Final Drought Plan 2022

Appendix L: **West Cumbria**

United Utilities

Water for the North West

1 Introduction

Our final Drought Plan 2022 aligns to our Water Resources Management Plan 2019 and the newly combined Strategic zone (was West Cumbria and Integrated Zones) by the completion of the new water treatment works and pipeline from Thirlmere Reservoir into West Cumbria. The scheme is currently expected to be completed in 2022. The new scheme will allow us to stop abstraction from Ennerdale Water, Crummock Water and several of the Quarry Hill sources. Abstraction at Ennerdale Water and Crummock Water have effects on Habitats Regulations sites, Overwater (Quarry Hill source) is a Site of Special Scientific Interest. Due to the final plan being published in 2022, we have placed the West Cumbria aspect of the 2018 drought plan in this Appendix. This Appendix will be used for West Cumbia until the Thirlmere Transfer scheme is complete.

The West Cumbria zones serves the areas of Workington, Whitehaven, Wigton and Solway. 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, 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 International and National legislation and we are legally required to protect these.

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2 Water Resources Management

2.1 Abstraction licence changes

The Environment Agency's Review of Consents process, undertaken to ensure our abstraction licences comply with the Habitats Regulations, resulted in changes to some of our abstraction licences. In addition, changes made by the Environment Agency's Restoring Sustainable Abstraction programme and the Water Framework Directive (WFD) have/will also result in licence changes. The following table (Table 1) 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 that are included within this drought plan (i.e. to derive drought triggers[1]).

Table 1 Abstraction licence changes for environmental protection for West Cumbria (these have all been included in the final drought plan, however all those with a * are not included in this Appendix until their implementation date)

Source	Driver for change	Nature of change	Implementation date	Included in this plan?
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	21 July 2015	Yes
South Egremont boreholes	Habitats Regulations	New water source to reduce abstraction from Ennerdale during low river flow periods	2017	Yes
Ennerdale Water	Habitats Regulations	Revocation of abstraction licence	16 December 2022	Yes*
Crummock Water	Habitats Regulations	Revocation of abstraction licence	16 December 2022	Yes*
Dash Beck (Quarry Hill)	Habitats Regulations	Increase in prescribed flow from 2.72Ml/d (summer) and 4.54Ml/d (winter) to 5Ml/d (year round)	1 April 2015	Yes
Overwater (Quarry Hill)	Restoring Sustainable Abstraction (local issue)	Abstraction not allowed if lake is lower than 1m below weir crest	1 April 2022	Yes*

[1] We have kept the previous triggers form the 2018 drought plan and have not altered these to align with the new guidance on drought levels, as the expectation is that this Appendix will not be in the final Drought Plan 2022.

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Overwater (Quarry Hill)	Habitats Regulations	Revocation of abstraction licence to provide compensation under the Habitats Regulations for the impacts of the Ennerdale abstraction	16 December 2022	Yes*
Chapel House (Quarry Hill)	Habitats Regulations	Revocation of abstraction licence to provide compensation under the Habitats Regulations for the impacts of the Ennerdale abstraction	16 December 2022	Yes*

2.2 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

Table 2 Water resources indicators, with resource zone specific detail, monitored weekly

Water Resource indicator for West Cumbria
High probability of sources failing to meet demand or failing to refill sufficiently
Storage at Chapel House and Overwater Reservoirs at or below 50% full and falling
Rapid decline in storage (or slow rise in storage during winter) of Chapel House and Overwater Reservoirs, Ennerdale Water and Crummock Water
River flow in Hause Gill, Dash Beck and River Ellen at low levels and continuing to decline
Scales boreholes operating at a high level of abstraction Low inflows from Aughertree Springs
Magnitude and duration of peak demands for water significantly higher than normal for the time of year
Rainfall significantly below average and soil moisture deficits significantly above average for period of 2 months and longer

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3 West Cumbria drought options

3.1 Background

Both Ennerdale Water and Crummock Water are natural lakes in the Lake District National Park and UNESCO Work Heritage Site, raised by weirs constructed at the outlets into the downstream rivers. Both lakes extend for a significant depth beyond the level at which our abstraction ceases – we only abstract water from the top meter or two of the lakes. The catchments are generally wet, with 1,800mm 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).

