Dŵr Cymru
Welsh Water

Final Drought Plan 2020

January 2021

dwrcymru.com

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A. Executive Summary

i. Overview

At Welsh Water, our vision is; “To earn the trust of customers, every day”. That vision reflects our unique ownership structure: we have no shareholders and so can concentrate solely on delivering the best possible value for money to our customers. All the profits that we make are reinvested in the business to improve outcomes for our customers and the natural environment or are used to benefit customers. We need to hold to this way of working every day, especially during stressful periods such as droughts which can be challenging for both ourselves and customers.

We are trusted to plan for drought and trusted to deliver these plans if and when drought periods occur – we must continue to earn that trust every day.

Welsh Water’s long term ambitions have been set out in our Water 2050 document and this places the maintenance of wholesome water supplies at its heart. One of our key strategies is what we have titled “Enough Water For All”. In essence, this is to ensure that we always have sufficient water in line with our customers’ expectations, even in times of drought.

Our Water Resources Management Plan and our Drought Plan are at the centre of this strategy. Producing and maintaining a Drought Plan is a statutory process required by Government who have set out the legal basis for this in The Water Industry Act 1991. We are directed by Welsh Government who also provide the guiding principles for our plan. We have worked closely with Natural Resources Wales who produce the Drought Planning Guidance for water companies in Wales.

Of most importance to our customers is the impact that a drought might have on them and in particular their expectation of how we might restrict water use through our powers to impose hose pipe bans (in legal terms, known as ‘Temporary Use Bans) or more stringent measures that might limit non-domestic supplies called ‘Non-essential Use Bans’.

We have engaged with our customers to understand their expectations on how resilient they feel our supply systems should be to drought, how often it is acceptable to impose such restrictions and how these measures should be put in place. We have used this information to inform our plan.

As demonstrated through history, our supply area is not immune from drought. In 1976, around a million people in south east Wales were subject to rota-cuts in order to ration supplies. It is clear from our customer engagement that such measures are now generally considered unacceptable.

With such events in mind, Government has asked the water industry to better understand the likelihood and impact of such measures being needed again. Furthermore, Government has challenged the industry to increase levels of drought resilience. In response, we have taken a new approach to our understanding of drought risk for this Plan and have tested it against more severe droughts than observed in our historic records.

Although the drought of 2018 was fairly short in duration it was intense with very low rainfall. We therefore, had significant concerns that this could impact our customers and we put our current plan into practice. This experience has given us greater insight into how we need to operate to manage our supplies in a drought and how additional network connectivity can provide increased system resilience. We installed a number of additional links within zones to maximise our water resources and treatment capability to meet peaks in demands and in some cases between zones to enable water resources to be shared.

We have subsequently built this learning into our updated Drought Plan and will be making permanent improvements to our network connectivity through our forthcoming investment planning work.

ii. Background

Welsh Water supplies on average around 800 million litres of water every day. Most of our water is supplied from our impounding reservoirs but we also obtain significant volumes from our lowland river sources. Groundwater accounts for less than five percent of our supplies at a Company level, but at a local level may be the whole supply.

This reliance on surface waters can make us vulnerable to relatively short periods of very low rainfall as experienced during 2018.

Although Wales has a relatively high rainfall compared to the rest of the UK the overall regional picture masks important geographical differences within our supply area: for example, at up to 3,000mm rainfall per year in Snowdonia, this can be more than four times the levels recorded in the border areas and Herefordshire, where 700mm per year is typical.

The diversity of our water supply systems reflects these regional variations, which can range from discrete small-scale local supplies, through to large scale multi-source integrated networks that are more typical of many other water company areas.

The amount of water that we take from the environment has fallen by around 12% since 2000 as demand for water has fallen due to lower customer use and because we have reduced leakage from our 27,400km network of pipes by around 40% in the same period. We are planning to reduce the leakage from our systems by a further 15% over the next 6 years.

As the water undertaker for Wales we are faced with some unique challenges in developing our drought plan:

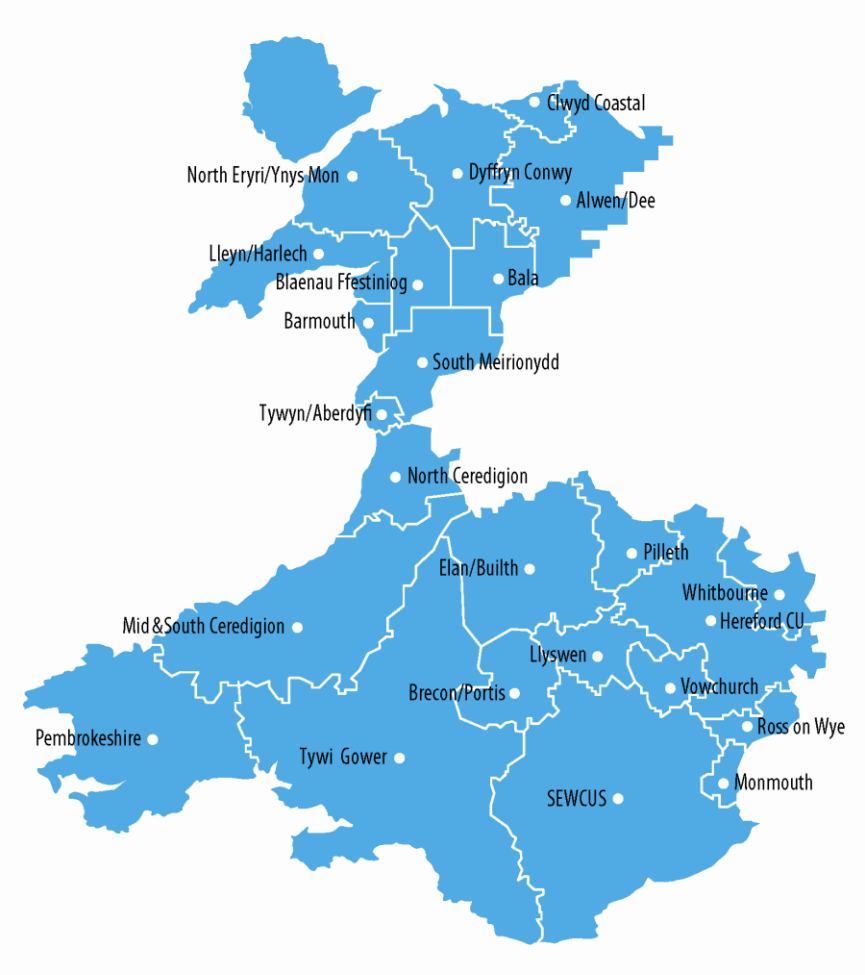
Because of the topography of Wales, Welsh Water has a high number of “water resource zones”. Our 24 water resource zones represent a fifth of the total for England and Wales (see figure below).

