compensation flow from 19.9 to 12.0 or 6.0 Ml/d
Longdendale reservoirs	Reduce compensation flow from 45.5 to 22.5 or 15.0 Ml/d
River Lune LCUS abstraction	Reduce prescribed flow from 365 to a minimum of 200 Ml/d
Rivington reservoirs – Brinscall Brook	Reduce compensation flow from 3.9 to 2.0 Ml/d
Rivington reservoirs – White Coppice	Reduce compensation flow from 4.9 to 2.0 Ml/d
Ullswater	Reduce hands-off flow conditions to a minimum of 95 Ml/d Relax 12-month rolling abstraction licence limit
Lake Vyrnwy	Reduce compensation flow from 45.0 to 25.0 Ml/d
Lake Windermere	Scenario 1: Reduce hands-off flow conditions to a minimum of 95 Ml/d and relax 12-month rolling abstraction licence limit Scenario 2: Relax 12-month rolling abstraction licence limit and permit drawdown of lake level (up to a maximum of 0.5 m below weir crest). During drawdown, releases to the River Leven would be made by the Environment Agency through their fisheries sluice depending on the requirements of the river
Swineshaw boreholes	Allow a new abstraction from Swineshaw boreholes of up to 4 Ml/d
West Cumbria Resource Zone	**Drought permit/order conditions**
Ennerdale Water	Allow abstraction for both compensation flow provision to the River Ehen and public water supply to continue down to a lake level of 2.5 m below weir crest
Crummock Water	Allow pumping of abstraction and compensation flows at lake levels below 0.97 m below weir crest level to 1.5 m below weir crest level
Scales boreholes	Increase the annual licence limit from 365 Ml to between 438 and 621 Ml to enable the continuation of a higher daily abstraction rate (up to the licence limit of 6 Ml/d)
North Eden Resource Zone	**Drought permit/order conditions**
Bowscar; Gamblesby; Tarn Wood boreholes	Increase annual licence limit to enable continuation of the maximum daily abstraction rate as annual limit constrains abstraction

* Note that only the Ennerdale Water and Swineshaw boreholes options are drought orders; the rest will be drought permits

5.7 Communication actions

This plan sets out the drought triggers that we use as decision points to guide us in determining what drought actions to take in any particular drought event. We have developed a detailed communication plan which maps these drought triggers to communication actions. The plan shows at what stage we would anticipate undertaking communication with various organisations. It also links communication actions and associated key messages to the drought triggers, together with information on the lead in times for the actions and the frequency with which they should be undertaken. The detailed communications plan can be found in Appendix 3. However it should be noted that the actual communication messages and methods used in a drought event will depend upon many factors including the current political climate, time of year, current and forecast weather conditions, and the geographical extent of the drought.

The following sections summarise the key aspects of drought liaison between ourselves and other organisations and interested parties. Our communications plan considers the conclusions from the Consumer Council for Water's Understanding Drought and Resilience report, 2013.

5.7.1 Internal United Utilities communications

Under normal operation we hold weekly internal meetings to review the current water resources position and agree actions required to address specific issues, for example, re-zoning of water supplies to enable abstraction rates to be reduced at sources that are deemed to be at relatively more risk. In times of potential drought, the frequency of such meetings increases and a drought management structure is established (see Section 3.12).

At Trigger 1 we establish an internal Executive Drought Management Group who typically meet weekly from Trigger 2 onwards. At Trigger 1 we also establish an internal Drought Coordination Group that meet more frequently than the Executive Drought Management Group.

5.7.2 Customer drought communications

We are responsible for communicating with our customers during droughts and deciding the content and timing of drought communications and the media to be used. We will also liaise closely with the Environment Agency, Consumer Council for Water and other bodies on water conservation publicity during drought events. This may involve joint communications or announcements, where appropriate, to ensure consistency of message and demonstrate consensus on the need for water saving actions.

We will enhance our on-going water conservation communication programme during a drought and will keep our customers fully informed of the actions being taken to protect water supplies, the need for any water use restrictions, and the current status of water resources. This will include information about how Temporary Use Bans work. We will ensure close dialogue with the Environment Agency and the Consumer Council for Water in relation to the need for any water use restrictions on customers.

Our customer communications will reflect the need to engage appropriately with both household and non-household customers as they can be affected differently. For example, business customers may be affected more by a drought order to prohibit non-essential uses of water. In the event of an application for such powers, we will discuss the measures with the Consumer Council for Water and endeavour to contact those business customers and trade organisations that will be directly affected to discuss ways to minimise any adverse impacts. To help businesses be prepared for the impact of drought on them, advice and guidance in relation to water use and water efficiency is a service that retailers will offer to their customers. We will respond to any requests for support from retailers in carrying out this activity.

Some household customers benefit from extra support from us; they receive Priority Services. This could be due to age, ill health, disability, mental-health problems, financial worries or language barriers. Priority Services is our support programme for customers with additional needs. The impact of drought powers on priority customers will be managed using our Priority Services approach and our usual incident management procedures and communication links with the health sector and local authorities will be used if necessary.

We undertake customer communications on a continual basis utilising media such as local papers, our website and billing leaflets. During a drought event, we will enhance this publicity, for example the placing of adverts in newspapers or on local radio. The nature of this promotion during a drought event will vary depending on aspects of the drought such as its geographical extent, the population centres affected and the time of year.

We recognise that in times of drought we are likely to experience a higher volume of customer contacts, for example water meter requests and requests for advice and reassurance on drought measures. We are

experienced at dealing with high volumes of customer contact and if necessary, additional personnel will be provided to ensure our customers receive the expected level of service from our customer contact centres.

During a drought, we will firstly seek to manage demand by an appropriate, phased escalation of our water conservation publicity campaign. In communicating with our customers it is essential to maintain good relationships. Our communications campaign will be carefully planned and timed to maintain high awareness of the need to conserve water, without provoking drought fatigue or antagonising customers.

During a drought a range of activity to increase the promotion of water efficiency would be undertaken, this is discussed in Section 5.3.1. The following list shows the additional possible customer communication actions that could be employed at various stages during a drought event:

- Messaging appropriate to the conditions e.g. encouraging drought tolerant garden planting in the spring or lagging pipes in the winter
- Dedicated webpages on unitedutilities.com including all messages, questions and answers about our actions, what we need customers to do, news on the state of our water resources and how we are managing them
- Increasing the profile of information on unitedutilities.com as the drought escalates, for example home page banners or a “splash screen” which everyone must read before accessing the main website
- Providing information about why we are applying for drought powers, e.g. Temporary Use Bans or drought permits, and the context within a common approach with other companies
- Joint water industry communications through Water UK
- Joint initiatives with other organisations to promote water efficiency
- Advertising our Leakline and website form for customer reporting of leaks
- Targeting emails to customers in areas particularly affected
- Targeting text messages to customers using our mass text system
- Issuing of media releases to the local press, including the sharing of additional video content for use by media and stakeholders from our Digital Press Office
- Printing adverts in the local press
- Local radio advertising
- Social media advertising – boosted posts on Facebook and promoted tweets on Twitter.

Our drought communications will be sensitive to avoid generating undue concerns about local areas. This is important so that impacts on the local economy, especially at drought permit sites, are mitigated. During a hot dry summer, for example, the Lake District will be very much “open for business” and we would seek to avoid any messaging that could give tourists the opposite impression.

5.7.3 Liaison with our environmental regulators

During normal conditions we hold regular liaison meetings with our environmental regulators to discuss water resource issues at various management levels. In particular, there are quarterly technical water resources meetings.

We have frequent discussions with the Environment Agency, Natural England and Defra regarding West Cumbria. The frequency of these will increase upon crossing Trigger 1 in that zone.

Drought management actions

In drought situations, a United Utilities-Environment Agency Drought Liaison Group is formed. If any of our sources in Wales are affected by the drought, this group will be extended to include Natural Resources Wales. This group will meet to ensure:

- A clear line of communication is maintained between us and the Environment Agency
- A consistent application of policy across the region by us and the Environment Agency
- Any actions agreed by the liaison group represent corporate decisions
- An on-going review of our Drought Action Plan developed for the specific drought event including stakeholder communications.

The frequency of liaison with environmental regulators changes as a drought develops. The group will meet fortnightly if Trigger 1 is crossed, increasing to weekly meetings on crossing Trigger 2. Director level engagement will also increase in frequency as the drought progresses. On reaching Trigger 3 at Haweswater Reservoir we would convene a meeting of the Windermere Stakeholder Group which also includes the Environment Agency.

We will prepare a Drought Action Plan prior to the first meeting of the Drought Liaison Group for discussion with the Environment Agency and Natural Resources Wales. The Drought Action Plan will set out the details of the specific actions that we are taking, or plan to undertake, to deal with the specific drought event that is occurring. The members of the Drought Liaison Group will ensure that any relevant information will be promptly briefed to the relevant staff in each organisation so that there is no misunderstanding at a local level.

In a drought the Environment Agency will also establish a Multi-Agency Drought Group. This will comprise senior managers from the Environment Agency, United Utilities, Natural England, Natural Resources Wales, the Canal and River Trust and others as appropriate. It is anticipated that this group will hold a weekly teleconference.

If appropriate we will engage Natural England and Natural Resources Wales at an early stage as the drought develops, particularly for sources within or upstream of a Special Area of Conservation (SAC) and/or a Site of Special Scientific Interest (SSSI), and also in general for non-designated sites. We will seek early and regular meetings with the Environment Agency and Natural England (and Natural Resources Wales, if appropriate) to discuss potential drought measures – these meetings worked well during the 2003 and 2010 droughts. During a drought, we will review the existing environmental monitoring arrangements for drought permit/order sites with our environmental regulators.

5.7.4 Dee Consultative Committee

We are a member of the Dee Consultative Committee. If storage in the River Dee regulation reservoirs falls to the drought action trigger level, a meeting of the Committee will take place to discuss the introduction of drought alleviation measures as enshrined in the Dee General Directions. The Committee will continue to meet on a regular basis during a drought to review the sustainable operation of the River Dee regulation scheme.

5.7.5 Liaison with other regulators and Government

We will provide regular and timely updates to Defra as a drought situation develops. Such updates will include details of available water resources and measures taken to conserve reservoir storage and reduce demand. We will also attempt to provide Defra with as much notice as possible of any drought order applications.

We will ensure that we keep the Drinking Water Inspectorate, Ofwat, Consumer Council for Water and the Welsh Government fully appraised of the drought situation and the actions being taken and under consideration. Customer communications and issues will be discussed with the Consumer Council for Water.

In relation to specific drought permits/orders, we will endeavour to provide as much prior warning as practicable.

5.7.6 Liaison with other water companies

We will liaise with other wholesale water companies as appropriate with respect to bulk supply arrangements or actions that could affect other companies. In the event of us introducing water use restrictions, we will inform neighbouring water companies. The decision to impose water use restrictions for each water company ultimately depends on the water resource position of that company. We will work constructively with our neighbouring water companies, for example we will work to ensure our drought management communications are consistent. We will participate in any national communication initiatives organised by Water UK.

Our approach to customer water use restrictions (see Section 5.3) is comparable to our neighbouring water companies. Following the experiences of companies in the South of England who imposed water use restrictions during 2011/12, we worked with other water companies through Water UK and UKWIR to update the Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014).

From April 2017 non-household customers of water and wastewater services will be able to choose their retail supplier. We will liaise with non-household retailers operating in our area in line with the Market Architecture Plan[9]. Further detail about customer communications, including communications to businesses and other non-household customers, can be found in Section 5.7.2.

5.7.7 Liaison with other bodies

Communication with the Fire Service will be maintained through the normal liaison channels and meetings will be arranged to discuss any concerns that may arise. We do not anticipate that any of the drought actions set out in this plan will reduce the pressure of water supplies below the legal minimum, and hence will not adversely affect fixed fire hydrant use.

We will discuss any specific issues relating to interactions between our sources and the Canal and River Trust canal systems with local trust staff or with their Head Office as appropriate.

With respect to Local Authorities and Public Health England, our normal communication channels will be maintained and briefings on the drought situation will be provided as necessary. In the event of an application for a drought order to prohibit non-essential uses of water, we will contact these organisations to explain the need for the restrictions and any mitigation measures that we are taking.

[9] In a drought our communications with retailers will follow Process E6, droughts or dry weather conditions, in the Operational Terms of the Wholesale-Retail Code (www.mosl.co.uk/wp-content/uploads/2016/10/3a-20161013-appendix2-wrc-part3-operationalterms.pdf)

Drought communications and liaison arrangements will include full and timely liaison with local authority emergency planning teams and other Category 1 responders under the Civil Contingencies Act through our existing lines of communication. This would particularly be the case in the event of a drought significantly worse than any in our historic record, where we may need to implement emergency plans agreed with Local Resilience Forums. These plans would be used to facilitate the appropriate distribution of water supplies within the North West region during civil emergencies.

Our assessment based on repeats of the worst droughts in our historic record, but with forecast future demand for water and current infrastructure, shows that we should not need recourse to rota cuts or standpipes in drought situations. Therefore, we do not expect any interruptions to supply arising from drought, nor should there be any adverse impact on priority customers, schools, the Health Services and other essential services. However, we will keep Public Health England, Local Authorities and the Consumer Council for Water fully informed of our actions during a drought, particularly to provide reassurance that essential supplies will be maintained.

5.7.8 Liaison with other stakeholders

Our liaison during a drought will also include discussions with organisations including:

- National Park Authorities
- Angling associations
- Environmental/conservation organisations
- Recreational users of our reservoirs and lake water sources
- Local industry and businesses (including those dependent on lake water sources such as Windermere and Ullswater)
- Local stakeholders.

We will disseminate information to these key stakeholders during a drought, including the potential need for drought permit/order applications.

The Windermere water bank agreement, updated in December 2012, states that at any time when Windermere is 2.5 cm below weir crest and/or Haweswater storage has crossed Trigger 3; a meeting of a Windermere stakeholder group will be convened. This group will include representatives from the following organisations: United Utilities, Environment Agency, Holker Estates, Windermere Lake User Forum, Windermere Lake Cruises Ltd and Windermere Marina Village Ltd.

There is a need for early consultation with recreational users of our reservoirs and lake water sources through our existing communication links via our Catchment Teams. We fully recognise that, regrettably, drought conditions may have an adverse effect on sailing activities on our reservoirs. Early consultation with recreational users is vital during drought conditions to enable them to plan ahead and try to make alternative arrangements. Where possible, we will seek to help find temporary alternative facilities for recreational activities (as has been the case during planned reservoir remedial works). Where sailing clubs and other recreational users are adversely affected during drought conditions, fees payable would be considered sympathetically on a case-by-case basis.

The environmental studies that we have undertaken for the drought permit/order sites included in this plan, were carried out in consultation with regulators (Environment Agency, Natural Resources Wales and Natural England, where appropriate) as well as local interested organisations and individuals. Through this process we have developed a database of local contacts, and their involvement in the drought planning

process ensures that they are better informed regarding any future proposals for actual drought permit/order applications that may be required.

5.8 West Cumbria drought options

5.8.1 Background

Both Ennerdale Water and Crummock Water have high levels of environmental designation. Ennerdale Water is a Site of Special Scientific Interest (SSSI) and, downstream of the lake, the River Ehen is both a SSSI and a Special Area of Conservation (SAC). Crummock Water and the River Cocker are both part of a SSSI and a SAC. Both Ennerdale and Crummock are in the Lake District National Park. Providing secure water supplies and protecting the aquatic environment in this setting is a fine balance. The Cumbrian mountains mean that the water network in West Cumbria is separate from the rest of our water supply area and public water supplies are reliant on the local sources. Both Ennerdale and Crummock are flashy catchments with short critical periods which mean that while severe droughts are extremely unlikely (see Appendix 5), there is very little time to take actions should a drought occur. All of this means that the drought management options in West Cumbria are limited.

All the demand side options discussed in this plan would be implemented in West Cumbria – including water efficiency promotion, leakage reduction and water use restrictions. However in the unlikely event of a very severe drought, when lake levels at Ennerdale and Crummock reach the point where abstraction is not licensed, there would still be a need to find significant volumes of water to maintain supplies to customers and provide compensation flows to the downstream rivers through drought permits/orders.

Droughts severe enough to cause Ennerdale and Crummock to reach lake levels where abstraction is not licensed are unlikely (see Appendix 5). For both Crummock and Ennerdale our water resource modelling has shown that the point of implementation of a drought permit/order would have not been reached in the 54 years of historic record.

5.8.2 Drought options for West Cumbria

This plan includes drought options at Ennerdale including a drought order to allow drawdown of the lake to 2.5 m below weir crest, earlier and more frequent restrictions on customers' water use and tankering of treated water to help support Ennerdale Water at times of drought.

Due to the environmental sensitivity of Ennerdale Water, the timing of restrictions on customers' water use differs to other areas. The sequencing of drought actions at Ennerdale is:

- Business as usual. Enhanced levels of water efficiency promotion, keep leakage as low as possible and investigate new ways of reducing leakage further
- Trigger 2. Initiate campaign for voluntary water use restraint. Start of representation period for Temporary Use Ban
- Trigger 3. Tankering of treated water commences. Drought order application
- Trigger 4. Implement Temporary Use Ban
- 1.7 m below weir crest. Increase tankering of treated water. Drought order implemented to allow public water supply to continue.

This sequencing of actions ensures that demand management and supply measures are adopted ahead of drought order implementation at Ennerdale Water. In the event that a drought order at Ennerdale only was being considered (i.e. storage in Crummock Water is healthy) then customer water use restrictions would

only apply to those customers supplied by Ennerdale Water as only demand reductions in this area would benefit the drought situation – this approach also ensures that the minimum number of customers are affected. This approach would be re-evaluated in the event that Crummock Water was also deemed to be at risk of drought.

If implementation of a Temporary Use Ban was altered so that implementation occurs earlier (i.e. at Trigger 3), we would fail to meet our company level of service of once in every 20 years on average for such restrictions (as set in our Water Resources Management Plan 2015) (see Figure 18). We also need to keep in mind the need to provide a representation period in advance of the implementation of a Temporary Use Ban. Given the rapid drawdown of Ennerdale Water during a drought event, allowing for a two week representation period means we would be initiating such restrictions very frequently (nearly every year) and only a few days after the lake was full. Such a frequency could be confusing for customers, especially as the lake would recover and the process stopped around 2 in every 3 times. It could also undermine confidence in public water supply.

Both Ennerdale Water and Crummock Water are natural lakes raised by weirs constructed at the outlet into the downstream river. Both lakes extend for a significant depth beyond the level at which our abstraction ceases – we only abstract water from the top metre or two of the lakes. The catchments are generally wet, with 1,800 mm of rainfall in a typical year. The catchments are steep and rocky and exhibit rapid run-off of rainfall into the lakes – this means that there is little retention of water in the catchment. During even relatively short periods of dry weather there can be very little flow into the lakes and lake levels can drop rapidly. Such short periods of dry weather could occur in both summer and winter (e.g. 1963 when the catchments froze).

Normally there is plenty of water for the environment and public water supply as the lakes are full and spilling over the weirs. Once the weather stays dry and the lake levels drop, there is a fine balance between the flow released down the rivers, the water abstracted for public water supply and the rate of decline in lake level. Low lake levels have a visual impact because of exposed shoreline and ecological impacts because of exposed plants (macrophytes); and low river flows can also have ecological impacts.

The generally wet climate in West Cumbria means that it is extremely unlikely that lake drawdown will be for more than around 60-90 days. However, during this time the lakes could reach historically low levels and reach the point where abstraction for public water supply is not licensed (1.7 m below weir crest at Ennerdale Water and 0.97m below weir crest at Crummock Water).

In developing our drought plan, we have conducted a thorough review of options to bring additional water sources into use. No non-commissioned water source options were identified in West Cumbria; however an option to tanker treated water from the Integrated Resource Zone to the West Cumbria Resource Zone (to help support Ennerdale at times of drought) is included. This tankering option only provides relatively small volumes of treated water and will not avoid the need for a drought order at Ennerdale in a severe drought; although it will reduce the volume of water abstracted from Ennerdale and hence, provide support in drought. Further details of the tankering supply side option can be found in Appendix 9.5. During the floods of winter 2015/16 we implemented tankering to several areas to ensure the continuation of water supplies to customers. Our response to this showed that tankering small volumes of water is a feasible method of maintaining water supplies to small communities, whether this be in response to flood, drought or other cause. Cumbria Resilience Forum's Environment workstream has established a Task and Finish group to develop a multi-agency plan for the tankering activities undertaken by us when Ennerdale reaches drought Trigger 3. It will ensure that the members affected are informed and co-ordinated in their activities around the risks and public communications relating to the movement of treated water from the Integrated Resource Zone into the West Cumbria Resource Zone.

Drought management actions

This plan includes the following drought permit/order options in West Cumbria:

- A drought order at Ennerdale to allow abstraction for both compensation flows and public water supply abstraction to continue to a lake level of 2.5 m below weir crest. A Stage 2 HRA Appropriate Assessment identified the potential for adverse impacts on the River Ehen SAC, however, following guidance from Defra, the drought order option is included in this plan as there are no alternatives
- A drought permit at Crummock to allow abstraction for both compensation flows and public water supply abstraction to continue to a lake level of 1.5 m below weir crest
- A drought permit at Scales boreholes to increase the annual abstraction licence limit. This option is assessed as having no impact on any designated sites.

The HRA assessment outcomes for these drought permit/order options are discussed further in Section 6.3.

Our Ennerdale abstraction licence has been subject to a 'Review of Consents' by the Environment Agency in line with Regulation 63 of the Habitats Regulations. Through this process the Environment Agency concluded that the existing abstraction licence could not be shown to have no adverse impact on the integrity of the River Ehen SAC. In December 2013 the Environment Agency issued an addendum to its Site Action Plan for the River Ehen (March 2009) stating that it intends to revoke our Ennerdale Water abstraction licence due to the adverse impact on the River Ehen mussel population. This revocation cannot occur until alternative water supplies for West Cumbria are secured and, as set out in our Final Water Resources Management Plan 2015, a new pipeline from Thirlmere reservoir (Integrated Resource Zone) is planned for 2022.

In the meantime, the Environment Agency are requiring us to release additional water from the lake to the River Ehen. Compensation flow releases to the downstream River Ehen of up to 80 Ml/d are now being provided, significantly greater than the original abstraction licence requirement of 31.8 Ml/d. The higher the compensation flow release out of the lake to the River Ehen, the faster the lake will drawdown and to a lower level, taking longer to refill following rainfall.

To partially offset this increase in compensation flow we have implemented a series of actions including:

- New boreholes at South Egremont were brought online in 2017 to allow us to reduce our abstraction from Ennerdale Water. Following some water quality concerns by customers, the boreholes will now run at a rate which maintains the softness of the water. However, if we are experiencing a prolonged dry period then abstraction from the boreholes will be increased to further reduce our abstraction from Ennerdale Water
- Every year until 2022 we will be carrying out an enhanced level of water efficiency promotion and leakage reduction in West Cumbria compared to the rest of the region
- We permanently re-zoned 3 Ml/d of water on to the Cornhow distribution network (supplied by Crummock Water) in 2012 allowing us to reduce our abstraction from Ennerdale. We have also implemented improvements at our Summergrove service reservoir to allow a further 3 Ml/d of water to be transferred on to Cornhow.

Until the new pipeline from Thirlmere is in place in 2022, we need to have drought options for the West Cumbria Resource Zone. Alternative options to a drought order at Ennerdale have been reviewed including temporary pipelines from other water sources in Cumbria and using road tankers to maintain supplies. There are considerable logistical and technical challenges with these options due to the long distances and terrain involved. Moreover, they could lead to disruption and loss of visual amenity in the National Park.

Drought management actions

We have submitted a report to Defra on the alternative options. This did not identify any feasible options that could be implemented during the timescale of an actual drought event that would avoid the need for a drought order at Ennerdale; although the option of tankering treated water could partially alleviate a drought situation, making a very small contribution to protecting the aquatic environment. This drought plan includes this tankering option.

This drought plan will be fully revised when the new pipeline from Thirlmere is operational.

6 Environmental assessments

Key messages

- We have completed detailed environmental assessments for all the drought permit/order options in this plan
- These have involved a range of stakeholders including local businesses, the Environment Agency, fishermen etc.
- We regularly update these environmental assessments to ensure they are fit for purpose in the event of a drought occurring
- Since our last plan (2014) we have updated our assessments for Ullswater, Windermere, River Lune, Ennerdale and Crummock and undertaken an assessment for the new Swineshaw boreholes drought order option
- We have completed a Strategic Environmental Assessment (SEA) of our drought plan
- We have completed Habitats Regulations Assessment (HRA) Screening of our drought plan
- The Ennerdale drought order is the only option in the plan that has a likely adverse impact on a Habitats Regulations site but it is still included due to reasons of Overriding Public Interest as there are no alternative water supplies for West Cumbria

6.1 Statutory duties for designated sites

At all times, not just in times of drought, we adhere to our statutory duties for designated sites. This is particularly important due to the location of many of our water abstractions within, adjacent or upstream of designated sites, and the large area of catchment land owned by us. The relevant statutory duties include:

- Conservation of Habitats and Species Regulations 2010 (as amended). Statutory responsibilities to Special Areas of Conservation (SAC) and Special Protection Areas (SPA)
- Government policy is to apply the same protection framework to Ramsar sites as to SPAs and SACs (Defra, 2006)
- The Environment Act, 1995. Section 62 to have regard to the purposes for which National Parks are designated
- The Water Resources Act 1991 (as amended by the Water Act 2003). Any work which may affect SSSIs, or other land of special interest, must involve consultation with Natural England before authorisation of the works
- Section 28G of the Wildlife and Countryside Act 1981, as inserted by Section 75 and Schedule 9 to the Countryside and Rights of Way Act 2000. This places a duty on public authorities, including water companies, to take reasonable steps consistent with the proper exercise of their functions to further the conservation and enhancement of SSSIs
- The Wildlife and Countryside Act 1981 and Section 85 of the Countryside and Rights of Way Act 2000. To have regard to the purpose of conserving and enhancing an Area of Outstanding Natural Beauty (AONB) when exercising or performing any function that will affect land in an AONB
- The Natural Environment and Rural Communities (NERC) Act 2006. An extension of the Countryside and Rights of Way Act 2000 biodiversity duty to ensure due regard to the conservation of biodiversity (particularly Section 40)
- Water Industry Act 1991: Code of Practice on Conservation, Access and Recreation – Guidance for the Environment Agency and Water and Sewerage Undertakers.

The drought option forms in Appendix 9 identify if potential supply side or drought permit/order sites are associated with statutory designated sites (including SACs, SPAs, Ramsar sites and SSSIs). For drought permit/order sites, these sites are also listed in Figure 31.

6.2 Drought permit/order environmental studies

Defra's Drought Plan Guidance (2015) specifies that a drought plan must include assessment of the effects that the planned actions will have on the environment, an environmental monitoring plan and details of any mitigation or compensation measures to lessen the effects on the environment.

Environment Agency guidance specifies that environmental assessment should include details of any likely changes as a result of a drought option on:

- Water flow or level regimes
- Water quality
- Ecology, including ecological status under the Water Framework Directive and fish populations
- Designated sites and priority habitats and species
- Conservation of biodiversity in our role as a public body under the Natural Environment and Rural Communities Act 2006 (NERC)
- Other physical, economic, cultural and heritage issues
- The spread of invasive non-native species.

Detailed environmental assessment studies have been completed for each potential drought permit/order site listed in Figure 30. The assessments consider each of the above topics and also the potential impact on Water Framework Directive status and River Basin Management Plan objectives. For some sites, other issues have been considered, including potential for impacts on landscape and visual amenity, recreation and tourism and potential noise or disturbance impacts of any construction phase which may be required.

The Environment Agency, Natural Resources Wales and Natural England (as appropriate) were involved in each environmental assessment study together with local interested stakeholders. Each study, and any subsequent updates, take approximately two years to complete.

Each study report presents the environmental baseline, i.e. habitats, species, designated sites and environmental pressures (including flow and water quality) in the zone of influence without the drought permit/order in place, using a description of the catchment, geomorphology, features and water quality. Key changes to the physical environment as a result of implementing the drought permit/order are identified and described and this information is used to frame and support the assessments of impacts on sensitive features. Where significant impacts on sensitive features have been identified, mitigation measures have been proposed to avoid or reduce the impacts on the environment.

Figure 33 and Figure 34 show the location of drought permit/order sites (as identified in Section 5.6) and supply side options (as identified in Section 5.5) along with environmental designated sites. The impact on any designated areas likely to be affected by a potential drought permit/order is considered within the environmental study.

The reports also present an Environmental Monitoring Plan (EMP) for each site, which puts forward any additional baseline data collection that is required (for example to fill gaps in the existing data and make the assessments more robust), monitoring that would be required just before or during implementation of a drought permit/order, and requirements for monitoring after a drought permit/order, to measure any impacts and monitor recovery of the site. Monitoring has been specified on a site by site basis, depending on the sensitive features and the predicted magnitude of potential impacts of drought permit/order implementation. Some baseline environmental monitoring at these sites is carried out by the Environment Agency and some is carried out by ourselves. Environmental monitoring associated with the

implementation of a drought permit/order (i.e. during and post-implementation) is our responsibility. We share environmental monitoring data freely with the Environment Agency and Natural England.

Following the 2010 drought event, the need to review the EMPs to ensure they are fit for purpose and to include new information from the 2010 drought event was identified. In 2013 we agreed revised Environmental Monitoring Plans for all our drought permit/order sites with the Environment Agency, Natural England and Natural Resources Wales (as appropriate). We have a single master record of the EMP requirements for all our drought permit/order sites which we share annually with the Environment Agency.

Further details on each drought permit/order site are included in Appendices 9.2, 9.4 and 9.7. These appendices contain a summary of the impacts identified by the environmental studies, together with monitoring and mitigation measures. Copies of our environmental assessment reports for potential drought permit/orders are available on request (you can contact us at water.resources@uuplc.co.uk).

The environmental assessments we have prepared are designed to be 'shelf-copy' reports. In the event of needing to apply for an actual drought permit/order, the environmental study report would be updated to reflect the current conditions, as well as to incorporate any relevant new information available since the study was completed.

We intend to review each environmental study in line with every other drought plan submission (i.e. every 10 years) unless there is a need to review it at an earlier stage. As part of this process, the EMP for each drought permit/order option is reviewed and updated. As part of these regular reviews of these assessments, we recently completed updates to our assessments at Ennerdale, Crummock, River Lune LCUS, Ullswater and Windermere. For the Ennerdale drought order option, due to the potential impact on the River Ehen SAC, this included an Appropriate Assessment. In 2017 we completed an environmental study of the Swineshaw boreholes drought order option (this was a supply side option in our previous plan) – this is a drought order due to the need to discharge the abstracted water to a watercourse.

Figure 31 gives the dates of the environmental study reports produced by us, together with an indication of when the next review is scheduled to commence.

6.3 Habitats Regulations Assessment

As a competent authority under the Habitats Regulations (Conservation of Habitats and Species Regulations 2010 (as amended)), we must ensure that the drought plan meets the requirements of the Habitats Directive. Therefore, the drought plan has been subject to Habitats Regulations Assessment. There are four stages of assessment:

- Stage 1: Screening to determine if drought options are likely to have a significant effect on Habitats Regulations designated sites
- Stage 2: Appropriate Assessment of options with likely significant effects to determine if they adversely impact the integrity of the designated site (both alone and in-combination with other plans and projects)
- Stage 3: Consideration of alternative options where significant adverse effects are identified at Stage 2
- Stage 4: Compensatory measures in the case that no alternative options exist and where Imperative Reasons of Overriding Public Interest can be demonstrated.

6.3.1 Stage 1 HRA Screening

Stage 1 HRA screening has been undertaken of all supply side options and drought permits/orders proposed in this drought plan. For drought permit/order sites, the environmental assessment reports we have prepared have been used to inform the assessment.

The HRA screening assessment identifies potential impacts of the options that are included in this plan to determine whether or not they could adversely affect the integrity of a designated site (SAC, SPA and Ramsar and candidate SACs/SPAs). If this is the case, then a detailed Appropriate Assessment of the option is required (HRA Stage 2). HRA Screening considered:

- Whether a scheme is likely to have a significant effect on a designated site(s)
- Whether the option would have an in-combination effect with existing consents
- Whether there would be an in-combination effect with other drought options in the plan.

The HRA Screening Report is published alongside this plan. The European designated sites associated with each drought permit/order option and the conclusions of HRA screening are identified in Figure 31. HRA Screening identified that only the drought order option at Ennerdale has the potential to impact a designated site. A HRA Stage 2 Appropriate Assessment has therefore been prepared for this drought order option (see Section 6.3.2).

Figure 31: Details of drought permit/order environmental studies and conclusions of HRA Screening

Drought permit/order site	Resource zone	Date of environmental study report	Next review to commence	Statutory designated sites in the vicinity	Conclusion of HRA Screening – will the option result in likely significant effects on European sites?
Delph	Integrated	July 2010	2020/21	None	No
Dovestone	Integrated	July 2010	2020/21	Rochdale Canal SAC	No
Jumbles	Integrated	July 2010	2020/21	None	No
Longdendale	Integrated	July 2010	2020/21	South Pennine Moors SAC	No
River Lune (LCUS)	Integrated	April 2016	2026/27	Morecambe Bay SPA/SAC/SSSI/Ramsar	No
Rivington (2 sites)	Integrated	July 2010	2020/21	None	No
Ullswater	Integrated	March 2016	2026/27	River Eden SAC/SSSI	No
Vyrnwy	Integrated	September 2010	2017	Severn Estuary SAC/SPA/Ramsar, Berwyn SPA, and the Berwyn and South Clwyd Mountains SAC, Montgomery Canal SAC	No
Windermere	Integrated	June 2016	2026/27	Morecambe Bay SPA/SAC/SSSI/Ramsar Low Wray Bay SSSI	No
Swineshaw boreholes	Integrated	April 2017	2027	South Pennine Moors SAC, Peak District Moors SPA, Dark Peak SSSI	No**
Ennerdale	West Cumbria	April 2014	Not required*	River Ehen SAC/SSSI, Ennerdale Water SSSI,	Yes***
Crummock	West Cumbria	January 2016	Not required*	River Derwent and Bassenthwaite Lake SAC/SSSI	No
Scales boreholes	West Cumbria	July 2010	Not required*	Solway Firth SAC, South Solway Mosses SAC, Upper Solway Flats and Marshes SPA/Ramsar	No
North Eden boreholes - Bowscar	North Eden	July 2010	2020/21	River Eden SAC/SSSI, River Eden SAC, North Pennine Moors SPA	No
North Eden boreholes - Gamblesby	North Eden	July 2010	2020/21	River Eden SAC/SSSI, River Eden SAC, North Pennine Moors SPA	No
North Eden boreholes - Tarn Wood	North Eden	July 2010	2020/21	River Eden SAC/SSSI, River Eden SAC, North Pennine Moors SPA	No

Only the Ennerdale and Swineshaw boreholes options are drought orders; the rest will be drought permits

* For Crummock, the next environmental study should commence in 2026/27 (ten years after the current study was published in January 2016). However we plan to cease abstraction from Crummock in 2022, therefore this update will not be required. Likewise for Ennerdale whose next study would be due in 2024/25. The next review of the Scales borehole study would be due in 2020/21 however as we plan to cease abstraction from this site in 2022 as part of the Thirlmere pipeline scheme, we are not planning to update it

** Following publication of the Draft Drought Plan 2016 we have confirmed that the Swineshaw boreholes option is a drought order and have undertaken an environmental assessment of the option. We have also completed Habitats Regulations Assessment screening which concluded no likely significant effects on the South Pennine Moors SAC and Peak District Moors (South Pennine Moors Phase 1) SPA. However we will also undertake a walkover survey during summer 2017 (when vegetation is present) to confirm these findings. If the walkover survey does not support the findings of the screening, we will consult with the Environment Agency and Natural England as to what further work may be needed or agree to remove this option from the drought plan (through the annual Water Resources Management Plan review process). We will not seek to implement this drought option until such time as impacts on the SAC are confirmed

*** For Ennerdale, the assessment could not conclude no likely significant effects on the River Ehen SAC, and therefore, an Appropriate Assessment has been undertaken

6.3.2 HRA Stage 2 Appropriate Assessment for Ennerdale Water

The Stage 2 HRA (Appropriate Assessment) undertaken in consultation with the Environment Agency and Natural England concluded the potential for major impacts on freshwater mussel populations and salmon populations of the River Ehen SAC as a result of drought order implementation at Ennerdale.

The freshwater mussel population of the River Ehen is in unfavourable condition due to insufficient juvenile recruitment. The lack of recruitment has been attributed to abstraction from Ennerdale and the flow regime in the River Ehen, and to nutrient and sediment issues. The River Ehen was classified as 'Probably at Risk' of not achieving salmon conservation limits in 2015 (from 'Probably not at Risk' in 2014). Salmon stocks across the UK are declining. There is the potential for significant adverse effects on both designated species from implementation of a drought order. Therefore, a Stage 3 alternative options assessment was undertaken.

6.3.3 HRA Stage 3 Alternative Options Assessment for Ennerdale Water

The Stage 3 HRA Alternative Options Assessment was undertaken in consultation with the Environment Agency and Natural England and did not identify any feasible alternatives to a drought order at Ennerdale Water to provide public water supply and the compensation flow during a drought.

As Section 5.8 explains, the Environment Agency recently reviewed our Ennerdale abstraction licence as part of their 'Review of Consents' process in line with Regulation 63 of the Habitats Regulations. The Environment Agency initially proposed changes to the abstraction licence, including increased and variable compensation flows, but in 2013 they confirmed that the conclusion of no adverse effect on site integrity of the River Ehen SAC cannot be reached for any option other than revocation of our abstraction licence.

We included revocation of the Ennerdale Water abstraction licence in our Final Water Resources Management Plan 2015, which set out plans for how public water supply will be maintained following revocation. Due to planning, land and Environmental Impact Assessment considerations, the current best estimate for cessation of abstraction at Ennerdale Water is 2022 when a new pipeline from Thirlmere Reservoir in the Integrated Resource Zone will be in place. Once complete, this will remove any on-going impact of public water supply abstraction on the River Ehen SAC and will mean that drought orders affecting this site will no longer be required for public water supply.

We will continue to significantly decrease public water supply abstraction from Ennerdale Water until the complete removal of abstraction is possible in 2022. In the meantime, abstraction from Ennerdale Water needs to continue and there remains the potential requirement for a drought order at this site between now and 2022. Since alternative options between now and 2022 have not been identified, the HRA proceeded to Stage 4 Compensatory measures and Imperative Reasons of Overriding Public Interest.

6.3.4 HRA Stage 4 Compensatory measures and Imperative Reasons of Overriding Public Interest for Ennerdale Water

There is over-riding public interest to continue to provide public water supply until the Thirlmere transfer scheme is in operation. In accordance with Article 6(4) of the Habitats Directive, compensatory measures need to be secured because it cannot be concluded that continued abstraction will not lead to an adverse effect on site integrity.

Working closely with Natural England and the Environment Agency, we have developed a package of compensatory measures that will reduce, or offset, adverse impacts on the River Ehen SAC as a result of continued abstraction from Ennerdale Water, and a potential drought order, whilst an alternative public water supply is put in place. This package includes both physical ecological measures and research measures and was submitted to Defra in February 2014. There is a legal agreement, signed in July 2015 between United Utilities, Natural England and the Environment Agency which describes each physical and research measure, programme and governance of the package. The aim of the agreed package of measures is to restore the habitat which enables the sustainable recruitment of freshwater mussels and salmon, primarily in the River Ehen SAC, and to undertake research and monitoring to understand how this outcome would best be achieved. Appendix 4 explains the proposed measures in further detail.

We have been in close discussion with Defra regarding the drought options at Ennerdale, including the assessment of alternative options and submission of a draft drought order application. This has led to the inclusion of a supply side option in this plan for tankering of treated water from the Integrated Resource Zone to the West Cumbria Resource Zone to help support Ennerdale at times of drought. Following guidance from Defra in 2013, this drought plan includes a drought order option for Ennerdale to allow drawdown to 2.5 m as there are no alternatives and without this option, abstraction for both compensation flow provision to the River Ehen and public water supply would need to cease once a lake level of 1.7 m below weir crest is reached. Imperative reasons of overriding public interest (IROPI) have been identified that relate to human health, public safety, social and economic reasons.

There is considerable research, monitoring and physical action currently being delivered by ourselves and other organisations focused on restoring the River Ehen SAC to favourable condition. The package of compensatory measures implemented by us will provide additional knowledge and ecological actions over and above the actions that are normal practice for the management of the SAC. We are committed to working with Natural England, the Environment Agency, local stakeholders and experts in order to find the best solution to the protection of the River Ehen SAC and public water supplies in light of emerging evidence.

6.4 Strategic Environmental Assessment

6.4.1 Requirements for SEA

Strategic Environmental Assessment (SEA) of plans and programmes is a statutory requirement under the Environmental Assessment of Plans and Programmes Regulations 2004 (the SEA Regulations). The purpose of SEA is to provide high level and strategic protection of the environment by incorporating environmental considerations into the preparation of plans and policy. In the context of drought planning, SEA assists in the identification of the likely significant environmental effects of our drought options and determines how any adverse impacts might be mitigated.

The key stages of SEA are:

- Screening to determine if SEA is required. Environment Agency, Natural England, Natural Resources Wales, Cadw and Historic England should be consulted before taking the screening decision
- Deciding the scope and level of detail required for the SEA
- Assess the effects of the plan/programme and its reasonable alternatives and prepare an environmental report
- Consultation on the environmental report and draft plan/programme
- Adoption of the plan/programme and monitoring of any significant environmental effects.

This section of the plan details the process which we have taken in preparing the SEA, and the outcomes and influences on this drought plan.

SEA was undertaken in line with government best practice guidance and UKWIR guidance which has been prepared specifically for water resource management plans and drought plans.

6.4.2 SEA Screening

The first step of the SEA process is to carry out a screening assessment to determine whether an SEA is required. We believe that an SEA is required because this plan includes drought options that will require assessment under the Habitats Regulations e.g. the drought order at Ennerdale. This was confirmed with the statutory consultees for SEA who are Natural England, Natural Resources Wales, Environment Agency, Cadw and Historic England.

6.4.3 SEA Scoping

SEA Scoping presents information on the scope of, and approach to work to be carried out to inform the SEA assessments presented in the Environmental Report. A Scoping Report was produced which described: the alternative drought measures that might be available to meet the need for water during a drought; the policies and other plans and programmes influencing the selection of measures that may be used; the environmental issues which will need to be considered; and the assessments that will be carried out to identify the environmental effects of saving and supplying water which will assist in the identification of preferred measures for implementation during a drought scenario.

Under the SEA Regulations, when deciding upon the scope and level of detail of the information to be included in an Environmental Report, we are required to undertake consultation with statutory consultees (Natural England, Natural Resources Wales, Environment Agency, Cadw and Historic England). The Scoping Report was used as the basis of that consultation process and underwent a statutory 5-week consultation period during March-April 2016. Feedback from the Project Steering Group of statutory consultees was incorporated into the SEA Draft Environmental Report.

6.4.4 SEA Environmental Report

The findings of the SEA are reported in the Draft SEA Environmental Report. The assessment was ‘objectives-led’. SEA objectives were derived from environmental objectives established in law, policy or other plans and programmes, and from a review of the baseline information. The SEA objectives were categorised under the following topic areas: biodiversity, flora and fauna; population and human health; material assets and resource use; water; soil, geology and land use; air and climate; archaeology and cultural heritage; landscape and visual amenity; and inter-relationships. The overall findings of the SEA describe the extent to which objectives for each topic are met by each of the drought options.

Environmental assessments

The outputs of the assessment are a completed appraisal framework table for each drought option, and a colour coded summary matrix (ranging from major beneficial impacts to major adverse impacts) which provides a comparative assessment of the residual environmental effects of implementing each drought option (i.e. those impacts remaining after the implementation of mitigation measures). The visual evaluation matrix and key for drought permit and order options is presented in Figure 32.

A cumulative, or in-combination, assessment has also been undertaken which has involved examining the likely significant effects of each of the drought options in combination with each other (both intra- and inter- water resource zone) and in combination with the implementation of other relevant plans and programmes.

Environmental assessments

Figure 32: Visual evaluation matrix summary for drought permit/order options

Drought option	Summary of potential impacts	SEA Topic								
		Biodiversity, flora and fauna	Population and human health	Material assets and resource use	Water	Soil, geology and land use	Air and climate	Archaeology and cultural heritage	Landscape and visual amenity	Inter-relationships
Integrated Resource Zone										
Longdendale Reservoirs	Impacts of riverine flow reduction on water quality, fish populations and landscape and visual amenity									
Rivington Reservoirs – White Coppice	Impact of hydrodynamics and water quality on riverine fish populations									
Rivington Reservoirs – Brinscall Brook	Impact of hydrodynamics and water quality on riverine fish populations									
Jumbles Reservoir	Impacts of hydrodynamics and water quality on biodiversity and landscape									
Delph Reservoir	Impacts of hydrodynamics and water quality on biodiversity									
Dovestone Reservoir	Impacts of hydrodynamics and water quality on biodiversity									
Lake Vyrnwy	Impacts of hydrodynamics and water quality on biodiversity									
River Lune LCUS abstraction	Impacts of hydrodynamics on biodiversity, recreation, navigation and landscape									
Lake Windermere – Scenario 1	Impacts of resource use due to increase pumped abstraction									
Lake Windermere – Scenario 2 (includes lake drawdown to 0.5m)	Impacts on lake level, recreation (navigation) and landscape and visual amenity									
Ullswater	Flow mediated impacts on biodiversity, noting the potential benefits resulting from augmented flows									
Swineshaw Boreholes	Impact on flow reductions are predicted to be negligible									
West Cumbria Resource Zone										
Scales boreholes	Impacts of hydrodynamics on biodiversity and landscape									
Ennerdale Water - (includes lake drawdown to 2.5m below weir crest)	Impacts of lake level on ecological features and landscape and visual amenity. River flow impacts on biodiversity									
Crummock Water – (includes pumping of abstraction and compensation flow, and lake drawdown from 0.97m to 1.5m below weir crest)	Impacts of lake level on lake landscape and visual amenity)									
Carlisle Resource Zone										
None	-	-	-	-	-	-	-	-	-	-
North Eden Resource Zone										
Bowscar boreholes	Impact on flow reductions are predicted to be negligible									
Gamblesby boreholes	Impact on flow reductions are predicted to be negligible									
Tarn Wood boreholes	Impact on flow reductions are predicted to be negligible									

Environmental assessments

Legend:

Major Beneficial	
Moderate Beneficial	
Minor Beneficial	
Negligible	
Minor Adverse	
Moderate Adverse	
Major Adverse	
NOT APPLICABLE	
Uncertain - Insufficient data available to undertake assessment	

Environmental assessments

In summary, the SEA Environmental Report concluded:

- Supply side options - the majority of our supply side options are groundwater sources. In most cases, minor construction works are required to bring the source back into operation and few residual environmental effects are anticipated. Operationally, all of the supply side options are within existing licensed abstraction limits and it is assumed that the existing abstraction licences would not have been granted if these options resulted in unsustainable abstraction. The supply side option for the West Cumbria Resource Zone involves tankering of treated water from the Integrated Resource Zone to support Ennerdale Water. Overall, most of the impacts of implementing these options are anticipated to be negligible or minor adverse, with minor to major beneficial impacts associated with benefits to security of public water supply

- Demand side measures - serve to reduce pressure on water resources by reducing customer demand for water, and therefore reducing the abstraction at source. This will in turn contribute to reducing the amount of energy needed for water abstraction, treatment and distribution. Overall, impacts for these drought options are considered to be negligible to minor beneficial

- Drought permit/order options - the magnitude of impacts on SEA objectives for drought permit/order options (i.e. where there is modification to the conditions of an existing abstraction licence) varies between and within the options, ranging from major beneficial for the SEA objective for population and human health, to major adverse for the SEA objective for biodiversity, flora and fauna. The latter were associated with adverse changes to surface water levels and flows. Those options which have the potential to adversely impact designated conservation sites had a higher magnitude of impacts on the SEA objective for biodiversity, flora and fauna

- Cumulative impacts - the assessment identified the potential for adverse impacts if two drought options were to be implemented at the same time, either intra- or inter- water resource zone. In the majority of combinations, no impacts are considered likely, however, in some cases, impacts have been identified where, for example, both options draw on the same water resource (e.g. same groundwater catchment or same river). Due to the uncertainty of timing of implementation of drought options, assessments of each drought option with each other drought option have been undertaken with the intention that in the event of a drought, the findings of the SEA be reviewed and a cumulative assessment made of the options proposed for implementation at that time, based on the findings of the one-on-one assessments

- Assessment of our drought plan with other plans and programmes, including our Water Resources Management Plan 2015, Environment Agency / Natural Resources Wales drought plans, other water company drought plans and National Policy Statements, concluded that no significant cumulative, or in-combination, effects are anticipated.