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 Water and Crummock Water have high levels of environmental protection. Ennerdale Water is a Site of Special Scientific Interest (SSSI) and, downstream of the lake, the River Ehen is both a SSSI and a SAC. Providing secure water supplies and protecting the aquatic environment in this setting is a fine balance. Both the Ennerdale and Crummock catchments are 'flashy' with short critical periods which mean that while severe droughts are extremely unlikely, 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. 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 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 impacts because of exposure of shoreline and ecological impacts because of exposure of aquatic plant communities for which the sites are designated and loss of connection between the lake and its tributaries which is important for fish spawning migrations. Extended periods where the rivers are at compensation flow can also have ecological impacts downstream of the lakes.

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 licenced (1.7m below weir crest at Ennerdale Water and 0.97m below weir crest at Crummock Water).

Droughts severe enough to cause Ennerdale and Crummock to reach lake levels where abstraction is not licenced are unlikely. 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.

All the demand side options discussed in this appendix 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 Crummock reach the point where abstraction is not licenced, there would still be a need to find significant volumes of water to maintain supplies to customers and to continue to provide compensation flows to the downstream river through drought permits/orders.

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3.1.1 Drought options for West Cumbria

This appendix includes drought options at Ennerdale including a drought order to allow drawdown of the lake to 2.5m below weir crest, and earlier and more frequent restrictions on customers' water use 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. Support increased from South Egremont Boreholes
- Trigger 3. Start representation period for Temporary Use Ban and Implement. Drought order application.
- Trigger 4. Continue above actions
- 1.7m below weir crest. Drought order implemented to allow public water supply to continue

Sequencing of actions ensures that demand management and supply measures are adopted ahead of drought order implementations at Ennerdale Water. In the event that a drought order at Ennerdale is 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.

In developing the 2018 drought plan, we conducted a thorough review of options to bring additional water sources into use. No non-commissioned water source options were identified in West Cumbria. 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 2.5m below weir crest. A Stage 2 HRA Appropriate Assessment identified the potential for adverse impacts of 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 1.5m below weir crest.
- A drought permit at Scales boreholes to increase the annual licence limit. This option is assessed as having no impact on any designated sites.

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 and 2019, a new pipeline from Thirlmere reservoir (Integrated Resource Zone) is planned for 2022.

In the meantime, we have agreed with the Environment Agency to release additional water from the lake to the River Ehen. Compensation flow releases to the downstream River Ehen of 60 to 80Ml/d (depending on lake level) are provided, which are significantly greater than the original abstraction licence requirement of 31.8Ml/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. Monitoring of the freshwater mussel population which is carried out three times a year by specialist contractors on behalf of UU has demonstrated that the increase in compensation flow since 2012 has had positive impacts to the mussel population.

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To partially offset the increase in compensation flow requirement since 2012 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.
- 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 3Ml/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 improvement at our Summergrove service reservoir to allow a further reductions of water to be transferred on to Cornhow, dependant on the storage at Cornhow.

Until the new pipeline from Thirlmere is in place in 2022, we need to have drought options from 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 Lake District National Park. We have submitted a report to Defra on the alternative options as part of the Imperative Reasons of Over-Riding Public Interest case for the continuation of the Ennerdale abstraction until 2022. 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.

This Appendix will be fully removed when the new pipeline from Thirlmere is operational.

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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 in 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 and implemented.

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 with 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 Riven 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 form 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

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- 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
- 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
- Severn 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 that has been undertaken or is 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.

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5 Drought triggers

Drought triggers have been developed for three sources in West Cumbria Resource Zone: Crummock Water, Ennerdale Water and Scales boreholes. 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. 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.

Table 3 Drought triggers for Crummock Water, Ennerdale Water and Scales boreholes

Trigger	Crummock Water (m below weir crest)	Ennerdale Water (m below weir crest)	Scales (cumulative annual abstraction 1 April – 31 March)
Trigger 1	0.13	0.55	265 Ml
Trigger 2	0.31	0.92	287 Ml
Trigger 3	0.50	1.05	309 Ml
Trigger 4	0.97	1.47	365 Ml

5.1.1 Drought trigger testing

The intervals between the Ennerdale Water and Crummock Water triggers are shown in Table 4. The intervals with both average and worst case drawdown rates are given to show the impact that drought severity can have in the time available to implement actions.

Table 4 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

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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 Hydro-Logic® 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.

These tests show that Crummock Water is more resilient to drought, Crummock Water would 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 downward rate.

The likelihood of crossing drought triggers is considered to be an acceptable balance to allow sufficient time for actions during severe drought events. Outputs comparing modelled storage to the drought triggers for key historic drought events are shown for Ennerdale Water (Figure 1) and Crummock Water (Figure 2).