The landscape means that each of these zones is essentially self-contained with only limited opportunity to transfer water across zonal boundaries. This results in less flexibility to manage potential drought impacts and may require local measures to be put in place even if the overall position with regard to water availability in Wales is healthy.

The aquatic environment in Wales is of exceptionally high quality, with many sites of special scientific interest and a number of rivers designated at a European level as Special Areas of Conservation. Any drought measures therefore must balance our twin responsibilities of protecting the environment and maintaining public water supply.

These geographic and environmental constraints mean that, despite the relatively high rainfall in parts of Wales, drought can present a significant risk that we need to plan for adequately.

This document sets out how we will deal with drought conditions within both the urban and rural parts of our supply area, and how we will monitor the effect of any actions that we take on the natural environment.



Welsh Water's Water Resource Zones

iii. The Drought Plan

a) Introduction

Our customers and stakeholders would like to understand our proposals, particularly how a drought might impact upon our water supplies and how we will communicate messages to them during periods of prolonged dry weather.

Therefore, we have written this Plan with customers, stakeholders and our regulators in mind. The latter require sufficient technical detail to understand the level of risk, if any, to our customers during drought and to be satisfied that our drought plans are rigorous and achievable.

Our Plan aims to do this through clearly setting out our response to drought in terms of;

- The way in which we monitor indicators so that we know a drought is happening.
- Defining the trigger levels at which we will take action and;
- Identifying the specific actions that we will take as trigger levels are met.

To support the drought planning process, a UK Water Industry Research (UKWIR) project was completed in 2013 to provide a voluntary Code of Practice and guidance to water companies. It provides advice on a potential staged approach to the implementation of demand restrictions such as Temporary Use Bans and Non-essential Use Bans with the aim of creating a more consistent approach between water companies across Wales and England. This general approach seeks to minimise the social and economic effects of water use restrictions, with restrictions placed initially on domestic customers before affecting commercial customers.

This Code of Practice was produced in collaboration with, and supported by representatives from regulators, consumer groups, trade bodies and customers. Welsh Water have signed up to this Code.

b) Drought Indicators

Droughts are a prolonged period of little or no rainfall which, when combined with the usually hotter temperatures experienced, puts severe pressure upon our water resources and our ability to meet high customer demand for water.

Droughts by their very nature are highly variable in terms of their timing, duration and severity but they all begin in the same way with a period of below average rainfall that continues for longer than expected. There are a number of indicators that show when a drought is developing and an important requirement of a drought plan is to identify those that we will monitor and use to trigger drought action. We use the following indicators across our water resource zones:

- Rainfall
- River flow
- Reservoir storage
- Groundwater levels
- Level of demand

Our regional water situation is monitored on a weekly basis and provides both rainfall and reservoir storage data. These are circulated widely both within Welsh Water and shared with external stakeholders, including Natural Resources Wales (NRW) and the Environment Agency (EA). Routine hydrometric monitoring is also carried out by NRW and the EA who share relevant data for rainfall and river flows with us. We also track zonal and sub-zonal demand across our water supply network on a daily basis.

A comparison of these indicators under current conditions against historical norms provides a measure of the drought severity.

c) When do we take action in a drought (Drought Triggers)

It is important to establish when action should be taken during droughts to protect public water supply. We have developed drought triggers to identify when we should consider implementing specific drought actions to reduce demand and, if necessary, obtain additional water resource. These triggers are used as decision making tools as part of the overall drought management process.

Drought indicators have been developed to identify when the water resource situation is moving into a drought. Drought trigger levels have been defined, aligned with drought guidance, to ensure that that drought actions are proportionate to the level of drought risk. These are:

- Stage 1 - Normal operation
- Stage 2 - Developing drought
- Stage 3 - Drought
- Stage 4 - Severe drought
- Stage 5 – Emergency Measures

d) Managing Drought

The approach we take within Welsh Water to managing all incidents, whether they are short term events such as a burst water supply main, or longer term events such as the loss of an asset, is to try and ensure little or no disruption to our customers' supplies whilst ensuring that our actions have minimal, if any, effects upon the environment.

Applying this approach during a drought event means we firstly take actions that are immediately available to us, such as reconfiguring our supply networks and increasing our leakage activity. We escalate communications activity when incidents or our actions impact upon our customers and in the case of drought, to ask for our customers support in using water wisely or to inform them of water use restrictions.