Consideration of mitigation measures has been an integral part of the SEA process. The SEA appraisals have been based on residual impacts, i.e. those impacts likely to remain after the implementation of reasonable mitigation.

During implementation of one or more drought options, appropriate monitoring will be undertaken to track any potential environmental effects which will in turn trigger deployment of suitable and practicable mitigation measures. Prior to implementation, we will review the specific requirements for environmental monitoring in consultation with the Environment Agency, Natural England and Natural Resources Wales.

6.4.5 Consultation

The findings of the SEA are reported in the SEA Environmental Report, which was open for public consultation alongside the Draft Drought Plan 2016.

We have worked closely with a project steering group comprised of representatives of Natural England, Natural Resources Wales, Environment Agency, Cadw and Historic England throughout the SEA process.

6.4.6 SEA post-adoption statement

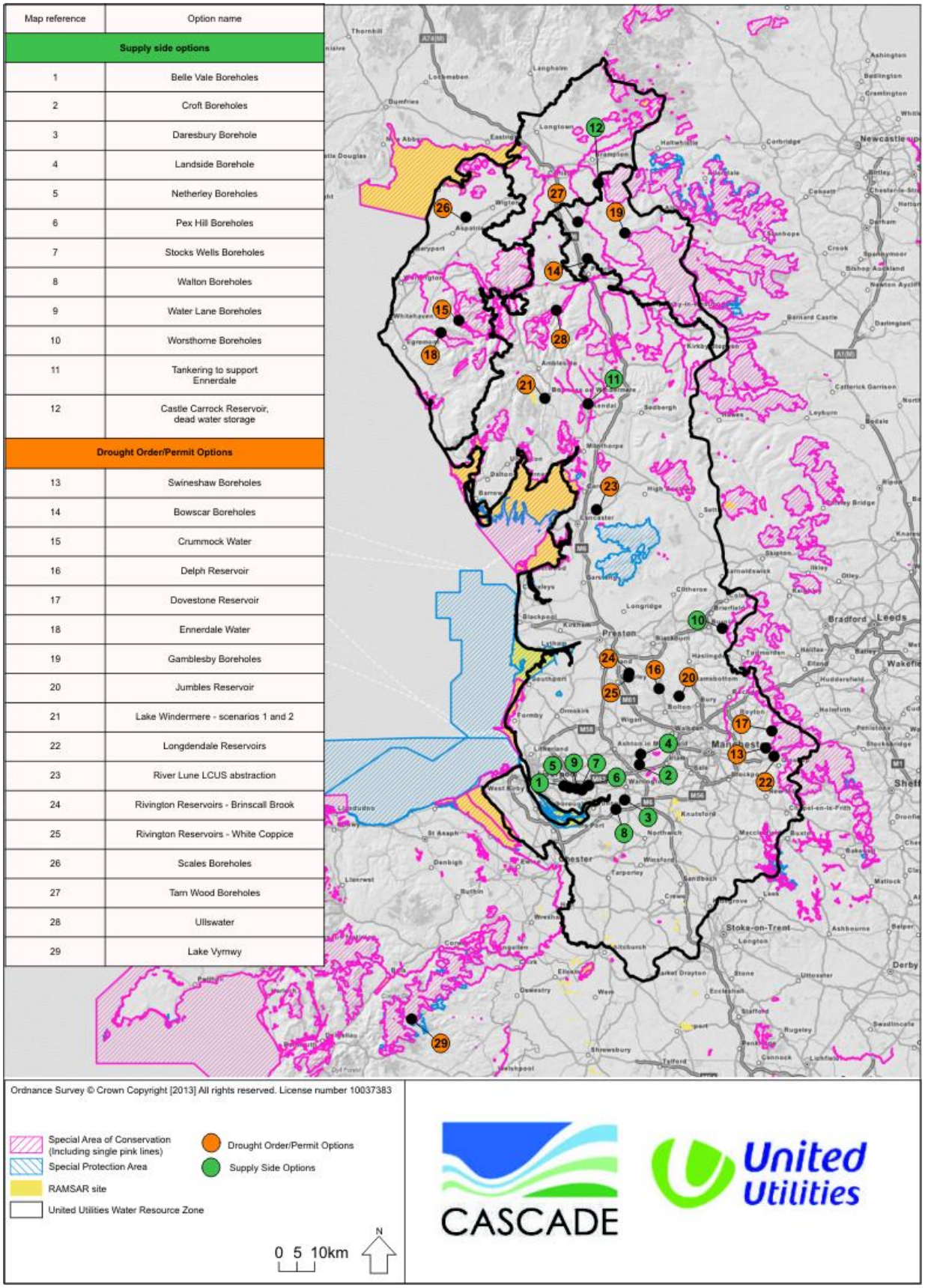
An SEA post-adoption statement has been produced and published alongside the final drought plan.

The SEA post adoption statement describes:

- How environmental considerations have been integrated into the final drought plan
- How the Environmental Report has been taken into account
- How responses to consultation have been taken into account
- Reasons for choosing the final drought plan as adopted, and why other reasonable alternatives were rejected
- The measures that are to be taken to monitor the significant environmental effects of implementation of the final drought plan.

Environmental assessments

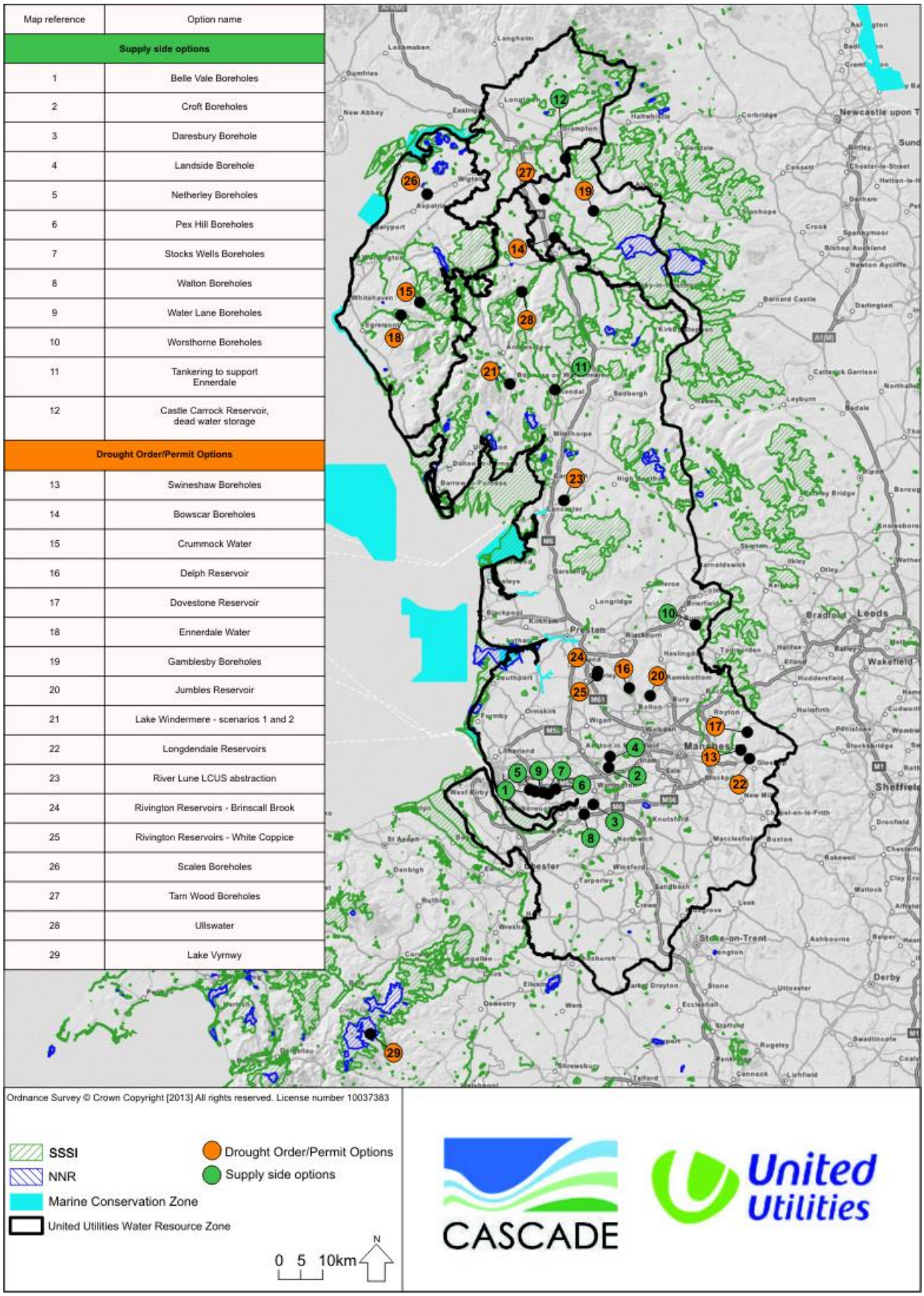
Figure 33: Map of designated sites showing drought permit/order sites and supply side options (Ramsar, Special Areas of Conservation (SAC), Special Protection Areas (SPA))



Environmental assessments

Figure 34: Map of nationally designated sites showing drought permit/order sites and supply side options (Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Marine Conservation Zones (MCZ))

Map reference	Option name
Supply side options	
1	Belle Vale Boreholes
2	Croft Boreholes
3	Daresbury Borehole
4	Landside Borehole
5	Netherley Boreholes
6	Pex Hill Boreholes
7	Stocks Wells Boreholes
8	Walton Boreholes
9	Water Lane Boreholes
10	Worsthorne Boreholes
11	Tankering to support Ennerdale
12	Castle Carrock Reservoir, dead water storage
Drought Order/Permit Options	
13	Swineshaw Boreholes
14	Bowscar Boreholes
15	Crummock Water
16	Delph Reservoir
17	Dovestone Reservoir
18	Ennerdale Water
19	Gamblesby Boreholes
20	Jumbles Reservoir
21	Lake Windermere - scenarios 1 and 2
22	Longdendale Reservoirs
23	River Lune LCUS abstraction
24	Rivington Reservoirs - Brinscall Brook
25	Rivington Reservoirs - White Coppice
26	Scales Boreholes
27	Tarn Wood Boreholes
28	Ullswater
29	Lake Vyrnwy



7 Conclusions and summary

Key messages

- We review our drought plan every 5 years or earlier in the event of a material change
- This drought plan updates our Final Drought Plan 2014 and was triggered due to a material change in our West Cumbria Resource Zone
- Our drought plans are publicly consulted on and are available on our website
- We consider that this plan sets out the best course of action to protect water supplies should a severe drought occur

This drought plan has been produced to provide a comprehensive statement of the actions that we will consider implementing during drought conditions to protect essential water supplies to our customers and minimise environmental impact. The reliable supply of water is essential to our customers in their everyday lives. This plan incorporates lessons learnt from the 2010 drought event as well as water use restriction legislation introduced in 2010/11. It updates our Final Drought Plan 2014 following a review of the drought triggers in our West Cumbria Resource Zone, which we considered to be a material change.

Following direction from the Secretary of State, a draft of this drought plan (Draft Drought Plan 2016) was published and went through a six week public consultation from 3 October to 14 November 2016. A Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) of the drought options was also done. Following the public consultation, we published a Statement of Response detailing the comments we received and submitted a Revised Draft Drought Plan 2017 to the Secretary of State which took those comments in to account. Following this, Defra have asked for further considerations on a number of aspects. This Revised Draft Drought Plan 2017 includes information to address these. Following direction from the Secretary of State, we hope to produce a new Final Drought Plan. Full details of our drought plan consultation can be found in Appendix 1.

As droughts do not follow any particular pattern and can occur at any time of year, showing differing characteristics, this plan sets out a range of options available in the event of drought, and the processes and timescales required for their implementation.

This plan presents four drought triggers for each of our four resource zones. The triggers are decision points, to consider the measures required to address the current situation. The plan includes a range of drought management actions, which are linked to the drought triggers, including:

- Operational actions
- Communication actions
- Demand side actions (water efficiency campaigns, campaign for voluntary water use restraint, Temporary Use Bans, drought order to ban non-essential use)
- Leakage actions
- Supply side actions (non-commissioned sources, tankering)
- Drought permit/order actions.

Drought actions may be applied either company wide, by resource zone or to target a specific geographic area depending on the nature of the drought event at that time.

The West Cumbria Resource Zone is the most sensitive to drought due to its short critical period and the limited number of drought options available; resulting in the need for prompt decisions and actions during

a drought event. West Cumbria contains a number of environmentally sensitive sites which are designated by legislation and we are legally required to protect such sites and in drought there is a fine balance between public water supply and environmental protection.

This drought plan takes account of legislation issued in 2010/11 relating to the imposition of water use restrictions on customers. The plan includes provision for a campaign for voluntary water use restraint, followed by a representation period, prior to the implementation of a Temporary Use Ban. For all resource zones (except Carlisle where no drought permits/orders are identified), applications for drought permits/orders would be made following the commencement of a campaign for voluntary water use restraint.

Our minimum level of service for water supply is for the implementation of Temporary Use Bans and drought permits/orders not more than once in every 20 years on average, with drought orders to ban non-essential water use not more than once in every 35 years on average. This drought plan does not include recourse to rota cuts or standpipes to ration essential supplies. This is consistent with the level of service in our Water Resources Management Plan (United Utilities, 2015) and is a balance between customer and environmental impacts. The level of service is reviewed as part of the Water Resources Management Plan process rather than this drought plan.

A separate Strategic Environmental Assessment and Habitats Regulations Assessment of the options included in this plan have been undertaken. Any options shown to have the potential to significantly affect designated sites (Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites), have been subjected to a detailed Appropriate Assessment. A drought option that has an adverse effect on the integrity of a site can only be included in the plan subject to there being no alternative solutions, and where the Secretary of State is satisfied that there are imperative reasons of overriding public interest for its inclusion and the adoption of suitable compensatory measures. This is the situation at Ennerdale.

Overall we consider that this plan sets out the best course of action to protect water supplies should a severe drought occur. Every drought is different and actions in this plan will need tailoring to the specific circumstances of a particular drought. However, the plan has been built on experience of recent droughts and the triggers tested in our water resources models. Even though reservoirs are not forecast to empty, even under a repeat of the worst drought on record, it is necessary to take action to conserve water supplies in case a future drought is even more severe.

8 References, legislation and guidance

APEM, River Lune Fish Migration Flows, 1999

Civil Contingencies Act 2004

Conservation of Habitats and Species Regulations 2010

Conservation of Habitats and Species (Amendment) Regulations 2011

Consumer Council for Water, Understanding drought and resilience, 2013

Countryside and Rights of Way Act 2000

Defra, Drought Plan Guidance, December 2015

Defra, Ramsar sites in England – A policy statement, 2006

Drought Direction 2011 (revoked Drought Direction 1991)

Drought Permits and Drought Orders: Information from Defra, Welsh Government, Natural Resources Wales and the Environment Agency, November 2015

Drought Plan Direction 2016

Drought Plan Regulations 2005 (Statutory Instrument No. 1905)

English Nature, Habitats Regulations Guidance Note HRGN 1, 1997

Environment Act 1995

Environment Agency, Cumbria and Lancashire Drought Plan, 2 July 2015

Environment Agency, Greater Manchester, Merseyside and Cheshire Drought Plan, May 2015

Environment Agency, Site Action Plan for the River Ehen, March 2009

Environment Agency, Addendum to the Site Action Plan for the River Ehen, December 2013

Environment Agency, Drought plan guideline extra information – drought permit and order application ready, November 2016

Environment Agency, Exceptional shortage of rain – principles for the assessment of drought orders and permits, 2012

Environmental Assessment of Plans and Programmes Regulations 2004

Flood and Water Management Act 2010

Natural Environment and Rural Communities (NERC) Act 2006

References, legislation and guidance

Natural Resources Wales, Dee General Directions, 2016

Office of the Deputy Prime Minister, A Practical Guide to the Strategic Environmental Assessment Directive, 2005

OpenWater, Operational Terms of the Wholesale-Retail Code, 2016

Peel Water Networks Ltd. Final Drought Plan, April 2014

Security and Emergency Measures Direction 1998

UKWIR, Code of Practice and Guidance for Water Companies on Water Use Restrictions (Report 14/WR/33/6), 2014

United Utilities, Final Water Resources Management Plan, 2015

United Utilities, Draft Drought Plan, 2016

United Utilities, Final Drought Plan, 2014

United Utilities, Statement of Response 2017

Water Act 2003

Water Environment (Water Framework Directive) (England and Wales) Regulations 2003

Water Industry Act 1991 and associated 'Code of Practice on Conservation, Access and Recreation: Guidance for the Environment Agency and Water and Sewerage Undertakers'

Water Resources Act 1991

Water Supply (Water Quality) Regulations 2000 (and amendments)

Water Use (Temporary Bans) Order 2010

Wildlife and Countryside Act 1981

9 Glossary of terms

AONB	Area of Outstanding Natural Beauty
Aquator	An advanced water resources simulation model used by us for drought and water resources planning
Blue Badge	The Blue Badge scheme is for people with severe mobility problems. It allows Blue Badge holders to park close to where they need to go. The scheme is managed by local authorities, who deal with applications and issue Blue Badges
BOD	Biological oxygen demand is a measure of the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present. High BOD levels are indicative of polluted water bodies
btwl	Below Top Water Level. Used to quote water levels below reservoir/lake top water level (i.e. how drawn down a reservoir/lake is and therefore how much water remains in storage)
Campaign for voluntary water use restraint	Prior to the introduction of a Temporary Use Ban we would implement a campaign for voluntary water use restraint. The time between the two would allow for a representation period on the intention to impose a Temporary Use Ban, together with time for the pubic to respond and for us to implement the ban
Compensation flow	Stored water released from a reservoir to ensure a continuous flow in the downstream watercourse
Consumer Council for Water	The Consumer Council for Water (Northern), which represents the interests of water customers
Countryside Council for Wales	Countryside Council for Wales (superseded by Natural Resources Wales as of 1 April 2013)
Critical period	The length of time between a reservoir being full and the reservoir reaching minimum storage during the worst drought on record
Defra	Department for Environment, Food and Rural Affairs
Deployable output	Deployable output (known as DO) is the output of a commissioned source or group of sources or of a bulk supply as constrained by: the environment; abstraction licences; water quality; existing water treatment and supply system capacities. Yield is a similar but more general term
DO	Dissolved oxygen
Drought order	The Water Resources Act 1991 gives the Secretary of State or the National Assembly for Wales the power to grant ordinary and emergency drought orders to water undertakers or the Environment Agency Ordinary drought orders can include the same powers to abstract water as drought permits, but they can also authorise water undertakers to further action Ordinary drought orders can also be used to ban non-essential use of water by customers – these are commonly called non-essential use bans or prescribed uses orders and are set under the Drought Direction 2011. See 'non-essential use ban' entry for further information An emergency drought order gives water companies complete discretion on the uses of water that may be prohibited or limited, and they can authorise supply of water by standpipes or water tanks, or impose rota cuts
Drought permit	Schedule 22 of the Environment Act 1995 amended the Water Resources Act 1991 to give the Environment Agency the power to grant drought permits. Drought permits can only authorise a water undertaker to 'take water' from specified sources or modify or suspend restrictions or obligations relating to a water undertaker's existing powers to 'take water' from a source
Droughtwatch	Joint United Utilities and Environment Agency spreadsheet tool used to assess a range of scenarios for reservoirs to assess their risk of failure
DWI	The Drinking Water Inspectorate regulates drinking water quality in England and Wales
EMP	Environmental Monitoring Plan. A plan for monitoring the impact of a drought permit/order on the environment
Environment Agency	The Environment Agency

Glossary of terms

Exception	An exception is a category of water use/activity that is outside of the restrictions imposed by a Temporary Use Ban or drought order. Exceptions can be statutory (i.e. set in legislation), discretionary universal (offered by all water companies) or discretionary concessional (exceptions offered by water companies on an individual basis)
HRA	Habitats Regulations Assessment is a process for identifying the implications of the drought plan options for designated sites (SAC, SPA, Ramsar). If likely significant adverse impacts are predicted, then a detailed Appropriate Assessment of the option is required
Hands-off flow	A hands-off flow (also known as a prescribed flow) is normally associated with a river abstraction and is the flow above which abstraction can occur. The purpose of a hands-off flow is to ensure a given flow of water continues in the river prior to abstraction
Hosepipe ban	Section 36 of The Flood and Water Management Act 2010 replaced the original Section 76 of the Water Industry Act 1991. The original legislation only allowed water undertakers to prohibit or restrict the use of hosepipes (or similar apparatus) for the purposes of watering private gardens and the washing of private motor cars, commonly known as a hosepipe ban. The new legislation gives water companies further powers to restrict water use by customers. Therefore this plan refers to water use restrictions (Temporary Use Bans) rather than hosepipe bans
Inset appointee	The inset appointment process is the route by which one company replaces the incumbent (i.e. United Utilities for the north west) as the appointed water and/or sewerage undertaker for a specified area. As such the replacement appointed water company will have all of the same duties and responsibilities as the previous statutory water company for the specified area (e.g. they are also required to have a drought plan). Our only inset appointment is for Peel Water Networks Ltd. who supply water to Media City, Salford. Their drought plan was published in April 2014: www.peelutilities.co.uk/pwnl/domestic/droughtplan Peel Water Limited (a different business to Peel Water Networks Ltd.) is a licensed supplier operating in our area
LCUS	The Lancashire Conjunctive Use Scheme. This scheme comprises river (River Lune and Wyre), borehole (Fylde aquifer) and reservoir (Barnacre) sources
Leakline	A free telephone number (0800 330033) for the public to report leaks to us. We also have a website form for online leak reporting (https://www.unitedutilities.com/report-a-leak-form.aspx)
Level of service	Reliability of water supply to our customers expressed as the frequency of the imposition of water use restrictions
Licensed supplier	Water supply licences are issued by Ofwat. Companies with water supply licences can supply water to non-domestic customers using the public water networks operated by water undertakers. There are two types of licence: • Retail supply licence: this allows the licensee to purchase a wholesale supply from an appointed water company's supply system and supply the premises of its customers • Combined supply licence: this allows the licensee to introduce water into a supply system and supply the premises of its customers. United Utilities Water Sales Ltd. have a supply licence to operate in other water company areas (i.e. outside the north west of England). Currently there are eight licensed water suppliers that supply customers within our geographical area through our supply system
Local Resilience Forums	Local Resilience Forums have a statutory responsibility in terms of emergency planning and response, including for priority customer groups
MISER	Our water supply system model used in assessments of water supply risk
Ml/d	Megalitres per day (million litres per day)
Natural England	Natural England
Natural Resources Wales	Supersedes Countryside Council for Wales as of 1 April 2013 – the new organisation also incorporates Environment Agency Wales and the Forestry Commission Wales
NNR	National Nature Reserve
Non-commissioned sources	Sources of water that are not currently in use but, with work, could be brought in to supply in a drought event
Non-essential use ban	This is an ordinary drought order

Glossary of terms

	Non-essential use bans are also known as a prescribed uses order. The Drought Direction 2011 sets out the non-essential uses of water that can be prohibited or limited by an ordinary drought order. It is more restrictive than Section 76 of the Water Industry Act 1991 (as replaced by Section 36 of The Flood and Water Management Act 2010) and can impact particularly on car washing businesses, building cleaning businesses and those businesses with private swimming pools
Ofwat	Office of Water Services (the economic regulator of the water industry in England and Wales). Ofwat was replaced by the Water Services Regulation Authority on 1 April 2006
pH	pH is a measure of the acidity of an aqueous solution. Pure water is neutral, with a pH close to 7.0 whilst solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline
Ramsar	Ramsar sites are wetlands of international importance designated under the Ramsar Convention. More formally known as 'The Convention on Wetlands of International Importance especially as Waterfowl Habitat' it is an intergovernmental treaty signed in Ramsar, Iran, in 1971
Resource zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall
Review of consents	The process by which abstraction licences (and other consents such as discharge consents) that have the potential to adversely affect SAC and SPA sites have been reviewed by the Environment Agency to determine if they need to be altered. This process has resulted in changes to many of our abstraction licences such as increases to compensation or prescribed flow requirements and reductions to the volume of water that can be abstracted
Rezone	We will undertake a variety of actions to rezone water supplies during a drought. This involves altering the water supply network such that the area that a particular water source supplies is altered (i.e. enlarged or contracted). Rezoning allows us to balance the abstractions of various water sources
SAC	Special Area of Conservation, as designated under the Habitats Regulations. Together with SPA's these form the Natura 2000 network of protected sites
SEA	Strategic Environmental Assessment. A process which occurs alongside the development of the drought plan to ensure that environmental aspects are fully considered
Secretary of State	The Secretary of State for Defra (Department for Environment, Food and Rural Affairs)
SPA	Special Protection Area, as designated under the Habitats Regulations on the conservation of wild birds (also known as the Birds Directive). Together with SAC's these form the Natura 2000 network of protected sites
SSSI	Site of Special Scientific Interest, as designated under the Countryside and Rights of Way (CRoW) Act 2000
Temporary Use Ban	A Temporary Use Ban would be implemented approximately 28 days following the start of a campaign for voluntary water use restraint. The Temporary Use Ban restrictions are as set out in Section 76 of the Water Industry Act 1991 (as replaced by Section 36 of The Flood and Water Management Act 2010)
UKWIR	United Kingdom Water Industry Research Limited is a research organisation jointly funded by all UK water and wastewater service suppliers
United Utilities	United Utilities Water Limited
WAG	Welsh Assembly Government (also known as the Welsh Government or Welsh Ministers)
WaterUK	WaterUK is the industry association that represents all UK water and wastewater service suppliers at national level
Waterwise	An organisation set up and jointly funded by all water companies. Acting independently, its aim is to increase demand management actions to address public water supply needs
WELM	West East Link Main commissioned in 2012 to enable us to transfer more water from the south of the Integrated Resource Zone towards Manchester
WFD	Water Framework Directive (2000/60/EC). Came in to force on 23 October 2000. This has been transposed in to UK legislation as the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003

Glossary of terms

WFD UKTAG	Water Framework Directive United Kingdom Technical Advisory Group (UKTAG). The group supports the implementation of the directive in the UK and has developed standards and classifications for water bodies
Water Resources Management Plan	We last published our Water Resources Management Plan in 2015 and it is updated every 5 years. The Water Resources Management Plan identifies if there is expected to be a deficit in the availability of water supplies compared to demand, resulting in the need for new sources of water. The assessment takes climate change impacts in to account. The Water Resources Management Plan identifies the preferred solutions for dealing with any deficits, which are then funded through the AMP process
WSRA	The Water Services Regulation Authority replaced Ofwat on the 1 April 2006, however the term Ofwat is still generally used
Yield	A general term for the reliable supply of water from a source. Deployable Output is a similar but more specific term and is used in preference

APPENDIX 1: How we've developed this plan

A1.1 Changes since our Final Drought Plan 2014

On the 26 January 2016 we announced a material change to our current published drought plan; our Final Drought Plan 2014; as we published an update to our Crummock Water drought permit environmental assessment report. In the event of a material change we are required to submit an updated Draft Drought Plan to Defra within 6 months of the material change – we did this on 20 July 2016.

There is no guidance as to the definition of a material change; it is up to the water company to determine if one has occurred.

We have never had to apply for a drought permit at Crummock Water in West Cumbria before. However, we are now more reliant on this water source as we are using it to support a reduction in abstraction from Ennerdale Water due to the need to protect the downstream River Ehen Special Area of Conservation. Due to this increased reliance on Crummock Water it is more likely that we will hit drought triggers at this source. Crummock Water is one of our potential drought permit sites in the West Cumbria Resource Zone as under our abstraction licence we are only legally allowed to abstract from it by gravity. However as the lake level falls, the ability to release water from the lake to the downstream River Cocker by gravity fails as the lake level reaches the bottom of the outlet penstocks. At this point we need a drought permit in force to allow us to continue to abstract water from the lake by pumping, both to provide compensation water to the River Cocker and also for public water supply – this action is associated with Trigger 4. Previously we thought that we needed to commence pumping at a lake level of 1.1 m below weir crest; however a detailed engineering study (completed for the drought permit environmental assessment report update) has shown that we need to start pumping at a higher lake level (i.e. earlier) at 0.97 m below weir crest. This change means that there is 319 Ml less water in Crummock Water available for us to abstract under our abstraction licence. This meant that the drought triggers for Crummock Water needed to be changed to ensure there is sufficient time between them to complete associated drought actions.

Updating our drought plan as a result of the material change at Crummock Water also gave us the opportunity to include other new developments including:

- UKWIR water use restrictions Code of Practice 2014
- New Defra/Environment Agency drought plan guidance (December 2015)
- New Drought Plan Direction 2016
- New Environment Agency drought plans (2015)
- New United Utilities Water Resources Management Plan (March 2015)
- New drought permit/order environmental assessments at Ullswater, Windermere, Lune LCUS, Ennerdale, Crummock
- Removal of temporary weir option at Ullswater
- Environment Agency confirmed as responsible for drought orders at compensation-only reservoirs
- Review of Consents sustainability changes implemented from 1 April 2015
- Feedback received through pre-consultation and customer research.

The following list summarises the key changes in this drought plan from our Final Drought Plan 2014:

- All drought triggers have been revisited and altered if required (see below)

- More sophisticated scenario testing of different possible future drought events
- Water resource modelling to test the benefits of the drought plan options e.g. maintain customers' water supply; stop reservoirs emptying; entering the next year in a better position
- Undertook a customer survey in 2014 to inform our approach to water use restrictions (see Appendix 2)
- Updated our approach to demand drought actions in light of the UKWIR Code of Practice 2014 (see Appendix 2)
- Review of supply side options following an engineering assessment and water resource model testing to understand their benefits (for further detail see Appendix 1.5)
- Updated environmental assessment information for drought permits/orders at Ennerdale Water, Crummock Water, Ullswater, Windermere and the River Lune LCUS. This has been reflected in the drought option forms in Appendix 9. This includes removal of a temporary weir from the Ullswater drought permit option
- New Strategic Environmental Assessment of all drought options
- New Habitats Regulations Assessment. Only the Ennerdale Water drought order option passes through screening and progresses to Stage 2 of the Habitats Regulations Assessment process, Appropriate Assessment, Stage 3 Alternative Options and Stage 4 Imperative Reasons of Overriding Public Interest
- Updated the information on the Ennerdale compensatory measures as these are now agreed and are being delivered (see Appendix 4)
- Updated the information on licensed water suppliers that supply customers within our geographical area through our supply system (Section 3.3)
- Following Environment Agency/Defra guidance issued in December 2015, we have altered the review cycle for our drought plan from once in $3^1/_2$ to once in 5 years. This affects the frequency of drought permit/order environmental study updates
- Agreed that the Environment Agency are responsible for drought order applications at compensation-only reservoirs (i.e. those where there is no abstraction for public water supply)
- Information on the outcome of the Environment Agency's Review of Consents process, under the Habitats Regulations, included (Section 3.4)
- Information on our water bank agreements included (Section 3.5)
- Our drought management structure has been altered to reflect our current company structure (Section 3.12)
- Document restructured to make it more accessible to stakeholders, including new appendices on how we developed the plan and on the likelihood of drought, and updated our drought communication plan.

Changes that have been made to the plan following consultation on the Draft Drought Plan 2016 are summarised in the next section, Section A1.2.

A1.2 Consultation on this plan

Since the publication of our Final Drought Plan 2014 we have completed updated environmental assessments for the following drought permit/order options:

- Windermere
- Ullswater
- Ennerdale

- Crummock
- River Lune LCUS.

For each of these environmental assessments we established a local stakeholder group to ensure they can contribute to the process and to raise awareness of our proposals. A project steering group was also established for each study which included the Environment Agency and Natural England (where appropriate). We follow this same approach to consultation for all our drought permit/order environmental studies.

To produce this plan we have held technical meetings with the Environment Agency, in particular to discuss our approach to supply side options and drought triggers, and to ensure consistency with their drought plans (Environment Agency, 2015). In addition, updates on drought plan progress have been shared with the Environment Agency at our regular quarterly liaison meetings.

We have consulted with Natural England, Environment Agency, Natural Resources Wales, Cadw and Historic England regarding the environmental aspects of the plan, in particular the Strategic Environmental Assessment and Habitats Regulations Assessment. Consultation on the scope of the Strategic Environmental Assessment ended on the 8 April 2016. Comments were only received from the Environment Agency and these were taken in to account in developing the Strategic Environmental Assessment Draft Environmental Report. Consultation on the draft HRA Screening Report ended on 24 June 2016. The Strategic Environmental Assessment Environmental Report was publicly consulted on alongside the Draft Drought Plan 2016 between 3 October and 14 November 2016.

We undertook a pre-consultation exercise with statutory consultees and neighbouring water companies during the period 26 January to 19 February 2016 inclusive. We issued eighteen pre-consultation letters and received 5 responses from Defra, Environment Agency, Natural England, Natural Resources Wales and Northumbrian Water. The issues raised in these pre-consultation responses have been addressed in this plan.

We also held two stakeholder pre-consultation workshops on 17 and 18 May 2016 in Bowness on Windermere and Workington, Cumbria. The aim of these was to get our stakeholders views on the planned changes to the drought plan. As a result of these events we have included this new appendix in the plan to explain the changes since our Final Drought Plan 2014.

On 20 July 2016 we submitted the Draft Drought Plan 2016, and accompanying documents, to the Secretary of State at Defra. On 21 September 2016, the Secretary of State confirmed that our Draft Drought Plan 2016 could be published and publicly consulted on. The public consultation period ran for 6 weeks from 3 October to 14 November 2016 inclusive. On 29 September 2016 a hard copy document was made available for public inspection at our head office (Haweswater House, Lingley Mere). On 3 October 2016 the Draft Drought Plan 2016, and its associated documents, were published on our website and we directly notified 785 stakeholders. We also issued a press release and a Youtube video, as well as emailing a display poster to public libraries. As part of the public consultation we held four stakeholder events throughout the northwest region in Ellesmere Port, Workington, Chorley and Kendal which were attended by 25 stakeholders. The stakeholder events covered consultation on our Draft Drought Plan 2016 as well as pre-consultation on our next Water Resources Management Plan.

The public consultation on our Draft Drought Plan 2016 closed on the 14 November 2016. We received 14 responses, identifying 90 issues for us to consider. On the 12 January 2017 (within 15 weeks from the start

of the consultation on 3 October 2016) we published a Statement of Response setting out how we have dealt with each of the issues raised, and submitted a Revised Draft Drought Plan 2017 to the Secretary of State for Defra. The key changes to the plan arising from the consultation on the Draft Drought Plan 2016, as outlined in the Statement of Response, are:

- The Swineshaw boreholes drought option has been confirmed as a drought order application due to the need to discharge the abstracted water to a watercourse. Following submission of our Draft Drought Plan 2016, we have undertaken an environmental assessment of this option and have fully involved the Environment Agency and Natural England in this process

- We have bought forward the planned review of the Environmental Assessment Report for our Lake Vyrnwy drought permit from 2020/21 to 2017 in response to comments raised by Natural Resources Wales in their response to our Draft Drought Plan 2016 consultation

- Trigger 4 at Ennerdale, representing the implementation of a Temporary Use Ban, has been moved up to make the time interval between Trigger 2 and Trigger 4 shorter. This also means that a Temporary Use Ban will be in place for longer before a drought order is required, although it will not be in place before the drought order application is submitted to Defra

- We have created a new Appendix 6 to bring together information on the drought scenario testing we have undertaken and have expanded on the information presented

- We have created a new Appendix 7 to show how we will make the case for an exceptional shortage of rain to support a drought permit/order application

- We have created a new Appendix 8 that sets out our decision making process for strategic pumping. This is in response to the issues raised by our stakeholders in Windermere in particular.

Following direction from the Secretary of State, this plan will become our new Final Drought Plan.

A1.3 Water resources modelling

We have used water resources models to develop drought triggers and to estimate the benefits of drought actions. We have Aquator hydrological models for our Carlisle, Integrated and West Cumbria Resource Zones[10], which were developed in close consultation with the Environment Agency[11]. Aquator is a water resources modelling/simulation package used by many water companies. In the modelling for this plan we used updated flow series to at least the 31 December 2013. The models use "dry" weather demands[12] and water supply system arrangements to reflect the period covered by this drought plan, including, for

[10] There is no Aquator model for the North Eden Resource Zone as this comprises borehole sources only and the trigger testing is covered by a separate groundwater review

[11] Including model performance verification

[12] Including allowance for uncertainty (based on the target headroom assessment carried out during the Water Resources Management Plan modelling) and asset outages

example, the West East Link Main commissioned in 2012. The model incorporates the rules by which we operate the supply network including the current flood drawdown rules for Thirlmere Reservoir[13]. The models show how our current system would cope with a repeat of historic hydrological drought events. This means that, particularly in the Integrated Resource Zone model, the impact of drought is reduced.

For example, the 2010 drought has a reduced impact, predominantly due to the benefit of the WELM. If, in 2010, the WELM had been available to move water from sources in the south and west of our area to areas normally supplied by Haweswater Reservoir, we would have approached Trigger 3 and then seen a recovery due to rainfall. This would have avoided the need to apply for drought permits to protect water supplies in the Integrated Resource Zone.

This also means that modelled storages in Haweswater Reservoir are greater than the actual storages seen during historic drought events. For example, in September 1995 the actual minimum storage reached in Haweswater was 0.35%, but the modelled minimum storage is higher at 39%. Similarly, in September 1976 the actual Haweswater minimum storage was 27% but the modelled minimum is 46%. The benefit of the current infrastructure varies for each historic drought depending on its nature, for example the geographical areas affected.

A1.4 Drought trigger development and testing

Drought trigger positioning is a balance between ensuring sufficient time between triggers, to undertake the required actions, and the frequency with which the triggers are reached. This drought plan includes a range of drought management actions, which are linked to the drought triggers (see Figure 1). Particular drought management actions will only be pursued if they are relevant to the current drought situation. Drought management actions may be applied either company wide, by resource zone or to target a specific geographic area depending on the nature of the drought event at that time.

Figure A1.1 below shows the target intervals between the drought triggers that we are aiming for, whilst also avoiding a disproportionate number of events being unnecessarily triggered. These are directly linked to the drought management actions that need to be considered at these points (see Section 5).

Figure A1.1: Target intervals between drought triggers

	Crummock Water and Scales boreholes (West Cumbria Resource Zone) and North Eden Resource Zone	Ennerdale Water (West Cumbria Resource Zone)	Integrated and Carlisle Resource Zones
Between Triggers 1 and 2	14 days	14 days	14 days
Between Triggers 2 and 3	14 days	7 days	14 days
Between Triggers 3 and 4	35 days	7 days (i.e. 2 weeks or 14 days from Trigger 2)	28 days

[13] Any changes to such operational rules in the future will be considered in the context of water supply resilience, including drought risk

The target interval between Triggers 1 and 3 is 28 days (21 days at Ennerdale Water). This allows time for drought management actions to be instigated, including production and implementation of a Drought Action Plan specific to the drought event being experienced.

The target interval between Triggers 3 and 4 is 28 days (7 days for Ennerdale Water). This is to allow sufficient time to consult on the implementation of a Temporary Use Ban, allow the public to respond and get ready to implement those restrictions, as well as to apply for drought permit/order applications (if appropriate) and provide time for the Environment Agency and Defra to consider these. At Crummock Water, Scales boreholes and North Eden boreholes, Trigger 4 represents the point where abstraction is not licenced and a drought permit is required to continue abstraction. At these sites the target interval between Triggers 3 and 4 has been increased to 35 days to allow an additional 7 days for consultation on a drought permit prior to application, assuming that the Environment Agency are able to determine that application within 28 days (as an example, in 2010 our Longdendale drought permit was granted by the Environment Agency 22 days after application). For the Integrated Resource Zone, there is no absolute need for drought permits to be in place at Trigger 4 but they are likely to follow after this trigger is crossed.

The number and location of drought permit/order applications is largely dependent on the time of year and the current water resources situation (i.e. drought severity). Applications are also likely to be phased in priority order as the drought progresses. For these reasons, an explicit trigger marking the point of application is not included although an indicative storage curve showing when the first drought permit/order applications are likely to be made is shown. This is expected to be at least 1 week after the first actions associated with Trigger 3. There are no drought permits/orders associated with the River Dee system.

For Ennerdale Water the actions associated with the triggers are different, meaning that the target intervals between the triggers are different. We would seek to implement a campaign for voluntary water use restraint at Trigger 2 (not Trigger 3 as for our other areas) and, therefore, less time (target of 7 days) is required between Triggers 2 and 3 at Ennerdale Water. Our plan now has a target timing of a further 7 days between Triggers 3 and 4 (the point of implementation of a Temporary Use Ban), although in modelling the minimum spacing is greater than this due to the need to protect customer levels of service. There is a target 28 days in total between Trigger 3 and reaching the limit of 1.7 m below weir crest level, below which we are not allowed to abstract under our abstraction licence, during which time Defra can determine a drought order application. This timescale is only a guide and the actual determination duration could exceed this. We have shared drafts of our Ennerdale Water drought order application with Defra and dealt with any issues they have raised – we anticipate that this will enable Defra to determine a future application in a timely manner.

The proposed triggers are set out in Section 4 of this plan. In summary, and in comparison to our Final Drought Plan 2014:

- The triggers for the Dee reservoirs (Integrated Resource Zone), Scales boreholes (West Cumbria Resource Zone) and the North Eden Resource Zone boreholes have not been changed
- The drought triggers for Ennerdale (West Cumbria Resource Zone) have been revisited in light of the new South Egremont boreholes, but have mostly remained unaltered for this plan as they are still appropriate in terms of frequency of crossing and time intervals between them. However, following consultation feedback on our Draft Drought Plan 2016, we have moved Trigger 4 up to reduce the time it takes to implement a Temporary Use Ban

(i.e. to reduce the interval between Triggers 3 and 4) and to allow more time for a Temporary Use Ban (i.e. demand restrictions on customers) to be in place before a drought order is implemented on reaching 1.7m below weir crest

- The drought triggers for Crummock Water (West Cumbria Resource Zone) have been altered as a result of Trigger 4 moving up to 0.97 m below weir crest, which then means the other triggers also need to be adjusted. The drought permit at Crummock Water has been altered to include pumping of the abstracted water not just the compensation flow release to the River Cocker
- The drought triggers for Castle Carrock reservoir (Carlisle Resource Zone) have been altered slightly due to an operational change meaning that we now commence pumping from the River Eden at Cumwhinton (to support Castle Carrock) earlier (at Trigger 1 rather than Trigger 3)
- The drought triggers for Haweswater have been shifted slightly to protect against the reservoir starting to drawdown earlier in the calendar year.

The Environment Agency guidance outlines that companies should scenario test their plan to a range of drought events covering short-term (single-season) events to long-term droughts covering multiple years. The Drought Plan Direction 2016 requires an understanding of the magnitude and duration of droughts for which the drought plan has been tested. We have outlined this process in more detail within APPENDIX 6: Testing of drought scenarios, which includes testing of more severe or extreme droughts than in the historic record.

A1.5 Review of supply side options

We have undertaken a review of the supply side options included in this plan. We undertook engineering assessments and water resource model testing to understand their benefits. This included considering the benefits under extreme drought scenarios (see Appendix 6).

We have included some new sources that were previously part of our day to day supply system but which have been taken out of normal use for various reasons.

This review has resulted in a reduction to the number of supply side options from 26 in our Final Drought Plan 2014 to 12 in this plan. There are various reasons why sources have been removed, such as that they are now used in normal operation, long lead in times, water quality constraints and/or no significant benefit. We have taken the following sources out of the current plan:

- Park Road South borehole, Melling boreholes – both sources are now operated as part of our day to day supply system
- Mow Cop borehole, Bromiley borehole, Belmont borehole, Springs borehole, Helsby boreholes, Greensbridge Lane boreholes, Randles Bridge boreholes, Ashton borehole, Eaton boreholes, Newton Hollows boreholes, Springhill borehole, Gorston borehole, Hooton borehole, Worthington reservoir – we have determined that these sources of water do not add benefit to our water supply system during droughts and that in some instances, there may be risks to customers' water quality due to the requirement for complicated temporary treatment solutions
- The Swineshaw boreholes as these have been confirmed to be a drought order option not a supply side option.

APPENDIX 2: Water use restrictions

APPENDIX 2: Water use restrictions

This appendix should be read in conjunction with the main text in this plan on managing demand (see Section 5.3), in particular Section 5.3.2 on water use restrictions.

This appendix describes:

- Relevant legislation
- The expected benefit of water use restrictions incorporating our experiences of the hosepipe ban imposed during the 2010 drought
- The results from our 2011 and 2014 customer surveys
- Our demand management process and plans for introducing the various water use restriction measures, together with any exception criteria which may be applied.

A2.1 Relevant legislation

There are three types of customer demand restrictions referred to in this plan:

- Campaign for voluntary water use restraint
- Temporary Use Ban (powers under Section 36 of the Flood and Water Management Act 2010 which amended Section 76 of the Water Industry Act 1991)
- Ordinary drought order (non-essential use) (powers under the Drought Direction 2011).

On 1 October 2010, Section 36 of the Flood and Water Management Act 2010 amended Section 76 of the Water Industry Act 1991. It introduced new powers of restriction on water usage known as Temporary Use Bans; supported by definitions set out in the Water Use (Temporary Bans) Order 2010. The term Temporary Use Ban is now used instead of hosepipe ban as it is more encompassing.

During a Temporary Use Ban, we will prohibit all categories of usage outlined in Section 76 of the Water Industry Act 1991. This is because all restrictions contribute to an overall reduction in demand and are therefore necessary during times drought.

The Drought Direction 2011 relates to ordinary drought orders (non-essential use) which are granted by the Secretary of State to restrict water use. Drought orders for non-essential use tend to cover non-domestic activities whereas Temporary Use Bans (under Section 76 of the Water Industry Act 1991) tend to cover domestic activities, although there are exceptions.

Companies must demonstrate that they have implemented appropriate demand side restrictions to support drought permit/order applications (with the exception of winter restrictions).

A2.2 Benefit of water use restrictions

The management of customer demand plays an important role in assisting the assurance of security of supply, particularly during times of drought.