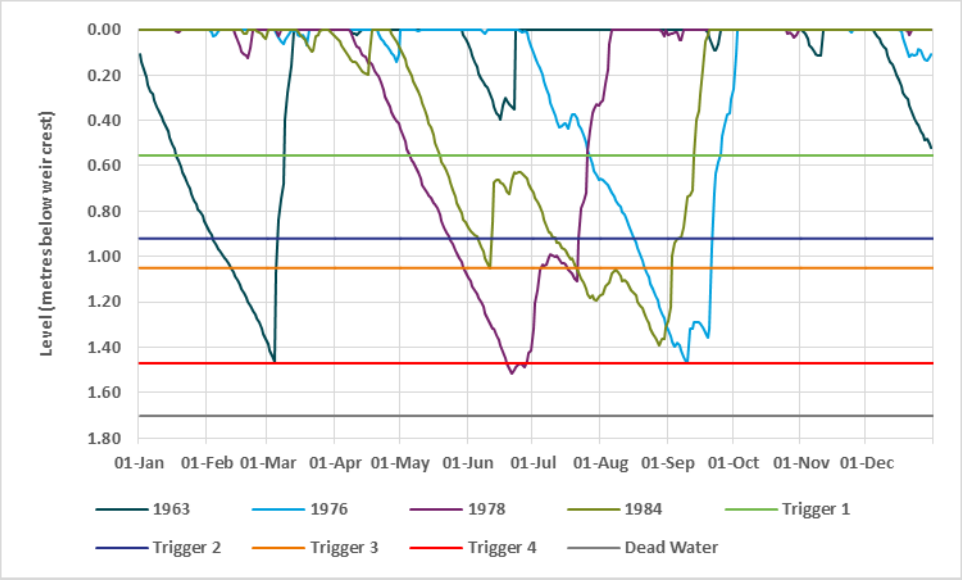

Figure 1 Ennerdale Water drawdown scenarios for key drought events against drought triggers

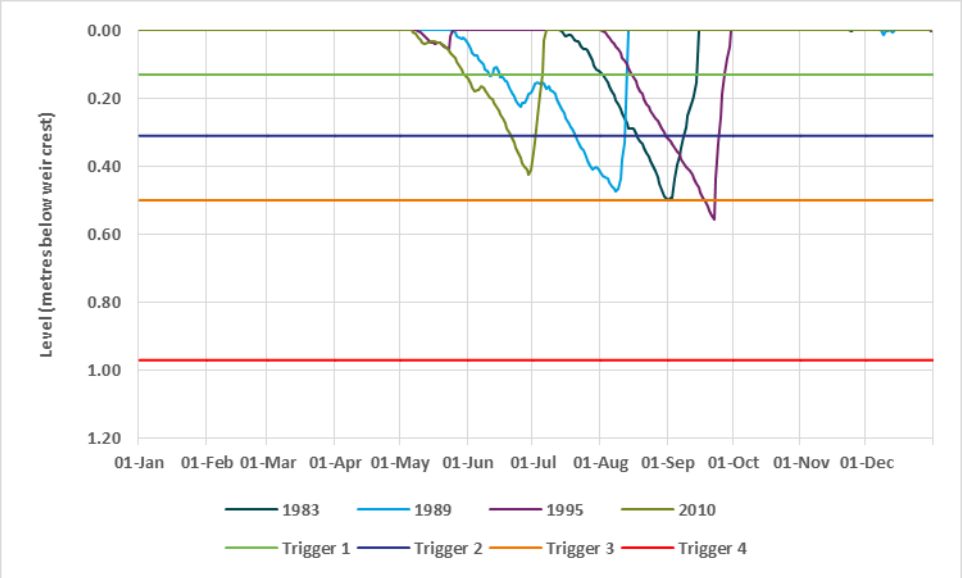

Figure 2 Crummock Water drawdown scenarios for key drought events against drought triggers

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 3). In this modelling, the lower triggers were not crossed. Therefore, a further assessment was carried out

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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.