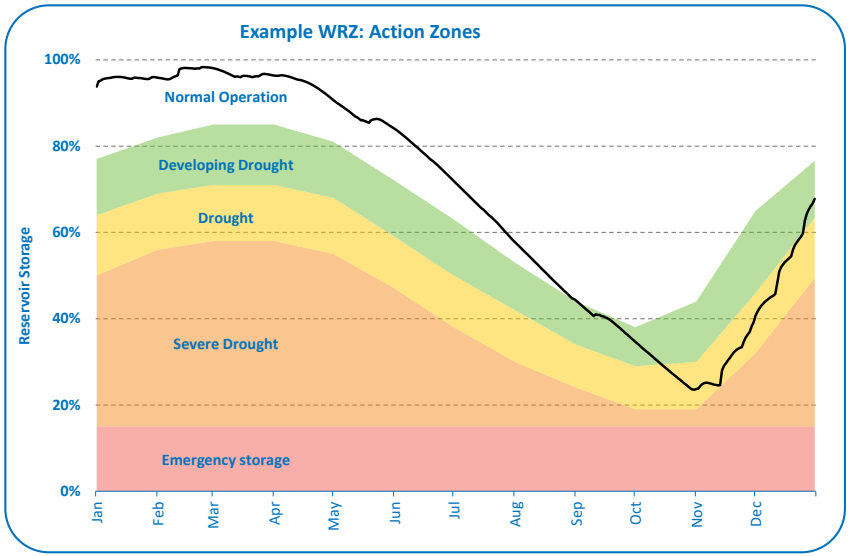
Our drought plan needs to be flexible in its approach as each drought is different in terms of its duration, severity and the areas it affects. It is not necessarily the case that all parts of our supply area would experience a drought at the same time, however we plan for a scenario where all our systems are under stress. We recognise that multiple events occurring simultaneously increase the magnitude and severity of an emergency situation. In an incident situation, our procedures require the separated but integrated operation of the following internal command centres; aligned to our emergency response manual.

Centre	Purpose
Retail Centre	for customer communications
SMART 'HUB'	for operations communications and real-time operations data
Silver Command Centre	for local tactical and operational management and response
Gold Command Centre	for strategic response and management
Crisis Management Team	for executive management and external agency support

These structures provided effective coordination and management of all internal and external activities in managing the events of 2018 and so we will take this approach in future drought events.

e) Reservoir drought triggers and actions.

The stocks available in our impounding reservoirs are critical in assessing our water resource position at any point in time. We track the levels in each of our reservoirs, against a series of pre-defined 'drought control lines', as shown by the black line in the next figure. These help us to understand our level of risk and the actions that we should be taking in relation to drought.



Example WRZ Drought Action Zone Plot

Normal Operation

Over the late Autumn/Winter period our reservoirs will typically fill and overtop due to rainfall. It is important that we make best use of our cheapest and environmentally preferred water sources during this period which are predominantly our impounding reservoirs. We use our lowland, river sources under these conditions but they are operated below their peak capacity.

As storage levels fall we start taking action to maximise the amount of water resource by increasing the use of the lowland river sources which in turn preserve our upland storage in case of drought.

Developing Drought

As we encounter a drought our reservoir storage will fall below that normally expected for the time of year. This is because less water than normal will be captured by reservoirs under dry conditions whilst the water demand leaving the reservoir stays the same or increases. We monitor this position and, as we move towards the 'Developing Drought' action zones of our reservoirs, the focus of operation switches to not only preserving and balancing water resource but to actions that will manage demand.

In general, we aim to maximise the water resource across each zone and this can require significant adjustments to our treatment works output and the reconfiguration of our trunk mains networks. Great care and planning are needed to ensure that the transition to new configurations is, from our customers' perspective, seamless.

As drought continues, we will increase our demand management effort through enhanced and targeted leakage control and/or pressure management. We will also be increasing our messaging to inform customers of the current water situation and the need to protect water supplies and the environment.

As the management of our systems becomes more complex, we establish our 'Silver' and 'Gold' command centres to manage this change process. We will also make our regulators aware of the situation and form appropriate lines of communication with Government, industry groups and our regulators. The 'Gold' and 'Silver' command centres manage the development and delivery of action plans with the objective of maximising the water resource available to meet customer need whilst taking a measured response to managing customer demand.

Drought

If dry weather conditions persist, we are encountering a drought and must respond accordingly, including by preparing for potential severe drought conditions.

If storage levels continue to decline then we will take further action to preserve storage until levels recover back to normal. We will be maximising our leakage effort and we will have introduced all supply side measures that do not need to take more water from the environment. We will have taken action through new schemes or possibly bulk water tankering to resolve any local pinch points.

At this stage we will seek to implement a Temporary Use Ban ("Hosepipe Ban"), which will restrict certain uses of water. This is inevitably a difficult decision as this will impact directly on some customers, but once made we will work with Welsh Government and Natural Resources Wales to effectively communicate the need to increase demand management in this way.

Within this 'Drought' action zone we may also submit applications to our environmental regulators (Natural Resources Wales and the Environment Agency) to allow us to gain more water in addition to that currently permitted. It will be clear to the general public at this stage that water supplies are under stress and this will doubtless attract media interest.

Severe Drought

There would need to be very dry weather patterns for an exceptionally long period for reservoir storage levels to fall in to the 'Severe Drought' action zone.

Our actions will be proportionate to such severe weather and we would seek further help from our customers, both domestic and non-domestic through implementation of a 'Non Essential Use Ban' to restrict certain public and commercial uses of water.

Assuming our Drought Permit/Drought Order applications have been successful, we would implement these schemes immediately and begin monitoring in line with our pre-prepared Environmental Monitoring Plans and Environmental Assessments. In preparing this Drought Plan, we have re-examined the environmental impact of potential Drought Permit/Drought Orders, so that we now have a better understanding of the need for monitoring and environmental mitigation measures to be put into place

Emergency Storage

Our planning for drought includes a reserve supply of water known as 'Emergency Storage'. This volume is designed to meet around 30 days of customer demand, as well any environmental requirements.

If we reach the stage where this is the only storage we have remaining in our reservoirs, we are in an exceptional drought event and we may need local 'extreme' measures such as water rationing to preserve supplies for as long as possible.