The saving associated with a campaign for voluntary water use restraint has been estimated to be 3-5% of the average dry weather demand expected during the drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010.

APPENDIX 2: Water use restrictions

A Temporary Use Ban will always be introduced before an ordinary drought order for non-essential uses. Evidence from the 1995/96 drought indicated very small demand savings were achieved from the drought order (approximately 0.2% demand reduction) and this would therefore need to be compared with the effectiveness of other drought actions for protecting essential water supplies. An assessment of the relative merits of a drought order to manage customer demand in a particular drought event would be discussed with our environmental regulators and the Consumer Council for Water, after the introduction of a Temporary Use Ban.

The benefit of demand restrictions during the winter is negligible given the limited use of hosepipes for garden watering and washing motor vehicles where most usage is seen. Therefore we believe that introducing demand restrictions in winter months is not appropriate as it will not result in a reduction in demand for water. During winter drought situations, we will continue to use enhanced communications to reinforce how customers can help save water and use water wisely inside the home, for example, by lagging pipes to prevent burst pipes in freezing temperatures. We may continue water use restrictions implemented during the summer into the winter months if there is a high risk of restrictions being required the following summer. Consequently, we do not plan to introduce restrictions during the winter period (October to March). Similarly, if storage is below the relevant triggers only for the Dee, and the storage is not being used to regulate flows in the river, then we may not introduce water use restrictions as this may not benefit storage in the Dee regulating reservoirs. However if there were wider zonal benefits, or a forecast that Dee regulation may be imposed, we would consider implementing water use restrictions.

It is intended that during any restriction, all categories of usage outlined by Section 76 of the Water Industry Act 1991 (as amended by the Flood and Water Management Act 2010) which apply to domestic usage (i.e. Temporary Use Ban) will be prohibited. All of the restrictions contribute to an overall reduction in demand and therefore the imposition of the restriction is necessary during times of drought. We believe that restrictions should be sensible and proportionate to the savings made and to their potential impact. Consequently we will operate the same exceptions as the 2010 hosepipe ban, where commercial companies who may be affected by a restriction will be exempt from any restriction. This could include mobile car washes, wheelie bin cleaners etc.

It is important not to place complete reliance on a drought order (non-essential use) achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances, including actual weather conditions and also the effectiveness due to the time it takes to obtain from the Secretary of State. As with Temporary Use Bans, there are very limited demand savings arising from a drought order in winter. Consequently, we do not plan to introduce drought orders to ban non-essential use of water during the winter (October to March). Instead, we will focus attention on publicity to advise customers to use water wisely in their homes and business activities, and the need to lag pipes to protect them from extreme temperatures.

A2.3 2011 customer survey

Following the 2010 drought, in 2011 we commissioned DJS research to undertake a customer survey for us into how demand restrictions should be implemented, including how to prioritise restrictions, how much notice customers require and how they wish to be communicated with. This resulted in the development of the water use restrictions process outlined below. It aims to maximise the amount of water to be saved during times of drought, meet legislative requirements and align to the four principles in the UKWIR Code of Practice on Water Use Restrictions (2014).

APPENDIX 2: Water use restrictions

Research was conducted with the following audiences:

- Domestic customers (400 structured telephone interviews)
- Business customers (50 structured telephone interviews)
- Key stakeholders (12 semi structured telephone interviews).

Prioritising restrictions

None of the uses of water listed under the Flood and Water Management Act 2010 are of great importance to domestic or business customers. To illustrate, the area of most importance to customers is 'watering a garden using a hosepipe', which scores 3.3 out of 10 on a scale of how important it is that customers are able to do each activity listed under the temporary restrictions. These results re-iterate that these uses are non-essential.

Most feel that placing a restriction on 'watering a garden with a hosepipe' or 'cleaning a private motor vehicle with a hosepipe' would have the greatest impact on conserving the region's water. This is followed by 'watering plants on domestic or other non-commercial premises using a hosepipe' and 'cleaning paths or patios using a hosepipe'.

Stakeholders feel that all the restrictions listed should be imposed and that, if anything, the Act does not take things far enough. However, they questioned how successful any imposed restriction would be, as water companies are relying on all customers putting it into practice.

Communications

The majority of domestic (87%) and business customers (70%) were aware of the 2010 hosepipe ban. Most found out about it via television and this was domestic customers' preferred way of finding out about the start and end of future restrictions. Businesses would prefer to be targeted either via television, local press or letter.

Domestic customers are generally happy to have 1 week notice or less that a restriction is going to be implemented, although stakeholders would argue that a longer period is needed to inform and educate them. Businesses (depending on their use of water) may need longer, with some even suggesting up to a month for factories using water as part of the process or other businesses reliant on water.

Stakeholders want to be informed of planned restrictions before customers and ideally 1-3 weeks before the restrictions are implemented.

Generally less time is needed to inform customers that the ban is ending, although a fifth (19%) of domestic and a quarter (24%) of businesses claim they did not find out that the 2010 hosepipe ban had been lifted. It could be argued however, that this was not a bad thing. Again, stakeholders want more notice that the ban is ending – generally 1-2 weeks, although some appreciate that this is not always possible.

Objections

It is unlikely that many domestic customers, businesses or stakeholders would object to any restrictions, but if they did most would want to telephone us.

They feel that we should make customers aware of the objections process and most stakeholders feel that any objections/exceptions should be in the public domain.

Domestic customers generally feel that exceptions shouldn't be granted (66%), but half of businesses (48%) and stakeholders feel that they should and, in most cases, they feel that the emergency services and other businesses reliant on the use of water should be exempted.

A few feel that exceptions should be made to vulnerable households, however, some stakeholders question how this would work in practice.

Attitudes towards the 2010 hosepipe ban and saving water

Domestic customers (75%) and to a lesser extent businesses (68%), felt that the 2010 hosepipe ban was necessary, with few (one in 6) affected by it.

Most were neutral in their feelings towards the ban, however a fifth of domestic customers (20%) felt negatively towards it.

All but one of the stakeholders interviewed felt that the 2010 hosepipe ban was necessary but some questioned how much impact it had, because its success is largely down to whether customers are aware of it and whether they abide by it.

Some stakeholders felt that if future restrictions were phased in, over two stages, that this would allow customers more time to get used to the idea. However, others felt that a two phased approach would just confuse customers.

Something like a hosepipe ban is difficult to impose and water companies have to rely on customers abiding by it for it to be effective.

By educating customers on the benefits of saving water throughout the year, as well as informing them about the positive things that we are doing to save water e.g. our leakage reduction programme, we will start to change customer attitudes.

Positively though, the research has shown that customer attitudes to saving water are starting to change, with a significant shift in those agreeing that they make a conscious effort to save water (74% agreed with this when we conducted a survey with a representative sample of 800 customers in 2009, compared to 80% in this consultation).

A2.4 2014 customer survey

In 2014 we commissioned DJS again to undertake a further customer survey in West Cumbria to understand and explore feelings towards water restrictions. This was because of the increased frequency of drought actions required in this zone.

The objectives of the study were:

- To explore customers thoughts around the frequency of Temporary Use Bans (TUBs) and drought orders to ban non-essential use
- To explore customers thoughts around the time of year we should introduce these bans (i.e. summer/winter)

- To gather feedback from customers to help demonstrate the customer appetite (or not) for these restrictions and when they are introduced
- To gather feedback from customers about the length of notice/consultation period before restrictions are introduced and the frequency of starting such consultations
- To explore customer thoughts about the geographic extent of the restrictions
- To explore customers attitude towards voluntary water use restrictions.

In summary the key findings were:

- Participants were happy to voluntarily reduce their water use
- Little or no notice (less than a week) needed for voluntary restrictions
- Minimal impact, particularly for those who do not own, or rarely use a hosepipe
- An enforced ban was generally not acceptable; perception that rainfall in plentiful in West Cumbria
- Different views on notice period for a Temporary Use Ban (between 48 hours and 4 weeks)
- Split opinions on geographic extent of restrictions – some feeling that it should apply to the smallest area possible, and others that everyone should share the impact
- Communicating at a local level is key to awareness and ultimately participation.

We have considered these findings in the development of the West Cumbria drought triggers and associated actions.

A2.5 Water use restrictions process

Our approach to implementing water use restrictions on customers has considered the conclusions from the Consumer Council for Water's Understanding Drought and Resilience report, 2013, as well as our own customer surveys in 2011 and 2014.

In line with the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014), we have adopted a phased approach to demand restrictions with a campaign for voluntary water use restraint preceding Temporary Use Bans and drought orders to ban non-essential use.

In order for us to implement a Temporary Use Ban we must be satisfied that we are "experiencing, or may experience, a serious shortage of water for distribution". There is no formal definition of this in legislation but notably there is no explicit link to drought.

In order to grant a drought order to ban non-essential use of water, the Secretary of State needs to be satisfied that "by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened". This differs from a Temporary Use Ban as it is expressly linked to drought. The Secretary of State can require a public inquiry or hearing in relation to the drought order, whether or not there are objections to it.

The geographical extent of water use restrictions will be determined based on consideration of the area at risk and the anticipated benefits arising from the action. For example, in West Cumbria, if a drought order to allow abstraction to continue from Ennerdale Water is being sought, demand restrictions would be considered for the customers supplied by this source. This is because there would be no benefit to Ennerdale Water if customer restrictions were imposed across a wider area.

APPENDIX 2: Water use restrictions

Our phased approach to implementing water use restrictions on customers is shown in Figure A2.1 below and follows that set out in the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) (see Figure A2.2):

Figure A2.1: Process for implementation of water use restrictions

Trigger	Action
Trigger 3 (Trigger 2 at Ennerdale)	Commence campaign for voluntary water use restraint and representation period for Temporary Use Ban
	Consider Temporary Use Ban representations
Trigger 4	Implement Temporary Use Ban and continue to consider representations
After Trigger 4	Consider need for ordinary drought order to ban non-essential uses; apply for and implement if appropriate

In order to encourage reduction in demand we will commence a campaign for voluntary water use restraint at Trigger 3 (Trigger 2 at Ennerdale), commensurate with the start of the representation period for a Temporary Use Ban. This will help avoid short-term increases in demand before a Temporary Use Ban takes effect. The message will be conveyed through the use of press releases and coverage on our website, as well as through the formal legal notice for the forthcoming Temporary Use Ban.

Details on how to make representations on the proposal to implement a Temporary Use Ban will be included in the legal notice and we will give three weeks (approximately two weeks at Ennerdale) for representations to be made by affected parties. We will provide a dedicated email address for the public to respond. As a water company we are well versed in dealing with incidents and have incident management processes in place in the event of an unexpectedly large response. Enforcement of the Temporary Use Ban will occur following the end of the representation period and should be in place around the time Trigger 4 is reached.

Most of the uses of water in a Temporary Use Ban only apply to the use of water drawn through a hosepipe or similar apparatus. The exception to this is filling/maintaining a domestic swimming/paddling pool and filling/maintaining an ornamental fountain in which the use of water which may be prohibited extends to all means of filling, including fixed or permanent plumbing (but excludes handheld containers in the case of domestic swimming/paddling pools).

Section 76 of the Water Industry Act 1991 (as amended) stipulates the following:

- Notice must be given to those affected (no time restriction is imposed)
- As a minimum, notice must be advertised in two newspapers circulating in the area to which the restrictions apply and on our website.

In line with the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014), a PDF version of the notice will be available for downloading from our website.

For drought orders to ban non-essential water use, a notice will be advertised if a drought order is granted.

We will take a pragmatic approach to granting exceptions for water use restrictions. The UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) categorises exceptions as:

APPENDIX 2: Water use restrictions

- Statutory exceptions – these are defined in the legislation and will be automatically granted
- Discretionary universal exceptions – these are offered by all water companies, including ourselves, and include exceptions on the grounds of disability (for Blue Badge holders), customers using an approved drip or trickle irrigation system fitted with a pressure reducing valve and timer system, commercial customers that use hosepipes as part of their business (e.g. hand car washing, window cleaning, graffiti removal)
- Discretionary concessional exceptions – these are offered at the discretion of each water company on an individual basis. We will apply **all** the discretionary concessional exceptions included in the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014).

Figure A2.2 is taken from the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) and sets out the phased approach to water use restrictions and the exceptions that apply to each.

Figure A2.3 is taken from the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) and sets out the exceptions that we will grant for Temporary Use Bans.

Figure A2.4 sets out the exceptions that we will grant for a drought order (non-essential use ban).

Customers may wish to apply for an exception even if they do not consider themselves to be part of an exception category.

Water use restrictions will be lifted when it is deemed that water resources have returned to a normal level of risk and will follow the statutory process as outlined in the Water Industry Act 1991. Notice of the lifting of water use restrictions will be given in the same manner as when they are imposed i.e. advertised in two newspapers and on our website. Our 2011 and 2014 customer surveys showed that customers do not require notice of removal of a ban.

Inset appointees and licensed/appointed suppliers operating in our area, operate under their own instrument of appointment; as such we have no control over demand restrictions imposed on their customers. We currently have one inset appointee in our area (Peel Water Networks Ltd.) and have eight licensed/appointed suppliers operating in our area. During the 2010 drought, we agreed with Peel Water Networks Ltd. that they would mirror the restrictions imposed by us and their Final Drought Plan 2014 mirrors our approach to drought actions (www.peelutilities.co.uk/pwnl/domestic/droughtplan). In any future drought event we would seek to reach similar agreements with any inset appointees or licensed/appointed suppliers operating in our area. At the time of a drought event, we will also discuss water use restrictions with neighbouring water companies to ensure they are aware of our situation.

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Figure A2.2: UKWIR phased approach to water use restrictions[†]

The restrictions		Notes	Summary of exceptions
No restrictions	No restrictions implemented	• Period of routine monitoring of water resources and environmental baseline by water companies • Usual company water efficiency and leakage activities	None required
Before restrictions	Voluntary restraint requested	• Awareness raising of water resource situation to promote efficient use of water • Enhanced water efficiency campaigns with customers • Enhanced leakage detection and repair activity	None required
Temporary Use Bans	Section 76(2) of the WIA 1991, as amended by Section 36 of the FWMA 2010, states the following 11 uses of water can be restricted: 1. Watering a garden using a hosepipe; 2. Cleaning a private motor-vehicle using a hosepipe; 3. Watering plants on domestic or other non-commercial premises using a hosepipe; 4. Cleaning a private leisure boat using a hosepipe; 5. Filling or maintaining a domestic swimming or paddling pool; 6. Drawing water, using a hosepipe, for domestic recreational use; 7. Filling or maintaining a domestic pond using a hosepipe; 8. Filling or maintaining an ornamental fountain; 9. Cleaning walls, or windows, of domestic premises using a hosepipe; 10. Cleaning paths or patios using a hosepipe; and 11. Cleaning other artificial outdoor surfaces using a hosepipe.	• Restrictions apply to domestic customers i.e. a domestic customer could not undertake these activities unless subject to an exception • Enhanced water efficiency campaigns with customers • Enhanced leakage detection and repair activity	**Statutory Exceptions** are common to all water companies **Discretionary Universal Exceptions** are common to all water companies and relate to: • Blue badge holders (NB not for all uses) • Customers using an approved drop or trickle irrigation system fitted with a PRV and timer systems • Commercial customers that use hosepipes as part of their business for some TUB categories, e.g. hand car washing, window cleaning, graffiti removal **Discretionary Concessional Exceptions** can be granted by individual water companies

APPENDIX 2: Water use restrictions

The restrictions		Notes	Summary of exceptions
Drought Order Restrictions	The Drought Direction 2011 defines the range of 10 water use activities that may be prohibited with the successful application of a Drought Order. 1. Watering outdoor plants on commercial premises; 2. Filling or maintaining a non-domestic swimming or paddling pool; 3. Filling or maintaining a pond; 4. Operating a mechanical vehicle-washer; 5. Cleaning any vehicle, boat, aircraft or railway rolling stock; 6. Cleaning non-domestic premises; 7. Cleaning a window of a non-domestic building; 8. Cleaning industrial plant; 9. Suppressing dust; and 10. Operating a cistern in any building that is unoccupied and closed.	• Restrictions apply to all customers (domestic and commercial) • Enhanced water efficiency campaigns with customers • Enhanced leakage detection and repair activity	**Statutory Exceptions** are common to all water companies **Discretionary Universal Exceptions** relate to: • Blue badge holders (NB not for all activities) The **Discretionary Concessional Exceptions** in Phase 3 may be rescinded
Lifting restrictions	All restrictions are lifted	• Period of awareness raising of water resources and lifting of restrictions • Usual company water efficiency and leakage activities	None required

† Copied from UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014): Table 2 – A common phased approach to water use restrictions. Note that our plan does not include emergency drought orders

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Figure A2.3: Temporary Use Ban exceptions[†]

TUB category	Statutory exception	Discretionary universal exception (granted by all water companies)	Suggested discretionary concessional exception	Note
1) Watering a garden using a hosepipe	Using a hosepipe to water a garden for health or safety reasons NB In this category, the definition of "a garden" includes "an area of grass used for sport or recreation". Therefore it should be notes that watering areas of grass, which are used for sport or recreation is covered by a statutory Exception for health & safety only in relation to the active strip/playing area, not the entire ground	• To Blue Badge holders on the grounds of disability • Use of an approved drip or trickle irrigation system fitted with a pressure reducing valve and timer	• To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge • To water newly bought plants for first 14 days • To water food crops at domestic premises or private allotments • To water newly laid turf for first 28 days	The whole of the sports pitch can still be watered using other methods. Some companies may wish to grant a Discretionary Concessional Exception to allow the use of a hosepipe to water other grassed areas used for sport where there is no health and safety risk
2) Cleaning a private motor vehicle using a hosepipe	A "private motor-vehicle" does not include (1) a public service vehicle, as defined in section 1 of the Public Passenger Vehicles Act 1981(c), and (2) a goods vehicle, as defined in section 192 of the Road Traffic Act 1988 (d)	• To Blue Badge holders on the grounds of disability • Use of a hosepipe in the course of a business to clean private motor vehicles where this is done as a service to customers	• To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge • Use of specific low water use apparatus, such as pressure washers	Taxis and minicabs are not considered to be public service vehicles and so are subject to bans[1]
3) Watering plants on domestic or other non-commercial premises using a hosepipe	Does not include watering plants that are (1) grown or kept for sale or commercial use, or (2) that are part or a National Plant Collection or temporary garden or flower display	• To Blue Badge holders on the grounds of disability. • Use of an approved drip or trickle irrigation system fitted with a PRV and timer.	• To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge • To water newly bought plants for first 14 days • To water newly laid turf for first 28 days	The water restriction does not apply to the watering of plants that are grown or kept for sale or commercial use by horticultural businesses e.g. plant nurseries etc.
4) Cleaning a private leisure boat using a hosepipe	(1) Cleaning any area of a private leisure boat which, except for doors or windows, is enclosed by a roof and walls (2) Using a hosepipe to clean private leisure boat for health or safety reasons	• Commercial cleaning • Vessels of primary residence. • Cases where fouling is causing increased fuel consumption • Engines designed to be cleaned with a hosepipe	• To remove graffiti • To prevent or control the spread of non-native and/or invasive species	

APPENDIX 2: Water use restrictions

TUB category	Statutory exception	Discretionary universal exception (granted by all water companies)	Suggested discretionary concessional exception	Note
5) Filling or maintaining a domestic swimming or paddling pool	(1) Filling or maintaining a pool where necessary in the course of its construction (2) Filling or maintaining a pool using a hand-held container which is filled with water drawn directly from a tap (3) Filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment (4) Filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease (5) Filling or maintaining a pool used in the course of a programme of veterinary treatment (6) Filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity	None	• Pools with covers used to minimise evaporative losses when not in use • Pools with water conservation and/or recycling systems approved by the water company • Paddling pools at early stages of a drought • Pools that are subject to significant repair and renovation • Filling new pools	• Hot tubs are not classed as pools • Pools with religious significance are not domestic pools • Pools used by school pupils for swimming lessons should be excluded: they are covered by Drought Order legislation
6) Drawing water, using a hosepipe, for domestic recreational use	None	None	• Pools with covers used to minimise evaporative losses when not in use • Pools with water conservation and/or recycling systems approved by the water company	
7) Filling or maintaining a domestic pond using a hosepipe	Filling or maintaining a domestic pond in which fish or other aquatic animals are being reared or kept in captivity	Blue Badge holders on the grounds of disability	To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge	Filling and topping up of a pond by fixed and buried pipes is not restricted
8) Filling or maintaining an ornamental fountain	Filling or maintaining an ornamental fountain which is in or near a fish-pond and whose purpose is to supply sufficient oxygen to the water in the pond in order to keep the fish healthy	None	To operate water features with religious significance	

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TUB category	Statutory exception	Discretionary universal exception (granted by all water companies)	Suggested discretionary concessional exception	Note
9) Cleaning walls or windows of domestic premises using a hosepipe	Using a hosepipe to clean the walls or windows of domestic premises for health or safety reasons	• To Blue Badge holders on the grounds of disability • Commercial cleaning	• To customers on the company's Vulnerable Customers List who have mobility issues bur are not in possession of a Blue Badge • For the removal of graffiti • Where very low water use technologies are employed and approved by the water company	• The use of water-fed poles for window cleaning at height is permitted under the H&S statutory exception • The restrictions do not apply where the cleaning apparatus is not connected to mains supply
10) Cleaning paths or patios using a hosepipe	Using a hosepipe to clean paths or patios for health and safety reasons	• To Blue Badge holders on the grounds of disability • Commercial cleaning	• To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge • For the removal of graffiti • Where very low water use technologies are employed and approved by the water company	
11) Cleaning other artificial outdoor surfaces using a hosepipe	Using a hosepipe to clean an artificial outdoor surface for health or safety reasons	• To Blue Badge holders on the grounds of disability • Commercial cleaning	• To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge • For the removal of graffiti • Where very low water use technologies are employed and approved by the water company	• The use of water-fed poles for window cleaning at height is permitted undertake the H&S statutory exception • The restrictions do not apply where the cleaning apparatus is not connected to mains supply

[†] Copied from UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014): Table 3 – TUB exceptions. Note that we will apply all of the listed exceptions

[1] Explanation regarding the position that taxis are not classed as public service vehicles is provided in the UKWIR Code of Practice

APPENDIX 2: Water use restrictions

Figure A2.4: Drought order exceptions[†]

Drought order purpose of use	Statutory exception	Discretionary universal exception (granted by all water companies)	Suggested discretionary concessional exception
Purpose 1: watering outdoor plants on commercial premises	The purpose specified does not include watering plants that are: (a) grown or kept for sale or commercial use; or (b) part of a National Plant Collection or temporary garden or flower display.	None	• Use of an approved drip or trickle irrigation system fitted with a PRV and timer • Watering newly-bought plants
Purpose 2: filling or maintaining a non- domestic swimming or paddling pool	The purpose does not include: (a) filling or maintaining a pool that is open to the public; (b) filling or maintaining a pool where necessary in the course of its construction; (c) filling or maintaining a pool using a hand-held container which is filled with water drawn directly from a tap; (d) filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment; (e) filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease; (f) filling or maintaining a pool that is used in the course of a programme of veterinary treatment; (g) filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity; (h) filling or maintaining a pool that is for use by pupils of a school for school swimming lessons. Note that a pool is not open to the public if it may only be used by paying members of an affiliated club or organisation.	None	• Swimming pools serving industrial training if considered justified • Swimming pools with covers • Pools with religious significance • Pools fitted with approved water conservation or recycling systems • Pools that are subject to significant repair and renovation
Purpose 3: filling or maintaining a pond	The purpose does not include: (a) filling or maintaining a pond in which fish or other aquatic animals are being reared or kept in captivity (b) filling or maintaining a pond using a hand-held container which is filled with water drawn directly from a tap	To Blue Badge holders on the grounds of disability	To customers on the company's Vulnerable Customers List who have mobility issues but are not in possession of a Blue Badge
Purpose 4: operating a mechanical vehicle-washer	Operating a mechanical vehicle-washer for health or safety reasons	None	• Washers which recycle water and thus use less than 23 litres per wash • On biosecurity grounds

APPENDIX 2: Water use restrictions

Drought order purpose of use	Statutory exception	Discretionary universal exception (granted by all water companies)	Suggested discretionary concessional exception
Purpose 5: cleaning any vehicle, boat, aircraft or railway rolling stock	Cleaning any vehicle, boat, aircraft or railway rolling stock for health or safety reasons	None	• Low water use technologies • Small businesses whose sole operations are cleaning of vehicles using hosepipes • Those using vessels as a primary residence • Cases where fouling of hulls causes increased fuel consumption • Removal of graffiti • To prevent or control the spread of non-native and or invasive species
Purpose 6: cleaning non-domestic premises	Cleaning of any exterior part of a non-domestic building or a non-domestic wall for health or safety reasons	None	• Small businesses whose sole operations are cleaning of non-domestic buildings using hosepipes • Low water use technologies • Removal of graffiti
Purpose 7: cleaning a window of a non-domestic building	Cleaning a window of a non-domestic building using a hosepipe for health or safety reasons	None	• Small businesses whose sole operations are cleaning of non-domestic buildings using hosepipes
Purpose 8: cleaning industrial plant	Cleaning industrial plant using a hosepipe for health or safety reasons	None	• For the removal of graffiti
Purpose 9: suppressing dust	Suppressing dust using a hosepipe for health or safety reasons	None	None
Purpose 10: operating cisterns (in unoccupied buildings)	None	None	None

[†] Copied from UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014): Table 4 – Drought Order exceptions. We will apply all of the exceptions listed

APPENDIX 3: Communication plan

APPENDIX 3: Communication plan

Following the identification of the potential for a drought situation to develop, it is essential that we commence liaison with a range of interested parties. Our approach has considered the conclusions from the Consumer Council for Water's Understanding Drought and Resilience report, 2013.

The following table summarises the key audiences and the media used to communicate with them in times of drought.

Figure A3.1: Media used to communicate to various audiences

Audience	Media
Customers	Press advertisements (ads); radio ads; TV ads; our website; service enquiries and billing call centre messages/recorded messages; e-shots; bulk text messaging; water efficiency events; water efficiency road shows; water efficiency product offers (e.g. water butts, showerheads); customer mailshots; social media posts (Twitter and Facebook)
Media	Proactive and reactive press statements; organising media interviews with senior managers; provision of media packages for use by media and online
MPs/ Department for Communities and Local Government	Email; phone call; e-shot updates
Environment Agency	Email; phone call; newsletter; regular meetings
Defra	Email; phone call; newsletter; e-shot updates
Ofwat	Email; phone call; newsletter; e-shot updates
Consumer Council for Water	Email; phone call; newsletter; e-shot updates
Drinking Water Inspectorate / Public Health England / Local Authorities	Email; phone call; newsletter; e-shot updates
YourVoice customer challenge group	Letter; phone call; newsletter; e-shot updates; meetings (as appropriate)
Water UK	Email; phone call; newsletter; e-shot updates
Natural England/Natural Resources Wales	Letter; phone call; newsletter; e-shot updates; meetings (as appropriate)
Local Resilience Forums	Resilience Direct portal
Local environmental and stakeholder groups including local businesses/National Parks/local councils/neighbouring water companies/licensed suppliers/Peel Water Networks Ltd./fire service/navigation authorities	Letter; phone call; newsletter; e-shot updates; meetings (as appropriate)
Our employees	Intranet announcement; Briefing Box; Email; Questions and Answers; posters; communications to operations employees

Examples of press adverts conveying the types of messages that may be used on reaching Trigger 2, Trigger 3 (campaign for voluntary water use restraint) and Trigger 4 (introduction of a Temporary Use Ban) are shown in Figures A3.2-A3.4. Note that, for Ennerdale, the messages relating to a campaign for voluntary water use restraint at Trigger 3 in the following text should be interpreted as applying to Trigger 2.

This plan set out the triggers that we use as decision points to guide us in determining what drought action measures to take in any particular drought event. The table in Figure A3.5 maps these triggers to

communication actions to show at what stage we would anticipate undertaking communication with various organisations. Organisations would only be contacted if drought powers of interest to them are being considered. For example, the Windermere Lake User Forum is particularly interested in a drought permit at Windermere. Figure A3.6 shows the key messages to be communicated at each trigger, although the detailed message will be determined in the particular drought event.

Some communications activity can be undertaken within a few days of crossing triggers, but other activities can take longer. For example, advertisements will need design work within a drought event to ensure they reflect the particular situation and some local newspapers are only published weekly. We will circulate weekly update reports to our regulators and undertake weekly telephone conferences with a Multi-Agency Drought Group comprising senior managers from the Environment Agency, United Utilities, Natural England, Canal and River Trust and others as appropriate. This approach worked well in the 2010 drought.

Figure A3.2: Example press advert conveying the types of message that may be used following Trigger 2 to highlight the general need for customers to use less water (prior to any communication of a Temporary Use Ban)

APPENDIX 3: Communication plan

Figure A3.3: Example press advert conveying the type of message that may be used following Trigger 3 (campaign for voluntary water use restraint)

Figure A3.4: Example press advert conveying the type of message that may be used following Trigger 4 (introduction of a Temporary Use Ban)

APPENDIX 3: Communication plan

Figure A3.5: Organisations that we may contact following the crossing of triggers (managed using incident management procedures to confirm ownership of activity as appropriate)

Group	Organisation	Stakeholders contacted by trigger			
		Trigger 1	Trigger 2	Trigger 3	Trigger 4
Regulators/ Government	Environment Agency	✓	✓	✓	✓
	Natural England	✓	✓	✓	✓
	Natural Resources Wales	✓	✓	✓	✓
	Ofwat		✓	✓	✓
	Water UK		✓	✓	✓
	Drinking Water Inspectorate / Public Health England		✓	✓	✓
	Consumer Council for Water		✓	✓	✓
	Defra		✓	✓	✓
National Park Authorities			✓	✓	✓
Neighbouring water companies			✓	✓	✓
Inset appointees	Peel Water Networks Ltd.	✓	✓	✓	✓
Licenced suppliers operating in our area			✓	✓	✓
Local councils and MPs	Local MPs			✓	✓
	Department for Communities and Local Government			✓	✓
	Local Authorities			✓	✓
	County Councils			✓	✓
	Borough Councils			✓	✓
	Unitary Authorities			✓	✓
Local Resilience Forums		✓	✓	✓	✓
Navigation authorities			✓	✓	✓
Fire service				✓	✓
Local environmental organisations and stakeholder interest groups including local businesses			✓	✓	✓

Please note that Table A3.5 is neither exhaustive nor mandatory, and communication actions would depend on the nature of the specific drought event (e.g. if we are considering applying for a drought permit at Ullswater we would consult with local businesses and affected individuals).

The key messages for each trigger are shown in Figure A3.6. Overall messaging will be used as appropriate, for example:

- **This has been an exceptionally dry year –** we've had the driest *N* month period since *Y,* so reservoir levels across the North West are lower than usual for the time of year
- **United Utilities must take the necessary responsible action to protect supplies**. Because dry weather is continuing we will need to consider temporary water use restrictions and drought permit applications to temporarily allow increased abstraction of water from rivers

and lakes. We are already following our drought plan and moving water around our network to balance supplies across the region

- **We would like the help of our customers to protect supplies.**

Figure A3.6: Key messages for communication

Trigger	Audience	Key messages
1	Customers	Please use water wisely Order a free water saver's pack Visit our online water efficient house Please report leaks using Leakline (https://www.unitedutilities.com/report-a-leak-form.aspx or 0800 330033)
	Regulators and stakeholders	We have crossed Trigger 1 – the risk of drought is higher than normal Assessment of current water resources situation We are developing a drought action plan with the Environment Agency and implementing a drought management structure Please support us by promoting water efficiency and using your organisation's social media to raise general awareness of water efficiency
2	Customers	The weather has been drier than normal and therefore reservoirs are lower than normal for the time of year Please use water wisely Order a free water saver's pack Visit our online water efficient house Please report leaks using Leakline
	Regulators and stakeholders	We have crossed Trigger 2 – we are implementing drought actions to manage the possible drought Assessment of current water resources situation Updates on the actions we are taking Please support us by promoting water efficiency and using your organisation's social media to raise general awareness of the dry weather and the need to save water
3	Customers	Assessment of current water resources situation We are taking action to protect water supplies Please use water wisely and report any leaks to help protect water supplies and the environment Please support our campaign for voluntary water use restraint We are consulting on the introduction of a Temporary Use Ban (if appropriate)
	Regulators and stakeholders	We have crossed Trigger 3 Assessment of current water resources situation Updates on the actions we are taking (including water use restrictions and drought permit/order applications if appropriate) Please support us by promoting water efficiency and restricting your own use of water where appropriate (e.g. vehicle washing) and using your organisation's social media to raise general awareness of the drought
4	Customers	Assessment of current water resources situation We are taking action to protect water supplies Please continue to use water wisely and report any leaks to help protect water supplies and the environment A Temporary Use Ban is in place (if restrictions are introduced) Drought permits/orders are in place (if they are introduced)
	Regulators and stakeholders	We have crossed Trigger 4 Assessment of current water resources situation Updates on the actions we are taking (including water use restrictions and drought permit/order applications if appropriate) Please support us by promoting water efficiency and restricting your own use of water where appropriate (e.g. vehicle washing) and using your organisation's social media to raise general awareness of the drought

APPENDIX 4: Ennerdale compensatory measures

APPENDIX 4: Ennerdale compensatory measures

The conclusions of the HRA Screening assessment for the drought order at Ennerdale Water were that implementation of the drought order has the potential for significant effects on the River Ehen SAC, both alone and in-combination with the existing abstraction licence at Ennerdale Water. An Appropriate Assessment has been prepared for this drought order option, in consultation with Natural England and the Environment Agency. The Appropriate Assessment could not conclude no adverse effects of drought order implementation on the integrity of the River Ehen SAC. Options with the potential to adversely impact the integrity of a SAC site can only be adopted (and included in the drought plan) subject to there being no alternative solutions, where the Secretary of State is satisfied that there are imperative reasons of overriding public interest and with the adoption of suitable compensatory measures.

A package of compensatory measures has been developed by us, under the advice of Natural England and the Environment Agency, to provide compensation in proportion to the impact to the River Ehen SAC from the effect of continued abstraction (to 2022 when the Thirlmere transfer scheme is operational) and a potential future drought order at Ennerdale Water acting in combination. The nature of potential impact can be described qualitatively as insufficient recruitment and/or a delay in recruitment recovery of the freshwater mussel population, and loss of salmon year class and/or reduced spawning success. The actual extent and duration of impact is impossible to predict and quantify, and will depend on weather patterns in the region. In order to account for this uncertainty, a flexible compensation package comprising physical ecological measures, supported by research measures, has been agreed.

The aim of the package of measures is to enable the recruitment of more mussels and salmon, primarily in the River Ehen SAC, and to undertake research and monitoring to understand how this would best be achieved. It is considered that the River Ehen SAC has the most suitable conditions for the compensatory measures to be successful and therefore most of the compensation is focused within the site. Additional measures will provide compensation for salmon in other Cumbrian lakes and rivers, including other Natura 2000 sites. The measures are therefore planned to both prevent and compensate for potential further damage to the River Ehen SAC.

The package includes 13 physical ecological measures and eight research measures and was submitted to Defra on 28 February 2014. Defra confirmed in November 2015 that there are Imperative Reasons of Overriding Public Interest to continue abstracting from Ennerdale Water until the Thirlmere Transfer scheme is operational.

The compensatory measures package consists of:

- Change of land use in perpetuity adjacent to the River Ehen SAC in the area of high mussel population density to remove risks to both freshwater mussels and salmon and thereby contribute to the protection of the Natura 2000 network
- A project officer to facilitate conservation actions in order to promote sustainable recruitment and utilisation of available potential natural habitat for both designated species in the River Ehen
- Artificial encystment of freshwater mussel glochidia to enhance recruitment in the population of the River Ehen SAC once river bed conditions are suitable
- Additional improvement works in the Ennerdale Water SSSI and River Ehen SAC catchment to reverse damage and remove the risk of further damage. This may include the removal of redundant infrastructure. The nature and scale of the improvement works will be informed by the research measures

APPENDIX 4: Ennerdale compensatory measures

- Revocation of abstraction licences and removal of associated abstraction related infrastructure at Crummock Water and Dash Beck (SAC and SSSI) and at Chapel House Reservoir and Overwater (SSSI) where this would provide benefits to the salmon population. This would restore natural functioning and improve salmon migration in a number of designated and undesignated Cumbrian lakes and rivers. Infrastructure removal will be informed by the supporting research measures
- Improvement works in an undesignated freshwater mussel priority recovery catchment to support a trial reintroduction programme
- A research trial reintroduction of freshwater mussels and artificial encystment in an undesignated priority recovery river in close proximity to the River Ehen SAC to contribute to the body of knowledge associated with freshwater mussel recovery efforts
- Seven research studies designed to inform the scope and monitor the effectiveness of the physical ecological compensatory measures and to improve the body of knowledge regarding factors which threaten the overall coherence of Natura 2000, particularly relating to the River Ehen SAC. The research will inform the future management of the compensation flow and the development and implementation of the package of compensatory measures.

There is considerable research, monitoring and physical action currently being delivered by us and other organisations focused on restoring the River Ehen SAC to favourable condition. The package of compensatory measures currently being delivered by us will provide additional knowledge and ecological actions over and above the actions that are normal practice for the management of the SAC. These actions will reduce the adverse effects over time and will bring the River Ehen SAC towards favourable condition. This means that there may not be a requirement for all of the measures in the package and that the likelihood of requiring additional compensatory measures will therefore reduce over time. We will review the package at regular intervals in line with timescales agreed with the Environment Agency and Natural England until cessation of abstraction at Ennerdale Water.

APPENDIX 5: Likelihood of drought

APPENDIX 5: Likelihood of drought

It is important to understand the likelihood of crossing drought triggers and therefore implementing various drought actions. Some systems have greater sensitivity than others to crossing triggers e.g. at Ennerdale Water in West Cumbria Resource Zone the likelihood of crossing triggers is higher than for other sources. There are various ways of presenting the likelihood of occurrence to articulate the risk of crossing drought triggers.

The likelihood or risk of drought triggers being reached is calculated using water resources models with hydrological data from the historic record. Different sources have different lengths of historical record on which to assess the likelihood. For example, for Ennerdale Water and Crummock Water there is a 54 year historical record but for the Integrated Resource Zone there is an 87 year historical record. The longer the historical record, the more confidence we have in our interpretation of the "risk" of reaching different drought triggers. However very extreme droughts may not have occurred in the period for which historical data are available.

The likelihood has traditionally been expressed as a return period. A return period is a statistical measure of how often an event of a certain magnitude is likely to happen. Return periods are commonly used in hydrology to understand extreme events of flooding and drought and should be based on as long a record period as possible. For example a return period of 1 in 100 years means that, when measured over a long period of time and averaged, an event of this magnitude, or greater, is not expected to occur more often than once in every 100 years. This doesn't mean that the event occurs regularly every 100 years. Events would occur irregularly in an unpredictable manner. Return period has an inverse relationship with the probability that the event will be exceeded in any one year. For example, a 1 in 100 year drought has a 1% chance of being exceeded by a worse drought in any one year.

The tables below show different ways of presenting the "risk" of reaching the drought triggers presented in this plan (with the exception of Scales boreholes and North Eden boreholes as these are not modelled within our Aquator water resources models).

The Integrated Resource Zone is a comparatively large, complex system across which water supply management decisions are made to balance risks across the zone. Over time, the zone has been enhanced with new connectivity and demand has reduced over recent decades. Our water resources models provide the best possible estimate of the frequency of crossing drought triggers in future. However, it is important to acknowledge that in reality, operational decisions take into account a wide range of factors that cannot be reflected entirely within any model (e.g. weather forecasting, specific event demand conditions or asset outages etc.), so we have undertaken sensitivity testing to indicate the impact of these on trigger frequencies. The likelihoods we have reported for hitting the triggers at Haweswater in this section and in the main report of the document (see Figure 11) are based on the mid estimate of frequencies that we consider likely.

APPENDIX 5: Likelihood of drought

Figure A5.1: Haweswater drought trigger risk

	Historic record	Return frequency	**Likelihood**	Likelihood of exceeding in any one year (%)	Likelihood of not exceeding in any one year (%)	Probability of crossing the trigger at least once in the 5 year lifetime of the plan (%)	Number of times the trigger is expected to be crossed in the next 50 years #
Trigger 1	Crossed in 23 years out of 87 years of historic record	1 in 5 years	Likelihood of crossing of 1 in 5 in any one year	19%	81%	66%	9
Trigger 2	Crossed in 7 years out of 87 years of historic record	1 in 15 years	Likelihood of crossing of 1 in 15 in any one year	7%	93%	29%	3
Trigger 3	Crossed in 2 years out of 87 years of historic record	1 in 36 years	Likelihood of crossing of 1 in 36 in any one year	3%	97%	13%	1
Trigger 4	Crossed in 1 year out of 87 years of historic record	1 in 65 years	Likelihood of crossing of 1 in 65 in any one year	2%	98%	7%	0

Rounded down to the nearest whole number

Figure A5.2: Dee drought trigger risk

	Historic record	Return frequency	**Likelihood**	Likelihood of exceeding in any one year (%)	Likelihood of not exceeding in any one year (%)	Probability of crossing the trigger at least once in the 5 year lifetime of the plan (%)	Number of times the trigger is expected to be crossed in the next 50 years #
Trigger 1	Crossed in 13 years out of 87 years of historic record	1 in 7 years	Likelihood of crossing of 1 in 7 in any one year	14%	86%	54%	7
Trigger 2	Crossed in 6 years out of 87 years of historic record	1 in 15 years	Likelihood of crossing of 1 in 15 in any one year	7%	93%	29%	3
Trigger 3	Crossed in 3 years out of 87 years of historic record	1 in 29 years	Likelihood of crossing of 1 in 29 in any one year	3%	97%	16%	1
Trigger 4	Crossed in 2 years out of 87 years of historic record	1 in 44 years	Likelihood of crossing of 1 in 44 in any one year	2%	98%	11%	1

Rounded down to the nearest whole number

APPENDIX 5: Likelihood of drought

Figure A5.3: Ennerdale drought trigger risk

	Historic record	Return frequency	**Likelihood**	Likelihood of exceeding in any one year (%)	Likelihood of not exceeding in any one year (%)	Probability of crossing the trigger at least once in the 5 year lifetime of the plan (%)	Number of times the trigger is expected to be crossed in the next 50 years #
Trigger 1	Crossed in 34 years out of 54 years of historic record	1 in 1.6 years	Likelihood of crossing of 1 in 1.6 in any one year	63%	37%	99%	31
Trigger 2	Crossed in 16 years out of 54 years of historic record	1 in 3.4 years	Likelihood of crossing of 1 in 3.4 in any one year	30%	70%	83%	15
Trigger 3	Crossed in 14 years out of 54 years of historic record	1 in 3.9 years	Likelihood of crossing of 1 in 3.9 in any one year	26%	74%	78%	13
Trigger 4	Crossed in 1 years out of 54 years of historic record	1 in 54.0 years	Likelihood of crossing of 1 in 54 in any one year	2%	98%	9%	1

Rounded down to the nearest whole number

Figure A5.4: Crummock drought trigger risk

	Historic record	Return frequency	**Likelihood**	Likelihood of exceeding in any one year (%)	Likelihood of not exceeding in any one year (%)	Probability of crossing the trigger at least once in the 5 year lifetime of the plan (%)	Number of times the trigger is expected to be crossed in the next 50 years #
Trigger 1	Crossed in 20 years out of 54 years of historic record	1 in 2.7 years	Likelihood of crossing of 1 in 2.7 in any one year	37%	63%	90%	19
Trigger 2	Crossed in 9 years out of 54 years of historic record	1 in 6.0years	Likelihood of crossing of 1 in 6.0 in any one year	17%	83%	60%	8
Trigger 3	Crossed in 1 years out of 54 years of historic record	1 in 54 years	Likelihood of crossing of 1 in 54 in any one year	2%	98%	9%	1
Trigger 4	Never crossed during the 54 years of historic record	Less than 1 in 54 years	Likelihood of crossing less than 1 in 54 in any one year	<2%	~99%	~2%	0

Rounded down to the nearest whole number

APPENDIX 5: Likelihood of drought

Figure A5.5: Castle Carrock drought trigger risk

	Historic record	Return frequency	**Likelihood**	Likelihood of exceeding in any one year (%)	Likelihood of not exceeding in any one year (%)	Probability of crossing the trigger at least once in the 5 year lifetime of the plan (%)	Number of times the trigger is expected to be crossed in the next 50 years #
Trigger 1	Crossed in 22 years out of 54 years of historic record	1 in 2 years	Likelihood of crossing of 1 in 2 in any one year	50%	50%	97%	25
Trigger 2	Crossed in 7 years out of 54 years of historic record	1 in 8 years	Likelihood of crossing of 1 in 8 in any one year	14%	86%	54%	7
Trigger 3	Crossed in 2 years out of 54 years of historic record	1 in 27 years	Likelihood of crossing of 1 in 27 in any one year	4%	96%	17%	1
Trigger 4	Never crossed during the 54 years of historic record	Less than 1 in 54 years	Likelihood of crossing less than 1 in 54 in any one year	<2%	~99%	~2%	0

Rounded down to the nearest whole number

APPENDIX 6: Testing of drought scenarios

APPENDIX 6: Testing of drought scenarios

A6.1 Process for testing and defining drought scenarios

A6.1.1 Generating drought scenarios

The Environment Agency guidance outlines that companies should scenario test their plan to a range of drought events covering short-term (single-season) events to long-term droughts covering multiple years. The Drought Plan (England) Direction 2016 also states that the drought plan should outline the magnitude and duration to which the plan has been tested. This section aims to summarise the extensive work completed in this area to meet the regulatory requirements.

We have modelled both a range of drought events contained in the historic record and also tested a range of approaches to define how to select more severe events (in terms of duration and/or magnitude) than contained in the historic record. When creating more severe events we have aimed to generate events that will test our system and the plan interventions, whilst also ensuring they are plausible. It is worth noting that for Water Resources Management Plan 2019, we are looking to utilise stochastic modelling techniques. This will help us to have more confidence in event probabilities described in our future plans and provide an even greater array of plausible drought scenarios to test our plans. The methods used in this drought plan have resulted in making significant progress in the testing of more extreme events in the interim period prior to stochastics being implemented. The outputs of the next Water Resources Management Plan will inform future drought plan revisions.

As part of developing this version of the drought plan, we considered different approaches[14] to subsequently select the best approach for each resource zone. From this process, as well as testing the impact of historic drought events if they were to recur with our current supply system, we have used the following approaches to derive more severe or extreme events:

- Sampled historic hydrological events to test what would happen if different patterns of past hydrological conditions were experienced in combination with each other. This builds on our approach in the Final Drought Plan 2014, where we tested synthetic drought events of greater severity and duration than experienced historically in the Carlisle, Integrated and West Cumbria Resource Zones, but allows for a greater range of events to be explored
- Used outputs from an UKWIR, Defra and Environment Agency project, *"Performance of water supply systems during extreme drought",* for which we participated in a case study using the Carlisle Resource Zone water supply system. This included droughts of different durations and severities, covering both summer and winter periods.

In developing synthetic drought events (using the historic hydrological sampling technique) of a greater severity than experienced historically using the historic sampling method, we have taken a systematic approach using our Aquator models (using a feature called the "risk analyser"). This allows the model, from

[14] In our initial investigations we applied a severe climate change scenario from our Water Resources Management Plan work based on the 2030s (using available UKCP09 data), as a proxy for more extreme weather. However, whilst this produces more severe events than in the historic record, this produced less severe events than the other methods we tested and/or had the disadvantage of not exploring different patterns of hydrological events (as such climate change scenarios are only used to perturb the existing record, i.e. make more or less severe in different months)

a defined starting point, to simulate all historic hydrological events from that point. This subsequently generates lots of alternative scenarios, and from them we can select different events for further testing.