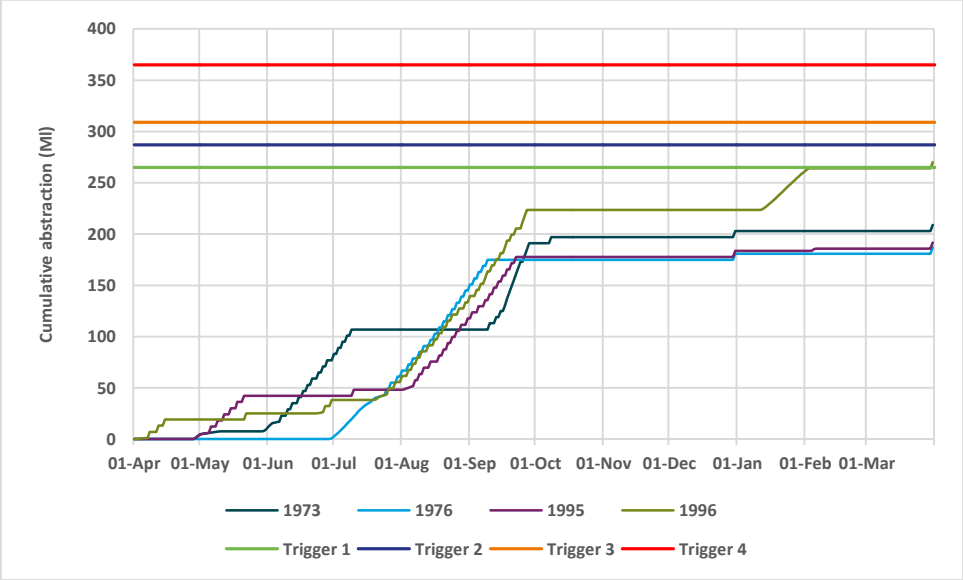

Figure 3 Scales boreholes modelled abstraction scenarios for key drought events against drought triggers

5.2 Operational Actions

Table 5 outlines operational actions that we would consider on reaching each drought trigger for each resource zone.

In our drought scenario testing 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.

Table 5 Operational drought management actions

Trigger	West Cumbria Resource Zone
Trigger 1	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
Trigger 2	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 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)

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Trigger	West Cumbria Resource Zone
Trigger 3	Continue with Trigger 1 and 2 drought actions; continue to balance risk across the zone where practical
Trigger 4	Continue with Trigger 1, 2 and 3 drought actions; continue to balance risk across the zone where possible Implementation of a drought order at Ennerdale

5.3 Likelihood of drought

The likelihood or risk of drought triggers being reached is calculated using water resources models with hydrological data from the historic record. For Ennerdale Water and Crummock Water there is a 54 year historic record (1961 to 2014). 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.

Table 6 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 (%)
Trigger 1	Crossed in 34 years out of 54 years	1 in 1.6 years	Likelihood of crossing of 1 in 1.6 in any one year	63%	37%	99%
Trigger 2	Crossed in 16 years out of 54 years	1 in 3.4 years	Likelihood of crossing of 1 in 3.4 in any one year	30%	70%	83%
Trigger 3	Crossed in 14 years out of 54 years	1 in 3.9 years	Likelihood of crossing of 1 in 3.9 in any one year	26%	74%	78%
Trigger 4	Crossed in 1 year out of 54 years	1 in 54 years	Likelihood of crossing of 1 in 54 in any one year	2%	98%	9%

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Table 7 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 (%)
Trigger 1	Crossed in 20 years out of 54 years	1 in 2.7 years	Likelihood of crossing of 1 in 2.7 in any one year	37%	63%	90%
Trigger 2	Crossed in 9 years out of 54 years	1 in 6 years	Likelihood of crossing of 1 in 6 in any one year	17%	83%	60%
Trigger 3	Crossed in 1 years out of 54 years	1 in 54 years	Likelihood of crossing of 1 in 54 in any one year	2%	98%	9%
Trigger 4	Never crossed during the 54 years	Less than 1 in 54 years	Likelihood of crossing less than 1 in 54 in any one year	<2%	~99%	0%

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6 Testing of drought scenarios

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. The methods used in this Appendix (from Drought Plan 2018) have resulted in making significant progress in the testing of more extreme events in the interim period prior to stochastics being implemented (stochastics have been used for all the resource zones which align with WRMP19).

As well as testing the impact of historic drought events if they were to recur with our current supply system, we have also used the following approach 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.

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 model (using a feature called the "risk analyser"). This allows the model, from a defined starting point, to simulate all historic hydrological events form 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 the most severe combinations have been presented in this Appendix up to an indicative likelihood of 0.1% in any one year.

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. Using Extreme Value Analysis we assigned an indicative return period to each drought event. From the analysis, we estimate that the severe droughts used to test West Cumbria Resource Zone has an indicative event likelihood of 0.1% in any one year[2].

A summary of the severe, generated events tested is provided in Table 8 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 West Cumbria, but the very short critical periods of these systems mean these longer events are

[2] The likelihoods estimates 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.