The table below summarises the measures that we will take in line with our Drought Action Zones.

f) Environmental Assessment

Within our Drought Plan we have options available under severe drought conditions to take more water from the environment than we are normally permitted. Given the potential impact this might have ecologically we would only do this once all other actions to both increase our existing supplies and to reduce demand have been exhausted.

For good reasons, the process by which we obtain this additional water is tightly controlled by legislation and enforced by our environmental regulators, Natural Resources Wales (NRW) and the Environment Agency (EA), with a formal process that we have to follow. If our supply side options require us to operate outside of our standard abstraction licence conditions, we will have to apply to NRW/EA and/or the Welsh Government/Defra for either a drought permit or drought order as appropriate.

Since publishing our previous Plan, we have undertaken environmental studies for drought options which have the potential to impact Habitats Directive designated sites and produced individual Environmental Assessment Reports for each of our drought permit/drought order schemes. For four of these schemes we cannot conclude 'no adverse effect' upon a European protected site, which means that we need to demonstrate that no reasonable alternative options are available. We will look further at the case for using these options, but for this Plan, to be certain of our compliance with the requirements of environmental legislation we have removed two of these options for use under severe drought circumstances, whilst for the other two we will ensure the necessary compensatory and mitigation measures are in place before we would use them.

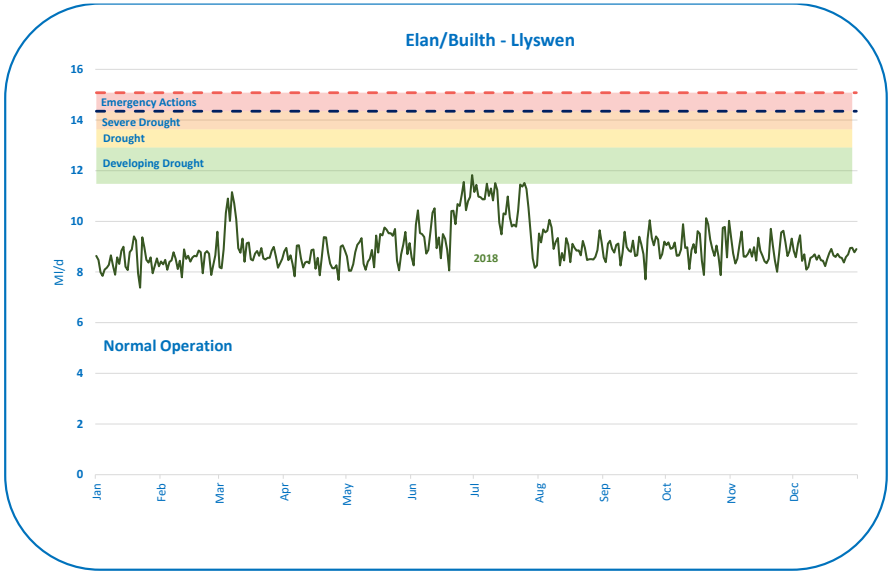
We have produced a Strategic Environmental Assessment and a Habitats Regulations Assessment of the Drought Plan.

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
Normal	Weekly monitoring of rainfall, reservoir and river levels. Optimise sources to minimise the costs of operations whilst remaining within licence, operation and quality constraints	Daily and weekly monitoring of demand levels including leakage and review of supply/demand situation.	**Use the water that you need but please don't waste it.** General Water Efficiency Campaigns via: • Company website water efficiency page • Social media • Press Releases • Organised events • Education Centres
Developing Drought	Targeted leakage management. Convene 'Gold incident' command centre. Implementation of dry weather operations to optimise water supply. Liaison in line with Management and Communication Plan	Continuous monitoring of demand levels including leakage and review of supply/demand situation. Implement demand side options: • Media Campaigns with Water Efficiency Device Offering • Enhanced Leakage Management	**Weather has been drier than normal therefore reservoir levels aren't where we would expect them to be for time of year.** **Introducing temporary use restrictions is a last resort. We would like to avoid this so are asking customers to work with us to help conserve water resources.** Continuation of Normal Activities plus: • Website – dedicated web page ready to go live as soon as required • Welsh Water spokesperson film clips • Targeted social media • Press releases - to be issued to relevant media. • Paid for adverts - to appear in relevant media • Letters to customers • Roadshow / local exhibition • Face to face meeting with stakeholders
Drought **Drought**	Continue to optimise current dry weather operational activities to preserve resource. Review feasibility of bringing mothballed sources back in supply. If applicable:	Continuation of preceding actions. Effectiveness of demand side measures estimated. Preplanning for the implementation of Temporary Use Bans. If applicable:	**Weather has been drier than normal therefore reservoir levels aren't where we would expect them to be for time of year.** **Introducing temporary use restrictions is a last resort. We would like to avoid this so are asking customers to work with us to help conserve water resources.** **We may have to introduce a temporary hosepipe ban as a last resort to help conserve water supplies.**

	Preparation of supply side application for Drought Permit/Drought Order from Natural Resources Wales/ Environment Agency and or Welsh Government/Defra. Commence baseline environmental monitoring	Implement demand side options: • Temporary Use Bans (saving of up to 5% of demand anticipated).	Continuation of Developing Drought Activities with enhanced messaging plus: • Media interview with senior managers • Water efficiency lessons • Billing call centre recorded messages
Severe Drought	Continuation of preceding actions. Bring mothballed sources back in supply where feasible. If applicable: Implement supply side options.	Continuation of preceding actions. Implement demand side options: • Temporary Use Bans (saving of up to 5% of demand anticipated). Preplanning for the implementation of Non Essential Use Bans. Preplanning for the implementation of Emergency Drought Order. If applicable: Implement demand side options: • Non Essential Use Bans (saving of up to 10% of demand anticipated). • Emergency Drought Order (saving of up to 17.5% of demand anticipated)	**Weather has been drier than normal therefore reservoir levels are exceptionally low for the time of year.** **Temporary use restrictions are in place. We thank customers for observing these to protect water supplies.** **We may have to introduce a non-essential use ban as a last resort to help conserve water supplies.** **We may have to implement alternative water supply options under drought permit/order.** Continuation of Drought Activities with enhanced messaging, details below: • Website – dedicated web page ready to go live as soon as required • Welsh Water spokesperson film clips • Targeted social media • Press releases - to be issued to relevant media. • Paid for adverts - to appear in relevant media • Letters to customers • Roadshow / local exhibition • Media interview with senior managers • Water efficiency lessons • Billing call centre recorded messages • Face to face meeting with stakeholders