We identified the lowest reservoir storage following the summer drawdown period, and also the most severe events where storage had not fully recovered during the winter refill period in the model. From these two different minimum points, we simulated all historic hydrological years, to then select a combined minimum. This enabled us to identify severe combinations of years to create multi-season drought scenarios, or single-season drought scenarios of increased intensity and/or duration, in which historic drought events are immediately followed by further drought conditions.

Whilst many alternative scenarios have been generated (and thus indirectly tested without the benefit of drought interventions in place), the most severe combinations have been presented in this Appendix (and may be compared to the historic events) up to an indicative likelihood of 0.1% in any one year. For the Carlisle Resource Zone, given the availability of outputs from the aforementioned extreme drought project, we chose to use these outputs to present a more severe event.

We have also used water resources system indicators (such as system storage annual minima) to enable us to understand the magnitude of the resulting drought events in each resource zone. Using Extreme Value Analysis we assigned an indicative return period to each drought event. From this analysis, we estimate that the severe droughts used to test the Carlisle, Integrated and West Cumbria Resource Zones have an indicative event likelihood of 0.1% in any one year[15]. For the North Eden Resource Zone, such testing is not needed as resource availability is insensitive to weather conditions, as evidenced within our Water Resources Management Plan climate change and yield appraisals, although we have presented demand based scenarios for the purpose of this Appendix.

A summary of the severe, generated events tested is provided in Figure A6.1 below in comparison to the most severe historic events. The duration and magnitude of these events is also shown. We also considered two and three-season events for the Carlisle and West Cumbria zones, but the very short critical periods of these systems mean these longer events are much less severe than single season events. Therefore it is only relevant to present more severe single-season events in this plan as these define the risks in these resource zones. This approach was discussed with the Environment Agency as we developed this drought plan.

[15] The concept of 'return period' or event likelihood should be treated with caution within the context of estimating the likelihood of artificially constructed events outside the historic record. It can sometimes be misleading for members of the general public and it can provide a false sense of accuracy of the probabilities involved. However, on a pragmatic basis it is important to be able to provide some understanding of the level of likelihood of events that have been tested. Therefore the likelihoods estimated should be interpreted as a pragmatic, approximate categorisation that is intended primarily to indicate that the events tested in the plan should be considered as "extreme droughts" compared to those in the historic record. Our next Water Resources Management Plan is seeking to explore the use of stochastic hydrology to generate more severe and extreme drought events than in the historic record, and this will be used to inform future revisions of the drought plan

APPENDIX 6: Testing of drought scenarios

Figure A6.1: Comparison of worst-historic drought events compared to severe events tested in this plan

Resource Zone	Indicative system source(s)	Assumptions	Critical historic event(s)				More severe event tested in drought plan			
			Year(s)	Magnitude	Duration	Indicative annual likelihood of drought event	Basis	Magnitude	Duration	Indicative annual likelihood of drought event
Carlisle	Castle Carrock Reservoir	Magnitude indicator is system storage remaining (below 171 Ml is dead water)	1976	405 Ml	3 months	1.4%	80% rainfall deficit over 12 months (HR Wallingford study)	301 Ml	12 months	0.1%
Integrated	Haweswater Reservoir, Pennine reservoirs, River Dee system, Thirlmere Reservoir	Magnitude indicator is indicative system storage remaining (below 25,034 Ml is dead water)	1984	148,343 Ml	7 months	0.8%	Severe single-season: Winter 1963 followed by spring/summer 1984	81,472 Ml	11 months	0.1%
							Severe two-season event: Summer 1984 followed by autumn/winter 1995 into 1996	122,280 Ml	20 months	0.2%
							Severe three-season event: 1995/96 followed by autumn/winter 1995 into 1996	137,495 Ml	30 months	0.5%
North Eden	North Eden boreholes	Not modelled	Not modelled	Not modelled	Not modelled	Not modelled	Not modelled	Not modelled	Not modelled	Not modelled
West Cumbria	Crummock Water	Magnitude indicator is lake level reached (lower than 0.97m below weir crest would require a drought permit)	1995	0.56m below weir crest	7 weeks	1.0%	Severe single season sampled: 1995 (critical historic event) followed by 1972	0.78m below weir crest	12 weeks	0.1%
	Ennerdale Water	Magnitude indicator is lake level reached (lower than 1.7m below weir crest would require a drought order)	1978	1.52m below weir crest	11 weeks	2.0%	Severe single season sampled: 1963 (a critical historic event) followed by 1969	1.70m below weir crest	14 weeks	0.1%

APPENDIX 6: Testing of drought scenarios

A6.1.2 Testing the drought plan

Taking account of the risks associated with each of the different scenarios (whether historic or a severe derived event), we have used the outputs to inform the development of our plan (e.g. drought triggers, drought interventions etc.) and to define, indicatively, what interventions or powers would be applied under different situations. We have used the outputs of this scenario testing to guide our drought plan, and this has demonstrated that the plan is robust. We have also used the outputs of this scenario testing to guide our thinking around drought management actions, particularly drought options in the Integrated Resource Zone, where water quality constraints and implementation timings can be prohibitive. This ensures that the options included provide suitable benefits under worse than historic hydrological conditions.

In the following sections we present a summary of each of the drought scenarios tested, with a brief outline of the likely timing and order of supply-side options and drought permits/orders which we would implement in each particular scenario. This is based on an assessment of modelled reservoir storage using our current Aquator models which represent our current supply system and demand profiles. In order to test a realistic “worst-case” scenario, we have based the assessment on an “upper bound” dry year demand (which includes raw and treated water process losses, outage allowances and target headroom).

Note that the selection and timing of drought interventions is indicative only, based on the characteristics of the particular scenario tested in each case. The sequence of drought interventions outlined would not necessarily be repeated in a future drought, as this would depend on the individual characteristics (for example, the duration, intensity and geographical extent) of the drought event occurring at the time.

In the case of some drought scenarios based on historic conditions, there is a difference in the timing and extent of drought interventions which were implemented historically, with those which would be likely to be implemented if similar drought conditions occurred again. This is particularly evident for the Integrated Resource Zone where there have been large improvements in our regional supply system to transfer water across the zone and balance risks during a drought event. We have also seen significant reductions in demand over the last two decades across the region. We have highlighted, in the sections below, those historic-based drought scenarios in which these differences in the implementation of drought measures are particularly notable so that likely future interventions may be seen in context.

For each of the drought scenarios outlined below, we have also presented illustrative rainfall statistics. These are based on the period up to and including the full month prior to the time at which drought permit/order applications would be made (based on our current system), or for the approximate period of reservoir drawdown for those scenarios in which drought permit/order applications would not be required. This complements and provides indicative context for the detail outlined in Appendix 7 on defining exceptional shortage of rainfall in drought. The rainfall totals for the appropriate rain gauge are compared against a 30-year long-term average (1961-1990) for the corresponding time period at that gauge. To provide a longer-term and more recent context, we have also compared the relevant rainfall value to a ranked series of data covering the available period of rainfall data up to the present time, to determine how it would be positioned within the overall historic ranking of rainfall events.

A6.2 Scenario testing for the Integrated Resource Zone

The scenario testing has used indicative drought interventions that would be applied under each eventuality. Whilst these are indicative, these relate to the actions outlined in the main body of this report.

APPENDIX 6: Testing of drought scenarios

In order to complete the exercise, we used the following rationale to indicate from the modelled scenarios the likely timing of supply-side options and drought permits/orders:

- Drought options related to boreholes in the south of the area (Belle Vale, Stockswell, Netherley, Pex Hill, Walton, Daresbury and Water Lane) would likely be initiated if either the River Dee system storage was below the relevant trigger, or if Haweswater crossed the relevant trigger and the River Dee system storage was below any drought trigger
- Windermere scenario 1, Ullswater and Longdendale drought permits would likely be implemented when Haweswater crosses Trigger 4
- Vyrnwy drought permit would likely be implemented if River Dee system storage is below Trigger 4
- Pennine drought permits are implemented when Pennine storage is significantly low for the time of year (i.e. reservoirs significantly below control curve, and Haweswater / Dee are also in drought and/or below triggers)
- Worsthorne borehole is initiated if the local system storage is low
- Croft and Kenyon boreholes are initiated if Wigan area storage is low
- Windermere scenario 2 (lake drawdown) drought permit is implemented only when Haweswater reaches emergency storage, around the same time that it is likely a Non-Essential Use Ban would also be initiated.

Demand side options would be implemented in the sequence: enhanced water efficiency communications (Trigger 1), further enhancements to water efficiency communications (Trigger 2), campaign for voluntary water use restraint (Trigger 3), Temporary Use Ban (Trigger 4). Because these are consistent across the scenarios presented the demand side actions are not shown in the graphs and tables below.

The rationale above is indicative only to show the typical sequence of events in the drought scenarios; this may be different in any future drought depending on the precise circumstances prevailing at the time. Figure A6.2 summarises a number of the key historic drought scenarios tested for the Integrated Resource Zone, as well as the artificially generated more severe events. These have been selected based on their severity, potential interest to stakeholders and to cover a range of drought characteristics as required by the drought planning guidelines. The scenarios show that if historic droughts were to occur with the current supply system then fewer drought powers would be needed than were implemented historically. In addition to those historic events shown below, we also considered 2003 and 2010. Our modelling shows that if these scenarios were repeated then no drought powers would now be implemented due to the benefit of demand reductions and our West-East link main which was completed in 2012.

Further detail on each of the Integrated Resource Zone drought scenarios summarised in Figure A6.2 is given in sections A6.2.1 to A6.2.6.

APPENDIX 6: Testing of drought scenarios

Figure A6.2 Integrated Resource Zone – summary of drought scenarios tested

Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Haweswater Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Haweswater Reservoir % of full capacity)	Indicative supply-side drought options and drought permit/order interventions (current system)
1984 conditions	Single season drought event; 7 months' duration Rainfall at Haweswater for 4 months to end of June at 33% of LTA and driest in 84 year record	7% (3/9/1984)	June 1984: Reduced compensation at Ashworth Moor, Cowpe, Clowbridge, Delph, Jumbles & Wayoh July 1984: Reduced compensation at Laneshaw, Bottoms Lodge, Stocks, Haweswater, Langden, Hareden, River Dunsop, Swineshaw, Hurst, Lamaload, Bottoms & Teggsnose, pumping allowed from Park Mine August 1984: Drought orders at Windermere, Ullswater (both more severe than the options in this plan), Rivington, River Lune and River Wyre September 1984: Reduced compensation at Black Moss, Lower Coldwell, Thirlmere and Greenbooth; drought orders at River Duddon, River Rawthay and Ullswater scenario 2.	28% (2/9/1984)	Mid-May (at Haweswater drought trigger 2): Initiate supply-side options at Belle Vale and Stockswell Late June (at Haweswater drought trigger 3): Initiate supply-side options at Netherley, Pex Hill, Worsthorne and Walton Early July (at Haweswater drought permit application indicator): apply for drought permits at Longdendale, Windermere (scenario 1) and Ullswater Mid-August (at Haweswater drought trigger 4): Initiate supply-side options at Daresbury and Water Lane; implement drought permits at Longdendale, Windermere (scenario 1) and Ullswater.
1995/96 conditions	Two season drought covering 1995/96 Rainfall at Holden Wood for 6 months to end of September 1995 at 49% of LTA and driest in 106	0% (1/10/1995) 35% (22/9/1996)	September 1995: Reduced compensation at Longdendale, Clowbridge, Jumbles, Delph and Rivington Reservoirs and drought order at River Derwent (further reduction at Jumbles November 1995) October 1995: Drought orders at	36% (24/9/1995) 37% (27/9/1996)	Late August 1995 (at Haweswater drought trigger 2): Initiate supply-side options at Belle Vale and Stockswell Late October 1995 (at Dee drought trigger 3): Initiate supply-side options at Netherley, Pex Hill, Worsthorne and Walton; apply for drought permits/orders at Lake Vyrnwy, Delph, Dovestone, Jumbles, Longdendale and Rivington Reservoirs, Swineshaw boreholes and River Lune LCUS Mid-December 1995 (at Dee drought trigger 4): Implement drought permits/orders at Delph, Dovestone, Jumbles, Longdendale and

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Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Haweswater Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Haweswater Reservoir % of full capacity)	Indicative supply-side drought options and drought permit/order interventions (current system)
	year record Regional rainfall for 7 months to end of October 1995 at 63% of LTA		Windermere, Ullswater (both more severe than the drought options in this plan), Hurstwood, Cant Clough, Swinden, Dovestone, Swineshaw and Walkerwood December 1995: drought orders at Piethorne and Castleshaw Some drought orders from 1995 still in force into 1996 January 1996: Reduced compensation at Churn Clough March 1996: Reduced compensation at Lake Vyrnwy April 1996: Reduced compensation at Rivington, Ashworth Moor, Spring Mill, Longdendale, Clowbridge, Jumbles and Delph June 1996: reduced compensation at New Year's Bridge and Laneshaw July 1996: drought permit at Broughton boreholes		Rivington Reservoirs, Swineshaw boreholes and River Lune LCUS Drought permits/orders remain implemented through the winter of 1995 and summer of 1996
1933/34 conditions	Two season drought Rainfall at Vyrnwy for 7 months to end of October at 64% of LTA and 3rd driest in 108 year record	Not available	This historic information is not available	48% in Dee system (6/10/1933)	Mid-November (at Dee drought trigger 3): apply for drought permit at Lake Vyrnwy

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Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Haweswater Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Haweswater Reservoir % of full capacity)	Indicative supply-side drought options and drought permit/order interventions (current system)
Single season severe: Winter 1963 & spring/summer 1984 combined conditions	Single season drought of a greater intensity than experienced in the historic record Rainfall at Haweswater for 4 months to end of January at 49% of LTA Rainfall at Haweswater for full event (October to August) at 44% of LTA (note that rainfall for 4 months to end of April was only 24% of LTA)	N/A	N/A	18%	Early Feb (at Haweswater drought trigger 3): Initiate supply-side option at Worsthorne Mid-Feb (at Haweswater drought permit application indicator): apply for drought permits at Longdendale, Windermere (scenario 1), Ullswater and River Lune LCUS Late Feb (at Haweswater drought trigger 4): Initiate supply-side options at Landside and Croft, implement drought permits at Longdendale, Windermere (scenario 1), Ullswater and River Lune LCUS Early March (28 days after crossing Haweswater drought permit application indicator): apply for drought permits/orders at Delph, Dovestone, Jumbles, Rivington Reservoirs and Swineshaw boreholes Late March (28 days after crossing Haweswater drought trigger 4): implement drought permits/orders at Delph, Dovestone, Jumbles, Rivington Reservoirs and Swineshaw boreholes Early May (at Dee drought trigger 2): Initiate supply-side options at Belle Vale and Stockswell Late May (at Dee drought trigger 3): Initiate supply-side options at Netherley, Pex Hill and Walton and apply for drought permit at Lake Vyrnwy Mid-August (at Dee drought trigger 4): Initiate supply-side options at Daresbury and Water Lane and implement drought permit at Lake Vyrnwy
Two season severe: Summer 1984 followed by autumn/winter 1995 through	Two season drought of a greater duration and intensity than experienced in the historic record	N/A	N/A	24%	First season Early July (at Haweswater drought trigger 3): Initiate supply-side option at Worsthorne Early July (at Haweswater drought permit application indicator): apply for drought permits at Longdendale, Windermere (scenario 1), Ullswater and River Lune LCUS

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Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Haweswater Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Haweswater Reservoir % of full capacity)	Indicative supply-side drought options and drought permit/order interventions (current system)
into summer 1996	Rainfall at Haweswater for 19 months to September in second season at 69% of LTA Regional rainfall for 19 months to September in second season at 65% of LTA				Mid-July (at Dee drought trigger 2): Initiate supply-side options at Belle Vale and Stockswell Late July (at Dee drought trigger 3): Initiate supply-side options at Netherley, Pex Hill and Walton and apply for drought permit at Lake Vyrnwy Early August (28 days after crossing Haweswater drought permit application indicator): apply for drought permits/orders at Delph, Dovestone, Jumbles, Rivington Reservoirs and Swineshaw boreholes Mid-August (at Haweswater drought trigger 4): Initiate supply-side options at Landside and Croft, implement drought permits at Longdendale, Windermere (scenario 1), Ullswater and River Lune LCUS Early September (at Dee drought trigger 4): Initiate supply-side options at Daresbury and Water Lane and implement drought permit at Vyrnwy Mid-September (28 days after crossing Haweswater drought trigger 4): implement drought permits/orders at Delph, Dovestone, Jumbles, Rivington Reservoirs and Swineshaw boreholes <u>Second season</u> Mid-September (at Dee drought trigger 3): Apply for drought permit at Lake Vyrnwy Late September (at Dee drought trigger 4): Implement drought permit at Vyrnwy
Three season severe: 1995/96 two season event, followed by a repeat of autumn/	Three season drought of a greater duration and intensity than experienced in the historic record	N/A	N/A	31%	<u>First season</u> Early October (at Dee drought trigger 2): Initiate supply-side options at Belle Vale and Stockswell Early November (at Dee drought trigger 3): Initiate supply-side options at Netherley, Pex Hill and Walton, apply for drought permits/orders at Lake Vyrnwy, Delph, Dovestone, Jumbles, Longdendale and Rivington Reservoirs, Swineshaw boreholes and River Lune LCUS

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Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Haweswater Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Haweswater Reservoir % of full capacity)	Indicative supply-side drought options and drought permit/order interventions (current system)
winter 1995 into 1996 summer conditions	Rainfall at Haweswater for 30 months to September in third season at 76% of LTA Regional rainfall for 30 months to September in third season at 67% of LTA				Mid-December 1995 (at Dee drought trigger 4): implement drought permits/orders at Delph, Dovestone, Jumbles, Longdendale and Rivington Reservoirs, Swineshaw boreholes and River Lune LCUS Drought permits/orders remain implemented through the winter into the following summer <u>Second season</u> Early November (at Dee drought trigger 3): Apply for drought permit at Lake Vyrnwy <u>Third season</u> Mid-September (at Haweswater drought trigger 3): Initiate supply-side option at Worsthorne Late September (at Haweswater drought permit application indicator): apply for drought permits at Longdendale, Windermere (scenario 1), Ullswater and River Lune LCUS

Note that the modelled minimum storage is that from the “worst-case” scenario with the benefits of the drought powers listed in the table

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A6.2.1 Integrated Resource Zone – 1984 drought conditions

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in our region in 1984, and has the following characteristics:

- Single season summer drought of duration approximately 7 months
- Impacts occurred particularly in the north of our region including the Pennines
- Historically, a range of drought permits and orders were applied for from mid-May onwards and implemented between June and September 1984
- Based on our current system, applications for drought permits would be made from early July 1984
- Rainfall at Burnbanks rain gauge (Haweswater) for the 4 month period to the end of June 1984 (last complete month prior to point of application) was 135mm or about 33% of the long-term average for the 4 month period from March to June inclusive
- Comparing this to a ranked data series of annual 4 month rainfall totals from March to June, for the 84-year period from 1932 – 2015, the 4 month period to June 1984 was the driest on record.

Figure A6.3 and Figure A6.4 illustrate the impact of a 1984-style drought event on our current system, and the indicative timing of drought interventions in this scenario. Historically, reservoir levels in Haweswater dropped to around 7% of available storage on 3 September 1984, however our models indicate that with the current level of demand and the improved interconnectivity in our Integrated Resource Zone, a repeat of 1984 conditions would lead to a minimum storage of 28% in Haweswater under a worst-case scenario. This means that drought permits would be implemented at a later stage than historically in 1984, and would remain in force for a shorter period of time. Without the drought interventions in place, Haweswater modelled storage reaches a minimum of 27%. This is only slightly lower than that with the drought interventions in place as the drought interventions are precautionary to protect against a worse drought than that in the historic record.

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Figure A6.3: Modelled Haweswater Reservoir storage in 1984 drought conditions

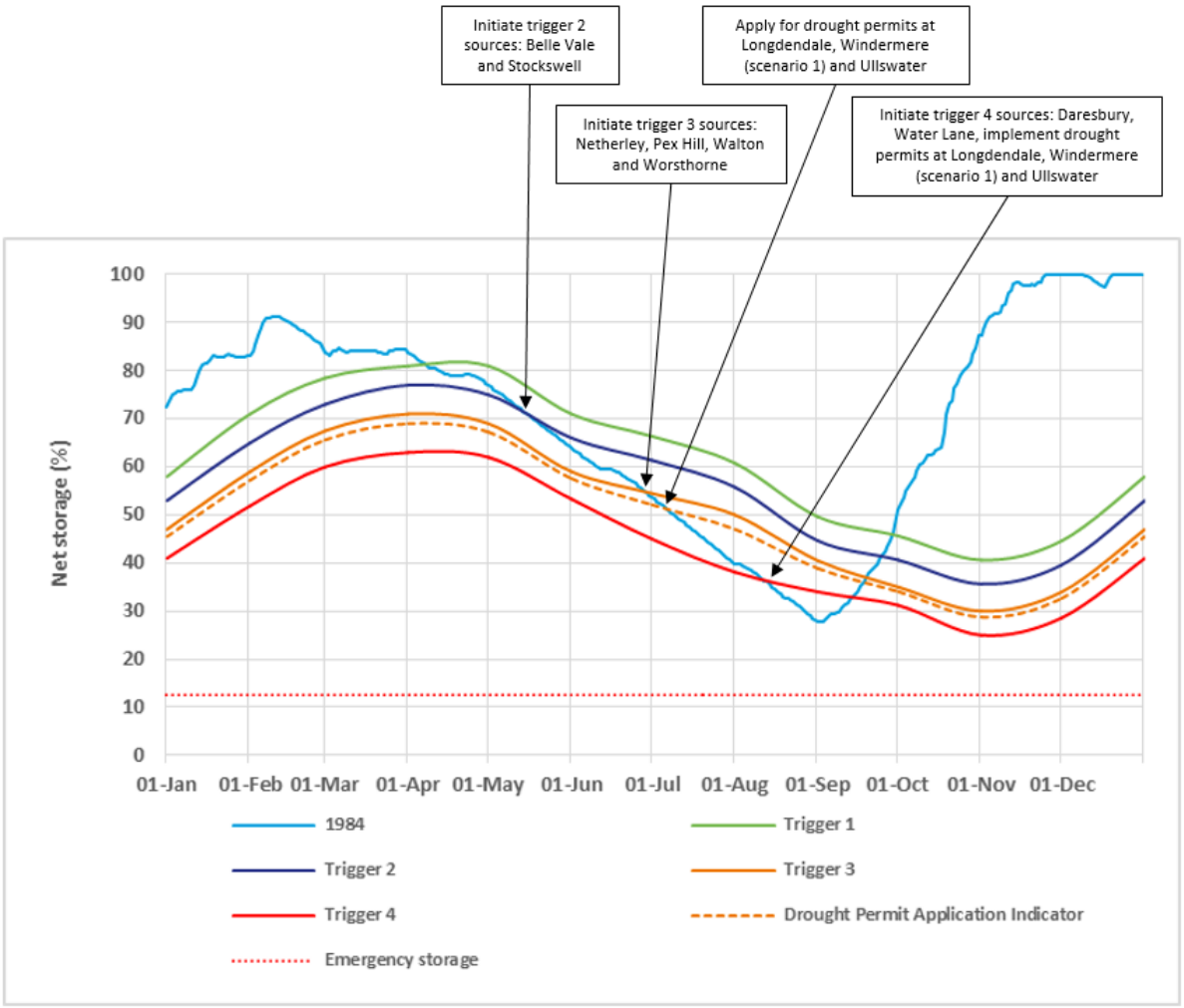

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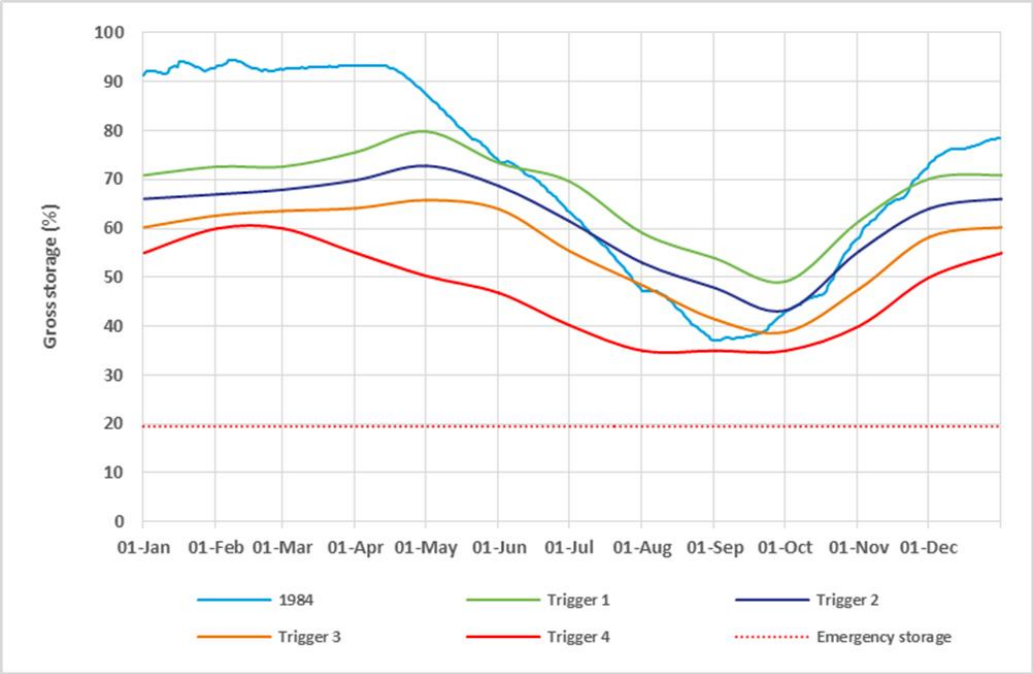
Figure A6.4: Modelled Dee Reservoir system storage in 1984 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Haweswater Reservoir	River Dee System
Trigger 1 to 2	36 days	31 days
Trigger 2 to 3	46 days	18 days
Trigger 3 to 4	44 days	n/a

A6.2.2 Integrated Resource Zone – 1995/96 drought conditions

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in our region in 1995, and has the following characteristics:

- A two season drought covering the period 1995/96
- Impacts affected the whole of our region
- Historically, drought permits and orders were applied for from early August onwards and implemented between early September 1995 and December 1995. A number of drought permits and orders were extended into 1996 and others were applied for from the beginning of the 1996 and implemented between late January and July. Note that the powers applied for were more severe than those which would be applied for now e.g. a more significant drawdown at Windermere
- Based on our current system, applications for drought permits for the Pennine reservoirs would be made from October onwards

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- Rainfall at Holden Wood rain gauge (a representative for the Pennine region) for the 6 month period to the end of September 1995 (last complete month prior to application) was 306mm or about 49% of the long-term average for the 6 month period from April to end of September inclusive
- Comparing this to a ranked data series of annual 6 month rainfall totals from April to September for the 106-year period from 1910 – 2015, the 6 month period to the end of September 1995 was the driest on record
- Regional rainfall (average of 10 gauges) for the 15 month period to the end of June 1996 (last full month prior to application) was 906 mm or about 53% of the long-term average for the 15 month period from April 1995 to end of June 1996
- Comparing this to a ranked data series of annual 15 month rainfall totals from the previous April to July for the 105-year period from 1911 – 2015, the 15 month period to the end of June 1996 was the driest on record.

Historically, reservoir levels in Haweswater dropped to around 0% of available storage on 1 October 1995, however our models indicate that with the current level of demand and the improved interconnectivity in our Integrated Resource Zone, a repeat of 1995 conditions would lead to a minimum storage of 36% in Haweswater under a worst-case scenario. Without the drought interventions in place, Haweswater modelled storage also reaches a minimum of 36%. This is because Haweswater only crosses the higher triggers so few drought interventions are implemented. The crossing of lower drought triggers in the Dee system combined with low storage in the Pennines mean that drought permits would be applied for at the Pennine reservoirs in October 1995 with implementation in December, in line with crossing Dee drought Trigger 4.

Figure A6.5 and Figure A6.6 illustrate the impact of a 1995/96-style drought event on our current system, and the indicative timing of drought interventions in this scenario. Haweswater and Dee Reservoirs recover somewhat over the winter, it is primarily the poor recovery of the Pennines (storage minimum of 31%) which prolongs the event into 1996.

Figure A6.5: Modelled Haweswater Reservoir storage in 1995/96 drought conditions

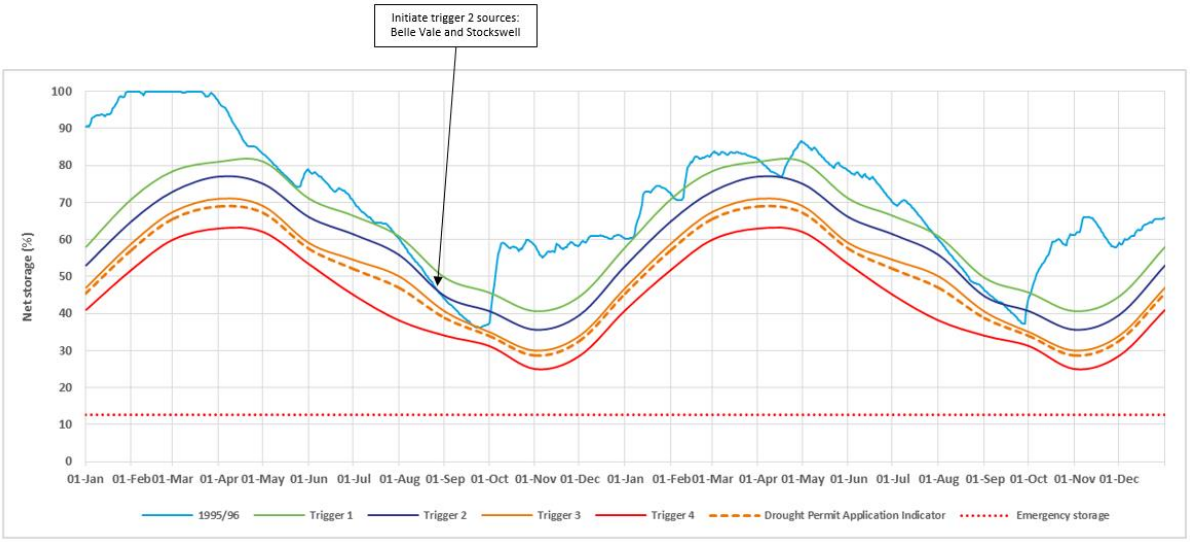

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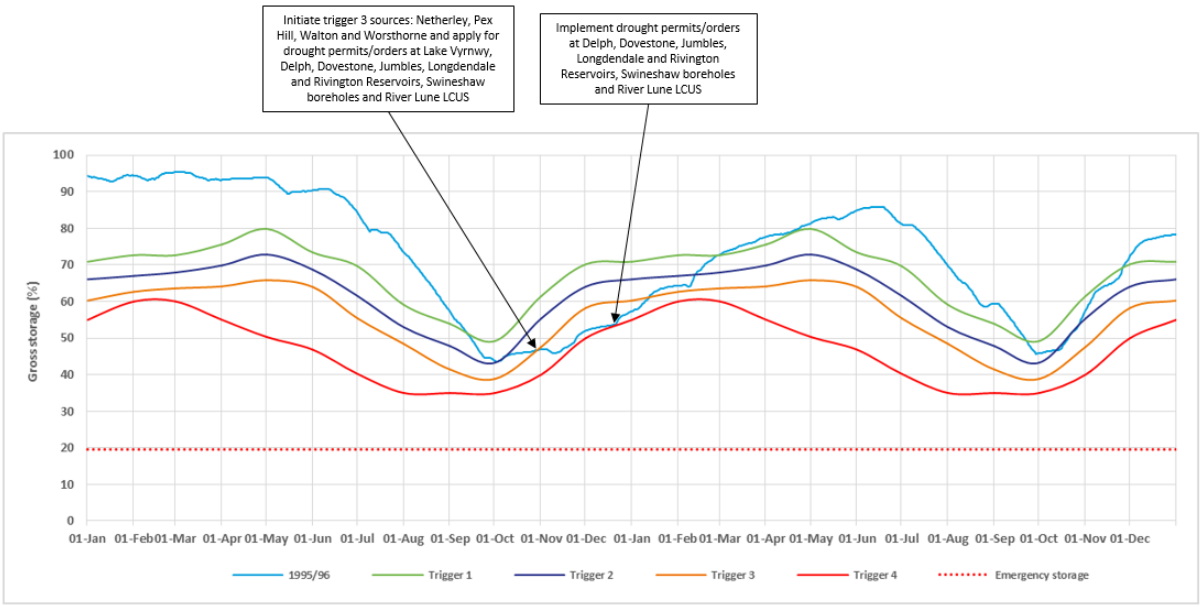
Figure A6.6: Modelled Dee Reservoir System storage in 1995/96 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	1995		1996	
	Haweswater Reservoir	River Dee System	Haweswater Reservoir	River Dee System
Trigger 1 to 2	30 days	20 days	49 days	21 days
Trigger 2 to 3	23 days	27 days	n/a	n/a
Trigger 3 to 4	n/a	n/a	n/a	n/a

A6.2.3 Integrated Resource Zone – 1933/34 drought conditions

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in our region in 1933/34, and has the following characteristics:

- Two season drought event covering 1933/34
- Impacts occurred in the south of the region
- Based on our current system, an application for a drought permit at Lake Vyrnwy would be made in mid-November 1933 when the Dee system storage (an indicator of storage in Lake Vyrnwy) crossed drought trigger 3. Haweswater storage remains above drought trigger 2 so no other drought permits/orders would be applied for
- Rainfall at the Vyrnwy rain gauge for the 7 month period to the end of October 1933 (last complete month prior to point of application) was 502 mm or about 64% of the long-term average for the 7 month period from April to October inclusive
- Comparing this to a ranked data series of annual 7 month rainfall totals from April to October for the 108-year period from 1908 – 2015, the 7 month period to end of October 1933 was the 3rd driest on record.

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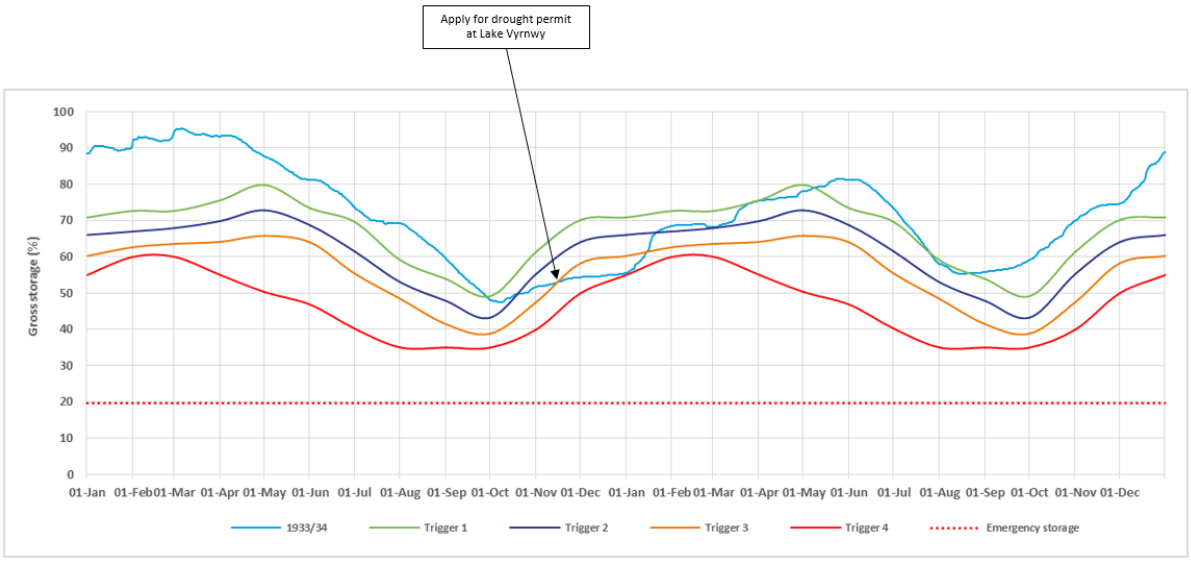
Figure A6.7 illustrates the impact of a 1933/34-style drought event on our current system, and the indicative timing of drought interventions in this scenario. As storage in the River Dee system (an indicator of storage in Lake Vyrnwy) just skimmed trigger 4 in late December 1933 and started refilling in early January 1934, it is likely that the drought permit at Lake Vyrnwy would not have been implemented. Haweswater Reservoir does not cross any drought triggers so is not shown.

Figure A6.7: Modelled Dee Reservoir system storage in 1933/34 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Haweswater Reservoir	River Dee System
Trigger 1 to 2	n/a	20 days
Trigger 2 to 3	n/a	26 days
Trigger 3 to 4	n/a	47 days

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A6.2.4 Integrated Resource Zone – synthetic drought combining winter 1963 and spring/summer 1984 conditions (more severe single season drought)

This is a synthetic single-season drought scenario based on a combination of the climatic and hydrological conditions experienced in our region during the winter of 1963, immediately followed by the conditions experienced during the spring and summer of 1984. The drought scenario is a more severe single-season drought than any drought observed historically in our available records and has an indicative return period of 1 in 1000 years. This scenario has the following characteristics:

- Severe single season drought of around 11 months' duration encompassing a dry winter followed by a dry summer
- Frozen reservoir catchments in the winter of 1962/63 along with lower than average rainfall in January and February 1963, leading to low inflows over this period
- Based on our current system, applications for drought orders and permits would be made from mid-February onwards, as indicated below
- Rainfall at Burnbanks rain gauge (Haweswater) for the synthetic 4 month period to the end of January (point of application for drought permits) would have been 394mm or about 49% of the long-term average for the 4 month period to the end of January
- Comparing this to a ranked data series of annual 4 month rainfall totals from October to January for the 84-year period from 1932 – 2015, this 4 month period to the end of January would represent the driest on record.

Figure A6.8 and Figure A6.9 illustrate the impact of this synthetic drought event on our current system, and the indicative timing of drought interventions in this scenario. Modelled Haweswater storage in this scenario with drought interventions reaches a minimum of 18% compared to a minimum of 0% if no interventions are implemented. The drought interventions stop the reservoir emptying and the associated consequences.

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Figure A6.8: Modelled Haweswater Reservoir storage in winter 1963 and spring/summer 1984 synthetic drought scenario

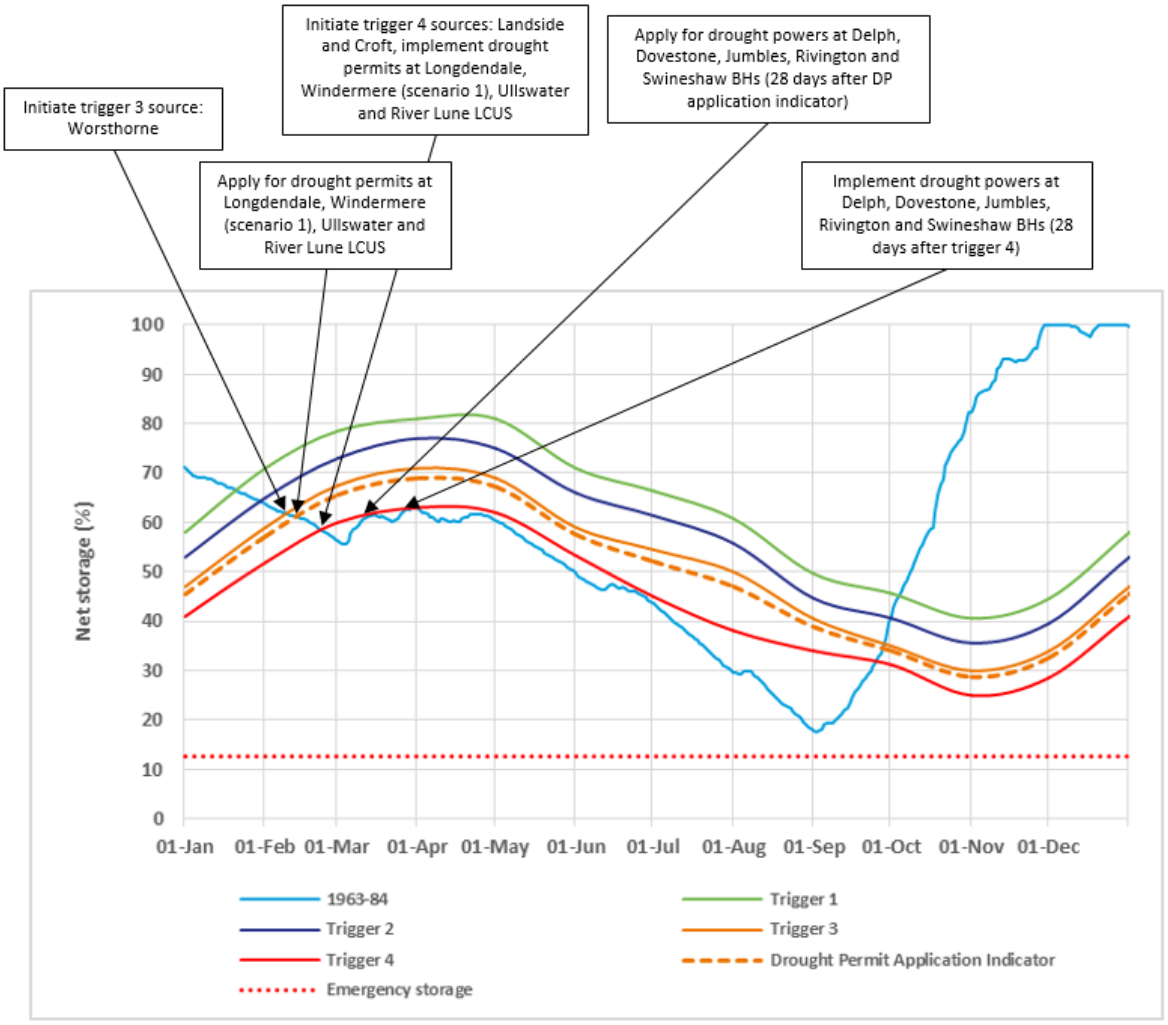

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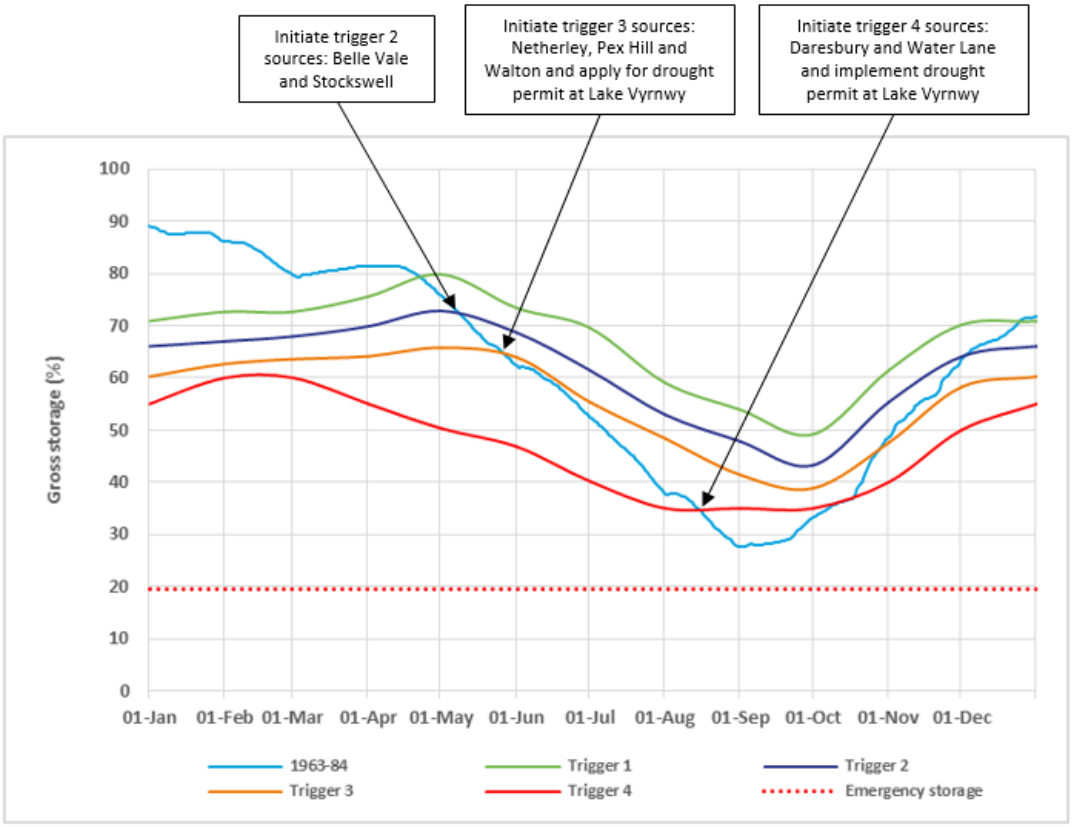
Figure A6.9: Modelled Dee Reservoir system storage in winter 1963 and spring/summer 1984 synthetic drought scenario



The predicted timings between the triggers are given in the table below. The intervals for Haweswater do not align with the target intervals between triggers presented in Figure A1.1. This is an extreme scenario and adjusting the triggers to meet minimum timings at this time of year in all events was not considered appropriate given the level of risk of such a severe drought event, as it would result in a disproportionally high trigger curve early in the year and would increase the frequency with which the triggers are reached. This decision was also taken in the context of the benefits of drought plan interventions that would mitigate such an event. Our modelling shows that with the implementation of drought interventions at the relevant timing, this severe event would not result in system failure. In a scenario such as this, we would consider implementing drought actions earlier than their triggers to allow sufficient time for actions to occur.

	Haweswater Reservoir	River Dee System
Trigger 1 to 2	9 days	16 days
Trigger 2 to 3	11 days	18 days
Trigger 3 to 4	13 days	81 days

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A6.2.5 Integrated Resource Zone – synthetic drought combining summer 1984 and autumn/winter 1995 into 1996 conditions (more severe two season drought)

This is a synthetic two-season drought scenario based on a combination of the climatic and hydrological conditions experienced in our region during the summer of 1984, immediately followed by a repeat of the conditions experienced during the autumn/winter and then summer of 1995/96. The drought scenario is more severe than any drought observed historically in our available records and has an indicative return period of 1 in 500 years. This scenario has the following characteristics:

- Two-season drought of around 20 months' duration encompassing two consecutive dry summers with a drier than average winter between them
- Based on our current system, applications for drought orders and permits would be made from July in the first summer onwards
- Rainfall at Burnbanks rain gauge (Haweswater) for the 19 month period from March (year 1) to September (year 2) inclusive would have been 1703mm or about 69% of the long-term average Comparing this to a ranked data series of annual 19 month rainfall totals from the previous March to September for the 83-year period from 1933 – 2015, the drought scenario would represent the driest on record

Figure A6.10 and Figure A6.11 and illustrate the impact of this synthetic drought event on our current system, and the indicative timing of drought interventions in this scenario. Modelled Haweswater storage in this scenario with drought interventions reaches a minimum of 24% compared to a minimum of 21% if no interventions are implemented.

Note that although storage in the River Dee system drops below drought trigger 4, the storage remains above the Dee General Directions Stage 3 curve.