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much less severe than single season events. Therefore it is only relevant to present more severe single-season events in this Appendix as these define the risks in this resource zone.

Table 8 Crummock Water, comparison of worst-historic drought events compared to severe events tested in this Appendix

	Year(s)	Magnitude	Duration	Indicative annual likelihood of drought event
Crummock Water, magnitude indicator is lake level reached (lower than 0.97m below weir crest would require a drought permit)				
Critical historic event	1995	0.56m below weir crest	7 weeks	1.0%
More severe event tested in drought plan	1995 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 permit)				
Critical historic event	1978	1.52m below weir crest	11 weeks	2.0%
More severe event tested in drought plan	1963 followed by 1969	1.70m below weir crest	14 weeks	0.1%

6.1 Testing the drought plan

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).

6.1.1 Scenario testing for West Cumbria Resource Zone

Table 9 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 on 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's droughts.

Demand side options would be implemented in the sequence: enhanced water efficiency communications (trigger1), campaign for voluntary water use restraint (trigger 2 Ennerdale Water or trigger 3 Crummock Water), Temporary Use Ban (trigger 3). Because these are consistent across scenarios presented the demand side actions are not shown in the table below.

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.

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Table 9 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	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): implement Temporary Use Ban and apply for drought order
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): implement Temporary Use Ban and apply for drought order
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): implement Temporary Use Ban and apply for drought order, apply for drought permit at Crummock, apply for drought order at Ennerdale
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): implement Temporary Use Ban and apply for drought order

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Winter 1963 & spring/summer 1969 combined conditions (Ennerdale focused event)	Single season winter drought of 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	N/A	N/A	Ennerdale 1.07 m btwl	<u>At Ennerdale</u> Early February (at drought trigger 2): increase abstraction from South Egremont boreholes Mid-February (at drought trigger 3): implement Temporary Use Ban and apply for drought order Late March (at dead water): implement drought order
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): implement Temporary Use Ban and apply for drought permit at Crummock Mid-September (at Ennerdale drought trigger 3): implement Temporary Use Ban and apply for drought order at Ennerdale

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7 Drought option forms

7.1 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
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
Permissions required and constraints	None

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Including details of liaison carried out with bodies responsible for giving any permits or approvals	
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

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

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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 representation period for a Temporary Use Ban. 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
Implementation timetable Time from trigger to implementation, time of year and durations of actions	The commencement of a campaign for voluntary water use restraint initiated at Trigger 3 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 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

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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

Option Name: Temporary Use Ban

Trigger(s) (or preceding actions)	We will give strong consideration to implementing a Temporary Use Ban at Trigger 3 during the summer (April to September) in order to attempt to reduce external household demand for water. 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 3, 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

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	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
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 with an accompanying communication regarding the commencement of a representation period before its implementation. 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
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

Option Name: Ordinary drought order (non-essential use ban)

Trigger(s) (or preceding actions)	Following the implementation of a Temporary Use Ban (after Trigger 3 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

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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
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

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7.3 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 public water supply is not licenced, however, abstraction for compensation flow release will continue in line with the impoundment licence. 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 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
	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 (but most likely in the summer) 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. 2020) where significant rainfall arrived just before the powers were granted and due to the flashy nature of the source, water storage rapidly recovered (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

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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 2019 taking into account comments received on the 2018 application ready version, 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 and UNESCO World Heritage Site. 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 to a maximum of 2.5m below weir crest level. 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)

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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 (HMWB) at moderate (Cycle 2, 2015); River Ehen (upper including Liza) (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, updated in 2019, 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, 2015, 2016 and 2019). 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 2019 Environmental Assessment Report and Appropriate Assessment was prepared in partnership with the Environment Agency and Natural England

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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) from 2013 to date 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 and 2019 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)

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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 minimum 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

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Option Name: Crummock Water drought permit: allow pumping of compensation and abstraction flows to a lake level of 1.5m 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

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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 and UNESCO World Heritage Site. 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 (HMWB) at moderate (Cycle 2, 2015); Dub (Park) Beck (not designated artificial or heavily modified) at good (Cycle 2, 2015); Cocker (Crummock Water to confluence with Whit Beck) (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

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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

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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

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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. Application ready version of the assessment prepared in support of 2018 application.
	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 at poor overall but good for quantitative (Cycle 2, 2015), Crummock Beck u/s Holme Dub (not a HMWB) at bad (Cycle 2, 2015), Holme Dub (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

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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. Annual rating of Crummock Beck (abstraction licence condition) 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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