g) Demand Triggers

In a number of Water Resource Zones, our primary concern is about the capacity of our infrastructure to meet increased demand from customers, rather than the availability of the raw water. Our Water Resources Management Plan and annual performance reviews look at the capability of our systems to meet peaks in demand. It is therefore unlikely that we will encounter such difficulties but to be prudent, we set water demand related triggers.



Elan / Builth – Llyswen Drought Action Zones

The figure above shows an example for our combined Elan/Builth and Llyswen zones. The graph plots our peak supply capability against historic and predicted maximum demand. If demands approach our peak capability for unprecedented reasons this indicates that we need to take actions to address this through demand management measures.

h) Our Communication Plan

Welsh Water's Drought Communications Plan (DCP) has been developed to ensure the effective flow of information to customers and stakeholders during the various stages of a drought. The strategy is designed to ramp up in response to the escalating stages of drought and crucially trigger behavioural changes from customers to help conserve water supplies. While we have not had a hosepipe ban for a number of years, and have successfully reduced our leakage rates, as a company we fully appreciate how impacted we can be by events such as the hot summer experienced in 2018. Our DCP will ensure we are in a position to respond immediately in the event of similar conditions occurring in future.

The key to the effective management of any drought situation will be engagement with customers and stakeholders. Their cooperation - and crucially behavioural changes - during such times is essential to help protect water resources for everyone. To achieve this we will need to ensure our communications are effective – particularly to generate understanding of the situation and actions we require customers to take.

We cannot however expect customers to play their part without also being explicit about all of the activities our company will undertake to keep them in supply, so this forms an important part of our messaging.

Our communications strategy also has flexibility to adapt to varying drought situations by using appropriate communication techniques and messaging. Multiple communication channels are utilised to ensure the most effective is used for the targeted audiences.

This also includes ensuring communication is fully bilingual to cater for our customers' language of choice. The company has also incorporated learning from the 2018 summer into the plan. We are confident that our not-for profit operating model will have a positive impact on our call for customer support in managing drought in our supply area.

i) Understanding our Drought Risk

The view from Government is that our water supply systems should be resilient to at least a 1:200 drought event before 'extreme' measures, such as water rationing, are taken to manage demand.

In order to understand the level of drought resilience we can provide to our customers, we have undertaken drought vulnerability assessments for all of our Water Resource Zones, in accordance with the Drought Vulnerability Framework (DVF) guidance that was jointly published by Natural Resources Wales and the Environment Agency in 2017.

This drought analysis work is relatively complex but the results are extremely useful and can be conveyed in reasonably simple terms. This is essentially an evaluation process that seeks to identify the level of drought risk that is faced by an individual zone across a range of drought scenarios of varying durations and severities. The DVF is a risk based approach with the initial phase of the assessment to screen out zones of low risk.

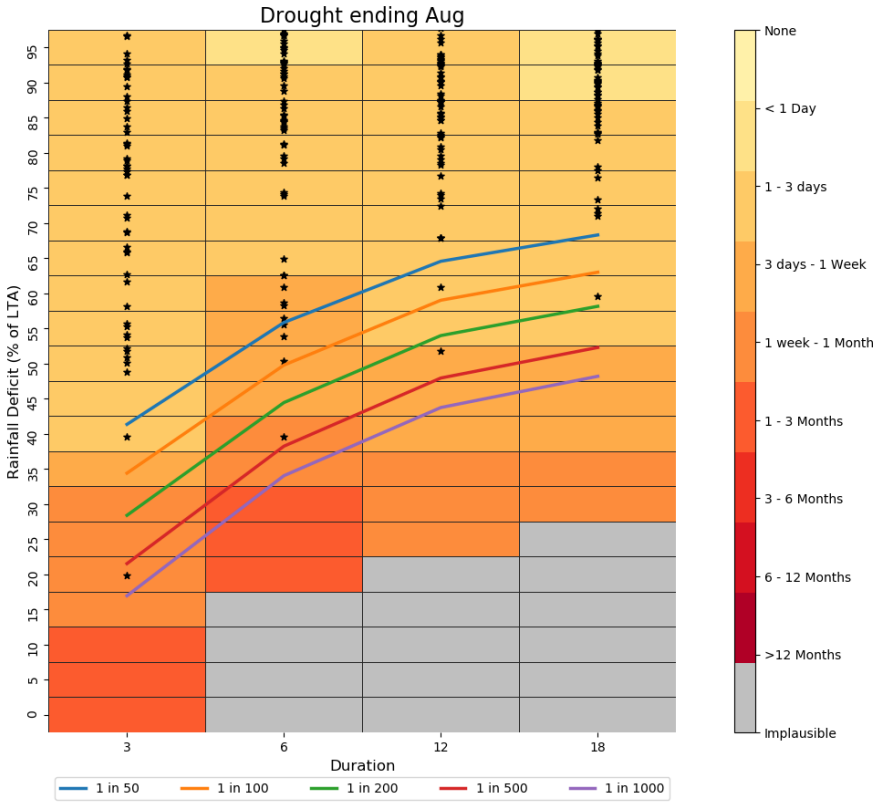
The table below provides a high level summary of the estimated risk for each Water Resource Zone of needing to implement customer water use restrictions. The return periods are not exact but are based on the results of our drought risk analysis; we have tried to interpret these into a 'simple' figure to present a high level view.