Figure A6.10: Modelled Haweswater Reservoir storage in 1984 + 1995/96 synthetic drought scenario

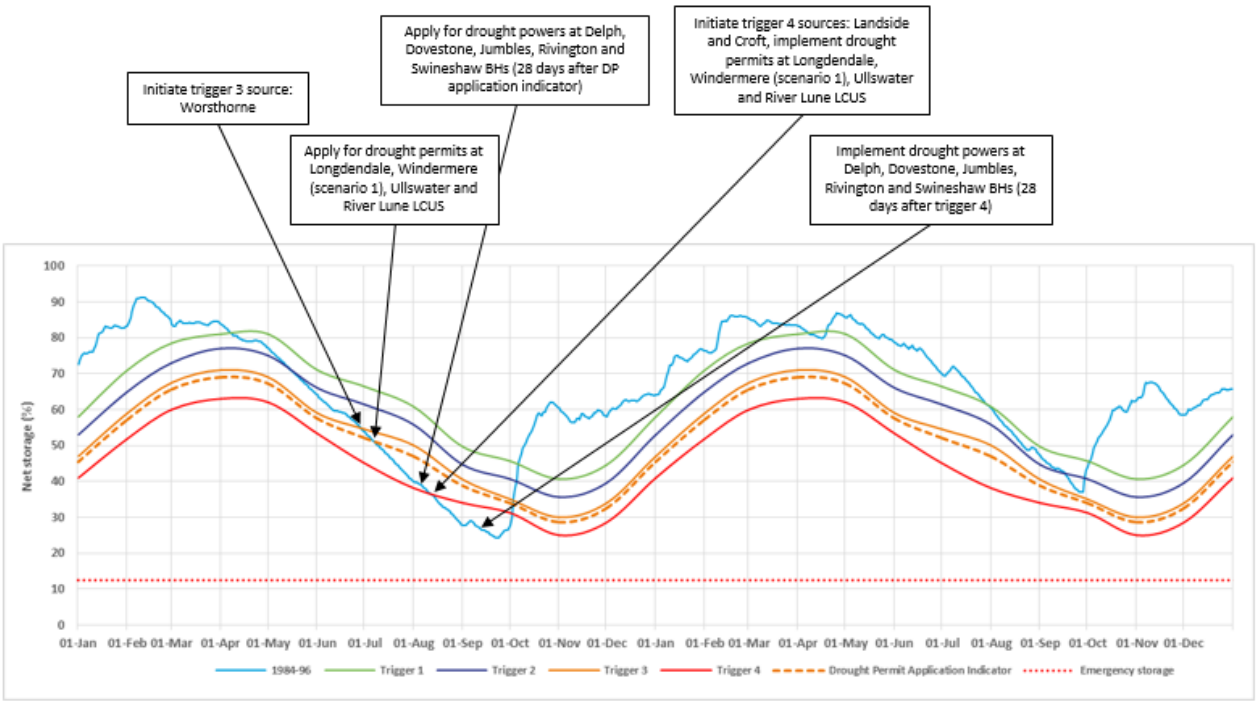

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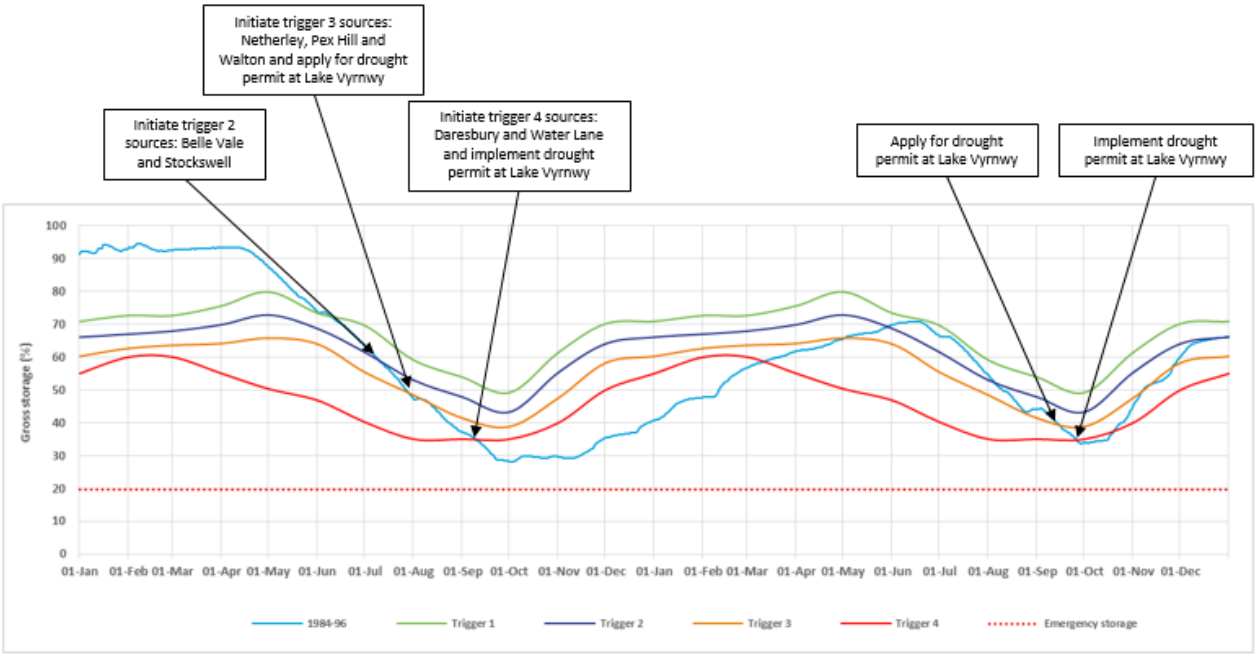
Figure A6.11: Modelled Dee Reservoir storage in 1984 + 1995/96 synthetic drought scenario



The predicted timings between the triggers are given in the table below. The interval between trigger 3 and 4 for the River Dee system in the second year does not align with the target interval between triggers presented in Figure A1.1; however there is sufficient time overall between triggers 2 and 4. As this is the second year of a two season drought, drought actions would be ongoing. This is a severe event designed to test the resilience of our supply system and our modelling shows that with the implementation of drought interventions at the relevant timing, this severe event would not result in system failure.

	Year 1		Year 2	
	Haweswater Reservoir	River Dee System	Haweswater Reservoir	River Dee System
Trigger 1 to 2	36 days	31 days	49 days	n/a[16]
Trigger 2 to 3	46 days	18 days	n/a	40 days
Trigger 3 to 4	44 days	43 days	n/a	11 days

A6.2.6 Integrated Resource Zone – synthetic drought combining the 1995/96 event followed by autumn/winter 1995 into a repeat of summer 1996 conditions (more severe three season drought)

This is a synthetic three-season drought scenario based on a combination of the climatic and hydrological conditions experienced in our region during the two-season drought of 1995/96, immediately followed by a

[16] Dee Reservoir storage remains below trigger 1 throughout the winter period

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repeat of the conditions experienced during the summer of 1995. The drought scenario is more severe and prolonged than any drought observed historically in our available records and has an indicative return period of 1 in 200 years. This scenario has the following characteristics:

- Three-season drought of around 30 months' duration encompassing three consecutive dry summers
- Based on our current system, applications for drought orders and permits would be made from early November in the first season onwards
- Rainfall at Burnbanks rain gauge (Haweswater) for the 30 month period to September in the third season would have been 3043mm or about 76% of the long-term average for the 30 month period from April in year 1 to September in year 3 inclusive
- Comparing this to a ranked data series of annual 30 month rainfall totals from April in year 1 to September in year 3 for the 83-year period from 1933 – 2015, the 30 month period to September in year 3 of the drought scenario would represent the driest on record.

Figure A6.12 and Figure A6.13 illustrates the impact of this synthetic drought event on our current system, and the indicative timing of drought interventions in this scenario. Modelled Haweswater storage in this scenario with drought interventions reaches a minimum of 31% compared to a minimum of 30% if no interventions are implemented. The crossing of lower drought triggers in the Dee system combined with low storage in the Pennines mean that drought permits would be applied for at the Pennine reservoirs in November in the first season with implementation in December, in line with crossing Dee drought trigger 4.

Figure A6.12: Modelled Haweswater Reservoir storage in 1995/96 + 1995 synthetic drought scenario

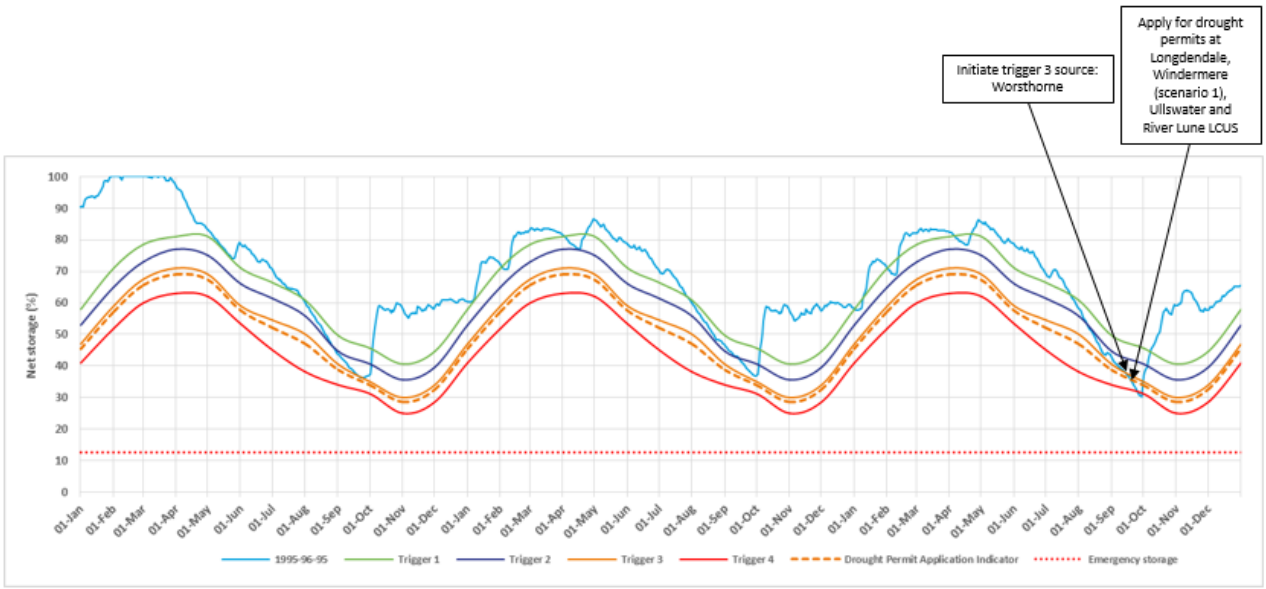

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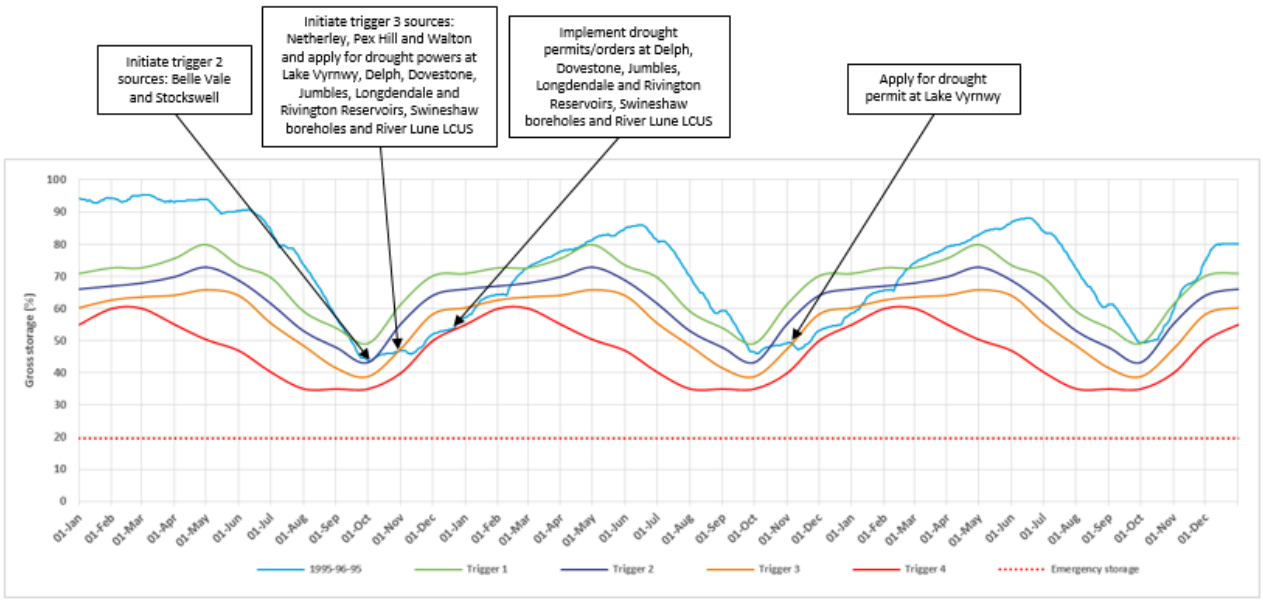
Figure A6.13: Modelled Dee Reservoir system storage in 1995/96 + 1995 synthetic drought scenario



The predicted timings between the triggers are given in the table below. The interval between trigger 3 and 4 for Haweswater Reservoir in the third year does not align with the target interval between triggers presented in Figure A1.1 however there is sufficient time overall time between triggers 1 and 4. As this is the third year of a three season drought, drought actions would be ongoing. This is a severe event designed to test the resilience of our supply system and our modelling shows that with the implementation of drought interventions at the relevant timing, this severe event would not result in system failure.

	Year 1		Year 2		Year 3	
	Haweswater Reservoir	River Dee System	Haweswater Reservoir	River Dee System	Haweswater Reservoir	River Dee System
Trigger 1 to 2	30 days	20 days	49 days	25 days	16 days	n/a
Trigger 2 to 3	23 days	27 days	n/a	19 days	37 days	n/a
Trigger 3 to 4	n/a	n/a	n/a	n/a	11 days	n/a

APPENDIX 6: Testing of drought scenarios

A6.3 Scenario testing for the Carlisle Resource Zone

Figure A6.14 summarises two key drought scenarios selected from testing in the Carlisle Resource Zone. These include two single-season droughts, one based on the most severe historic drawdown conditions modelled (1976) and one synthetic event of a greater severity than experienced historically. Due to the nature of the Carlisle Resource Zone, where even severe single-season droughts are followed by the reservoir refilling during the winter refill period, it is not relevant to present droughts of increased duration e.g. two or three-season droughts.

There is only one supply side option in Carlisle: pumping from dead water at Castle Carrock Reservoir. Implementation of this is discussed below. Demand side options would be implemented in the sequence: enhanced water efficiency communications (Trigger 1), further enhancements to water efficiency communications (Trigger 2), campaign for voluntary water use restraint (trigger 3), Temporary Use Ban (Trigger 4). Because these are consistent across the scenarios presented the demand side actions are not shown in the graphs and tables below. There are no drought permit/order options for the Carlisle Resource Zone.

Further detail on each of the Carlisle Resource Zone drought scenarios summarised in Figure A6.14 is given in sections A6.3.1 and A6.3.2.

Figure A6.14 Carlisle Resource Zone – summary of drought scenarios tested

Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: Castle Carrock Reservoir % of full capacity)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: Castle Carrock Reservoir % of full capacity)	Indicative supply-side drought interventions (current system)
1976 conditions	Single-season drought event; 3 months' duration Rainfall for 3 months to August at 43% of LTA	Not available	None	35% (8/9/1976)	None
80% rainfall deficit over 12 months	Single season drought of a greater intensity than experienced in the historic record Rainfall for 12 months to October at 20% of LTA	N/A	N/A	20%	Late August (at drought trigger 4): initiate supply-side option to prepare for pumping from dead water at Castle Carrock Reservoir Note that as dead water is not reached the pumping is not used in this scenario

Note that the modelled minimum storage is that from the "worst-case" scenario with the benefits of the drought powers listed in the table

APPENDIX 6: Testing of drought scenarios

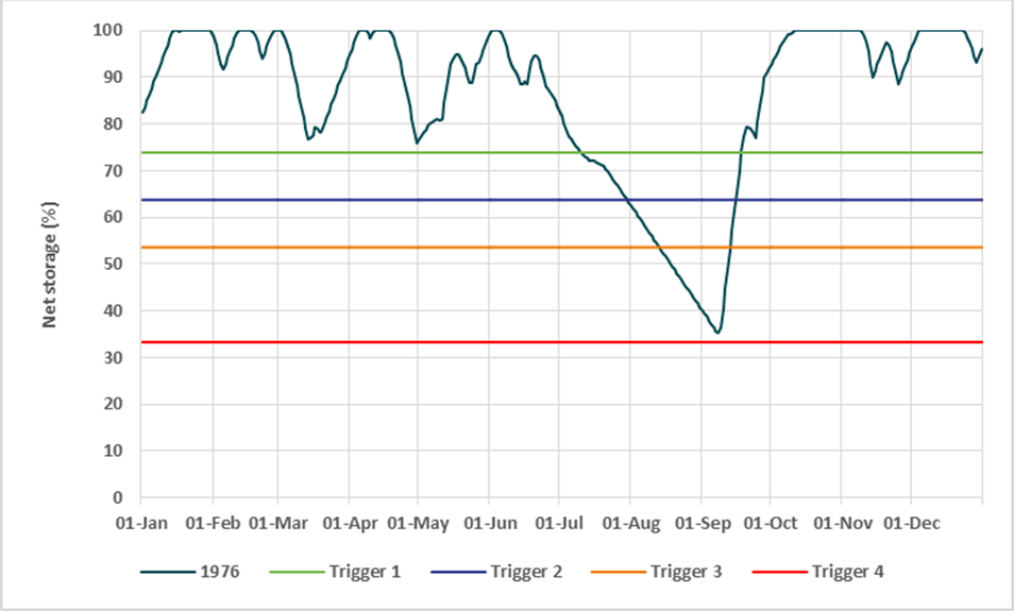
A6.3.1 Carlisle Resource Zone – 1976 drought conditions

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in the Carlisle Resource Zone in 1976, the most severe historic event, and has the following characteristics:

- Single season drought (in Cumbria) of approximately 3 months' duration
- Historically, no drought orders and permits were applied for during 1976 in the Carlisle Resource Zone
- Rainfall at Burnbanks rain gauge (Haweswater) for the 3 month period to August 1976 was 126mm or about 43% of the long-term average for the 3 month period from June to August inclusive
- Comparing this to a ranked data series of annual 3 month rainfall totals from June to August, for the 84-year period from 1932 – 2015, the 3 month period to August 1976 was the third driest on record.

Figure A6.15 illustrates the impact of a 1976-style drought event on our current Carlisle Resource Zone system (represented by storage in Castle Carrock Reservoir, which is the key water resource storage in the zone). Note that as drought Trigger 4 is not crossed, no drought actions are implemented.

Figure A6.15: Modelled Castle Carrock Reservoir storage in 1976 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Castle Carrock
Trigger 1 to 2	20 days
Trigger 2 to 3	14 days
Trigger 3 to 4	n/a

APPENDIX 6: Testing of drought scenarios

A6.3.2 Carlisle Resource Zone – Synthetic drought based on 80% rainfall deficit

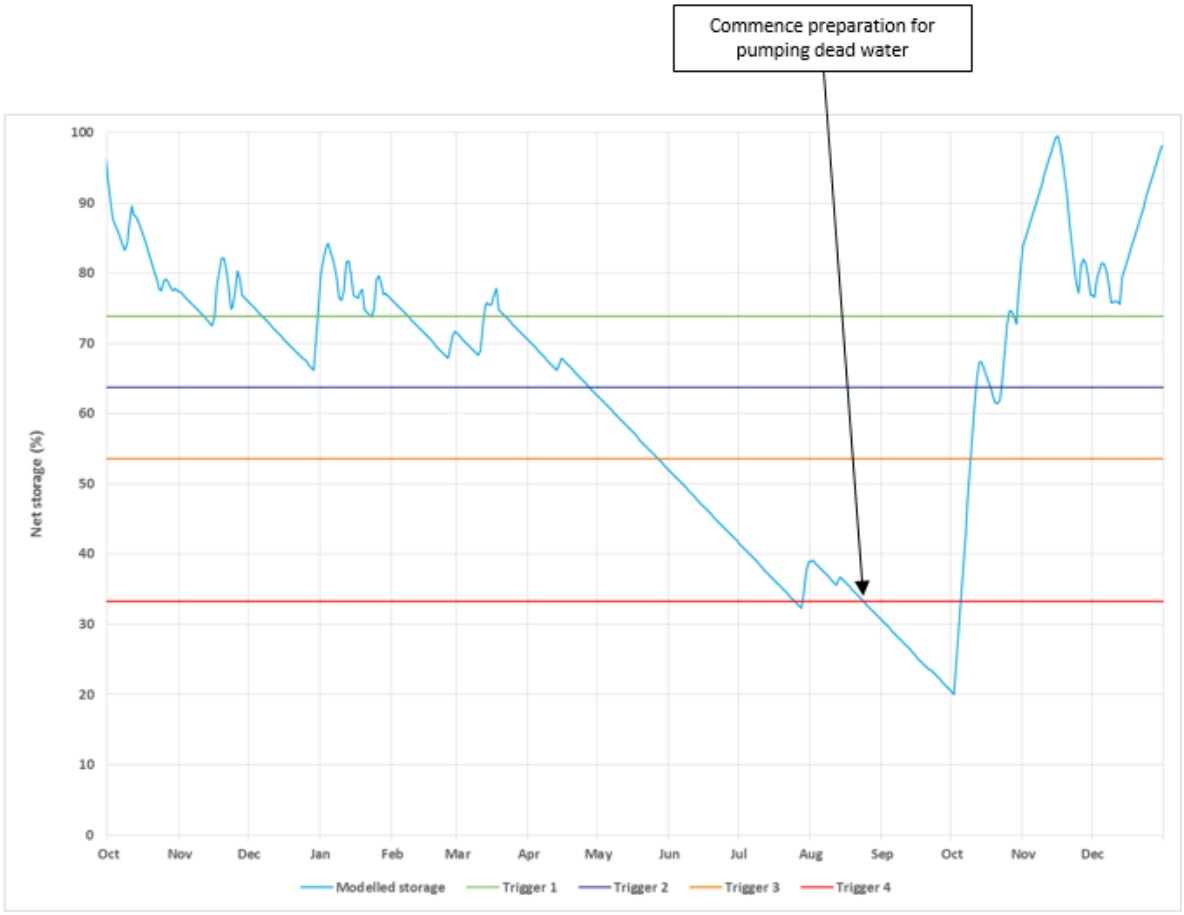
This is a synthetic single-season drought scenario based on a flow time series output from the UKWIR, Defra and Environment Agency project, *"Performance of water supply systems during extreme drought"*, with an indicative return period of 1 in 1000 years. This scenario has the following characteristics:

- Single season drought of approximately 12 months' duration
- Rainfall assumed to be at 20% of long-term average for the 12-month duration of the drought (i.e. a deficit of 80% compared to the LTA)
- Modelled reservoir storage based on inflow time series generated from the 20% LTA rainfall sequence
- The duration and intensity of this drought scenario are more severe than any drought event experienced historically in the Carlisle Resource Zone
- Based on our current system, we would implement preparations for pumping from dead water at Castle Carrock Reservoir in late August (when drought trigger 4 is crossed) in this drought scenario.

Figure A6.16 illustrates the impact of this severe drought scenario on our current Carlisle resource zone system. Note that as dead water is not reached, pumping of dead water is not actually implemented.

APPENDIX 6: Testing of drought scenarios

Figure A6.16: Modelled Castle Carrock Reservoir storage in 80% rainfall deficit drought scenario



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Castle Carrock
Trigger 1 to 2	37 days
Trigger 2 to 3	29 days
Trigger 3 to 4	60 days

APPENDIX 6: Testing of drought scenarios

A6.4 Scenario testing for West Cumbria Resource Zone

Figure A6.17 summarises a number of the key drought scenarios tested for the West Cumbria Resource Zone. These include two single-season droughts, one based on historic conditions experienced in 1995 and one synthetic event of a greater severity than experienced historically. Due to the nature of the West Cumbria Resource Zone, where even severe single-season droughts result in the reservoirs refilling rapidly following the drought event, it is not relevant to present droughts of increased duration e.g. two or three-season droughts.

Demand side options would be implemented in the sequence: enhanced water efficiency communications (Trigger 1), campaign for voluntary water use restraint (Trigger 2 Ennerdale Water or Trigger 3 Crummock Water), Temporary Use Ban (Trigger 4). Because these are consistent across the scenarios presented the demand side actions are not shown in the graphs and tables below.

Further detail on each of the West Cumbria Resource Zone drought scenarios summarised in Figure A6.17 is given in sections A6.4.1 to A6.4.6.

Note that for Ennerdale, due to the increased compensation flow requirement to protect the environment, the drawdowns in the modelled scenarios can be more severe than those actually observed in the corresponding historic record. Also note that the modelled minimum storage is that from the “worst-case” scenario with the benefits of the drought powers listed in the table.

APPENDIX 6: Testing of drought scenarios

Figure A6.17 West Cumbria Resource Zone – summary of drought scenarios tested

Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: level, m below weir crest)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: level m below weir crest)	Indicative supply-side drought options and drought permit/order interventions (current system)
1963 conditions (Ennerdale focused event)	Short drought event of around 2 months' duration Rainfall at Ennerdale for January 1963 at 14% of LTA, 2nd driest in 60 year record	Not available	This historic information is not available	Ennerdale 1.46 m btwl (4/3/1963)	At Ennerdale Early February (at drought trigger 2): increase abstraction from South Egremont boreholes Mid-February (at drought trigger 3): apply for drought order and commence tankering at a rate of 0.6 Ml/d
1978 conditions (Ennerdale focused event)	Single-season drought event; 3 months' duration Rainfall at Ennerdale for 2 months to end of May at 19% of LTA, driest in 60 year record	Ennerdale 1.40 m btwl (12/6/1978) (NB - missing data 13/6/1978 – 1/10/1978)	Yes – at Ennerdale	Ennerdale 1.52 m btwl (21/6/1978)	At Ennerdale Late May (at drought trigger 2): increase abstraction from South Egremont boreholes Early June (at drought trigger 3): apply for drought order and commence tankering at a rate of 0.6 Ml/d Mid-June (at drought trigger 4): implement Temporary Use Ban
1995 conditions (Crummock and Ennerdale focused event)	Short drought event of around 7 weeks' duration Rainfall at Ennerdale for 1 month (August) at 26% of LTA, 3rd driest in 60 year record	Crummock 0.748 m btwl (22/9/1995) Ennerdale Data missing 26/4/1995 – 4/10/1995	None	Crummock 0.56 m btwl (22/9/1995) Ennerdale 1.18 m btwl (24/9/1995)	Early September (at drought trigger 2): increase abstraction from South Egremont boreholes Mid-September (at drought trigger 3): apply for drought permit at Crummock, apply for drought order at Ennerdale and commence tankering at a rate of 0.6 Ml/d
2010 conditions (Ennerdale focused event)	Single-season drought event; 3 months' duration Rainfall at Ennerdale for 2 months to end of May at 60% of LTA, 6th driest in 60 year record	Ennerdale 0.90 m btwl (28/6/2010)	None	Ennerdale 1.31 m btwl (26/6/2010)	At Ennerdale Early June (at drought trigger 2): increase abstraction from South Egremont boreholes Mid-June (at drought trigger 3): apply for drought order and commence tankering at a rate of 0.6 Ml/d
Winter 1963 &	Single season winter drought of	N/A	N/A	Ennerdale 1.07 m btwl	At Ennerdale Early February (at drought trigger 2): increase

APPENDIX 6: Testing of drought scenarios

Drought scenario	Drought characteristics (rainfall to point of drought permit application)	Historic minimum (observed: level, m below weir crest)	Drought powers granted historically (excluding supply-side options)	Modelled minimum (current system: level m below weir crest)	Indicative supply-side drought options and drought permit/order interventions (current system)
spring/summer 1969 combined conditions (Ennerdale focused event)	a greater intensity than experienced in the historic record Rainfall at Ennerdale for 2 months to end of January at 37% of LTA, 3rd driest in 60 year record Rainfall at Ennerdale for 6 months to April (i.e. the whole drought event) at 45% of LTA				abstraction from South Egremont boreholes Mid-February (at drought trigger 3): apply for drought order and commence tankering at a rate of 0.6 Ml/d Early March (at drought trigger 4): implement Temporary Use Ban Late March (at dead water): implement drought order and increase tankering to 2.0 Ml/d
1995 maximum drawdown, followed by 1972 conditions (extended single season event)	Single season drought of a greater intensity than experienced in the historic record; 3 months' duration Rainfall at Ennerdale for August at 26% of LTA, 3rd driest in 60 year record Rainfall at Ennerdale for 3 months to October (i.e. the whole drought event) at 28% of LTA	N/A	N/A	Ennerdale 1.53 m btwl Crummock 0.78 m btwl	Early September (at Ennerdale drought trigger 2): increase abstraction from South Egremont boreholes Mid-September (at Crummock drought trigger 3): apply for drought permit at Crummock Mid-September (at Ennerdale drought trigger 3): apply for drought order at Ennerdale and commence tankering at a rate of 0.6 Ml/d Early October (at Ennerdale drought trigger 4): implement Temporary Use Ban

APPENDIX 6: Testing of drought scenarios

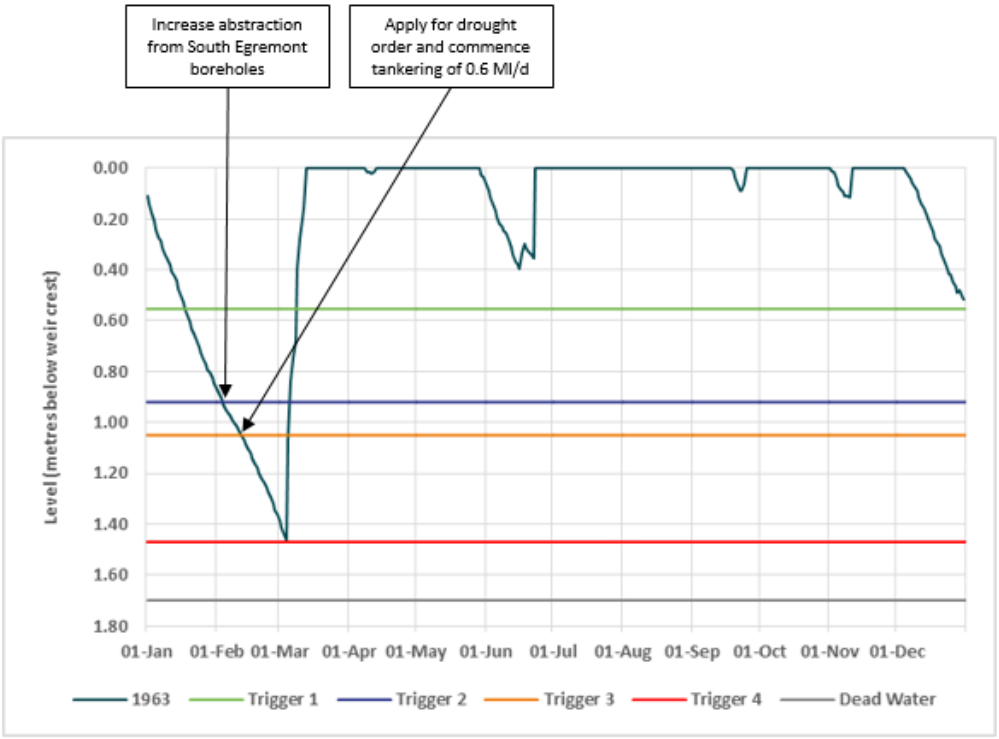
A6.4.1 West Cumbria Resource Zone – 1963 drought conditions (Ennerdale focused event)

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in the West Cumbria Resource Zone in 1963, and has the following characteristics:

- Single season drought of approximately 2 months' duration
- Based on our current system, abstraction from South Egremont boreholes would be increased in early February and tankering at a daily rate of 0.6 Ml/d would be implemented in mid-February
- A drought order would be applied for in this drought scenario, but would not be implemented
- Rainfall at Ennerdale rain gauge for January 1963 (the complete month prior to drought order application) was 25mm or about 14% of the long-term average for January
- Comparing this to a ranked data series of annual January rainfall totals for the 60-year period from 1956 – 2015, January 1963 was the 2nd driest on record.

Figure A6.18 illustrates the impact of a 1963-style drought event on our current West Cumbria resource zone system (represented by water levels in Ennerdale Water). Storage in Crummock Water remains above drought triggers.

Figure A6.18: Modelled Ennerdale Water level in 1963 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Ennerdale	Crummock
Trigger 1 to 2	17 days	n/a
Trigger 2 to 3	8 days	n/a
Trigger 3 to 4	n/a	n/a

APPENDIX 6: Testing of drought scenarios

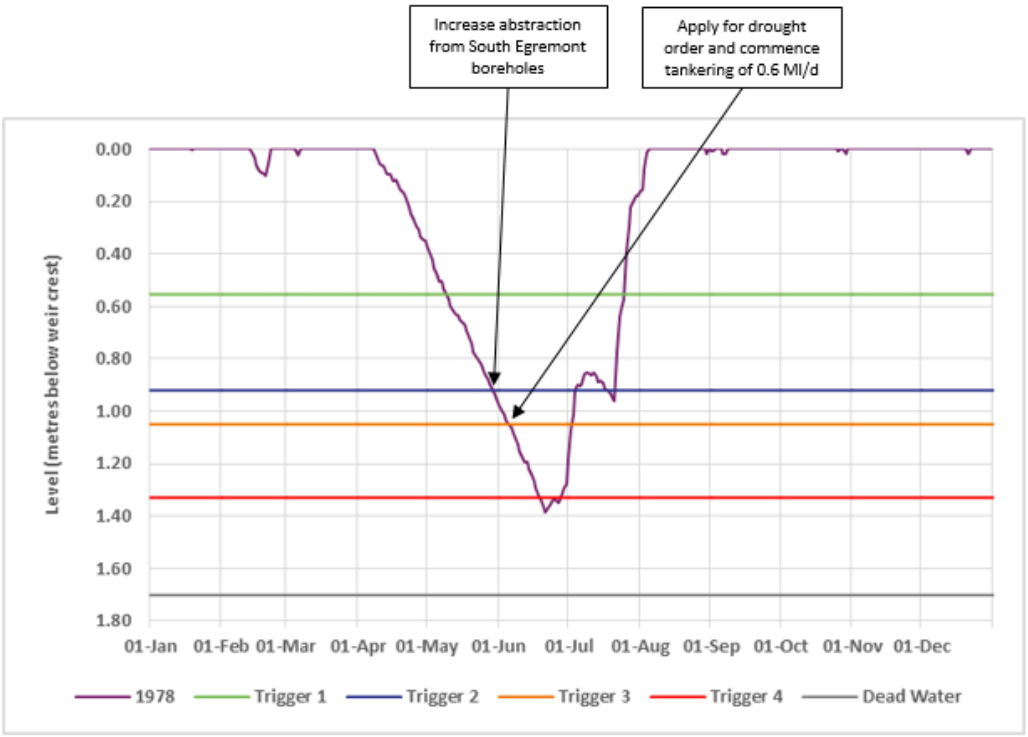
A6.4.2 West Cumbria Resource Zone – 1978 drought conditions (Ennerdale focused event)

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in the West Cumbria Resource Zone in 1978, and has the following characteristics:

- Single season drought (in Cumbria) of approximately 3 months' duration
- Historically, drought powers were applied for in the West Cumbria Resource Zone during 1978
- Based on our current system, abstraction from South Egremont boreholes would be increased in late May, tankering at a daily rate of 0.6 Ml/d would be implemented in early June and a Temporary Use Ban in mid-June at drought trigger 4
- A drought order would be applied for in this drought scenario but would not be implemented
- Rainfall at Ennerdale rain gauge for the 2 month period to the end of May 1978 (point of application for drought order) was 37mm or about 19% of the long-term average for the 2 month period from April and May inclusive
- Comparing this to a ranked data series of annual 2 month rainfall totals from April to May for the 60-year period from 1956 – 2015, the 2 month period to the end of May 1978 was the driest on record.

Figure A6.19 illustrates the impact of a 1978-style drought event on our current West Cumbria resource zone system (represented by water levels in Ennerdale Water). Storage in Crummock Water drops below drought Trigger 2 but as this does not trigger any drought actions, the graph is not presented.

Figure A6.19: Modelled Ennerdale Water level in 1978 drought conditions



APPENDIX 6: Testing of drought scenarios

The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Ennerdale	Crummock
Trigger 1 to 2	18 days	13 days
Trigger 2 to 3	7 days	n/a
Trigger 3 to 4	19 days	n/a

A6.4.3 West Cumbria Resource Zone – 1995 drought conditions (Crummock and Ennerdale focused event)

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in West Cumbria in 1995, and has the following characteristics:

- Short drought event of around 7 weeks' duration
- Historically no drought orders and permits were applied for at Crummock Water or Ennerdale Water during 1995
- Based on our current system, abstraction from South Egremont boreholes would be increased in early September and tankering at a daily rate of 0.6 Ml/d would be implemented in mid-September
- A drought permit would be applied for at Crummock Water and a drought order applied for at Ennerdale Water, but neither would be implemented
- Rainfall at Ennerdale rain gauge for the 1 month period of August 1995 was 43mm or about 26% of the long-term average for August
- Comparing this to a ranked data series of annual August rainfall totals, for the 60-year period from 1956 – 2015, August 1995 was the third driest on record.

Figures A6.20 and A6.21 illustrates the impact of a 1995-style drought event on our current West Cumbria resource zone system, represented by water level in Crummock Water and Ennerdale Water.

APPENDIX 6: Testing of drought scenarios

Figure A6.20: Modelled Crummock Water level in 1995 drought conditions

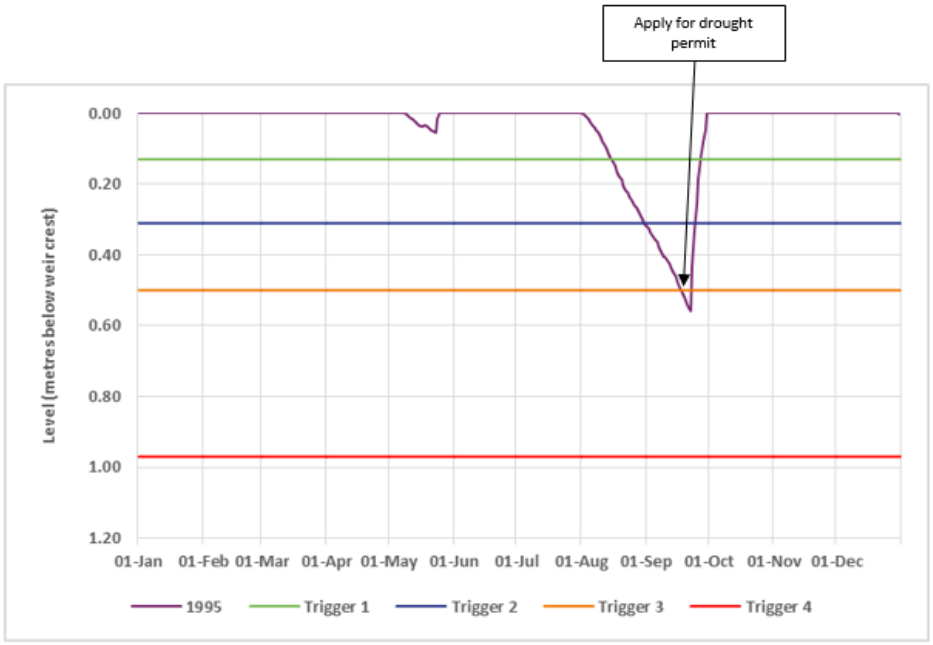
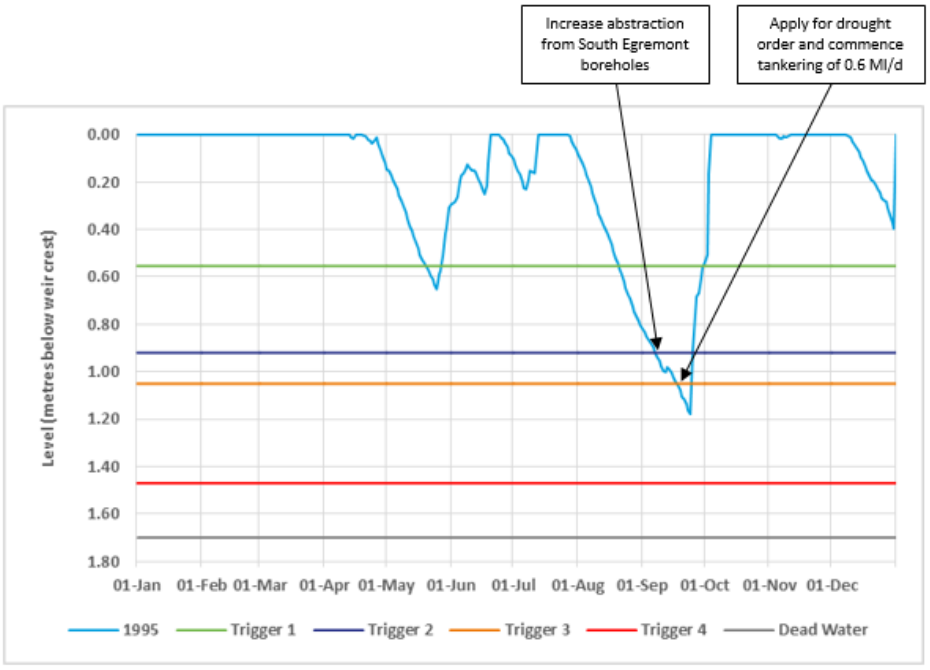


Figure A6.21: Modelled Ennerdale Water level in 1995 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Ennerdale	Crummock
Trigger 1 to 2	17 days	16 days
Trigger 2 to 3	11 days	18 days
Trigger 3 to 4	n/a	n/a

APPENDIX 6: Testing of drought scenarios

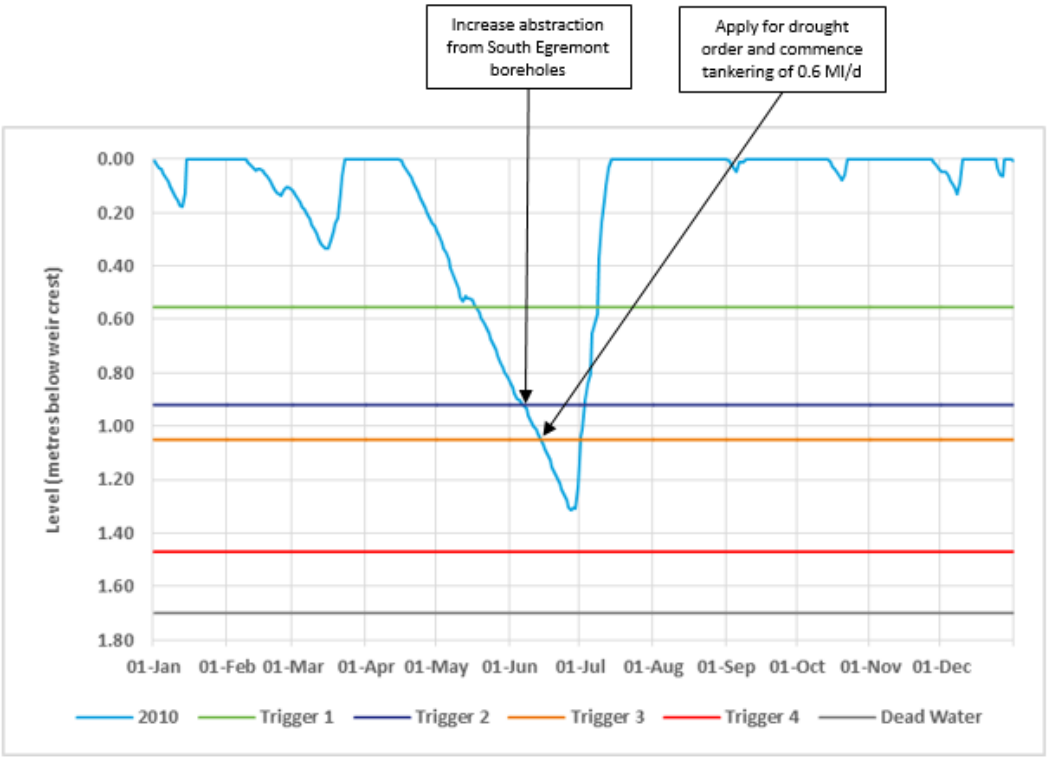
A6.4.4 West Cumbria Resource Zone – 2010 drought conditions (Ennerdale focused event)

This drought scenario is based on a repeat of the climatic and hydrological conditions experienced in the West Cumbria Resource Zone in 2010, and has the following characteristics:

- Single season drought (in Cumbria) of approximately 3 months' duration
- Historically, a drought permit was applied for on 24 June 2010 relating to abstraction at Ennerdale. The application was withdrawn following rainfall in early July 2010
- Based on our current system, abstraction from South Egremont boreholes would be increased in early June and tankering at a daily rate of 0.6 Ml/d would be implemented in late June
- A drought order would be applied for in this drought scenario, but wouldn't be implemented
- Rainfall at Ennerdale rain gauge for the 2 month period to the end of May 2010 (month prior to drought order application) was 119mm or about 60% of the long-term average for the 2 month period from April to May inclusive
- Comparing this to a ranked data series of annual 2 month rainfall totals from April to May for the 60-year period from 1956 – 2015, the 2 month period to end of May 2010 was the 6th driest on record.

Figure A6.22 illustrates the impact of a 2010-style drought event on our current West Cumbria resource zone system (represented by water levels in Ennerdale Water). Storage in Crummock Water drops below drought Trigger 2 but as this does not trigger any drought actions, the graph is not presented.