Of particular importance to Government is our system's performance to the most extreme droughts and new targets have been set to ensure that water supplies are resilient to droughts that might be expected one in every 200 years or 0.5% likelihood. For zones where there is a risk of not achieving this we have undertaken further work to understand the types of drought that are cause for concern and the likelihood that our systems may fail to meet this target.

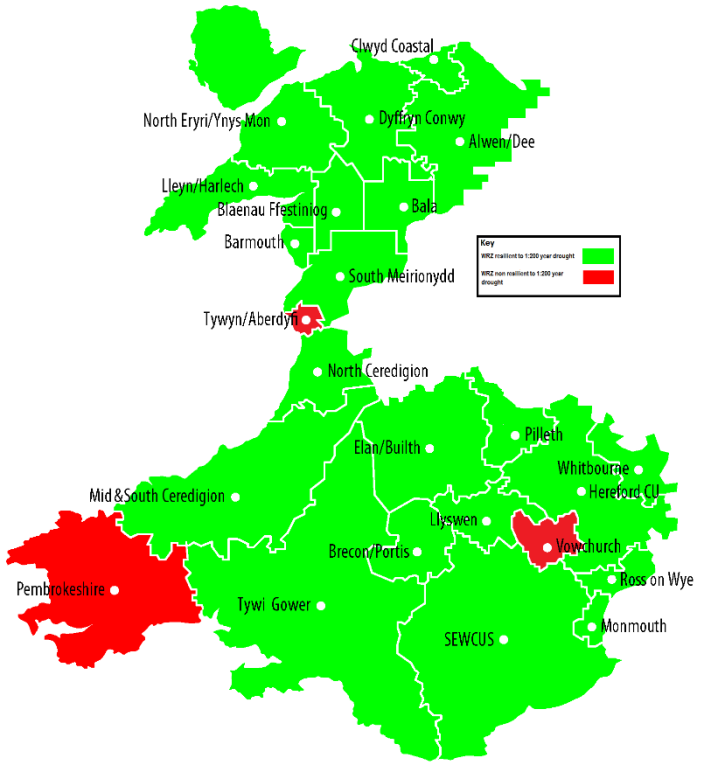
We have defined a failure in our models as the point at which we can no longer meet the demands of our customers without the imposition of extreme demand management measures. This is the point on our reservoir drought control charts at which only 'Emergency Storage' is available to us, a position that we would never want to reach as this is an unacceptable risk to our customers. The extent of failure is how long we would remain in this position of relying on 'Emergency Storage'.

The water industry has developed a standard way to show this information called a Drought Response Surface (DRS) chart. This collates the output of the assessment and helps in communicating the findings. A DRS chart (below) is a visual presentation of the sensitivity of a zone to a range of droughts. Each drought is expressed in terms of rainfall deficit as a measure of drought severity (defined as the percentage of Long Term Average Rainfall, as shown on the y-axis, and the duration of the drought assessed in 6 monthly intervals on the x-axis of the chart).

The risk of water supply 'failure' and drought frequency are plotted on these axes for comparison. The chart then can be used to understand, for example, the likelihood of zonal water supply failure for a 1:100 year return period type of drought.



Example drought response surface



Results of 1:200 year drought response surface testing

Overall, the results of our drought risk analysis demonstrate that our resilience to drought is high in all but three zones (see map overleaf). Once we complete our investments planned for the next 3 years, this will improve to high across the Welsh Water region. This means that there should be a very low chance of us needing to implement customer water supply rationing.

The advanced statistical approaches we have used for this testing are very new to the industry and further analysis of the data we have undertaken outside of this Plan indicates that we should be mindful of the uncertainties inherent within this approach. We have, therefore, provided a range of drought risks in the summary table below.

WRZ	Temporary Use Ban – 'Drought' Action Zone	Non Essential Use Ban/Drought Permit/Drought Order – 'Severe Drought' Action Zone	Extreme Measures – 'Emergency Storage' Action Zone
North Eryri Ynys Mon	Around 1:200	Around 1:200 to 1:500	>1:500
Clwyd Coastal	<1:200	Around 1:200 to 1:500	Around 1:500
Alwen Dee	Around 1:200	Around 1:500	>1:500
Bala	>1:500	>1:500	>1:500
Tywyn Aberdyfi (without planned WRMP19 scheme)	<1:20	<1:40	<1:50
Tywyn Aberdyfi (with planned WRMP19 scheme)	Around 1:200	Around 1:200 to 1:500	Around 1:500
Blaenau Ffestiniog	Around 1:200	Around 1:200 to 1:500	>1:500
Barmouth (As now connected to Lleyn Harlech)**	<1:200	Around 1:200	Around 1:200 to 1:500
Lleyn Harlech (As now connected to Barmouth)**	<1:200	Around 1:200	Around 1:200 to 1:500
Dyffryn Conwy	<1:200	Around 1:200 to 1:500	>1:500
South Meirionydd	Around 1:200	Around 1:200 to 1:500	>1:500
Ross on Wye	N/A*	N/A*	>1:500
Elan Builth	N/A*	N/A*	>1:500
Hereford	N/A*	N/A*	>1:500
Llyswen	N/A*	N/A*	>1:500
Monmouth	N/A*	N/A*	>1:500
Pilleth	N/A*	N/A*	>1:200
Brecon Portis	N/A	N/A*	>1:500
Vowchurch (without/with planned WRMP19 scheme)	N/A*	N/A*	<1:100/Around 1:500
Whitbourne	N/A*	N/A*	>1:200
SEWCUS	Around 1:200	Around 1:200 to 1:500	Around 1:500
Tywi CUS	Around 1:200	Around 1:200 to 1:500	Around 1:500
Mid & South Ceredigion	Around 1:200	Around 1:200 to 1:500	Around 1:500
North Ceredigion	Around 1:200	Around 1:200 to 1:500	Around 1:500
Pembrokeshire (without/with planned WRMP19 scheme)	<1:100/ Around 1:200	<1:100/ Around 1:200 to 1:500	<1:100/ Around 1:500

*The WRZ has sufficient water resource and the trigger for action is on levels of demand. We are only likely to impose TUBs and NEUBs in line with actions in the wider region, principally the SEWCUS zone.
**This high level of resilience is based on the temporary schemes from the 2018 drought being made permanent and the two zones are joined together.

Summary results of the Drought Vulnerability Assessment for all 24 WRZs

j) End of drought

As the water resources situation at the end of a drought returns to the normal level, we will continue to undertake similar risk assessments as those made during the drought period but with greater attention to the longer term impact. We will look both at the prospect of the weather turning dry once again and the likelihood that our reservoirs will re-fill over the winter/spring period and not lead to further issues the following year. At this stage we will look at the need to apply for additional drought permits aimed at securing water supply for the following year.

For these reasons, the initial recovery out of the Drought Action Zone would not typically be the point at which all measures would be lifted. A more likely point for declaring the end of a drought would be in the approach to the Normal Action Zone, where reservoirs are well stocked for the time of year and, in demand trigger zones, abstraction quantities fall below the developing drought trigger level.

As with the onset of drought, it is important that we take a flexible approach to the lifting of restrictions imposed on our customers or in taking additional water from the environment outside of our permitted volumes. We may also choose to lift restrictions on an area basis in a proportional manner. These decisions will be led by the Gold incident team and further discussed with government through the Wales Drought Liaison group and the National Drought Liaison Group. The factors that will be taken into account in making this decision will be:

- The results of risk forecasts for individual Water Resources Zones
- The time of year and anticipated savings from demand side measures
- Forecast weather conditions
- Natural Resources Wales and the Environment Agency, environmental drought status

Throughout the post-drought stage as conditions recover, post-drought environmental monitoring will be undertaken as part of the suite of actions to ensure we have the fullest possible understanding of the impact that any supply side drought actions have had. This post-drought environmental monitoring also informs our decision making so that appropriate measures can be taken to support the recovery of the environment after a period of drought.

Once we are confident that conditions have recovered and we are able to ‘stand down’ our incident response teams, we will hold a number of internal meetings involving all the members of our Gold and Silver centres to review the drought event.

The extent of the review will be dependent upon the level of drought encountered. We will review the effectiveness of the drought management actions we took to understand any impacts on customers and the environment.

For more severe droughts where we have put Temporary Use Bans in place, we will prepare a ‘lessons learnt’ report.

Once we have completed our internal review we will meet with Government and regulators to review how effective they felt our drought management was, how well we worked together across organisations and whether improvements could be made, particularly in terms of communication and support to other sectors.

1 Introduction

1.1. Dŵr Cymru Welsh Water

At Welsh Water, our vision is; “To earn the trust of customers every day”. That vision reflects our unique ownership structure: we have no shareholders and so can concentrate solely on delivering the best possible value for money to our customers. All the profits that we make are reinvested in the business to improve outcomes for our customers and the natural environment, or are used to benefit customers. Earning the trust of customers every day is especially important during stressful periods such as droughts which can be challenging for both ourselves and customers. We are trusted to plan for drought and trusted to deliver on these plans if and when drought periods occur.

Figure 1 - Welsh Water's operating area

1.2. Water resources in our supply area

We are the sixth largest of the ten regulated water and sewerage companies in England and Wales and provide an essential public service to over three million people across most of Wales, and adjoining parts of England (Figure 1). About forty per cent are concentrated in the south east of Wales around Cardiff and Newport, with much of the remainder located in the other main population centres around the coast. These are in sharp contrast to the sparsely populated areas of mid-Wales, where population densities are among the lowest in the UK.

Wales has a relatively wet climate when compared to other parts of the UK but this does not mean that we are immune to drought. The overall regional picture masks important geographical differences within our supply area: for example, at up to 3,000mm rainfall per year in Snowdonia this can be more than four times the levels recorded in the border areas and Herefordshire, where 700mm per year is typical. In 2018 however, data from our rain gauge at Llyn Alaw reservoir in Anglesey recorded only 1,140 mm whilst at our Broomy Hill water treatment works rain gauge in Hereford, the annual rainfall total for 2018 was 677mm. When analysing rainfall data to understand drought risk, it is the timing and duration that is important to understand, not just the total volume. Of the 1,140 mm recorded rainfall in 2018 at our Llyn Alaw rain gauge, 70% occurred in January to March and October to December, meaning that only 30% fell in the remaining six months through April to September. This partly explains why in the summer of 2018 we were concerned about our reservoir levels in North West Wales.

The diversity of our water supply systems reflects these regional variations, which can range from discrete small-scale local supplies, through to large scale multi-source integrated networks that are more typical of many other water company areas.

We abstract water from a variety of sources under a number of environmental licences to supply our customers. Most of our water is supplied from our impounding reservoirs; these are reservoirs which fill naturally with water from the land surrounding them. We also obtain significant volumes from our lowland river sources such as those on the Rivers Wye and Usk in south east Wales, the River Towy in south west Wales and the River Dee in north Wales. Groundwater accounts for less than five percent of our supplies at a Company level, but at a local level may be the whole supply.

A significant proportion of the water bodies that are key to our supplies, are designated under national and international law in recognition of their nature conservation importance. To protect these features of the natural environment, we have a duty to comply with the terms of our abstraction licences granted by Natural Resources Wales and the Environment Agency. As drought conditions develop, we work increasingly closely with our regulators to ensure that we fully meet our environmental obligations stated within any drought order/drought permit that we obtain.