Figure A6.22: Modelled Ennerdale Water level in 2010 drought conditions



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

APPENDIX 6: Testing of drought scenarios

	Ennerdale	Crummock
Trigger 1 to 2	20 days	22 days
Trigger 2 to 3	7 days	n/a
Trigger 3 to 4	n/a	n/a

A6.4.5 West Cumbria Resource Zone – synthetic drought combining winter 1963 and spring/summer 1969 conditions (Ennerdale focused event)

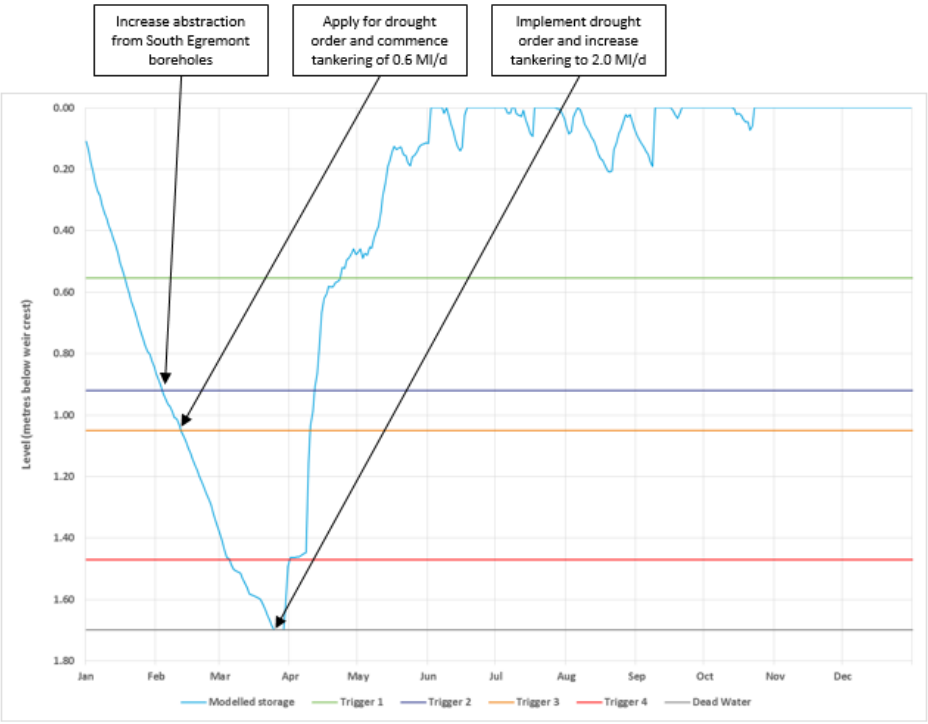
This is a synthetic single-season drought scenario based on a combination of the climatic and hydrological conditions experienced in West Cumbria during the winter of 1963, immediately followed by the conditions experienced during the early spring and summer of 1969. The drought scenario is a more severe single-season drought than any drought observed historically in our available records and has an indicative return period of 1 in 1000 years. This scenario has the following characteristics:

- Severe single season winter/spring drought of around 6 months' duration
- Frozen reservoir catchments in the winter of 1962/63 along with lower than average rainfall during October 1962 to February 1963, leading to low inflows over this period
- Based on our current system, abstraction from South Egremont boreholes would be increased in early February and tankering at a daily rate of 0.6 Ml/d would be implemented in mid-February. Tankering would increase to 2.0 Ml/d in late March. A Temporary Use Ban would be implemented at the beginning of March at drought trigger 4
- A drought order would be applied for and briefly implemented when Ennerdale Water reaches 1.7 mbtwl in late March (noting that this scenario represents a very extreme drought event outside the range of those experienced in the historic record)
- Rainfall at Ennerdale rain gauge for the synthetic 2 month period to the end of January (last complete month prior to drought order application) would have been 130mm or about 37% of the long-term average for the 2 month period from December to January inclusive
- Comparing this to a ranked data series of annual 2 month rainfall totals from December to January for the 60-year period from 1956 – 2015, this 2 month period to the end of January would represent the 3rd driest on record.

Figure A6.23 illustrates the impact of this drought scenario on our current West Cumbria resource zone system (represented by water levels in Ennerdale Water). Storage in Crummock Water remains above drought triggers.

APPENDIX 6: Testing of drought scenarios

Figure A6.23: Modelled Ennerdale Water level in winter 1963 and spring/summer 1969 synthetic drought scenario



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Ennerdale	Crummock
Trigger 1 to 2	17 days	n/a
Trigger 2 to 3	8 days	n/a
Trigger 3 to 4	21 days	n/a

A6.4.6 West Cumbria Resource Zone – synthetic drought combining summer 1995 and autumn/winter 1972 conditions

This is a synthetic single-season drought scenario based on a combination of the climatic and hydrological conditions experienced in West Cumbria during the summer of 1995, immediately followed by the conditions experienced during the autumn and winter of 1972. The drought scenario is a more severe single-season drought than any drought observed historically in our available records and has an indicative return period of 1 in 1000 years. This scenario has the following characteristics:

- Severe single season drought of approximately 3 months' duration
- Based on our current system, abstraction from South Egremont boreholes would be increased in early September and tankering at a daily rate of 0.6 Ml/d would be implemented in mid-September. A Temporary Use Ban would be implemented at the beginning of October at drought Trigger 4

APPENDIX 6: Testing of drought scenarios

- We would have applied for, but not implemented, a drought permit at Crummock and a drought order at Ennerdale
- Rainfall at Ennerdale rain gauge for August (complete month prior to drought permit application) would have been 43mm or about 26% of the long-term average for August
- Comparing this to a ranked data series of annual August rainfall totals for the 60-year period from 1956 – 2015, this August period would have represented the 3rd driest on record.

Figure A6.24 and Figure A6.25 illustrates the impact of this drought scenario on Ennerdale Water and Crummock Water levels in our current West Cumbria Resource Zone system.

Figure A6.24: Modelled Ennerdale Water level in summer 1995 and autumn/winter 1972 synthetic drought scenario

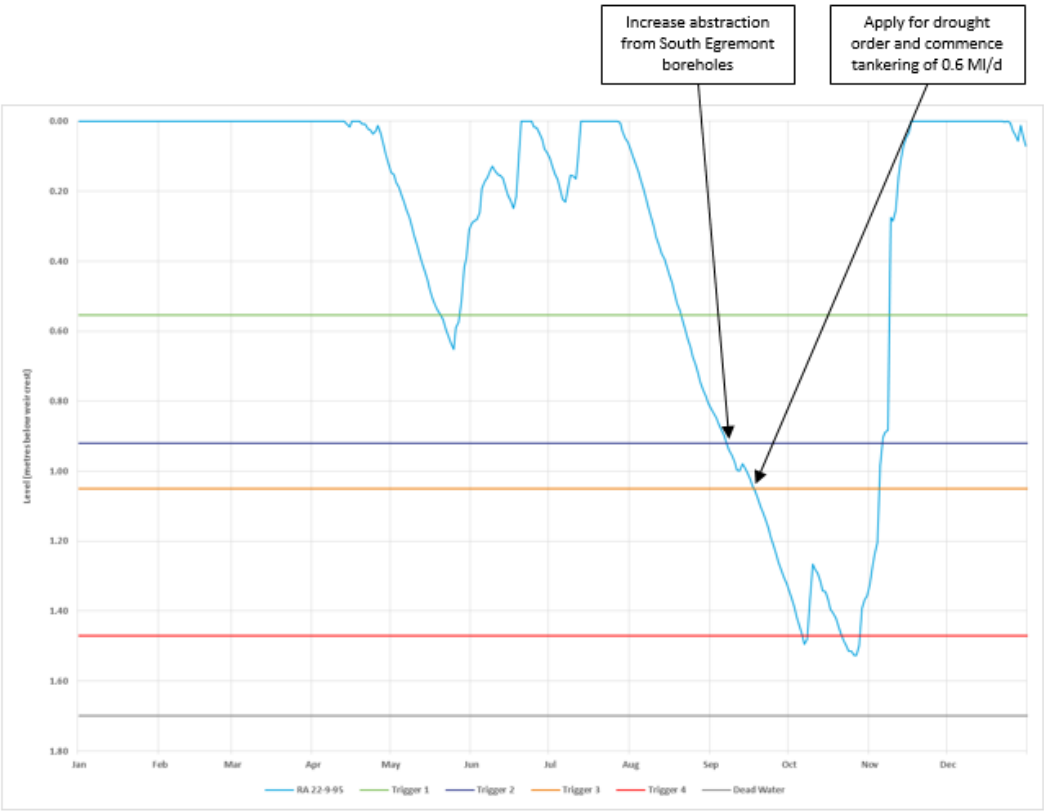


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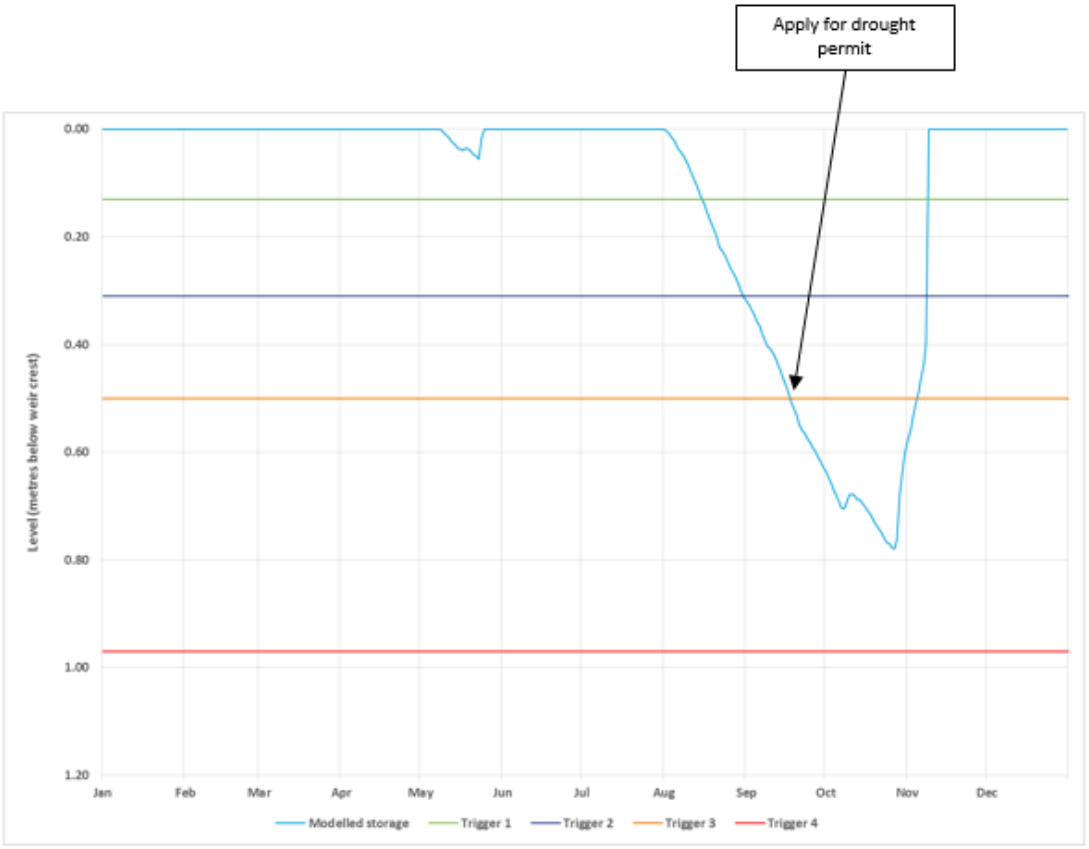
Figure A6.25: Modelled Crummock Water level in summer 1995 and autumn/winter 1972 synthetic drought scenario



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	Ennerdale	Crummock
Trigger 1 to 2	17 days	16 days
Trigger 2 to 3	11 days	18 days
Trigger 3 to 4	18 days	n/a

APPENDIX 6: Testing of drought scenarios

A6.5 North Eden Resource Zone – synthetic drought based on increased demand

In the North Eden Resource Zone, drought measures are only likely to be required if increased zonal demand leads to a risk of exceeding the cumulative annual abstraction licence total for all the borehole sources in the zone (see Section 4.5.1).

Observed demands in 2015 resulted in a total annual abstraction of 1,869.4 Ml/d, or around 59% of the cumulative annual abstraction licence total, so a significant increase in demand would have to occur before drought measures need to be considered. It should be noted that demands in the zone have been higher historically, so given the lower demand conditions now experienced, historic observed patterns essentially now constitute more severe scenarios. A range of modelled historic observed demands have been modelled, none of which require drought powers to be implemented.

We have tested a number of higher demand scenarios. In the most extreme of these, we have assumed that the maximum 7-day rolling average abstraction from the full historic record (occurring in August 1995) is repeated throughout a full calendar year. This results in the following demand profile:

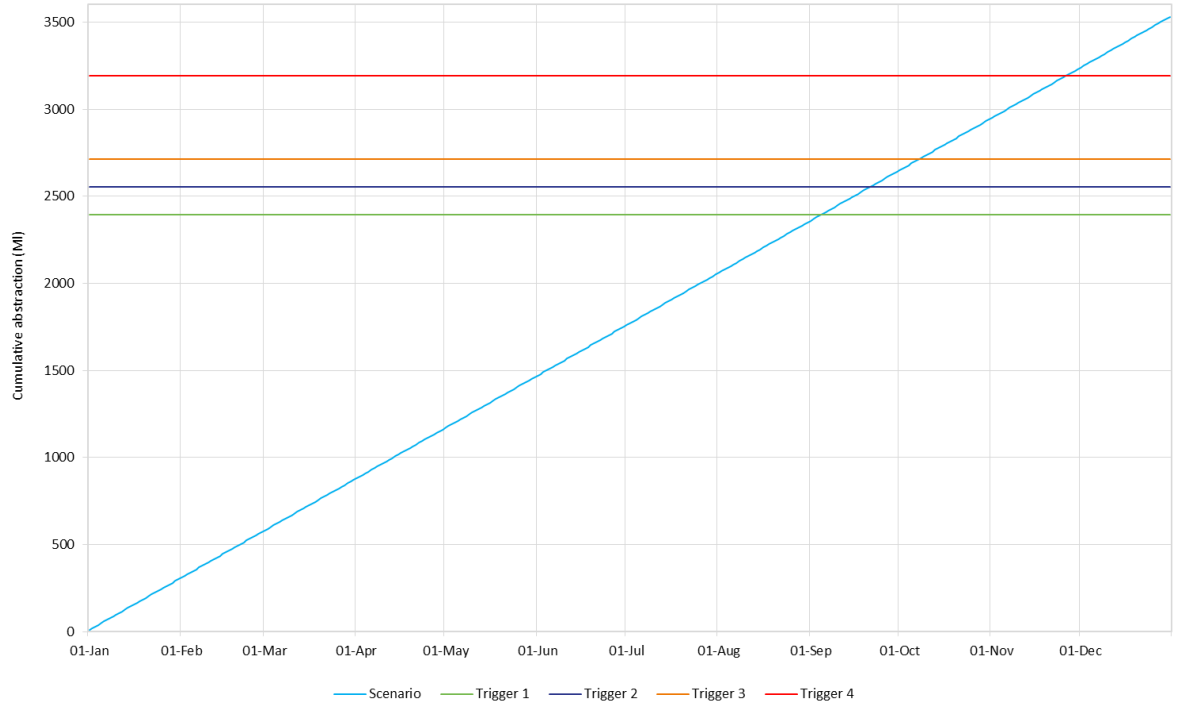
- Daily average abstraction of 9.7 Ml/d
- Total annual abstraction of 3,540.5 Ml/d
- Total annual abstraction represents an increase of around 89% compared to the observed annual demand of 1,869.4 Ml/d in North Eden Resource Zone in 2015
- Total annual abstraction represents an increase of around 11% compared to the cumulative annual abstraction licence total of 3,192.42 Ml/d.

In this scenario, a drought permit application to relax the annual abstraction licence limit would be made in early-October, and implemented in late November on crossing drought Trigger 4. However, this scenario serves to demonstrate how unlikely the implementation of a drought permit would be in this zone.

Figure A6.26 illustrates the impact of this drought scenario on the cumulative demand profile in our North Eden resource zone compared to the drought triggers as outlined in Section 4.

APPENDIX 6: Testing of drought scenarios

Figure A6.26: Cumulative demand drought scenario – North Eden boreholes



The predicted timings between the triggers are given in the table below. These align with the target intervals between triggers presented in Figure A1.1.

	North Eden boreholes
Trigger 1 to 2	17 days
Trigger 2 to 3	16 days
Trigger 3 to 4	50 days

APPENDIX 7: Exceptional shortage of rain

APPENDIX 7: Exceptional shortage of rain

It is a requirement for any drought permit/order application to show that *'…by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened…*'. The Environment Agency has produced a guideline on exceptional shortage of rain and the principles for the assessment of drought permits and orders (Environment Agency, 2012). Our process for demonstrating exceptional shortage of rain follows this guidance.

A key indicator in assessing drought conditions is a significant shortage of rain in the period leading up to a drought. Rainfall data is collected and analysed as part of our routine water situation monitoring and also at an increasing level of detail as drought conditions develop.

Each drought event has different characteristics and therefore it is not possible to define the exact process of rainfall assessment in advance of a drought occurring. A range of data and technical analysis approaches may be appropriate to assess and report on the significant shortage of rain which has caused drought conditions to develop. Rainfall data is also assessed in the context of other relevant climate variables, such as temperature, soil moisture deficit and effective rainfall (the amount of rainfall remaining after evapotranspiration is taken into account), as such factors can influence the water resources response that results during a drought event.

Daily rainfall data is provided by the Environment Agency on a regular basis for 11 rain gauges in the North West region, which correspond to our key water sources (see Figure A7.1). The period of available data varies for each rain gauge, from 80 to 161 years, and monthly long term averages for each gauge for the 30-year period 1961 to 1990 are used for standard comparisons between sites. Data for the Geltsdale rain gauge is also provided, but this is a shorter record of data, from 1994 only, so is not included in standard comparisons.

Factors considered in selecting the time period and specific gauge(s) to support a drought permit/order application will depend on the duration and intensity of the dry weather experienced and the geographical location and extent of these weather conditions. Typically for a single season drought it may be appropriate to analyse rainfall totals for the six month period from April to September (or from the point of initial reservoir drawdown), however for droughts continuing into the autumn/winter season it may be necessary to extend this to longer periods to correspond with the duration of dry weather conditions. Shorter periods may also be selected, particularly for our West Cumbria sources where reservoir drawdown can be rapid in response to a significant shortage of rainfall. As the length of drought events can only be defined with certainty in hindsight; at the time of application for drought powers, the period of rainfall analysis may be shorter than the length of the dry weather period in the historic record.

For dry conditions affecting only certain parts of our region and/or supply system it may be appropriate to focus on specific rain gauges, however, for droughts affecting all or large parts of our region then we also consider the average rainfall at a number of relevant gauges (e.g. an average across nine rain gauges within our Integrated Resource Zone).

Monthly rainfall totals are calculated for each gauge and analysed within our rainfall analysis tool, which enables recent rainfall totals to be ranked within the overall historic data record. For example, rainfall at Burnbanks rain gauge (Haweswater) for the 4 month period to June 1984 was 135 mm; if this rainfall event were to occur again now it would be the driest on record for the 84-year period from 1932 to 2015. Information on the ranking of selected periods of low rainfall will be included in the supporting statement

APPENDIX 7: Exceptional shortage of rain

for a particular drought permit/order application, together with details of monthly or longer periods of recent rainfall data expressed as percentages of long term average rainfall for the corresponding period.

Other types of analysis may include comparison with rainfall patterns experienced in other recent drought events such as 1995/96, as well as percentage deficits compared to expected (long term average) rainfall over monthly or longer periods. If monthly or cumulative deficits are high, and/or periods of low rainfall have a high ranking relative to the historic data record, then this indicates an exceptional shortage of rain in support of drought permit/order applications. Further examples of the types of rainfall analysis which may be carried out are given in Appendix 6 for a number of drought scenarios which we have tested.

Figure A7.1 lists the key rain gauges used in our routine monitoring of the water resources situation and more detailed analysis during developing drought conditions. Details are included of the specific water resources zone(s) and drought permits/orders for which each rain gauge would typically be considered to help demonstrate an exceptional shortage of rainfall. However, due to the interconnected nature of our Integrated Resource Zone, the selection of rain gauges for analysis in support of any particular drought permit/order application is not predetermined and would depend on the nature of the drought.

Figure A7.1: Rain gauges to support the case for an exceptional shortage of rain for drought permit/order applications

Name of rain gauge	Data period available	Water Resources Zone	Relevant Drought Permits/Orders
Vyrnwy	1908 - 2016	Integrated	Lake Vyrnwy
Woodhead	1855 - 2016	Integrated	Longdendale and Dovestone Reservoirs
Holden Wood	1910 - 2016	Integrated	Delph and Jumbles Reservoirs
Langley Bottoms	1920 - 2016	Integrated	
Lower Rivington	1900 - 2016	Integrated	Rivington Reservoirs
Stocks	1936 - 2016	Integrated	River Lune LCUS
Barnacre	1880 - 2016	Integrated	River Lune LCUS
Ulpha	1916 - 2016	Integrated	
Ennerdale	1956 - 2016	West Cumbria	Ennerdale Water, Crummock Water
Dale Head Hall (Thirlmere)	1894 - 2016	Integrated	Ullswater, Windermere
Burnbanks (Haweswater)	1932 - 2016	Integrated	Ullswater, Windermere
Geltsdale	1994 - 2016	Carlisle	Castle Carrock Reservoir #
Mean of 9 rain gauges (all except Vyrnwy, Ennerdale and Geltsdale) *	1936 - 2016	Integrated	All in Integrated Resource Zone
Mean of 10 rain gauges (all except Vyrnwy and Geltsdale) *	1956 - 2016	All (United Utilities region)	All in United Utilities region

Castle Carrock Reservoir is not a drought permit/order site, but is the key storage for the Carlisle Resource Zone so it has been included in the table

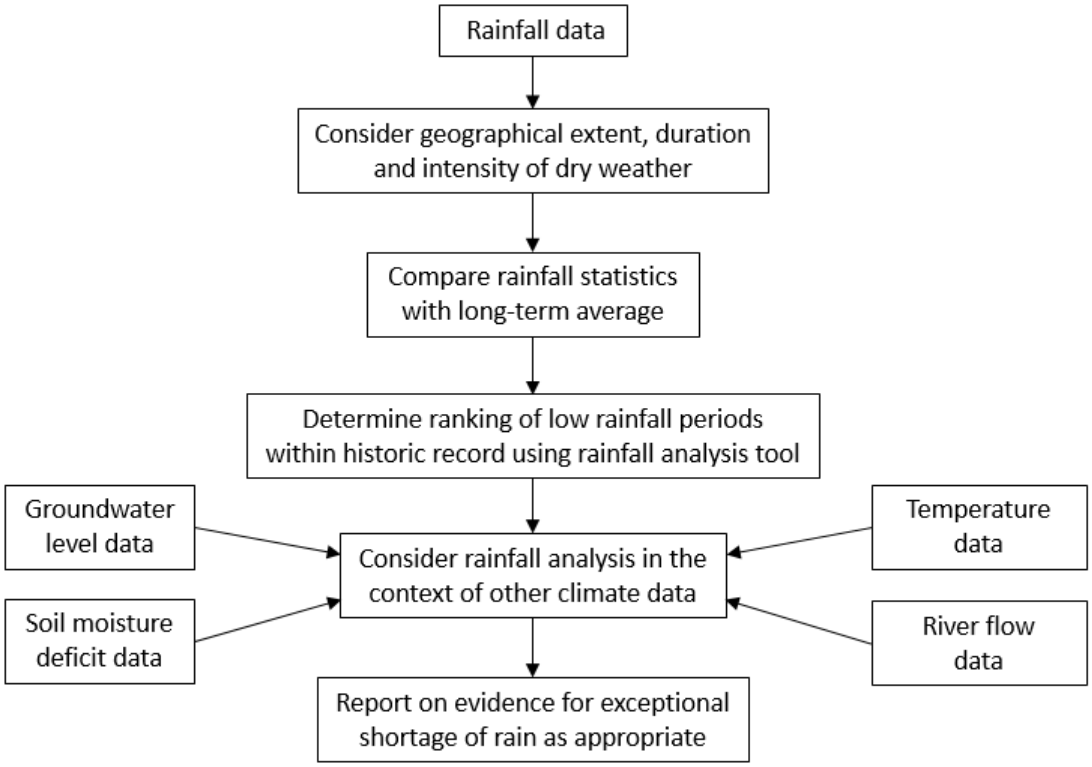
* Geltsdale and Vyrnwy rain gauges are not included in the mean of 9 or 10 rain gauges due to the short record length and location outside of our water supply region, respectively

Other relevant climate data, such as temperature, soil moisture deficit and effective rainfall (the amount of rainfall remaining after evapotranspiration is taken into account), is also collated to support the assessment of dry weather conditions. In each case recent data for the relevant time period is compared to the corresponding long term average values to assess the severity of the developing dry conditions. Trends in this data over the relevant time period are also reviewed and reported on, for example declining river flows

and groundwater levels, or rising soil moisture deficit values, and are additional indicators of developing drought conditions.

A summary of the process involved in analysing rainfall and other climate data and reviewing the evidence for an exceptional shortage of rain is shown in Figure A7.2 below.

Figure A7.2: Summary of rainfall analysis process



APPENDIX 8: Operation of strategic pumping

APPENDIX 8: Operation of strategic pumping

A8.1 Background

As defined in Section 3 (particularly Section 3.6 and Section 3.7), we routinely monitor a range of water resources indicators to determine operational actions and ensure that we can protect water resources should there be a dry year or drought. In doing so, we seek to balance and manage risk across the resource zone using hydrological data and modelling tools. This process is continual, and reviewed each week, so whilst any individual decision in perfect hindsight may prove to be suboptimal, the process is designed to limit the extent of any resulting risk through close monitoring.

Haweswater Reservoir is one of two sources in the Integrated Resource Zone that has drought triggers (see Section 4.2.1). Ullswater and Windermere provide support by offsetting abstraction from Haweswater to retain storage to reduce the risk of needing to implement drought powers. Storage in Haweswater can also be protected directly by reducing abstraction. Additionally the West East Link Main, commissioned in 2012, enables us to transfer more water from the south of the Integrated Resource Zone towards Manchester. These actions, and others, reduce demand on Haweswater, and risk is balanced across the resource zone as a whole as part of operational management.

A8.2 Operational decision-making process

Following the dry winter and spring of 2016/17 we have reviewed and amended our operational decision-making process for strategic pumping. In May 2017 we held discussions with the Environment Agency and the Windermere stakeholders to explain this revised approach to the strategic pumping decision making process. We have also agreed to hold regular meetings with the Environment Agency and Windermere stakeholders to review recent strategic pumping. The first of these meetings was held on 9 October 2017 where operation of strategic pumping between June and September 2017 was discussed.

Figure A8.1 depicts the revised process, which is described below.

The overarching principle is that strategic pumping from Ullswater and/or Windermere will be optimised when Haweswater storage is below resource state curve[17]. However, there are some factors which will be taken into account when determining whether strategic pumping should occur:

- If there is a risk to water quality or the water treatment process at the receiving water treatment works then pumping will not take place
- If rainfall is forecast in the next 5 days[18] which could result in storage in Haweswater recovering to above resource state, then the decision to pump may be deferred until the impact of the rainfall has been observed

[17] The resource state curve is approximately halfway between Trigger 1 and full

[18] Weather forecasts from the Met Office will be regularly reviewed with emphasis on the near-term forecast as there is greater certainty

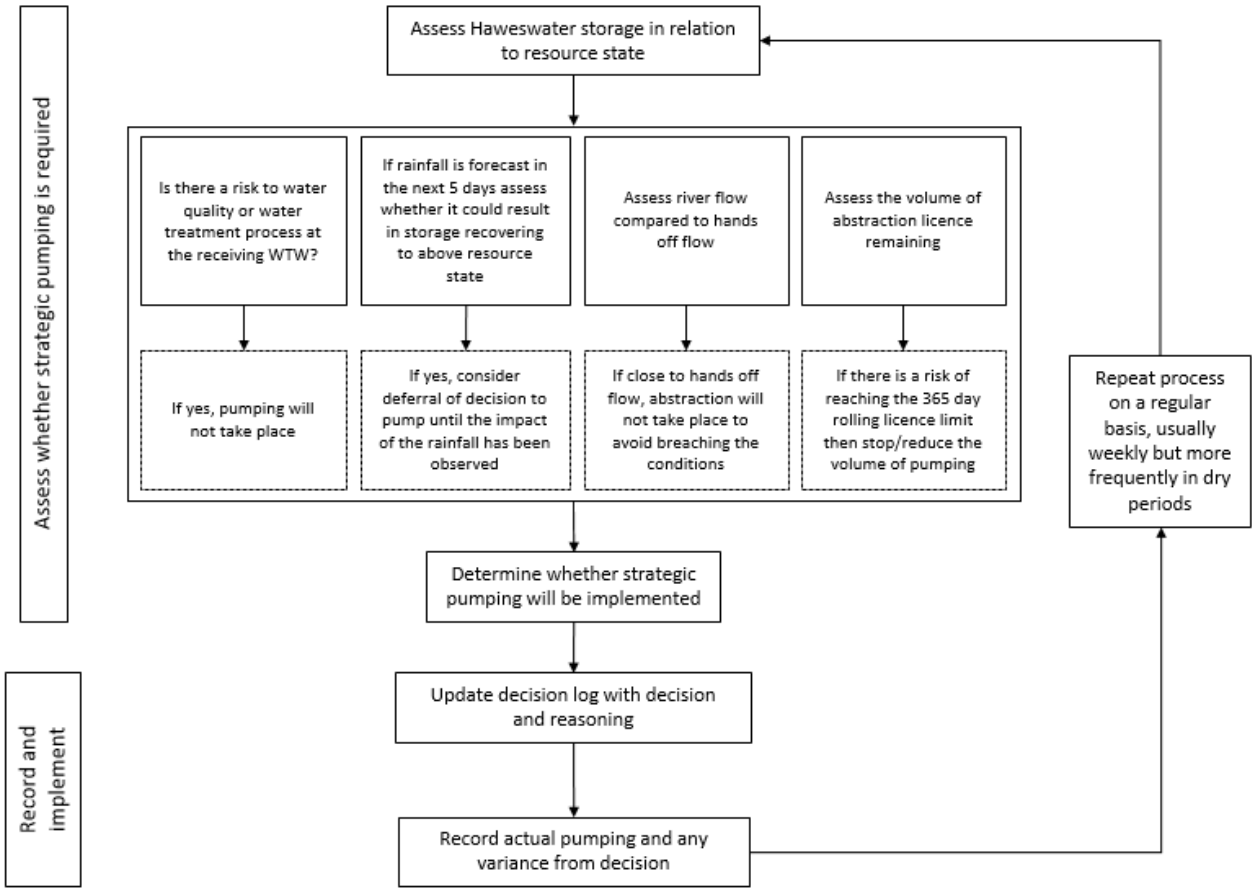
APPENDIX 8: Operation of strategic pumping

- When the downstream river flow is close to the hands off flow, abstraction will not take place to avoid breaching the conditions
- Abstraction licence limits may result in pumping being curtailed if there is a risk of approaching the 365 day rolling licence volume limit. Based on modelled and historic abstraction from Ullswater and Windermere, we do not expect this to be a limitation
- In addition, maintenance activities or asset failure may mean that pumping is sometimes unavailable[19].

The process is split into two phases as shown in Figure A8.1:

1. **Assess whether strategic pumping is required** – based on Haweswater storage relative to resource state and consideration of the factors highlighted
2. **Record and implement** – this is where we record the decision, the actual abstraction rate achieved and explanations for any variance

Figure A8.1: Operational process governing the use of strategic pumped sources



[19] We will seek to plan and complete maintenance and repair work to minimise periods of unavailability

APPENDIX 9: Drought option forms

APPENDIX 9: Drought option forms

A9.1 Demand side options

Option Name: Drought publicity	
Trigger(s) (or preceding actions)	On reaching Trigger 1 we would enhance our water conservation/efficiency publicity programme to customers. At each subsequent trigger the communications to customers would reflect the actions associated with that trigger (e.g. at Trigger 3, a campaign for voluntary water use restraint may commence). Concurrent actions could include rezoning of water supplies
Demand Saving Ml/d unless stated otherwise	The saving associated with drought publicity is difficult to quantify separately to the impact on demand resulting from the implementation of water use restrictions (see following drought option forms). We believe that a combination of increased publicity and a campaign for voluntary water use restraint could result in a saving of 3-5% of the average dry weather demand expected during a drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010 It is important not to place too much reliance on drought publicity achieving a predefined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances, such as uptake of publicity by local and national media
Demand Saving Percentage reduction on peak week demand	The saving associated with a combination of increased publicity and water use restrictions has been estimated to be 3-5% of the average dry weather demand expected during the drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010
Location Area affected or whole supply zone	Drought publicity would be targeted to those areas where it is considered appropriate, however it is likely that the effects would be seen in neighbouring areas

APPENDIX 9: Drought option forms

Option Name: Drought publicity (continued)	
Implementation timetable Time from trigger to implementation, time of year and durations of actions	As part of our normal operation we take an active role in promoting the efficient use of water to all types of household and non-household customers. A range of measures are undertaken including many publicity, education and advisory activities. These activities are estimated to save 3 Ml/d each year during 2015-20. In times of drought, this publicity is enhanced Drought publicity is relevant at all times of year however the nature of the publicity depends on a variety of circumstances, particularly the time of year and recent weather. During the winter, publicity will focus on providing advice to customers to use water wisely inside the home and to lag their pipes to prevent bursts in freezing temperatures. Whereas in the spring/summer, publicity would concentrate on the use of water for garden watering etc. Drought publicity would continue for the duration of a drought event, including drought recovery. It is important that following a drought, customers are thanked for their role in helping the water situation A substantial customer communications programme would accompany the implementation of a Temporary Use Ban to highlight the reasons for the restriction, the need to comply to conserve water, the details of the restriction, to explain the actions being taken by us to protect water supplies and to promote Leakline. A detailed communications plan will be prepared in preparation for the lead up to Trigger 3 (a campaign for voluntary water use restraint) We will also communicate with the Consumer Council for Water, Ofwat and other regulators and bodies as appropriate. Neighbouring water companies, licensed suppliers and inset appointees will also be informed in case of any queries from their own customers. We will also seek to provide a telephone information line or similar service to deal with customer queries, and this will be publicised as part of the communications programme We have an archive of publicity material used in previous drought events and this has been updated to take account of the new legislation on water use restrictions. Examples of drought publicity can be found in Appendix 3
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	None
Risks associated with option	It is important not to place reliance on drought publicity achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances

APPENDIX 9: Drought option forms

Option Name: Enhanced leakage detection and repair	
Trigger(s) (or preceding actions)	On reaching Trigger 2 we would enhance our leakage detection and repair activities Preceding actions could include rezoning of water supplies and customer communication actions
Demand Saving Ml/d unless stated otherwise	Savings made through enhanced leakage detection and repair will vary across the region and will depend upon the situation in other regions of the country, the location and severity of the drought, the timescale for implementation of the action etc. We estimate that there could be a potential saving of up to 5 Ml/d per month It is important not to place too much reliance on leakage detection and repair achieving a predefined demand reduction since the magnitude of any reduction is also influenced by a variety of circumstances including soil moisture deficit, leakage levels at the time and the availability of leak detection and repair resources. Pressure management in the water distribution network is a key aspect of leakage management Droughts can increase leak breakout rates as there is a link between soil-moisture deficit and increasing leakage levels, for example, due to increased subsidence of soils. In this event, additional resources are needed to simply hold leakage steady and the benefit of significant increase to our leakage control activities would be to minimise increases in leakage which might otherwise occur. Therefore, enhanced leakage detection and repair may not result in a reduction in leakage levels, but rather reduce the increase that would otherwise have occurred
Demand Saving Percentage reduction on peak week demand	Potential saving of up to 5 Ml/d per month, however enhanced leakage detection and repair may not result in a reduction in leakage levels, but rather reduce the increase that would otherwise have occurred
Location Area affected or whole supply zone	Enhanced leakage detection and repair would be targeted to those areas where it is considered appropriate, and where the greatest savings can be achieved
Implementation timetable Time from trigger to implementation, time of year and durations of actions	Leakage control is a key activity in managing the balance between water supply and water demand. Our long-term programme for leakage reduction is outlined in our business plan in line with our Water Resources Management Plan. This ensures that we manage leakage at a sustainable and economic level and achieve our target set by Ofwat. Whilst leakage control is a long-term activity, during a drought situation we will make every effort to further reduce leakage beyond our Ofwat target through additional leakage detection and repair over and above our normal efforts. The extent to which, during a drought, our intensive efforts can further reduce leakage will depend on leakage levels and weather conditions at the time Enhanced leakage detection and repair is relevant at all times of year however the success of such activity depends on a variety of circumstances, particularly the time of year and ground conditions Enhanced leakage detection and repair would continue for the duration of a drought event
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Liaise with councils and Highways Agency to reduce notice periods required before a repair can be carried out in the highway
Risks associated with option	It is important not to place reliance on enhanced leakage detection and repair achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances i.e. leakage levels and weather conditions at the time

APPENDIX 9: Drought option forms

Option Name: Campaign for voluntary water use restraint	
Trigger(s) (or preceding actions)	We will give strong consideration to commencing a campaign for voluntary water use restraint at Trigger 3 during the summer (April to September) in order to attempt to reduce external household demand for water. For Ennerdale, this action will occur at Trigger 2 During this time we will undertake a three week representation period for a Temporary Use Ban (at Ennerdale this is reduced to around 2 weeks). We will use this as an opportunity for customers to review their current levels of demand and adjust their behaviour accordingly before implementing a Temporary Use Ban under Section 76 of the Water Industry Act 1991 However, before deciding to commence a campaign for voluntary water use restraint, we would assess actual customer demand data to establish whether sufficient reductions in demand were being achieved from the preceding drought publicity Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions
Demand Saving Ml/d unless stated otherwise	Before commencing a campaign for voluntary water use restraint (particularly on the use of hosepipes connected to the mains water supply for domestic purposes), we will consider carefully what impact it will have on current and forecast levels of demand. It is expected that this will achieve the highest saving of demand from the beginning to reduce the risk of having any further restrictions The saving associated with a campaign for voluntary water use restraint has been estimated to be 3-5% of the average dry weather demand expected during the drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010, however it is possible that greater demand savings could be realised in a future drought event. We believe that the combination of the increased publicity a campaign for voluntary water use restraint could result in a similar level of saving It is important not to place too much reliance on a campaign for voluntary water use restraint achieving a predefined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances, such as temperature, soil moisture deficit, political climate and uptake of publicity by local and national media. All of these factors play a part in reducing demand
Demand Saving Percentage reduction on peak week demand	The saving associated with a campaign for voluntary water use restraint has been estimated to be 3-5% of the average dry weather demand expected during the drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010
Location Area affected or whole supply zone	A campaign for voluntary water use restraint will only be introduced in those areas where it is considered appropriate, as in the case of 2010 drought where the hosepipe ban was only implemented in the Integrated Resource Zone

APPENDIX 9: Drought option forms

Option Name: Campaign for voluntary water use restraint (continued)	
Implementation timetable Time from trigger to implementation, time of year and durations of actions	The commencement of a campaign for voluntary water use restraint would be the first step in the implementation of a Temporary Use Ban and would be initiated at Trigger 3 (Trigger 2 at Ennerdale) with an accompanying communication regarding the commencement of a representation period for the introduction of a Temporary Use Ban. This would be implemented during the summer (April to September). We do not plan to implement a campaign for voluntary water use restraint during the winter (October to March). Instead, we will focus attention in winter on publicity to advise customers to use water wisely inside the home and to lag their pipes to prevent bursts in freezing temperatures. The duration of a campaign for voluntary water use restraint would depend on the current situation but there is no limit on the length of time it could be in place for Duration of a campaign for voluntary water use restraint will depend on the particular circumstances of a drought event. In 1995/96 a hosepipe ban was in place for 14 months and in 2010 one was in place for just 42 days A substantial customer communications programme would accompany a campaign for voluntary water use restraint to highlight the reasons it is needed to help conserve water and to explain the actions being taken by us to protect water supplies and to promote Leakline. It would also explain details of the Temporary Use Ban restrictions, the exception process and detail the timings of the proposed Temporary Use Ban We will also communicate with the Consumer Council for Water, Ofwat and other regulators and bodies as appropriate. Neighbouring water companies, licensed suppliers and inset appointees will also be informed in case of any queries from their own customers. We will also seek to provide a telephone information line or similar service to deal with customer queries, and this will be publicised as part of the communications programme Preparation for a campaign for voluntary water use restraint will commence at Trigger 2 (Trigger 1 at Ennerdale) and a detailed communications plan will be prepared There will be no prior notification for the public for a campaign for voluntary water use restraint, however communications leading up to it will highlight the need for it should customer demand not reduce, and drought permits/orders continue to be required
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	The decision to commence a campaign for voluntary water use restraint rests with the board of United Utilities. The decision will be taken at the same time as the decision to implement a Temporary Use Ban. This will be subject to satisfying the serious deficiency of water available for distribution criteria in Section 76 of the Water Industry Act 1991 We would consult with the Consumer Council for Water and the Environment Agency before implementing a campaign for voluntary water use restraint. We would also have regular communications with these bodies as well as others including Ofwat, Drinking Water Inspectorate, Natural England, Defra etc.
Risks associated with option	It is important not to place reliance on a campaign for voluntary water use restraint achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances. It is important to consider the credibility of any communications with customers

APPENDIX 9: Drought option forms

Option Name: Temporary Use Ban	
Trigger(s) (or preceding actions)	We will give strong consideration to implementing a Temporary Use Ban at Trigger 4 during the summer (April to September) in order to attempt to reduce external household demand for water. We will use the representation period (of three weeks) to implement a campaign for voluntary water use restraint, whilst the notice period runs. The representation period will commence at Trigger 3 (Trigger 2 at Ennerdale). We will use this as an opportunity for customers to review their current levels of demand and adjust their behaviour accordingly before implementing full Temporary Use Ban restrictions under Section 76 of the Water Industry Act However, before deciding to introduce a Temporary Use Ban, we would assess actual customer demand data to establish whether sufficient reductions in demand were being achieved from the campaign for voluntary water use restraint to meet our commitment to customers to not have a Temporary Use Ban in place any earlier than necessary Prior to Trigger 4, we will have implemented an escalated water conservation publicity programme and commenced a campaign for voluntary water use restraint. Preceding actions could also include rezoning of water supplies; bringing water sources online; enhanced leakage control etc.
Demand Saving Ml/d unless stated otherwise	Before implementing a Temporary Use Ban we will consider carefully what impact it will have on current and forecast levels of demand. We would implement all options available under Section 76 of the Water Industry Act. This includes the prohibition of the following: • Watering a garden using a hosepipe • Cleaning a private motor-vehicle using a hosepipe • Watering plants on domestic or other non-commercial premises using a hosepipe • Cleaning a private leisure boat using a hosepipe • Filling or maintaining a domestic swimming or paddling pool • Drawing water, using a hosepipe, for domestic recreational use • Filling or maintaining a domestic pond using a hosepipe • Filling or maintaining an ornamental fountain • Cleaning walls, or windows, of domestic premises using a hosepipe • Cleaning paths or patios using a hosepipe • Cleaning other artificial outdoor surfaces using a hosepipe. The saving associated with water use restrictions has been estimated to be 3-5% of the average dry weather demand expected during the drought period. This is based on experience of hosepipe bans introduced by us in 1995/96 and 2010, however it is possible that greater demand savings could be realised in a future drought event. We have not planned for a further reduction of demand between a campaign for voluntary water use restraint and a Temporary Use Ban It is important not to place reliance on a water use restriction achieving a predefined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances, such as temperature, soil moisture deficit, political climate and uptake of publicity by local and national media, which all play a part in reducing demand

APPENDIX 9: Drought option forms

Option Name: Temporary Use Ban (continued)	
Demand Saving Percentage reduction on peak week demand	During the 2010 drought, implementation of the hosepipe ban resulted in a reduction in demand of approximately 3% - this is the assumption on which our plans have been based upon
Location Area affected or whole supply zone	A Temporary Use Ban will only be introduced in those areas where it is considered appropriate, as in the case of 2010 drought where the hosepipe ban was only implemented in the Integrated Resource Zone
Implementation timetable Time from trigger to implementation, time of year and durations of actions	Preparation for a Temporary Use Ban would begin at Trigger 3 (Trigger 2 for Ennerdale) with an accompanying communication regarding the commencement of a representation period before its implementation at Trigger 4. This would be implemented during the summer (April to September). We do not plan to introduce Temporary Use Bans during the winter (October to March). Instead, we will focus attention in winter on publicity to advise customers to use water wisely inside the home and to lag pipes to prevent bursts in freezing temperatures. The duration of a Temporary Use Ban would depend on the current situation but there is no limit on the length of time a restriction could be in place for Duration of the restrictions will depend on the particular circumstances of a drought event. In 1995/96 the hosepipe ban was in place for 14 months and in 2010 one was in place for just 42 days A substantial customer communications programme would accompany the implementation of a Temporary Use Ban to highlight the reasons for the restriction, the need to comply to conserve water, the details of the restriction, to explain the actions being taken by us to protect water supplies and to promote Leakline. It would also explain the details of any exceptions available to customers and the process by which a customer may apply for an exception We will also communicate with the Consumer Council for Water, Ofwat and other regulators and bodies as appropriate. Neighbouring water companies, licensed suppliers and Inset Appointees will also be informed in case of any queries from their own customers. We will also seek to provide a telephone information line or similar service to deal with customer queries, and this will be publicised as part of the communications programme There will be three weeks notification for the public before the implementation of a Temporary Use Ban, however communications leading up to the restriction will signal our intention to introduce a Temporary Use Ban should demand not reduce and drought permits/orders continue to be required
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	The decision to introduce a Temporary Use Ban rests with the board of United Utilities subject to satisfying the serious deficiency of water available for distribution criteria in Section 76 of the Water Industry Act 1991 Before implementing a Temporary Use Ban, we would consult with the Consumer Council for Water and the Environment Agency. We would have regular communications with these bodies, as well as Ofwat, Drinking Water Inspectorate, Natural England, Defra and other relevant organisations We have developed a customer code of practice that sets out our approach to enforcement of water use restrictions on customers
Risks associated with option	It is important not to place reliance on a Temporary Use Ban achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances. It is important to consider the credibility of any communications with customers

APPENDIX 9: Drought option forms

Option Name: Ordinary drought order (non-essential use ban)	
Trigger(s) (or preceding actions)	Following the implementation of a Temporary Use Ban (after Trigger 4 during the summer (April to September)) we will carefully consider the merits of implementing a drought order to ban non-essential uses of water. This would follow a full assessment of the potential demand savings and the socio-economic impacts such a restriction could have in the North West A campaign for voluntary water use restraint and a Temporary Use Ban (primarily affecting domestic customers) will always be introduced before a drought order to ban non-essential use (primarily affecting commercial customers) is applied for. This approach is in line with the UKWIR Code of Practice and Guidance for Water Companies on Water Use Restrictions (2014) (see Section 3.7 in the UKWIR document) Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions etc. The implementation of a drought order to ban non-essential use may not necessarily be associated with drought permit/order applications depending on factors such as the likely benefit of such an action
Demand Saving Ml/d unless stated otherwise	The benefit will depend upon various factors including the time of year, weather conditions, the supply area concerned and the proportion of demand accounted for by the water uses prescribed in the Drought Direction 2011 (which replaced the Drought Direction of 1991). It will be important to carefully evaluate the possible demand benefits before deciding to implement the ban In 1995/96 we sought to prohibit the full set of uses specified in the Drought Direction 1991 with exceptions applied to automatic car washes that recycled the water. The 1995/96 drought order to ban non-essential use was in force in Greater Manchester, most of Lancashire and south Cumbria from 9 October 1995 to 2 April 1996, affecting a population of 4.1 million. In evaluating the impact of this on demand, it was concluded that it was not a direct demand management tool. The quantity of water saved was very small (about 0.2% of regional supply) and no significant direct impact on demand was observed It is important not to place reliance on a drought order achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances
Demand Saving Percentage reduction on peak week demand	Based on the savings observed during the 1995-96 drought, we would expect to see a reduction of 0.2% in demand
Location Area affected or whole supply zone	A drought order to ban non-essential use will only be introduced in those areas where it is considered appropriate, as in the case of the 1995-96 drought where the ban was only implemented in parts of the region

APPENDIX 9: Drought option forms

Option Name: Ordinary drought order (non-essential use ban) (continued)	
Implementation timetable Time from trigger to implementation, time of year and durations of actions	Following the implementation of a Temporary Use Ban (after Trigger 4 during the summer (April to September)) we will carefully consider the merits of implementing a drought order to ban non-essential uses of water. This would follow a full assessment of the potential demand savings and the socio-economic impacts such a restriction could have in the North West. A drought order will only be introduced in those areas where it is considered appropriate. It will not always be the case that a drought order will be applied across the whole of a resource zone A substantial customer communications programme would accompany the implementation of a drought order to ban non-essential use to highlight the reasons for the restriction, the need to comply to conserve water, the details of the restriction, to explain the actions being taken by us to protect water supplies and to promote Leakline We will also communicate with the Consumer Council for Water, Ofwat and other regulators and bodies as appropriate. Neighbouring water companies, licensed suppliers and Inset Appointees will also be informed in case of any queries from their own customers. We will also seek to provide a telephone information line or similar service to deal with customer queries, and this will be publicised as part of the communications programme The preparation time for a drought order is relatively prolonged due to the need for application to the Secretary of State. There is no statutory time period for the Secretary of State to make a decision. Defra (2015) advise that applicants should allow 28 days for an application to be determined if there are no objections or complications A drought order can last up to six months, though it can be amended to last up to a maximum of one year. We will have a drought order to ban non-essential use in place no longer than necessary
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	The Drought Direction 2011 sets out the non-essential uses of water that can be prohibited or limited by an ordinary drought order (a Non-Essential Use Ban). If we were to apply for such a drought order, a decision would be taken as to which uses to include in the order and whether the use should be prohibited or limited. The decision to apply for a drought order to ban non-essential use rests with the board of United Utilities. To grant such an order the Secretary of State must be satisfied that a serious deficiency of supplies of water in an area exists or is threatened and that the reason for the deficiency is an exceptional shortage of rain (Water Resources Act 1991) Our assessment of the relative merits of a drought order in the summer months would be discussed with the Environment Agency and the Consumer Council for Water
Risks associated with option	It is important not to place reliance on a drought order achieving a pre-defined demand reduction since the magnitude of any reduction is influenced by a variety of circumstances. There is a risk that the Secretary of State will not grant the drought order or may restrict the extent to which certain water uses are curtailed

APPENDIX 9: Drought option forms

A9.2 Integrated Resource Zone drought permits/orders

Option Name: Delph Reservoir drought permit: reduce compensation flow from 3.7 to 1.0 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 3.7 Ml/d to 1 Ml/d. This would result in a temporary reduction in the flow from Delph reservoir to Delph Brook. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the reservoir would be c.2.7 Ml/d, based on the compensation flow reduction. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Local impact in Bolton area. Benefit to Integrated Resource Zone due to conservation of reservoir storage in Delph reservoir, resulting in reduced need to support the area from other local and regional water sources
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Delph Reservoir drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		No designated sites affected The environmental study identified a moderate adverse environmental impact on bullhead, and impacts to all other features were concluded to be minor or negligible. Mitigation measures are expected to reduce the potential impact on bullhead to a non-significant level Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Delph reservoir GB31231264 (HMWB) at moderate (Cycle 2, 2015); Eagley Brook GB112069064570 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological and chemical status are likely to be negligible based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities – fish, quantitative surveys on the Delph Brook (undertaken in 2014, 2015 and 2016)
		Pre- and during drought permit monitoring	United Utilities – fish; weekly walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, or dead fish)
		Post- drought permit monitoring	United Utilities – repeat baseline fish monitoring survey
	Mitigation and compensation measures		We will use Eagley borehole (deployable output of 1.43 Ml/d) to help sustain flows in Eagley Brook (into which Delph Brook flows) and to help mitigate the reduction in Delph reservoir's compensation flow from 3.7 Ml/d to 1.0 Ml/d The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring then various measures could be implemented to mitigate the moderate adverse environmental impact on bullhead, including a return to the statutory compensation flow or a temporary increase in discharge
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

APPENDIX 9: Drought option forms

Option Name: Dovestone Reservoir drought permit: reduce compensation flow from 15.9 to 10.0 or 5.0 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions. A drought action to bring the Swineshaw boreholes (see subsequent drought option form for this source) into supply will be considered prior to an application for drought powers at Dovestone reservoir
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 15.9 Ml/d to between 10 Ml/d and 5 Ml/d. This would result in a temporary reduction in the flow from Dovestone reservoir to Chew Brook. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of Greenfield, Yeoman Hey and Dovestone reservoirs would be between c.5.9 Ml/d to 10.9 Ml/d depending on the magnitude of the compensation flow reduction applied for, or this water could be conserved in the reservoirs to protect the compensation flow. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Local impact in Tameside and Oldham areas. Benefit to Integrated Resource Zone due to conservation of reservoir storage in Dovestone reservoir, resulting in reduced need to support the area from other local and regional water sources
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved. In 1995, one objection was made to the proposed compensation flow reduction at Dovestone reservoir due to concern about the impact on fisheries and ecology in Chew Brook and the River Tame. A local public hearing was held, but the Inspector recommended that the permit be granted

APPENDIX 9: Drought option forms

Option Name: Dovestone Reservoir drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		The Rochdale Canal SAC, primarily designated for its floating water-plantain, is in the local area although the environmental study concluded no impact on the SAC. The site is located within the Peak District National Park The environmental study assessed reducing the compensation flow to 10 Ml/d and 5 Ml/d. The study identified no moderate or major adverse environmental impacts Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Dovestone Reservoir GB31231829 (HMWB) at moderate (Cycle 2, 2015); Chew Brook GB112069061300 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status are likely to be negligible and chemical status are minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities – hydrodynamics cross-section surveys on River Tame, River Mersey, Chew Brook undertaken in 2014 Environment Agency – river flow monitoring on River Tame, River Mersey, Chew Brook (continuous) Environment Agency – water quality monitoring; spot samples on River Tame, River Mersey, Dovestone reservoir (four sites, monthly or bi-monthly depending on parameter)
		Pre- and during drought permit monitoring	United Utilities – hydrodynamics cross-section surveys on River Tame, River Mersey, Chew Brook (fortnightly) United Utilities – fish; weekly walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, or dead fish) Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		As the environmental study did not identify any moderate or major adverse impacts, no mitigation measures are anticipated to be required
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

APPENDIX 9: Drought option forms

Option Name: Swineshaw boreholes drought order		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	Up to 4 Ml/d (based on daily licence limit on abstraction licence revoked in 1992: annual licence limit 727 Ml/yr, daily licence limit 4.1 Ml/d). Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone, also provides local support to the Tameside area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 1 month to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application. No valid abstraction licence in place, therefore a drought order is needed to be able to abstract in a drought (due to the need to discharge the abstracted water in to a watercourse) There are two boreholes each requiring new pump-sets, starter panels, control panels, temporary power (generators) and, potentially, rising mains. Some remedial work on each of the boreholes is also likely to be required. Water will be transferred into existing raw water storage using existing infrastructure to Buckton Castle water treatment works for treatment
	Risks associated with option	That the application, as applied for, is not approved. The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply

APPENDIX 9: Drought option forms

Option Name: Swineshaw boreholes drought order (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2017
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		Following publication of the Draft Drought Plan 2016 we have confirmed that the Swineshaw boreholes option is a drought order and have undertaken an environmental assessment of the option. This concluded the drought order will have a negligible impact on the aquifer, the Higher and Lower Swineshaw Reservoirs and Swineshaw Brook and therefore, negligible impacts on ecological receptors We have also completed Habitats Regulations Assessment Screening which concluded no likely significant effects of implementation of this option (either alone or in-combination with other consents) on the South Pennine Moors SAC and Peak District Moors (South Pennine Moors Phase 1) SPA (1 km from source). South Pennine Moors SAC are primary habitats for dry heaths, blanket bogs, old sessile oak woods and qualifying features are Northern Atlantic wet heaths, transition mires and quaking bogs. The South Pennine Moors SPA supports breeding bird populations. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase. In order to provide additional evidence to support the conclusions of the environmental assessment we commissioned a walkover survey during summer 2017 (when vegetation is present). The survey indicates the vegetation type associated with springs in the study area is not likely to be impacted by any abstraction from the boreholes. We will consult with the Environment Agency and Natural England regarding these conclusions and as to what further work may be needed or agree to remove this option from the drought plan (through the annual Water Resources Management Plan review process). We will not seek to implement this drought option until such time as impacts on the SAC are confirmed WFD waterbodies: Chew Brook to Swineshaw Brook (GB112069061111) and Manchester and East Cheshire Carboniferous Aquifers GB41202G102900 at poor overall (good for quantitative) (Cycle 2, 2015). The Environmental Assessment of the drought option identified negligible impacts on groundwater and surface waterbodies. Risks of drought order implementation on WFD ecological status and chemical status are anticipated to be negligible based on the conclusions of the environmental assessment. No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data from borehole pump tests, the Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	Baseline walkover survey to identify any water dependant features of the South Pennine Moors SAC (completed in summer 2017)
		Pre- and during drought order monitoring	Walkover survey of water dependant features before and during drought order implementation (frequency and areas to be surveyed to be confirmed following baseline survey completion)
		Post- drought order monitoring	Walkover survey of water dependant features after drought order implementation (areas to be surveyed to be confirmed following baseline survey completion)
	Mitigation and compensation measures		None
	Impact on other activities e.g. fisheries, industry etc.		None

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Option Name: Jumbles Reservoir drought permit: reduce compensation flow from 19.9 to 12.0 or 6.0 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 19.9 Ml/d to between 12 Ml/d and 6 Ml/d. This would result in a temporary reduction in the flow from Jumbles reservoir to Bradshaw Brook. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the associated supply reservoirs of Wayoh and Entwistle would be between c.8 Ml/d to 14 Ml/d depending on the magnitude of the compensation flow reduction applied for. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Local impact in Bolton area. Benefit to Integrated Resource Zone due to conservation of reservoir storage in Jumbles reservoir for the purpose of providing a compensation flow release to Bradshaw Brook, resulting in reduced need to support the area from other local and regional water sources
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Jumbles Reservoir drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		No protected sites affected The environmental study identified a moderate adverse environmental impact on hydrodynamics (river flow, level and wetted area) for the option of reducing compensation flow to 6 Ml/d. Mitigation measures are expected to reduce the impact to a non-significant level. No moderate or major adverse environmental impacts were identified for the option of reducing compensation flow to 12 Ml/d Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Jumbles Reservoir GB31231306 (HMWB) at moderate (Cycle 2, 2015); Bradshaw Brook GB112069064580 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities – hydrodynamics cross-section surveys on Bradshaw Brook and River Irwell undertaken in 2014-2015 Environment Agency – river flow monitoring on Bradshaw Brook, River Croal and River Irwell (continuous) Environment Agency – water quality monitoring; spot samples on Bradshaw Brook and River Croal (two sites, quarterly)
		Pre- and during drought permit monitoring	United Utilities – hydrodynamics cross-section surveys on River Tame, River Mersey, Chew Brook (fortnightly) United Utilities – fish; weekly walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, or dead fish) Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring then various measures could be implemented to mitigate the moderate adverse environmental impact on hydrodynamics, including a return to the statutory compensation flow or a temporary increase in discharge In implementing the drought powers, we will aim to keep Jumbles reservoir above 11.45 m btwl to protect fish in the reservoir. If this is not possible, we will agree further actions with the Environment Agency e.g. a new application to further reduce compensation flows (to conserve storage in the reservoir) or a fish rescue
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified a minor adverse impact on landscape and visual amenity due to reduced river levels for the option of reducing compensation flow to 6 Ml/d

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Option Name: Longdendale Reservoirs drought permit: reduce compensation flow from 45.5 to 22.5 or 15 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 45.5 Ml/d to 22.5 Ml/d or 15 Ml/d. This would result in a temporary reduction in flow from the Longdendale reservoirs to the River Etherow. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the source would be between c.23 Ml/d to 30 Ml/d depending on the magnitude of the compensation flow reduction applied for. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Integrated Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

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Option Name: Longdendale Reservoirs drought permit (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	No protected sites affected. The Longdendale reservoirs are located just within the Peak District National Park, however the downstream watercourse (River Etherow) is outside the boundary The environmental study identified the following moderate environmental impacts for the option of reducing the compensation flow to 22.5 Ml/d. Mitigation measures are expected to reduce these impacts to a non-significant level: • Moderate adverse impact on Atlantic salmon (fry and parr), bullhead and lamprey ammocoetes The environmental study identified the following moderate or major adverse environmental impacts for the option of reducing the compensation flow to 15 Ml/d. Mitigation measures are expected to reduce these impacts to a non-significant level: • Moderate adverse impact on hydrodynamics (river flow, level and wetted area) • Moderate adverse impact on water quality (DO, BOD, ammonia, pH) and WFD UKTAG standards • Major adverse impact on Atlantic salmon (fry and parr) • Moderate adverse impact on sea/brown trout (fry and juveniles/parr), bullhead and lamprey ammocoetes Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Valehouse (includes Bottoms) reservoir GB31232150 (HMWB) at moderate (Cycle 2, 2015); Etherow (Woodhead Reservoir to Glossop Brook) GB112069060780 (HMWB) at moderate (Cycle 2, 2015); Etherow (Glossop Brook to Goyt) GB112069061050 (not designated artificial or heavily modified) at poor (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be moderate to major based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken

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Option Name: Longdendale Reservoirs drought permit (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	United Utilities – hydrodynamics cross-section surveys on River Etherow, River Goyt and River Mersey, undertaken in 2014 United Utilities – fish, quantitative surveys on River Etherow, and lamprey surveys on River Etherow and River Goyt (undertaken in 2014, 2015 and 2016) United Utilities – wet woodland/fen habitat, baseline survey of species composition and water level preferences 2 sites in SSSI (undertaken in 2014) Environment Agency – routine macroinvertebrate monitoring at four sites Environment Agency – river flow monitoring on River Etherow, River Goyt and River Mersey (continuous) Environment Agency – water quality monitoring; spot samples on River Etherow (four sites, quarterly)
		Pre- and during drought permit monitoring	United Utilities – hydrodynamics cross-section surveys on River Etherow, River Goyt and River Mersey (fortnightly) United Utilities – fish; weekly walkover surveys of River Etherow, looking for signs of fish in distress (e.g. gasping, trapped, or dead fish) Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	United Utilities – continue baseline monitoring programme Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring then various measures could be implemented to mitigate the moderate/major adverse environmental impacts outlined above, including a return to the statutory compensation flow, a temporary increase in discharge or freshet flow releases In implementing drought powers, we will aim to keep Bottoms reservoir (part of the Longdendale reservoir system) above 9.5 m btwl to protect fish in the reservoir. If this is not possible, we will agree further actions with the Environment Agency e.g. a new application to further reduce compensation flows (to conserve storage in the reservoir) or a fish rescue
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified a minor adverse impact on landscape and visual amenity due to reduced river levels

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Option Name: River Lune LCUS drought permit: reduce prescribed flow from 365 to a minimum of 200 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the prescribed flow requirement at Skerton Weir from 365 Ml/d to a minimum of 200 Ml/d. This would allow us to abstract from the River Lune (part of the Lancashire Conjunctive Use Scheme, LCUS) at lower river flows than normal. This would result in a temporary reduction in the flow in the River Lune. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances The potential benefit of drought powers at River Lune (LCUS) is dependent upon the exact scope of the application and the pattern of weather conditions. Drought powers to allow increased abstraction from the River Lune (LCUS) will reduce demand on the Lake District and Pennine reservoirs. The benefits of drought powers would be greatest over a dry winter to aid refill of reservoirs. For this reason, the Deployable Output based on Aquator modelling of historic drought conditions is small, however, greater benefits are likely to be realised under prolonged or multiple-season drought events that are more severe than historically experienced (and to supplement resources elsewhere in the zone to reduce risks). To indicate the material benefit that may be realised in a multiple-season drought event, analysis of historic flow data in the 1995/96 drought has indicated the drought permit could provide up to 26 Ml/d additional yield over the course of the event
	Location Area affected or whole supply zone	Integrated Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

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Option Name: River Lune LCUS drought permit (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low Environmental study completed in 2016
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	The River Lune is one of five major fresh water sources to Morecambe Bay (SAC/SPA/Ramsar/SSSI) which also include the rivers Leven, Kent, Keer and Wyre however the environmental study showed that there are no impacts of drought permit implementation on these designated sites. The LCUS abstraction site is located just within the Forest of Bowland AONB, however the downstream watercourse (River Lune) is outside the boundary The prescribed flow reduction would result in reduced river flows in the lower stretches of the River Lune. In drought conditions, the flow in the River Lune will naturally be lower than normal and the drought permit provisions will not result in any significant further reduction to low flows (as a prescribed flow, albeit lower, will still be in place to govern abstraction) although it could increase the number of days at lower flows The environmental study assessed two prescribed flow reductions, to 250 Ml/d and 200 Ml/d, and two abstraction scenarios (1995/96 drought maximum abstraction rate and licence maximum). The study identified potential moderate impacts on downstream migrating salmon smolts due to increased predation if a drought permit is implemented in March to May. All other environmental impacts were identified as minor or negligible Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbody: Lune (Wenning confluence to tidal) GB112072065980 (not designated artificial or heavily modified) at good (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, ecological monitoring and water quality. In addition river cross-section measurements were taken to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Water quality (including SIMCAT) and river flow modelling was also undertaken. An extreme high tide occurred on 29 September 2015 (the highest predicted until 2035) and we used this to collect salinity measurements close to third party abstraction intakes (near Skerton weir). A walkover survey to map habitat was completed. Discussions were held with the Lancaster Port Commission to understand potential impacts near Glasson Dock and they made their historic reports and hard copy maps of their bathymetric mapping of the low flow channel of the approach to the port available to us In 1995, following a public hearing, an application to reduce the prescribed flow to 200 Ml/d over the winter months was refused on grounds of adverse impacts on a specific genetic strain of spring salmon. Following this refusal, the Environment Agency and us commissioned an independent report from APEM to assess the spring salmon issues and the impacts of winter River Lune drought powers. The final report by APEM (1999) concluded that a reduction to the prescribed flow from 365 Ml/d to 200 Ml/d during winter months would have little or no impact on spring salmon migration in the River Lune

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Option Name: River Lune LCUS drought permit (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	United Utilities – monitoring to identify saline incursion that may affect industrial users. Hourly when tidal and/or storm overtopping of Skerton Weir is predicted during low river flows (three occasions)
		Pre- and during drought permit monitoring	United Utilities – water salinity, hourly monitoring during selected overtopping (Skerton Weir) events and to monitor flushing, if necessary, only during low river flows United Utilities – walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, dead fish) and/or of aggregations of piscivorous birds. Evidence of algal blooms should also be noted Industrial abstractors - routine monitoring by abstractors during drought permit operation for evidence of cavitation
		Post- drought permit monitoring	None required
	Mitigation and compensation measures		The EMP recommended implementation of measures to scare piscivorous birds; installation of fish refuges; provision of elver passes; temporary reduction/cessation of our abstraction; rapid deployment for fish rescue and localised aeration should fish in distress be observed
	Impact on other activities e.g. fisheries, industry etc.		For the 200 Ml/d prescribed flow scenario, the environmental study identified a precautionary moderate adverse impact on the availability of water to other abstractors as a result of lower river levels resulting in potential pump cavitation issues The environmental study also identified minor adverse impacts on: • Landscape and visual amenity due to reduced river flows • Other abstractors due to water quality (saline incursion over Skerton weir) • Recreational angling A potential benefit to the Lune estuary haaf netting industry was identified

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Option Name: Rivington Reservoir – Brinscall Brook drought permit: reduce compensation flow from 3.9 to 2.0 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 3.9 Ml/d to 2 Ml/d. This would result in a temporary reduction in the flow from The Goit (a man-made channel linking Rake Brook and Anglezarke reservoirs) to Brinscall Lodge. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the source would be c.1.9 Ml/d. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Local impact in Wigan area
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Rivington Reservoir – Brinscall Brook drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		No protected sites affected The environmental study identified a moderate adverse impact on Atlantic salmon and brown/sea trout fry and parr, bullhead and eel. Mitigation measures are expected to reduce the impacts to a non-significant level Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Rivington reservoirs GB31231288 (HMWB) at moderate (Cycle 2, 2015); Douglas Upper GB112070064850 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities – lamprey surveys of the River Yarrow and Black Brook (carried out in 2014, 2015 and 2016) Environment Agency – fish monitoring of the River Yarrow, Black Brook and The Goit (frequency as per routine monitoring programme) Environment Agency – macroinvertebrate monitoring of the Black Brook and The Goit at three routine sites (in line with Environmental Agency routine monitoring programme) Environment Agency – water quality monitoring; spot samples on River Yarrow (three sites, quarterly)
		Pre- and during drought permit monitoring	United Utilities – fish; weekly walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, or dead fish) United Utilities – repeat baseline monitoring programme for lamprey Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	United Utilities – repeat baseline monitoring programme for lamprey Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring then various measures could be implemented to mitigate the moderate adverse environmental impact on fish, including: • A return to the statutory compensation flow • A temporary increase in discharge • Provision of juvenile trout habitat creation to provide alternative, less flow sensitive, sites through impacted river reaches
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

APPENDIX 9: Drought option forms

Option Name: Rivington Reservoir – White Coppice drought permit: reduce compensation flow from 4.9 to 2.0 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would reduce the compensation flow requirement from 4.9 Ml/d to 2 Ml/d. This would result in a temporary reduction in the flow from The Goit (a man-made channel linking Rake Brook and Anglezarke reservoirs) to White Coppice Lodge. The precise reduction would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the source would be c.2.9 Ml/d. Previous Aquator modelling has shown that compensation flow reductions of this type have a 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Local impact in Wigan area
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Rivington Reservoir – White Coppice drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		No protected sites affected The environmental study identified a moderate adverse impact on Atlantic salmon and brown/sea trout fry and parr and bullhead. Mitigation measures are expected to reduce the impacts to a non-significant level Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Rivington Reservoirs GB31231288 (HMWB) at moderate (Cycle 2, 2015); Douglas Upper GB112070064850 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities – lamprey surveys of the River Yarrow and Black Brook (carried out in 2014, 2015 and 2016) Environment Agency – fish monitoring of the River Yarrow, Black Brook and The Goit (frequency as per routine monitoring programme) Environment Agency – macroinvertebrate monitoring of the Black Brook and The Goit at three routine sites (in line with Environmental Agency routine monitoring programme) Environment Agency – water quality monitoring; spot samples on River Yarrow (three sites, quarterly)
		Pre- and during drought permit monitoring	United Utilities – fish; weekly walkover surveys looking for signs of fish in distress (e.g. gasping, trapped, or dead fish) United Utilities – repeat baseline monitoring programme for lamprey Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	United Utilities – repeat baseline monitoring programme for lamprey Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring then various measures could be implemented to mitigate the moderate adverse environmental impact on fish, including: • A return to the statutory compensation flow • A temporary increase in discharge • Provision of juvenile trout habitat creation to provide alternative, less flow sensitive, sites through impacted river reaches
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

APPENDIX 9: Drought option forms

Option Name: Ullswater drought permit: reduce hands-off flow conditions and/or relax 12-month rolling abstraction licence limit		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	Drought powers could cover the following aspects to allow us to continue abstracting: • Reduce hands-off flow in the River Eamont at Pooley Bridge to a minimum of 95 Ml/d (the statutory prescribed flow varies throughout the year from January to December: 386 Ml/d, 386 Ml/d, 350 Ml/d, 273 Ml/d, 273 Ml/d, 195 Ml/d, 195 Ml/d, 195 Ml/d, 195 Ml/d, 195 Ml/d, 232 Ml/d, 232 Ml/d) • Relax 12-month rolling abstraction licence limit (45,634 Ml/yr) The scope of required powers would be discussed fully with the Environment Agency and Natural England and will depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output depends on the extent of the drought powers applied for and the pattern of weather conditions. Based on the 'design' 1984 single-season drought event the Deployable Output benefit is modest at 5 Ml/d (derived using our Aquator models), however, this masks wider benefits during more extreme or two-season drought events (such as 1995/96, when the modelled Deployable Output benefit increases to ~13 Ml/d). During such events, winter refill is particularly critical to protect against a subsequent risk of a dry summer the following year. Based on previous drought experience, during dry summer weather conditions, the abstraction benefit could be as high as 50-60 Ml/d, and 70-100 Ml/d under dry winter conditions
	Location Area affected or whole supply zone	Integrated Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Ullswater drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2016
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		Ullswater and the River Eamont are within the River Eden SAC which is designated primarily for its oligotrophic to mesotrophic standing water habitats, water courses of plain to montane levels and alluvial forest habitats. The primary designated species are white-clawed crayfish, sea/brook/river lamprey, Atlantic salmon, bullhead and otter. The River Eden and Tributaries is also a SSSI. Ullswater is located within the Lake District National Park The environmental study assessed the impact of reducing the hands-off flow to 95 Ml/d and relaxation of the annual licence limit. The study concluded that environmental impacts of drought permit implementation on designated sites including the River Eden SAC, fish and all designated and non-designated features would be negligible Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites and that Appropriate Assessment would not be required WFD waterbodies: Ullswater GB30228955 (not designated artificial or heavily modified) at moderate (Cycle 2, 2015); Eamont Upper GB102076071020 (not designated artificial or heavily modified) at good (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, lake level, ecological monitoring and water quality. River cross-section measurements were taken in 2010 throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Water quality and water resources modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities - River Eamont vulnerable areas walkover survey (undertaken in 2013, update after 5 years (or if events likely to have significantly altered baseline)) Environment Agency – continuous lake level and river flow monitoring Environment Agency – river water quality spot samples (three sites, monthly). Continuous lake water quality monitoring
		Pre- and during drought permit monitoring	United Utilities – continue baseline monitoring programme Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	United Utilities – continue baseline monitoring programme Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study concluded that the impacts of drought permit implementation would be negligible. Consequently, no mitigation measures are considered necessary
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify impacts on any other features

APPENDIX 9: Drought option forms

Option Name: Lake Vyrnwy drought permit: reduce compensation flow from 45 to 25 Ml/d		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	Reducing the compensation flow from 45 Ml/d to 25 Ml/d would result in a temporary reduction in flow from Lake Vyrnwy to the Afon Vyrnwy. The precise reduction would be discussed fully with the Environment Agency and Natural Resources Wales and would depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output of the reservoir would be c.20 Ml/d. Previous Aquator modelling has shown that compensation flow reductions of this type have a typically 1:1 benefit on source yield. Benefits to the wider zone are drought event specific
	Location Area affected or whole supply zone	Integrated Resource Zone: supports Liverpool area and Manchester via West-East link
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of application
	Risks associated with option	That the application, as applied for, is not approved or that the application conflicts with a drought order application by the Environment Agency to temporarily increase the Vyrnwy water bank releases to the River Severn system

APPENDIX 9: Drought option forms

Option Name: Lake Vyrnwy drought permit (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	The Severn Estuary SAC/SPA/Ramsar, Berwyn SPA, and the Berwyn and South Clwyd Mountains SAC designated sites are within the locality of Lake Vyrnwy. The environmental study concluded no adverse impacts on these protected sites In their response to our Draft Drought Plan 2006 consultation, Countryside Council for Wales (now Natural Resources Wales) confirmed that the drought permit is unlikely to have any adverse effect on the Berwyn SAC features or adjacent SSSIs The environmental study identified moderate adverse impacts on Atlantic salmon (fry and parr only), although this impact would be reduced to minor adverse with mitigation measures adopted Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Lake Vyrnwy GB30935568 (HMWB) at moderate (Cycle 2, 2015); Afon Vyrnwy - Lake Vyrnwy to confluence with Afon Cownwy (i.e. Marchnant) GB109054049880 (HMWB) at moderate (Cycle 2, 2015; Afon Cownwy - source to confluence with Afon Vyrnwy GB109054049750 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, reservoir level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken The Environment Agency and Natural Resources Wales, working with relevant water companies and stakeholders, manage the River Severn regulation system. The Environment Agency is responsible for applying for a River Severn drought order. This reduces the prescribed flow at Bewdley to prolong storage in Llyn Clywedog, enabling regulation to continue supporting the environment and public water supply needs for as long as possible during a severe drought. The Environment Agency and Natural Resources Wales reviewed the process for such applications in 2013, in consultation with all relevant water companies, stakeholders and the public. This ensures that water company drought plans and the Environment Agency's plans are aligned. One of the actions in the Environment Agency's River Severn Drought Order Environmental Assessment report (https://www.gov.uk/government/publications/river-severn-drought-order-environmental-report) is to discuss an overdraft of the Lake Vyrnwy water bank but notes that the feasibility of this will depend on whether there is sufficient excess storage in Lake Vyrnwy, and if we are able to spare the water at low risk to public water supplies. During drought conditions, we will liaise with the Environment Agency to discuss potential management actions for the River Severn system

APPENDIX 9: Drought option forms

Option Name: Lake Vyrnwy drought permit (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	United Utilities – hydrodynamics, cross-section surveys, undertaken 2014 United Utilities – record occasions (including frequency and duration) when it is not possible to operate Dolanog hydroelectric plant due to low flows United Utilities – fish and lamprey surveys at six sites, undertaken in 2014, 2015 and 2016 United Utilities – macroinvertebrate surveys at three sites, undertaken in 2014, 2015 and 2016 Natural Resources Wales – river flow monitoring of Afon Vyrnwy (continuous) Natural Resources Wales – macroinvertebrates; routine monitoring at three sites (spring and autumn in line with Natural Resources Wales routine monitoring programme)
		Pre- and during drought permit monitoring	United Utilities – fortnightly walkover surveys (including cross-sections) to identify signs of environmental stress (fish in distress, dry channel etc.) United Utilities – record occasions (including frequency and duration) when it is not possible to operate Dolanog hydroelectric plant due to low flows United Utilities – macroinvertebrates, repeat baseline survey at three sites Natural Resources Wales – continue baseline monitoring programme
		Post- drought permit monitoring	United Utilities – repeat baseline fish and macroinvertebrate surveys Natural Resources Wales – resume baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts on salmon are occurring, various mitigation measures could be implemented including a temporary return to the statutory compensation flow or freshet flow releases. If these are adopted then the impact on salmon would reduce to minor adverse
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified a moderate adverse impact on another abstractor, the hydroelectric power station at Dolanog, and mitigation measures were considered e.g. provision of temporary pumps or appropriate compensation in the event that the power station cannot operate due to lower river flows resulting from the drought permit. Adoption of these mitigation measures would result in the impact reducing to minor adverse The environmental study identified a minor adverse impact during April to September on recreational angling opportunity on the downstream river Lake Vyrnwy can release water to the River Severn to support the river flow. This is important to the Canal and River Trust for both navigation on the River Severn and abstraction of water to the Gloucester and Sharpness Canal (from which Bristol Water abstracts). The Canal and River Trust will be consulted if drought powers at Vyrnwy are being considered

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: reduce hands-off flow conditions and/or relax 12-month rolling abstraction licence limit (Scenario 1 with no lake drawdown)		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (Integrated Resource Zone). Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	Drought powers at Windermere could cover either or both of the following aspects to allow us to continue abstracting: • Reduce hands-off flow conditions in the River Leven at Newby Bridge to a minimum of 95 Ml/d (the statutory prescribed flow varies throughout the year: 273 Ml/d in May to September and 136 Ml/d in October to April) • Relax 12-month rolling abstraction licence limit (36,504 Ml/yr) This scenario, Scenario 1, does not include a lake drawdown The scope of required powers would be discussed fully with the Environment Agency and will depend upon the need for additional water, time of year and current environmental circumstances. The benefit to deployable output depends on the extent of the drought powers applied for and the pattern of weather conditions. Based on the 'design' 1984 single-season drought event the Deployable Output benefit is around 10 Ml/d (using our Aquator models), although this masks wider benefits during more extreme or two-season drought events (such as 1995/96). During such events, winter refill is particularly critical to protect against a subsequent risk of a dry summer the following year. For example, it was estimated that the 2003 drought permit would give an abstraction benefit of up to 50 Ml/d in dry conditions over the period December to March inclusive (with no drawdown of the lake)
	Location Area affected or whole supply zone	Integrated Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: (Scenario 1 with no lake drawdown, continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low Environmental study completed in 2016
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Lake Windermere is located within the Lake District National Park and is designated as a County Wildlife Site. A small proportion of Windermere is within the Low Wray Bay SSSI designated for its preserved sediments. The environmental assessment concluded a Scenario 1 drought permit would have negligible impact on this SSSI. The River Leven, which flows out of Windermere, is one of five major fresh water sources to Morecambe Bay (SAC/SPA/Ramsar/SSSI) which also include the rivers Lune, Kent, Keer and Wyre. Discussions with the Environment Agency and Natural England, as part of the environmental study, ascertained that the impact on Morecambe Bay is likely to be insignificant given the relative volumes of water involved and the large attenuation volumes available in Morecambe Bay. Therefore, no designated sites are impacted by implementation of a Scenario 1 drought permit The environmental study assessed the impacts of reducing the hands-off flow to 95 Ml/d and relaxing the annual licence limit. The study identified no moderate or major adverse environmental impacts Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Windermere South Basin GB31247008 (HMWB) at moderate (Cycle 2, 2015); Windermere North Basin GB31247007 (HMWB) at moderate (Cycle 2, 2014); River Leven GB112073071420 (not designated artificial or heavily modified) at good (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, lake level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Water resources modelling was also undertaken. The Windermere water bank agreement was revised and agreed with the Environment Agency and local stakeholders in December 2012

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: (Scenario 1 with no lake drawdown, continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	**River Leven** United Utilities – hydrodynamics flow gauging at four sites. Flows at or below baseline hands off flows, and at or below 95 Ml/d Environment Agency – river water quality spot samples (two sites, monthly / bi-monthly) **Windermere** United Utilities – fixed point photography of shoreline exposure at key locations to inform landscape assessment if water level in Windermere falls significantly below the weir crest United Utilities - *Setodes argentipunctellus* (a rare caddisfly), one spring survey to establish baseline population count Environment Agency – routine lake level and water quality monitoring
		Pre- and during drought permit monitoring	**River Leven** United Utilities – walkover survey from Newby Bridge to tidal limit fortnightly during drought permit implementation Environment Agency – continue baseline monitoring programme **Windermere** United Utilities – fixed point photography of shoreline exposure at key locations fortnightly during drought permit implementation. Photography of tributary mouths (fish access), fortnightly if drought permit is implemented between October and March United Utilities – visual assessment of known Arctic charr spawning sites fortnightly if drought permit is implemented between October and May United Utilities - *Setodes argentipunctellus* (a rare caddisfly) survey in spring Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	**River Leven** Environment Agency – continue baseline monitoring programme **Windermere** United Utilities – continue fixed point photography surveys if required United Utilities - *Setodes argentipunctellus,* repeat baseline survey annually in spring for two years following implementation of a drought permit Environment Agency – continue baseline monitoring programme
	Mitigation and compensation measures		The environmental study concluded that there are no moderate or major impacts of implementing a Scenario 1 drought permit. Consequently, no mitigation measures are considered necessary. The new Windermere water bank agreement agreed in December 2012 states that at any time that Windermere is 2.5 cm below weir crest and/or Haweswater storage has crossed Trigger 3, a meeting of the Windermere stakeholder group will be convened to include representatives from the following organisations: United Utilities, Environment Agency, Holker Estates, Windermere Lake User Forum, Windermere Lake Cruises Ltd and Windermere Marina Village Ltd. Through this process the most effective use of the Windermere water bank will be discussed
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified no adverse impacts of implementation of a Scenario 1 drought permit on non-environmental features. The Windermere stakeholder group would be consulted if drought powers at Windermere are being considered

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: relax 12-month rolling abstraction licence limit and/or permit drawdown of lake level (up to a maximum of 0.5 m below weir crest) (Scenario 2 with lake drawdown)		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	We would only consider applying for a Scenario 2 drought permit at Windermere (i.e. with a lake drawdown) once we had applied for and implemented the Scenario 1 drought permit (i.e. without a lake drawdown). The implementation of the Scenario 1 drought permit, at Haweswater Trigger 4, is expected to be once every 65 years (see Figure 11). The likelihood of applying for a Scenario 2 drought permit is therefore even lower. The drought scenario testing outlined in Appendix 6 used an indicative implementation point for the Scenario 2 drought permit at emergency storage, i.e. to protect against the most severe of drought eventualities. In testing more severe drought events, with the benefit of earlier drought interventions and powers taken into account, this level was not reached even under a drought event estimated indicatively to be of a 0.1% annual probability of occurrence. Preceding actions could include rezoning of water supplies; bringing water sources online; customer communication actions and demand restrictions
	Deployable Output of action Ml/day. Include how this is calculated	Drought powers at Windermere could cover the following aspects to allow us to continue abstracting: • Permit drawdown of lake level up to a maximum of 0.5 m below the crest of Newby Bridge weir. During drawdown, releases to the River Leven would be made by the Environment Agency through their fisheries sluice depending on the current requirements of the river • Relax 12-month rolling abstraction licence limit (36,504 Ml/yr) This scenario, Scenario 2, includes a lake drawdown The scope of required powers would be discussed fully with the Environment Agency and will depend upon the need for additional water, time of year and current environmental circumstances. The option to lower the level of Windermere would be introduced as a precautionary measure that might be required during a very extreme drought. Based on the 'design' 1984 single-season drought event the Deployable Output benefit is around 18 Ml/d (using our Aquator models), although the benefit to deployable output depends on the extent of the drought powers applied for and the pattern of weather conditions. Previous estimates have indicated that under dry summer weather conditions, the abstraction benefit could be up to 90-110 Ml/d. It was also estimated that the 2003 drought permit would give a benefit of up to 50 Ml/d in dry conditions over the period December to March inclusive (with no drawdown of the lake)
	Location Area affected or whole supply zone	Integrated Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 3 Application of drought permit from Trigger 4 Implementation of drought permit indicatively at around emergency storage in Haweswater Reservoir Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application. Approval for dredging (if required)
	Risks associated with option	That the application, as applied for, is not approved or that dredging, if required, is not approved

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: (Scenario 2 with lake drawdown, continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Medium Environmental study completed in 2016 including an extensive socio-economic assessment
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Lake Windermere is located within the Lake District National Park and is designated as a County Wildlife Site. A small proportion of Windermere is within the Low Wray Bay SSSI designated for its preserved sediments. The environmental assessment concluded a Scenario 2 drought permit/order would have minor impacts on this SSSI. The River Leven, which flows out of Windermere, is one of five major fresh water sources to Morecambe Bay (SAC/SPA/Ramsar/SSSI) which also include the rivers Lune, Kent, Keer and Wyre. Discussions with the Environment Agency and Natural England, as part of the environmental study, ascertained that the impact on Morecambe Bay is likely to be insignificant given the relative volumes of water involved and the large attenuation volumes available in Morecambe Bay. Therefore, no designated sites would be impacted by implementation of a Scenario 2 drought permit The environmental study assessed the impacts of drawdown of the lake by a maximum of 0.5 m below weir crest level and relaxation of the annual licence limit The study identified the following moderate/major environmental impacts: • Moderate adverse environmental impact on lake hydrodynamics/shoreline exposure in Windermere around Belle Isle due to lowered lake levels and • Moderate adverse impact on Atlantic salmon migration to and from tributaries of Windermere • Moderate adverse impact on some species of invertebrates/macroinvertebrates in Windermere (during July to September) • Moderate adverse impact on flow in the River Leven downstream of Newby Bridge and at Low Wood Weir Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Windermere South Basin GB31247008 (HMWB) at moderate (Cycle 2, 2015); Windermere North Basin GB31247007 (HMWB) at moderate (Cycle 2, 2014); River Leven GB112073071420 (not designated artificial or heavily modified) at good (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, lake level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Water resources modelling was also undertaken. The Windermere water bank agreement was revised and agreed with the Environment Agency and local stakeholders in December 2012

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: (Scenario 2 with lake drawdown, continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	**River Leven** United Utilities – hydrodynamics flow gauging at four sites. Flows at or below baseline hands off flows, and at or below 95 Ml/d Environment Agency – river water quality spot samples (two sites, monthly / bi-monthly) **Windermere** United Utilities – fixed point photography of shoreline exposure at key locations to inform landscape assessment if water level in Windermere falls significantly below the weir crest United Utilities - *Setodes argentipunctellus* (a rare caddisfly), one spring survey to establish baseline population count Environment Agency – routine lake level and water quality monitoring
		Pre- and during drought permit monitoring	**River Leven** United Utilities – walkover survey from Newby Bridge to tidal limit fortnightly during drought permit implementation Environment Agency – continue baseline monitoring programme **Windermere** United Utilities – fixed point photography of shoreline exposure at key locations fortnightly during drought permit implementation. Photography of tributary mouths (fish access), fortnightly if drought permit is implemented between October and March United Utilities – visual assessment of known Arctic charr spawning sites fortnightly if drought permit is implemented between October and May United Utilities - *Setodes argentipunctellus* (a rare caddisfly) survey in spring Environment Agency – continue baseline monitoring programme
		Post- drought permit monitoring	**River Leven** Environment Agency – continue baseline monitoring programme **Windermere** United Utilities – continue fixed point photography surveys if required United Utilities - *Setodes argentipunctellus,* repeat baseline survey annually in spring for two years following implementation of a drought permit Environment Agency – continue baseline monitoring programme

APPENDIX 9: Drought option forms

Option Name: Lake Windermere drought permit: (Scenario 2 with lake drawdown, continued)		
Environmental Assessment	**Mitigation and compensation measures**	Possible mitigation measures that have been identified for a Scenario 2 drought permit include: • Dredging • Temporary extensions of jetties and slipways • Provision to release additional flows to the River Leven via the Newby Bridge fish sluice in the event of a pollution incident, if there is evidence of ecological distress, and/or if reduced flows are considered to be having serious detrimental environmental consequences on downstream water bodies If the mitigation measures proposed in the 2016 environmental study are adopted all environmental impacts are reduced to minor The 2016 environmental study identified the need for a further study into the feasibility of measures, particularly dredging, to mitigate the potential adverse impacts of a Windermere Scenario 2 drought permit on lake users (e.g. Windermere Lake Cruises). The current dredging protocol from 1996 requires updating and the process/timescale for obtaining the necessary consents/permits needs to be confirmed to ensure implementation is possible within a drought event. The fieldwork for this study was completed in summer 2017 with a dissemination seminar held with stakeholders in October 2017. The study concluded that dredging is technically feasible so we are progressing with a study to assess the environmental impact of dredging. The study outcomes will be used to inform any future drought permit applications at Windermere that involve lake drawdown. We will ensure that local stakeholders are involved in this study The 2016 environmental study highlighted some uncertainty about the impact on other abstractors. Affected abstractors were contacted as part of the mitigation measures feasibility study to develop our understanding of the potential impacts and suitable mitigation The Windermere water bank agreement agreed in December 2012 states that at any time that Windermere is 2.5 cm below weir crest and/or Haweswater storage has crossed Trigger 3, a meeting of the Windermere stakeholder group will be convened to include representatives from the following organisations: United Utilities, Environment Agency, Holker Estates, Windermere Lake User Forum, Windermere Lake Cruises Ltd. and Windermere Marina Village Ltd. Through this process the most effective use of the Windermere water bank will be discussed
	Impact on other activities e.g. fisheries, industry etc.	The 2016 environmental study concluded that implementation of a Scenario 2 drought permit would result in major adverse impacts on tourism, recreation, socio-economics and communities associated with Windermere and moderate impacts on aesthetics and landscape of Windermere Mitigation measures are discussed above; however, due to the current uncertainty around dredging, the impact remains as major adverse on tourism, recreation, socio-economics and communities associated with Windermere. The impact on aesthetics and landscape of Windermere is reduced to minor adverse if mitigation is adopted The Windermere stakeholder group would be consulted if drought powers at Windermere are being considered

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A9.3 Integrated Resource Zone supply side options

Option Name: Belle Vale boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 2. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	4 Ml/d, based upon the individual source deployable output. This was derived within previous Water Resources Management Plan appraisals using the appropriate UKWIR Source Yield methodologies. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Widnes area
	Implementation timetable Time from trigger to implementation, time of year and duration	There are two options at Belle Vale, one is to treat abstracted raw water from Belle Vale boreholes at Netherley water treatment works which would take approximately 1 month to implement. The second option involves provision of new process treatment at Belle Vale and would take approximately 12 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 1,660 Ml/yr, daily licence limit 5.5 Ml/d If the treatment at Netherley water treatment works option is progressed it is likely a temporary kiosk will be required. Provision of new process treatment on site would require construction of a new building on land already owned by us
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source Some enabling works may have to be completed at the adjacent Netherley water treatment works (associated with Trigger 3) at the same time as Belle Vale which may complicate the delivery of the Belle Vale option

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Option Name: Belle Vale boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar site (5.5 km from source). SPA designated as an over-wintering area for a number of bird species including golden plover, northern pintail and teal; on passage the area regularly supports ringed plover and redshank. Ramsar designation for populations of birds with international importance Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Stocks Well boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 2. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	8 Ml/d, based upon the individual source deployable output. This was derived within previous Water Resources Management Plan appraisals using the appropriate UKWIR Source Yield methodologies. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Widnes area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 6 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 3,360 Ml/yr, daily licence limit 10.9 Ml/d It is assumed that existing pump-sets and boreholes will be used along with the current water treatment works configuration. It will be necessary to remediate the existing treated water mains between Stocks Well water treatment works and Pex Hill service reservoir and to confirm that this satisfies the elevated turbidity readings currently observed
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

APPENDIX 9: Drought option forms

Option Name: Stocks Well boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar site (5.9 km from source). SPA designated as an over-wintering area for a number of bird species including golden plover, northern pintail and teal; on passage the area regularly supports ringed plover and redshank. Ramsar designation for populations of birds with international importance. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

APPENDIX 9: Drought option forms

Option Name: Netherley boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	11.4 Ml/d, based upon the individual source licensed output. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Widnes area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 3 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 4,127 Ml/yr, daily licence limit 11.4 Ml/d It is assumed that existing pump-sets and boreholes at Netherley will be used. It is proposed to construct temporary water treatment works (filtration) in combination with UV treatment, if required. This is assumed to be housed within the existing water treatment works buildings
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

APPENDIX 9: Drought option forms

Option Name: Netherley boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar site (5.9 km from source). SPA designated as an over-wintering area for a number of bird species including golden plover, northern pintail and teal; on passage the area regularly supports ringed plover and redshank. Ramsar designation for populations of birds with international importance Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Pex Hill boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	5.8 Ml/d, based upon the individual source deployable output. This was derived within previous Water Resources Management Plan appraisals using the appropriate UKWIR Source Yield methodologies. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone, also provides local support to the Widnes area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 3 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 2,500 Ml/yr, daily licence limit 9.1 Ml/d It is assumed that existing pump-sets and boreholes will be used. Return the two borehole pumps to service, upgrade the chemical dosing system and install a UV system
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

APPENDIX 9: Drought option forms

Option Name: Pex Hill Boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar site (4.8 km from source). SPA designation is for over-wintering area for a number of bird species including golden plover, northern pintail and teal. On passage the area regularly supports ringed plover and redshank. Ramsar designation is for populations of birds with international importance. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Worsthorne borehole		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	2 Ml/d (Note: this is additional water to the 0.5 Ml/d artesian supply already detailed in the Water Resources Management Plan). Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone, also provides local support to the Burnley area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 3 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 2,454 Ml/yr, daily licence limit 2.7 Ml/d Modifications to the borehole and water treatment works will be required. New borehole pump, control panels, pH correction system at Worsthorne water treatment works
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply No customer impact expected as raw water blended with other sources of water and treated at existing water treatment works

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Option Name: Worsthorne borehole (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	The Environment Agency's Review of Consents for the South Pennine Moors SAC/SPA (approximately 1.5 km from source) concluded no impacts of any abstraction licences (either alone or in-combination with other consents), therefore no operational impacts on these sites are anticipated. The South Pennine Moors SAC is designated for dry heaths, blanket bogs, oak woods, quaking bogs and transition mires. The SPA is designated for short eared owls and golden plover amongst other bird species Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Douglas, Darwen and Calder Carboniferous Aquifers GB41202G100300 at poor overall (good for quantitative) (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Walton boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	3.9 Ml/d, based upon the individual source licensed output. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Warrington area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 5 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 1,245 Ml/yr, daily licence limit 3.9 Ml/d It is assumed that the existing boreholes will be used with new pumps and starter panel required. It will be necessary to construct chemical dosing and filtration equipment on site. These may be housed in a temporary pre-fabricated structure adjacent to existing pump-house on land already owned by us
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

APPENDIX 9: Drought option forms

Option Name: Walton boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Manchester Mosses SAC (designated for degraded raised bogs still capable of natural regeneration) are located 9 km from the boreholes; Rixton Clay Pits SAC (designated for the occurrence of great crested newt populations) are 9.8 km from the boreholes; Mersey Estuary SPA is located 9.4 km from source (designated as an over-wintering area for a number of bird species including golden plover, northern pintail and teal; on passage the area regularly supports ringed plover and redshank). Mersey Estuary Ramsar is located 9.4 km from source (designated for populations of birds with international importance) No licence modifications were made as part of the Environment Agency's Review of Consents for Manchester Mosses SAC and Rixton Clay Pits SAC, therefore, it is concluded that there will be no impacts on these sites (either alone or in-combination with other consents). No impacts on the Mersey Estuary SPA or Ramsar sites are anticipated either Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: on boundary of Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015) and Weaver and Dane Quaternary Sand and Gravel Aquifers GB41202G991700 at poor overall (good for quantitative) (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Daresbury borehole		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	4.5 Ml/d, based upon the individual source licensed output. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone, also provides local support to the Warrington area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 6 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 1,245 Ml/yr, daily licence limit 4.5 Ml/d It is assumed that existing pump-sets and boreholes will be used. It will be necessary to construct chemical dosing and filtration equipment on site. These may be housed in a temporary pre-fabricated structure adjacent to existing pump-house on land already owned by us
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

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Option Name: Daresbury borehole (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Mersey Estuary SPA and Ramsar site located 7.1 km from source, Midland Mere and Mosses Phase 1 Ramsar located 9.9 km from source. SPA designation for over-wintering area for a number of bird species including golden plover, northern pintail and teal. On passage the area regularly supports ringed plover and redshank. Mersey Ramsar designation for populations of birds with international importance. Midland Mere Ramsar designated for open water and raised bog habitats including rare plants and invertebrates No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar sites. The West Midland Mosses SAC and Ramsar Review of Consents Stage 3 (which includes the Midland Meres and Mosses Phase 1 site), concluded that existing abstraction licences could be shown to have no adverse impact on site integrity (either alone or in-combination with other consents). Therefore, no operational phase impact on these sites is anticipated Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: on boundary of Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015) and Weaver and Dane Quaternary Sand and Gravel Aquifers GB41202G991700 at poor overall (good for quantitative) (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

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Option Name: Water Lane boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	6.5 Ml/d, based upon the individual source deployable output. This was derived within previous Water Resources Management Plan appraisals using the appropriate UKWIR Source Yield methodologies. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Widnes area
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 4 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 3,000 Ml/yr, daily licence limit 11.4 Ml/d It is assumed that existing pump-sets and boreholes will be used. It will be necessary to test the existing water treatment works located on site and provide a new treated water feed from Pex Hill service reservoir
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply There may be some customer impact caused by changes in water quality associated with change of source

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Option Name: Water Lane boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Mersey Estuary SPA and Ramsar site located 7.1 km from source. SPA designation for over-wintering area for a number of bird species including golden plover, northern pintail and teal. On passage the area regularly supports ringed plover and redshank. Mersey Ramsar designation for populations of birds with international importance No operational impacts of the option are anticipated on the Mersey Estuary SPA and Ramsar sites Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report and SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	None

APPENDIX 9: Drought option forms

Option Name: Landside Borehole		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day	4.8 Ml/d, based upon the individual source deployable output. This was derived within previous Water Resources Management Plan appraisals using the appropriate UKWIR Source Yield methodologies. Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone and also provides local support to the Wigan area. Water from Landside borehole is treated at Lightshaw water treatment works
	Implementation timetable Preparation time, time of year effective, duration	Approximately 3 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 3,319 Ml/yr, daily licence limit 9 Ml/d It is assumed that a new borehole pump together with 75m of rising main will be required. This will involve the use of mobile lifting equipment on site. Construction period 3 months
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply

APPENDIX 9: Drought option forms

Option Name: Landside Borehole (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites	Manchester Mosses SAC (designated for degraded raised bogs still capable of natural regeneration) are located 3.8 km from the borehole, Rixton Clay Pits SAC (designated for the occurrence of great crested newt populations) are 7.3 km from the borehole No licence modifications were made as part of the EA's Review of Consents for Manchester Mosses SAC and Rixton Clay Pits SAC. Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Baseline information used	Habitats Regulations Assessment Screening Report for this drought plan
	Summary of additional baseline monitoring requirements	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc	None

APPENDIX 9: Drought option forms

Option Name: Croft Boreholes		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4. On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to bring the source in to operation in line with the implementation timescale outlined below
	Deployable Output of action Ml/day	6 Ml/d, based upon the individual source licensed output (no recent deployable output figures). Benefits to the wider zone are event specific and have been tested within Aquator simulation based scenario analysis as described within Appendix 6
	Location Area affected or whole supply zone	Integrated Resource Zone, also provides local support to the Wigan area
	Implementation timetable Preparation time, time of year effective, duration	Approximately 6 months to implement Available throughout year
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Abstraction licence already held by us. Annual licence limit 2,495 Ml/yr, daily licence limit 6.8 Ml/d. It is assumed that 2 new pump-sets and rising main will be required. It will be necessary to construct a new pressure filter and dosing and UV rigs on site - the land is owned by us. Associated control equipment and instrumentation will also be needed. Construction period 6 months
	Risks associated with option	The use of this source is subject to Section 15 of The Water Supply (Water Quality) Regulations 2000 and there is a risk that the source will not comply

APPENDIX 9: Drought option forms

Option Name: Croft Boreholes (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites	Manchester Mosses SAC (designated for degraded raised bogs still capable of natural regeneration) are located 3.1 km from the borehole, Rixton Clay Pits SAC (designated for the occurrence of great crested newt populations) are 5.5 km from the borehole No licence modifications were made as part of the EA's Review of Consents for Manchester Mosses SAC and Rixton Clay Pits SAC. Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this option on designated sites. Assuming best practice construction methods are implemented, no significant environmental impacts are anticipated as a result of the construction phase WFD waterbody: Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers GB41201G101700 at poor (Cycle 2, 2015). No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Baseline information used	Habitats Regulations Assessment Screening Report for this drought plan
	Summary of additional baseline monitoring requirements	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc	None

APPENDIX 9: Drought option forms

A9.4 West Cumbria Resource Zone drought permits/orders

Option Name: Ennerdale Water drought order: drawdown of the lake to 2.5 m below weir crest level		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Implementation when the lake level in Ennerdale Water reaches 1.7 m below weir crest. Preceding actions would include rezoning of water supplies, customer communication actions and demand restrictions (campaign for voluntary water use restraint at Trigger 2 and Temporary Use Ban at Trigger 4). At a lake level of 1.7 m below weir crest (just below Trigger 4), abstraction from Ennerdale for both compensation flow provision to the River Ehen and for public water supply is not licensed. As part of our business as usual activities in West Cumbria we carry out enhanced levels of water efficiency promotion, keep leakage as low as possible and investigate new ways of reducing leakage further
	Deployable Output of action Ml/day. Include how this is calculated	Allow abstraction for compensation flow provision and public water supply to occur between lake levels of 1.7 m and 2.5 m below weir crest The scope of required powers would be discussed fully with the Environment Agency and Natural England and will depend upon the need for additional water, time of year and current environmental circumstances, as well as the balance between protecting lake level and river flow The ability to abstract water from Ennerdale will allow compensation flows to the River Ehen to be maintained
	Location Area affected or whole supply zone	Whitehaven area (West Cumbria Resource Zone) with partial support to other areas of the resource zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought order preparation from Trigger 2 Application of drought order from Trigger 3 Implementation of drought order on reaching 1.7 m below weir crest level (just below Trigger 4) Drought order could be effective at all times of the year Drought orders are valid for up to 6 months however, in this case the application would be for a three month period To guard against continuing drought conditions it may be prudent to apply for a drought order although it may not need to be implemented if weather conditions improve. This has been the experience in the past at Ennerdale (e.g. 2010) where significant rainfall arrived just before the powers are implemented and due to the flashy nature of the source, water storage has rapidly recovered to above Trigger 1 (within a few days)
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application. In the event of an application for drought powers for Ennerdale an Appropriate Assessment and CRoW Assessment (under the Countryside and Rights of Way Act 2000) will be required due to potential impacts on the River Ehen SAC, Ennerdale SSSI and River Ehen and Tributaries SSSI
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Ennerdale Water drought order: drawdown of the lake to 2.5 m below weir crest level (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	High An Environmental Assessment Report for this option was produced in April 2014, and includes an Appropriate Assessment of impacts on the SAC
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	The River Ehen SAC is primarily designated for the freshwater mussel species (*Margaritifera margaritifera*) and has Atlantic salmon as a qualifying feature – the River Ehen is also a SSSI. Ennerdale is also a SSSI and is located within the Lake District National Park. The River Ehen SAC and SSSI are currently classified as being at unfavourable status. The Environment Agency's Review of Consents could not conclude that our existing abstraction licence at this site could not be demonstrated not to impact the River Ehen SAC. As a result, licence changes were implemented in 2015 to increase the compensation flow requirement from Ennerdale Water to the River Ehen and the Environment Agency plans to revoke our Ennerdale abstraction licence once an alternative public water supply is in place (expected c.2022) Ennerdale Water supports an Arctic charr population, aquatic lake flora community, and important plant communities in the lagoons and wetlands at the head of the lake The drought order would result in a temporary reduction to Ennerdale lake level but would allow both abstraction for public water supply and the provision of compensation flow to the downstream River Ehen to continue. It should be noted that, without a drought order, our abstraction licence states that if the level of Ennerdale Water drops below 1.7 m below weir crest, abstraction for both public water supply and for compensation flow releases to the River Ehen must cease Habitats Regulations Assessment Screening identified the need for an Appropriate Assessment for this drought option. The findings of the Appropriate Assessment, undertaken in consultation with the Environment Agency and Natural England, were that the proposed drawdown of the lake from 1.7 m to 2.5 m below weir crest is likely to result in adverse impacts on the River Ehen SAC (both alone, and in-combination with our abstraction licence) Increased drawdown of the lake impacts river flows, as the lake stays below weir crest level for longer as, following rain, it would take longer for the lake to refill to weir crest level and begin to spill (by up to one month, more typically around 10 days), therefore flows from Ennerdale to the River Ehen remain at the compensation flow level for longer (by up to one month, more typically around 10 days). However, during this period, natural accretion from rain in the catchment contributes to river flows downstream. Lake drawdown also affects connectivity with tributaries in to the lake and the outflow to the River Ehen. Lake drawdown also increases the amount of shoreline exposure The environmental study identified the following impacts: • Major and irreversible adverse impacts on designated features of the River Ehen SAC and SSSI. Failure to meet River Ehen SAC and SSSI conservation objectives • Major adverse impacts on freshwater mussel populations and Atlantic salmon spawning and egg survival in the River Ehen • Moderate adverse impacts on adult upstream migration of Atlantic salmon and sea trout in the River Ehen • Moderate adverse impacts on sea trout and brown trout spawning and egg survival in the River Ehen • Moderate adverse impact on diatoms and algae in the River Ehen • Major adverse impacts on exposure of redds and egg incubation in Ennerdale Water • Moderate adverse impact on Ennerdale lake hydrodynamics (including lake margin exposure)

APPENDIX 9: Drought option forms

Option Name: Ennerdale Water drought order: drawdown of the lake to 2.5 m below weir crest level (continued)		
Environmental Assessment	**Summary of likely environmental impacts** **(continued)**	• Moderate (but temporary and reversible) adverse impact on designated features of Ennerdale Water SSSI. Failure to meet many of the Ennerdale Water SSSI conservation objectives • Moderate adverse impacts on resident fish and spawning (Arctic charr, Atlantic salmon and brown trout) in Ennerdale Water • Moderate adverse impacts on macrophytes in Ennerdale Water • Moderate adverse impacts on migration of smolts out of Ennerdale Water (April to May) and minor adverse impacts on migration of adult fish (salmon, sea trout and eel) out of and into Ennerdale Water • Minor adverse impacts to marginal wetland habitats in Ennerdale Water • Minor adverse impacts on the Whins Meadows and Mireside County Wildlife Sites Habitats Regulation Assessment Stage 3, an assessment of alternative options has been undertaken, and no feasible alternative options to this drought order at Ennerdale were found. A package of Compensatory Measures for the continued abstraction from Ennerdale and a future potential drought order was agreed with the Environment Agency and Natural England in July 2015 and is being implemented WFD waterbodies: Ennerdale Water GB31229062 (HMWB) at moderate (Cycle 2, 2015); River Ehen (upper including Liza) GB112074070010 (HMWB) at moderate (Cycle 2, 2015). Risks of drought order implementation on WFD ecological status and chemical status are anticipated to be moderate and negligible respectively based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The Environmental Assessment Report, produced in April 2014, has drawn on available information from surveys and investigations undertaken by us, the Environment Agency and Natural England over a number of years A detailed bathymetry survey of Ennerdale Water was carried out by us to provide information on shoreline exposure and this was distributed to all key stakeholders in 2000 The environmental study used historical data on river flow, lake level, ecological monitoring and water quality. SIMCAT water quality and water resources modelling was also undertaken In 2011, we commissioned a macrophyte survey of Ennerdale Water to aid the impact assessment of lake drawdown on macrophytes (this was subsequently repeated in 2014 and 2015). Surveys of marginal wetland plant communities were undertaken in 2013. In recent years numerous studies of the freshwater mussel population in the River Ehen have been undertaken by both ourselves and the Environment Agency. All of this information has been used to inform the environmental study The 2014 Environmental Assessment Report and Appropriate Assessment was prepared in partnership with the Environment Agency and Natural England

APPENDIX 9: Drought option forms

Option Name: Ennerdale Water drought order: drawdown of the lake to 2.5 m below weir crest level (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	**River Ehen** United Utilities - freshwater mussel population size and demography, mussel condition survey and river bed condition survey (three times a year in March/ April, July/August and September/ October). Mussel brooding survey in July each year United Utilities - algal surveys (quarterly) United Utilities – eel monitoring survey if there is a prolonged period of 60 Ml/d compensation flow during May-July Environment Agency – Glochidia encystment in fish (annually in May) and juvenile fish monitoring (alternate years) Environment Agency – river patrols for fish unwilling/unable to migrate upstream, smolt and kelt migration (all times of year when lake is below weir crest level) Environment Agency – macroinvertebrate monitoring at three routine sites (spring and autumn in line with Environment Agency routine monitoring programme) Environment Agency – river flow and level monitoring (continuous) Environment Agency – water quality monitoring; spot samples (four sites, monthly or quarterly depending on parameter) and continuous sonde monitoring **Ennerdale Water** United Utilities – macrophytes; baseline whole lake survey (three vulnerable areas) undertaken in 2011. Monitoring transects surveyed in 2014, 2015, 2016 United Utilities - baseline vulnerable wetlands survey undertaken in 2013 United Utilities - lake level margin & exposure, fixed-point photography at pre-selected sites. Every 0.25 m below weir crest level United Utilities – bathymetry survey to determine tributary connectivity with the lake at lower lake levels (undertaken in 2015) United Utilities – smolt downstream migration; Consider lake level and time of year to determine need for mitigation for smolt coming down River Liza and whether mitigation is possible (March to June whilst lake is ~0.5 m below weir crest level) Environment Agency - salmonid redd mapping in tributaries and lake margins (annually) Environment Agency – Arctic charr; annual hydroacoustic survey and gill-netting surveys (every three years) Environment Agency – walkover surveys for lake level margin and exposure and tributary connectivity for fish access (as appropriate depending on lake levels) Environment Agency – water quality monitoring; spot samples (one site, monthly or quarterly depending on parameter) Environment Agency – lake level monitoring (continuous)

APPENDIX 9: Drought option forms

Option Name: Ennerdale Water drought order: drawdown of the lake to 2.5 m below weir crest level (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features (continued)**	Pre- and during drought order monitoring	**River Ehen** United Utilities – monitor condition of freshwater mussels and river bed habitat (potentially increase frequency depending on expert judgement) United Utilities - algal surveys (monthly) United Utilities – continue baseline monitoring programme for all other sensitive features Environment Agency – water quality monitoring; spot samples (four sites plus an additional site downstream of Croasdale Beck, monthly or quarterly depending on parameter) and continuous sonde monitoring Environment Agency – continue baseline programme monitoring for all other sensitive features **Ennerdale Water** United Utilities – macrophytes; repeat baseline and transect survey in the following growing season if lake level is at or below 1 m below weir crest level for more than one month. If species distribution/ composition has changed, repeat full survey and transects following next 2 growing seasons United Utilities - lake level margin and exposure, fixed-point photography at pre-selected sites. Every 0.25 m below weir crest level United Utilities – continue baseline monitoring programme for all sensitive features Environment Agency – continue baseline programme monitoring for all sensitive features
		Post- drought order monitoring	**River Ehen** United Utilities – resume baseline monitoring programme for all sensitive features Environment Agency – resume baseline programme monitoring for all sensitive features **Ennerdale Water** United Utilities – macrophytes; repeat baseline and transect survey in the following growing season if lake level is at or below 1 m below weir crest level for more than one month. If species distribution/ composition has changed, repeat full survey and transects following next 2 growing seasons United Utilities – resume baseline monitoring programme for all sensitive features Environment Agency – resume baseline programme monitoring for all sensitive features
	Mitigation and compensation measures		A compensation flow of at least 60 Ml/d is being provided to the River Ehen The environmental study considers mitigation measures. If monitoring during drought order implementation indicates that significant impacts are occurring, various mitigation measures could be implemented, in consultation with Environment Agency, Natural England and experts. These include modifications to the flow regime (not including freshets, however potentially including gradual, limited increases in compensation flow); temporary modification of in-river structures to improve fish passage; transfer of migrating salmon smolts from the River Liza (a tributary flowing into Ennerdale Water) for release to the River Ehen (downstream of Ennerdale Water); transfer of migrating adult salmon from the River Ehen into Ennerdale Water; excavation of channels to improve or restore connectivity of the River Liza or Smithy Beck with Ennerdale Water and to improve fish access; targeted habitat alteration/improvements to enhance natural recovery
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified the following adverse impacts on other activities: • Moderate adverse impacts on landscape and visual amenity in Ennerdale Water due to lake drawdown and temporary infrastructure • Minor adverse impacts on angling in Ennerdale Water and moderate adverse impacts to angling in the River Ehen (July to October) • Minor adverse impact on access for boat launching / berthing in Ennerdale Water The Wild Ennerdale Partnership would be consulted if drought powers at Ennerdale Water are being considered

APPENDIX 9: Drought option forms

Option Name: Crummock Water drought permit: allow pumping of compensation and abstraction flows to a lake level of 1.5 m below weir crest		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4 (Crummock Water). Preceding actions could include rezoning of water supplies, customer communication actions and demand restrictions. Trigger 4 is reached when Crummock reaches a level of 0.97 m below weir crest, the point at which the ability to release the compensation flow by gravity to the River Cocker is lost
	Deployable Output of action Ml/day. Include how this is calculated	Allow pumping of the compensation and abstraction flows once gravity flows cease at about 0.97 m below weir crest level down to a level of 1.5 m below weir crest The scope of required powers would be discussed fully with the Environment Agency and Natural England and will depend upon the need for additional water, time of year and current environmental circumstances, as well as the balance between protecting lake level and river flow The ability to pump water from Crummock will allow compensation flows to the River Cocker and public water supplies to be maintained
	Location Area affected or whole supply zone	Workington area (West Cumbria Resource Zone) with partial support to other areas of the resource zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months We have never previously sought drought powers at Crummock, however to guard against continuing drought conditions it may be prudent to apply for them, although they may not need to be implemented if weather conditions improve. This has been the experience in the past at Ennerdale (e.g. 2010) where significant rainfall has arrived just before the powers are implemented and due to the flashy nature of the source, water storage has rapidly recovered
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application Installation of overland temporary pipework (and associated pump equipment) is required to provide compensation flow to the River Cocker As part of the 2016 environmental study we agreed with the Environment Agency and Natural England that due to the minor impacts on the River Derwent and Bassenthwaite Lake SAC and River Derwent and Tributaries SSSI, the application at Crummock Water would be for a drought permit (not an order)
	Risks associated with option	That the application, as applied for, is not approved. That any temporary pumping facilities can be implemented swiftly and deliver the required compensation and abstraction flows. 24-hour security may be required to protect the temporary pump installations

APPENDIX 9: Drought option forms

Option Name: Crummock Water drought permit (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low Environmental study completed in 2016
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Crummock is within the River Derwent and Bassenthwaite Lake SAC. The SAC is primarily designated for its oligotrophic to mesotrophic standing water habitat and the marsh fritillary butterfly, sea/brook/river lamprey, Atlantic salmon, otter and floating water plantain. Its water courses of plain to montane levels are a qualifying feature. The River Derwent and Tributaries is also a SSSI. Crummock is located within the Lake District National Park There would be a temporary reduction to Crummock lake level during drought permit implementation The environmental assessment concluded: • Minor adverse impacts during July to December (negligible at other times of the year) on the River Derwent and Bassenthwaite Lake SAC and River Derwent and Tributaries SSSI • Minor impacts on macroinvertebrates and fish populations in Crummock Water during July to December • Minor impacts on eel escapement from Crummock Water during October to November • Minor (but temporary and reversible) impacts on upstream adult salmon/trout migration in the River Cocker during August to October • Disturbance during construction/removal of the temporary pipeline could cause temporary minor adverse impact on adjacent mossy grassland • All other impacts on environmental features were negligible including salmon, Arctic charr and macrophyte communities HRA Screening carried out as part of the environmental assessment concluded no likely significant impacts of drought permit implementation on designated sites and that Appropriate Assessment would not be required WFD waterbodies: Crummock Water GB31229000 (HMWB) at moderate (Cycle 2, 2015); Dub (Park) Beck GB112075070360 (not designated artificial or heavily modified) at good (Cycle 2, 2015); Cocker (Crummock Water to confluence with Whit Beck) GB112075070370 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status are anticipated to be negligible to minor based on the conclusions of the environmental assessment. No risk of deterioration to any surface waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, lake level, ecological monitoring and water quality. Water resources modelling was also undertaken. Arctic charr surveys and surveys of the lake macrophyte community have been undertaken and have informed the environmental assessment

APPENDIX 9: Drought option forms

Option Name: Crummock Water drought permit (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	**River Cocker** Environment Agency – river flow monitoring (continuous) Environment Agency – water quality monitoring; spot samples (five sites, monthly) **Crummock Water** United Utilities - baseline lake macrophyte survey (undertaken in 2012) United Utilities – fixed point photography and mapping and measurement of exposed areas at different lake levels Environment Agency – water quality monitoring; spot samples (one site, monthly) Environment Agency – lake level monitoring at lake outflow (continuous)
		Pre- and during drought permit monitoring	**River Cocker** Environment Agency – river flow monitoring (continuous) Environment Agency – water quality monitoring; spot samples (five sites, weekly) **Crummock Water** United Utilities - repeat baseline lake macrophyte survey during drought permit implementation (in summer) United Utilities - lake margin exposure in relation to lake level (relating to effects on SAC macrophytes, wetland and landscape character (commenced at drought trigger 2 and repeated at lake level of 0.97m below weir crest and again if lake level drops further)) Environment Agency – water quality monitoring; spot samples (one site, weekly) Environment Agency – lake level monitoring at lake outflow (continuous)
		Post- drought permit monitoring	**River Cocker** Environment Agency – resume baseline monitoring programme **Crummock Water** United Utilities - repeat baseline lake macrophyte survey in the year following drought permit implementation (in summer) Environment Agency – resume baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures, however, it was concluded that the impacts of drought permit implementation would be negligible to minor and consequently, no mitigation measures for ecological features are considered necessary Temporary measures will allow safe access over the temporary pumping infrastructure for walkers and birdwatchers and no issues with restricted access are anticipated. Signs will be installed to explain the background to the drought permit and the need for pumping
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified the following adverse impacts on other activities: • Moderate (but temporary and reversible) adverse impact on landscape and visual amenity in Crummock Water during July to December as a result of shoreline exposure and installation of pumping/pipeline infrastructure • Minor adverse impacts on walkers and birdwatchers during July to December The Derwent Owners' Association would be consulted if drought powers at Crummock are being considered

APPENDIX 9: Drought option forms

Option Name: Scales boreholes drought permit: increase annual licence limit to enable continuation of abstraction		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4 (Scales boreholes). Preceding actions could include rezoning of water supplies, customer communication actions and demand restrictions. Trigger 4 is reached when 100% of the annual licence volume has been abstracted
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would vary the annual licence limit (increase from 365 Ml/yr to between 438 Ml/yr and 621 Ml/yr) for the Scales boreholes to enable the continuation of abstraction up to the current licensed daily abstraction rate of 6 Ml/d (the annual licence limit of 365 Ml/yr allows for an average daily abstraction rate of 1 Ml/d). This would allow the associated surface water sources (Overwater and Chapel House reservoirs) to be kept at a sustainable rate of abstraction. The scope of required powers would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year, the overall condition of the local aquifer and current environmental circumstances
	Location Area affected or whole supply zone	Wigton and Solway areas (West Cumbria Resource Zone) with partial support to other areas of the resource zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months To guard against continuing drought conditions it may be prudent to apply for drought powers at Scales, however they may not need to be implemented if weather conditions improve
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

APPENDIX 9: Drought option forms

Option Name: Scales boreholes drought permit (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Medium to low depending on nature of drought powers sought Environmental study completed in 2010. Baseline data monitoring programme completed in 2017 and reviewed with Environment Agency, no change to impact magnitude or significance based on these latest available data
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	There are several protected sites in the vicinity of the Scales boreholes (e.g. Solway Firth SAC, South Solway Mosses SAC/NNR, Upper Solway Flats and Marshes SSSI/SAC/Ramsar). However, the environmental study showed that these sites lie outside the potential zone of impact as they do not lie above the St Bees Sandstone aquifer in which the boreholes are located. Therefore, no protected sites are affected. However, the ability to increase abstraction from the Scales boreholes will reduce the need to abstract from other local water sources which have environmental designations. Overwater reservoir is a SSSI, whilst Hause Gill and Dash Beck (which feed Chapel House reservoir) are upstream of a SAC. It is important to keep these surface water abstractions at a sustainable level and increased abstraction from Scales helps to achieve this. The environmental study assessed the impact of increasing the average daily abstraction rate from 1 Ml/d to 6 Ml/d and identified significant adverse effects which resulted in the identification and assessment of three alternative drought scenarios to increase the existing average daily abstraction rate of 1 Ml/d to: • 1.5 Ml/d • 2 Ml/d • 3 Ml/d Assessment of these three drought power scenarios identified the following adverse environmental impacts for all three scenarios: • Moderate adverse impact on hydrodynamics (river flow, wetted area and water levels) • Moderate adverse impact on aquatic macrophytes • Moderate adverse impact on otter The scenario to increase average daily abstraction to 3 Ml/d identified the following additional impact: moderate adverse impact on water quality (reduced dilution of consented point source discharges (DO, BOD, ammonia, pH); WFD UKTAG standards; water quality interactions; water temperature) Mitigation measures are expected to reduce these impacts to non-significant levels Following discussions with the Environment Agency regarding the impact of this drought permit on river flows (hydrodynamics), we commissioned additional monitoring and a review of this aspect of the environmental assessment previously completed in 2010. The study concluded that the zone of hydrological influence of the drought permit is smaller than that presented in the 2010 environmental assessment report dated 2010. Therefore, the assessment presented in the 2010 report is worst case. The influence of other pressures in the catchment, including poor water quality and morphological alteration are likely to have a big influence on the ecological features present. Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbodies: Eden Valley and Carlisle Basin Permo-Triassic sandstone aquifers GB40201G100400 at poor overall but good for quantitative (Cycle 2, 2015), Crummock Beck u/s Holme Dub GB102075073480 (not a HMWB) at bad (Cycle 2, 2015), Holme Dub GB102075073490 (HMWB) at moderate (Cycle 2, 2015). Risks of drought permit implementation on WFD ecological status and chemical status of surface water bodies are anticipated to be minor to moderate based on the conclusions of the environmental assessment. No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)

	Information used to understand conditions before drought or any drought actions are implemented	The environmental study used historical data on river flow, groundwater level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken

APPENDIX 9: Drought option forms

Option Name: Scales boreholes drought permit (continued)			
Environmental Assessment	**Environmental Monitoring Plan for sensitive features**	Baseline monitoring	United Utilities – hydrodynamics, cross-section surveys and spot flow gauging, completed 2014-2016 United Utilities – water quality baseline monthly surveys in 2014-2016 United Utilities – fish surveys at ten sites in 2014-2015 United Utilities – macroinvertebrate surveys at eight sites in 2014, 2015 and 2016; no need to continue with baseline requirement United Utilities – continue baseline monitoring of groundwater levels in observation boreholes Environment Agency – continue baseline monitoring of groundwater levels in observation boreholes Environment Agency – river flow monitoring of River Waver (continuous) Environment Agency – water quality monitoring; spot samples (seven sites, monthly)
		Pre- and during drought permit monitoring	United Utilities – hydrodynamics, cross-section surveys at low flows United Utilities – initial walkover to identify signs of environmental stress (fish in distress, dry channel etc.), assess requirement for continued need. To be undertaken twice and then need reviewed United Utilities – water quality fortnightly surveys. To be undertaken during walkover surveys as above. Twice, then review requirement United Utilities – baseline monitoring of groundwater levels in observation boreholes Environment Agency – baseline monitoring of groundwater levels in observation boreholes Environment Agency – river flow monitoring of River Waver (continuous) Environment Agency – water quality monitoring; spot samples (seven sites, increase frequency to fortnightly)
		Post- drought permit monitoring	United Utilities – one year of repeat of baseline surveys for fish (ten sites) and macroinvertebrate surveys (eight sites), then review United Utilities – continue baseline monitoring of groundwater levels in observation boreholes Environment Agency – resume baseline monitoring programme
	Mitigation and compensation measures		The environmental study considered mitigation measures. If monitoring during a drought permit indicates that significant impacts are occurring, various mitigation measures could be implemented including a temporary reduction in abstraction rate; a temporary return to the statutory abstraction rate; creation of neighbouring wetlands which are suitable to support self-sustainable coarse fish populations (e.g. stickleback and other small fish species to protect dietary needs of otter and piscivorous birds)
	Impact on other activities e.g. fisheries, industry etc.		The environmental study identified the following adverse impacts on other activities: • Potential impact on the availability of water to other abstractors • Minor adverse impact on landscape and visual amenity (for the 2 Ml/d and 3 Ml/d abstraction rate options only)

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A9.5 West Cumbria Resource Zone supply side option

Option Name: Tankering to support Ennerdale Water		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 3 (Ennerdale Water). On reaching this trigger we will commence tankering of treated water from the Integrated Resource Zone to the West Cumbria Resource Zone to support Ennerdale Water
	Deployable Output of action Ml/day. Include how this is calculated	Approximately 0.6 Ml/d at Trigger 3; increasing to approximately 2 Ml/d if a drought order is implemented at Ennerdale Water (on reaching a lake level of 1.7 m below weir crest). This is based on the estimated volume of tanker deliveries
	Location Area affected or whole supply zone	Transfer from the Integrated Resource Zone to the West Cumbria Resource Zone to provide support to Ennerdale at times of drought
	Implementation timetable Time from trigger to implementation, time of year and duration	2 weeks (the 2 week preparation period required for this action will take place prior to reaching Trigger 3 when implementation of the action is required) Available throughout year and for any duration
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	None We have developed an Ennerdale tankering plan that considers issues such as tanker availability, driver availability, driver welfare, working time directive requirements, traffic management, tanker route etc. We have also developed a communications plan in which we have identified key stakeholders along the tanker route such as schools/commercial premises/fire stations/cemetery/caravan parks/post offices. We have worked closely with the Local Resilience Forum to develop our plans for tankering at Ennerdale
	Risks associated with option	Availability of suitable tankers to undertake operation and maintain a wholesome supply of water; delays on road network impacting on tanker deliveries; adverse weather conditions; tanker filling and emptying logistics

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Option Name: Tankering to support Ennerdale (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	Tankering will utilise the existing road network and infrastructure. Tankering operations will increase traffic on local roads and may cause some disturbance to the local population (especially around tanker filling and emptying locations). A transfer of 0.6 Ml/d is estimated to require 24 tanker deliveries a day; a transfer of 2 Ml/d is estimated to require 76 tanker deliveries a day Carbon emissions relating to tanker movements Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought option on designated sites No risks to WFD waterbodies are anticipated
	Information used to understand conditions before drought or any drought actions are implemented	Habitats Regulations Assessment Screening Report for this drought plan SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None
	Mitigation and compensation measures	None
	Impact on other activities e.g. fisheries, industry etc.	Minor adverse impacts predicted in SEA environmental report on material assets and resource use (due to the increased energy use arising from tanker movements) Tankering treated water from the Integrated Resource Zone will reduce the volume of water abstracted from Ennerdale for public water supply by a commensurate amount; resulting in an increase in the volume of water retained in Ennerdale Water. The tankered volumes are relatively small (0.6-2 Ml/d) compared to the volumes abstracted for public water supply (approximately 25 Ml/d) and the volumes released to the River Ehen as compensation flow (up to 80 Ml/d)

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A9.6 Carlisle Resource Zone supply side option

Option Name: Castle Carrock: utilisation of reservoir dead water storage		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	Trigger 4 (Castle Carrock Reservoir). On reaching this trigger we would review the circumstances associated with making this source available for supply and whether it would aid the drought situation. If so, then on crossing this trigger, we would commence actions to enable us to abstract dead water within the reservoir, in line with the implementation timescale outlined below
	Deployable Output of action Ml/day. Include how this is calculated	The benefit of this option is specific to a given drought event, but is estimated at between 2-6 Ml/d. The lower end of the range is derived using Aquator water resources modelling assessment using historic drought events and the benefit based upon the dead water volume apportioned over the critical period. The upper end of the range is informed by testing of very severe drought events; in such an event the dead water volume of 170.7 Ml would provide around an additional 30 days of supply at approximately 6 Ml/d (equivalent to the yield of the source)
	Location Area affected or whole supply zone	Carlisle Resource Zone
	Implementation timetable Time from trigger to implementation, time of year and duration	Approximately 1 month to implement (this timescale may be extended if a temporary filter plant is required) Available throughout year subject to reservoir storage levels
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	This option would seek to utilise dead water (170.7 Ml) at the base of the storage reservoir by installation of temporary pumping equipment and associated pipework. Treatment would be through the existing Castle Carrock water treatment works
	Risks associated with option	Water quality problems at the water treatment works including elevated turbidity and colour We carried out water quality sampling of the dead water in 2016. This did not identify any treatability issues. However this sampling was not carried out under drought conditions therefore there is a risk that additional treatment may be required at Castle Carrock water treatment works (e.g. modifications to add a temporary filter plant at the front of the works, housed within the existing water treatment works site). If this is required the timescale for implementation is likely to be extended to up to 3 months

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Option Name: Castle Carrock (continued)		
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status	The drought option comprises abstraction of the dead water from Castle Carrock storage reservoir only (i.e. water that is not normally available for abstraction). The reservoir has no compensation flow and no statutory releases would be put at risk. No abstraction licence changes would be required and no reduction to the hands-off flow on the associated River Gelt river sources is proposed There will be no loss of designated habitat due to the scheme as the construction footprint does not overlap any designated sites. However, given the distance between the drought option site and the North Pennine Moors SAC and River Eden SAC designated sites, there is the potential for impacts from noise, dust or chemical leak. Assuming best practice construction measures, impacts on designated sites will be negligible The Environment Agency's Review of Consents for the North Pennine Moors SAC and North Pennine Moors SPA concluded that there was no adverse impact of this licence on the integrity of these sites (either alone or in-combination) The River Eden Review of Consents assessed that the River Gelt abstractions alone have an adverse impact on the integrity of the River Eden SAC and changes were made to our abstraction licences in 2015 to address the issue. This drought option involves abstraction of dead water from Castle Carrock storage reservoir only (which is not part of the designated area), and is not dependant on abstraction from the river i.e. the reservoir can be drawn down even if there is no abstraction from the river. As such, there are no impacts on the designated features of the River Eden SAC Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought option on designated sites WFD waterbody: Castle Carrock GB30228476 (artificial) at good (Cycle 2, 2015). Castle Carrock is classified as an artificial waterbody under the WFD. No risk of deterioration to any surface or groundwater waterbodies associated with this source have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented	Water quality sampling of the dead water in Castle Carrock reservoir was carried out in 2016. This did not identify any water quality issues that would be of concern if we wished to abstract this water, however this sampling was undertaken when the reservoir was full and in a drought, lowered water levels and reduced inflows could result in different conditions to those sampled Habitats Regulations Assessment Screening Report for this drought plan SEA Environmental Report for this drought plan
	Summary of additional monitoring requirements before application	None required
	Mitigation and compensation measures	None required

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Option Name: Castle Carrock (continued)		
	Impact on other activities e.g. fisheries, industry etc.	Minor adverse impacts predicted in SEA Environmental Report on: biodiversity (flora/fauna); water; soil, geology and land use Moderate adverse impacts predicted in SEA Environmental Report on: landscape and visual amenity; inter-relationships There may be fish resident in the reservoir, and there may be impacts on this population dependant on the extent of drawdown. It is assumed any impacts on fish populations will be mitigated e.g. through fish rescues. Therefore the impact on biodiversity (flora/fauna) has been assessed as minor adverse Abstraction of dead water would result in increased drawdown of the reservoir. Therefore the impact on water has been assessed as minor adverse, temporary and reversible Reservoir drawdown and exposure of shoreline margins may result in minor adverse, temporary and reversible geomorphological impacts. Overall impacts on soil, geology and land use are summarised as minor adverse Temporary minor adverse effects on landscape and visual amenity are anticipated due to changes in exposure of the reservoir shoreline. The new buildings are relatively small in size and within the existing site area. In view of the fact that the reservoir levels are likely to be at their lowest during peak tourist season and the site is within the North Pennines AONB, the impact of the drought option on landscape and visual amenity is considered to be moderate adverse but temporary Key inter-relationships between topics include reservoir level impacts on biodiversity, flora and fauna, soil, geology and land use and landscape and visual amenity. Overall these have been summarised as moderate adverse

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A9.7 North Eden Resource Zone drought permits

Option Name: Bowscar boreholes drought permit: increase annual licence limit to enable continuation of abstraction at the maximum daily abstraction rate		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (North Eden boreholes). Preceding actions could include rezoning of water supplies; customer communication actions and demand restrictions. Trigger 4 is reached when 100% of the annual licence volume for the whole North Eden borehole group (Bowscar, Cliburn, Gamblesby and Tarn Wood boreholes) has been abstracted
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would vary the annual licence limit (618 Ml/yr equivalent to an average abstraction rate of 1.69 Ml/d) for the Bowscar boreholes to enable the continuation of abstraction at the maximum daily abstraction rate (3.36 Ml/d). The drought option would give a benefit of 1.67 Ml/d which would help keep abstractions from other sources at sustainable levels, or in isolated supply areas, ensure that essential demands for water would continue to be met. The exact conditions of the application would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year, the overall condition of the local aquifer and current environmental circumstances
	Location Area affected or whole supply zone	Local area supplied by Bowscar boreholes (North Eden Resource Zone)
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

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Option Name: Bowscar boreholes drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		Watercourses in proximity to the Bowscar boreholes are tributaries to the River Eden which is a SAC and is designated primarily for its oligotrophic to mesotrophic standing waters, its water courses of plain to montane levels and its alluvial forest habitats. The primary designated species are white-clawed crayfish, sea/brook/river lamprey, Atlantic salmon, bullhead and otter. The River Eden is also a SSSI. In addition, the North Pennine Moors SPA is in the locality. The environmental study showed that drought powers at Bowscar are unlikely to have a measurable impact on river flows; therefore no designated sites are impacted. No moderate or major adverse environmental impacts were identified in the environmental study Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbody: Eden Valley and Carlisle Basin Permo-Triassic sandstone aquifers GB40201G100400 at poor overall but good for quantitative (Cycle 2, 2015). No surface waterbodies identified as impacted. No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, groundwater level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities - baseline monitoring of groundwater levels
		Pre- and during drought permit monitoring	United Utilities - continue baseline monitoring of groundwater levels United Utilities - Eden Hall Marshes and SSSI at Udford, walkover surveys with photographs to check water levels and wetness, once in dry conditions - in period before drought permit application, and fortnightly during implementation
		Post- drought permit monitoring	United Utilities - continue baseline monitoring of groundwater levels
	Mitigation and compensation measures		As the environmental study did not identify any moderate or major adverse impacts, therefore, no mitigation measures are anticipated to be required
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

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Option Name: Gamblesby boreholes drought permit: increase annual licence limit to enable continuation of abstraction at the maximum daily abstraction rate		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (North Eden boreholes). Preceding actions could include rezoning of water supplies; customer communication actions and demand restrictions. Trigger 4 is reached when 100% of the annual licence volume for the whole North Eden borehole group (Bowscar, Cliburn, Gamblesby and Tarn Wood boreholes) has been abstracted
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would vary the annual licence limit (500 Ml/yr equivalent to an average abstraction rate of 1.37 Ml/d) for the Gamblesby boreholes to enable the continuation of abstraction at the maximum daily abstraction rate (1.6 Ml/d). The drought option would give a benefit of 0.23 Ml/d which would help keep abstractions from other sources at sustainable levels, or in isolated supply areas, ensure that essential demands for water would continue to be met. The exact conditions of the application would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year, the overall condition of the local aquifer and current environmental circumstances
	Location Area affected or whole supply zone	Local area supplied by Gamblesby boreholes (North Eden Resource Zone)
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

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Option Name: Gamblesby boreholes drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		The site is located within the North Pennines AONB Watercourses in proximity to the Gamblesby boreholes are tributaries to the River Eden which is a SAC and is designated primarily for its oligotrophic to mesotrophic standing waters, its water courses of plain to montane levels and its alluvial forest habitats. The primary designated species are white-clawed crayfish, sea/brook/river lamprey, Atlantic salmon, bullhead and otter. The River Eden is also a SSSI. In addition, the North Pennine Moors SPA is in the locality. However the environmental study showed that drought powers at Gamblesby are unlikely to have impacts on flows in the River Eden. Therefore no designated sites are impacted. No moderate or major adverse environmental impacts were identified in the environmental study, all potential impacts were assessed as negligible Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbody: Eden Valley and Carlisle Basin Permo-Triassic sandstone aquifers GB40201G100400 at poor overall but good for quantitative (Cycle 2, 2015). No surface waterbodies identified. No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, groundwater level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities - baseline monitoring of groundwater levels
		Pre- and during drought permit monitoring	United Utilities – continue baseline monitoring of groundwater levels United Utilities – hydrodynamics; undertake geo-referenced, repeatable assessment of channel wetted width, depth and velocity including field notes and fixed point photographs once in dry conditions - in period before drought permit application, and fortnightly during implementation
		Post- drought permit monitoring	United Utilities - baseline monitoring of groundwater levels
	Mitigation and compensation measures		As the environmental study did not identify any moderate or major adverse impacts, therefore, no mitigation measures are anticipated to be required
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities

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Option Name: Tarn Wood boreholes drought permit: increase annual licence limit to enable continuation of abstraction at the maximum daily abstraction rate		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	If appropriate, implementation from Trigger 4 (North Eden boreholes). Preceding actions could include rezoning of water supplies; customer communication actions and demand restrictions. Trigger 4 is reached when 100% of the annual licence volume for the whole North Eden borehole group (Bowscar, Cliburn, Gamblesby and Tarn Wood boreholes) has been abstracted
	Deployable Output of action Ml/day. Include how this is calculated	The drought option would vary the annual licence limit (592 Ml/yr equivalent to an average abstraction rate of 1.62 Ml/d) for the Tarn Wood boreholes to enable the continuation of abstraction at the maximum daily abstraction rate (2.37 Ml/d). The drought option would give a benefit of 0.75 Ml/d which would help keep abstractions from other sources at sustainable levels, or in isolated supply areas, ensure that essential demands for water would continue to be met. The exact conditions of the application would be discussed fully with the Environment Agency and would depend upon the need for additional water, time of year, the overall condition of the local aquifer and current environmental circumstances
	Location Area affected or whole supply zone	Local area supplied by Tarn Wood boreholes (North Eden Resource Zone)
	Implementation timetable Time from trigger to implementation, time of year and duration	Commencement of drought permit preparation from Trigger 2 Application of drought permit from Trigger 3 Implementation of drought permit from Trigger 4 Drought permit could be effective at all times of the year Drought permits are valid for up to 6 months and can be extended for a further 6 months
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	Approval of the application
	Risks associated with option	That the application, as applied for, is not approved

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Option Name: Tarn Wood boreholes drought permit (continued)			
Environmental Assessment	**Risk to the Environment** (High/Medium/Low or unknown)		Low Environmental study completed in 2010
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites. Assess likely impact on WFD ecological and chemical status		Watercourses in proximity to the Tarn Wood boreholes are tributaries to the River Eden which is a SAC and is designated primarily for its oligotrophic to mesotrophic standing waters, its water courses of plain to montane levels and its alluvial forest habitats. The primary designated species are white-clawed crayfish, sea/brook/river lamprey, Atlantic salmon, bullhead and otter. The River Eden is also a SSSI. In addition, the North Pennine Moors SPA is in the locality. The environmental study showed that drought powers at Tarn Wood are unlikely to have a measurable impact on river flows; therefore no designated sites are impacted. No moderate or major adverse environmental impacts were identified in the environmental study Habitats Regulations Assessment Screening for this drought plan concluded no likely significant effects of implementation of this drought permit on designated sites WFD waterbody: Eden Valley and Carlisle Basin Permo-Triassic sandstone aquifers GB40201G100400 at poor overall but good for quantitative (Cycle 2, 2015). No surface waterbodies identified. No risk of deterioration to any surface or groundwater waterbodies associated with this licence have been identified (as per the release of data from the Environment Agency, 5 October 2016)
	Information used to understand conditions before drought or any drought actions are implemented		The environmental study used historical data on river flow, groundwater level, ecological monitoring and water quality. In addition river cross-section measurements were taken throughout the study area to enable hydraulic modelling to translate flow changes in to habitat parameter changes (e.g. depth, velocity), and thus ecological impact. Mass-flux, trend analysis and SIMCAT water quality modelling was also undertaken
	Environmental Monitoring Plan for sensitive features	Baseline monitoring	United Utilities - baseline monitoring of groundwater levels
		Pre- and during drought permit monitoring	United Utilities – continue baseline monitoring of groundwater levels
		Post- drought permit monitoring	United Utilities - baseline monitoring of groundwater levels
	Mitigation and compensation measures		As the environmental study did not identify any moderate or major adverse impacts, therefore, no mitigation measures are anticipated to be required
	Impact on other activities e.g. fisheries, industry etc.		The environmental study did not identify any adverse impacts on other activities