1.2.1. Water Resource Areas

For operational purposes we divide our water supply area into three regions; North Wales, South West Wales and South East Wales. However, for water resource planning purposes we further subdivide these regions into Water Resource Zones (WRZ). A WRZ is defined as the largest area in which water resources can be shared such that all customers, with some limitations, experience the same risk of water resource failure.

Figure 2 shows our 24 WRZs. Taken together our two largest zones, the South East Wales Conjunctive Use System (SEWCUS) and the Tywi conjunctive use system, supply around 64 per cent of our customers. In stark contrast, the eight smallest zones together supply just 1.6 per cent of our customers.

We have a relatively large number of WRZs when compared to other water companies, only Scottish water having more. This is due to the mountainous geography of Wales making upland reservoirs our primary source of water and strategic connectivity more costly. However, isolated zones are inherently less operationally flexible and we are seeking to increase water supply resilience in the long term through the linking of WRZs where appropriate. The experience in operating our water supply systems during the 2018 drought has highlighted where the merging of zones can provide significant benefit and we will be making permanent improvements to our network connectivity through our forthcoming (AMP7) investment planning work.

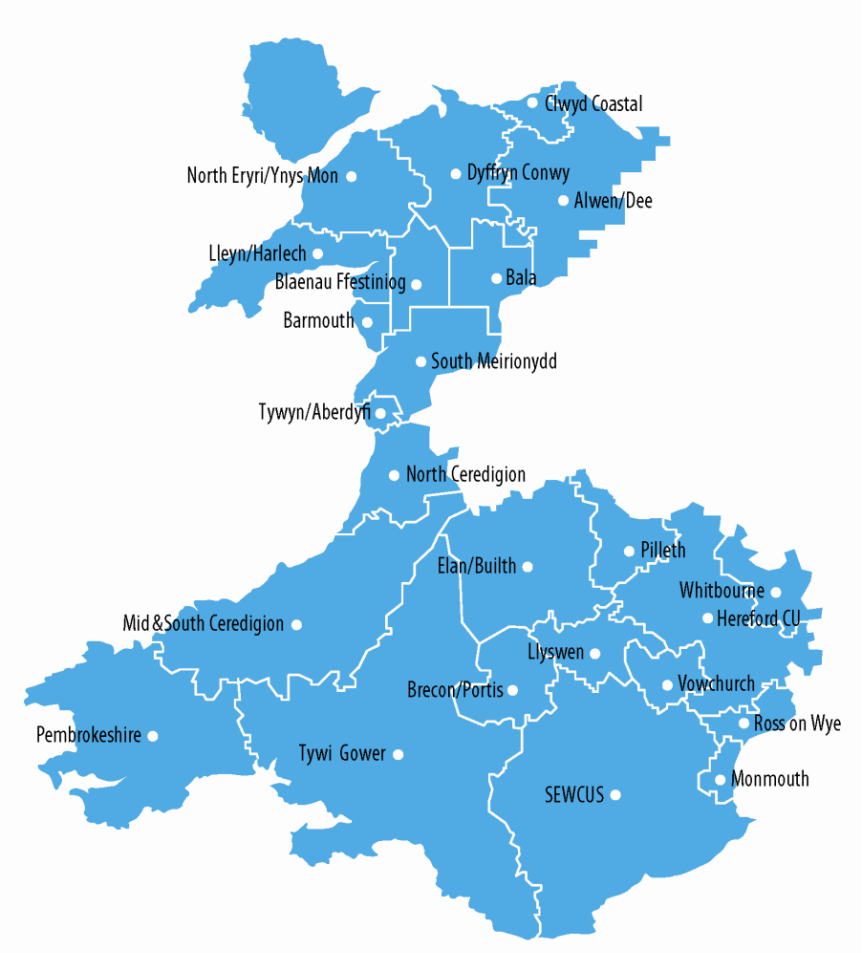


Figure 2 - Welsh Water's Water Resource Zones

1.3.The Drought Planning Process

Welsh Water's long term ambitions have been set out in our Water 2050 document[1] which places the maintenance of wholesome water supplies at its heart. One of our key strategies is what we have titled "Enough Water For All". In essence, this is to ensure that we always have sufficient water in line with our customers' expectations, even in times of drought.

[1] https://www.dwrcymru.com/en/Company-Information/Business-Planning/Welsh-Water-2050.aspx

At the head of this strategy are our Water Resources Management Plan and our Drought Plan. Producing and maintaining a Drought Plan is a statutory process required by Government who have set out the legal basis for this in The Water Industry Act 1991. We are directed by Welsh Government who also provide the guiding principles for our Plan. We have worked closely with Natural Resources Wales who produce the Drought Planning Guidance for water companies in Wales.

We have also signed up to the voluntary Code of Practice (CoP) as developed by UKWIR with support from regulators, consumer groups, trade bodies, customers and water companies across England and Wales. The CoP provides a consistent approach across water companies to the staged implementation of restrictions on customers' use of water in drought conditions.

Prior to producing our draft Drought Plan, we ran a pre-consultation exercise with our stakeholders to help identify any key issues that we need to account for in the development of our Plan.

This is undertaken early in the process so that the results can influence the drought management strategies we include in the Plan. As with our other strategic plans, full consultation is an essential component in the production of our Drought Plan. We submitted our draft Drought Plan to the Welsh Government at the end of March 2019 and were directed to publish the draft plan for consultation on the 25th July 2019 for 8 weeks, closing on 19th September. During the consultation process we:

- Contacted over 120 organisations directly
- Contacted all relevant Members of Parliament and all Welsh Assembly Members
- Published the Plan on our website and publicised it via our Welsh Water Twitter, Facebook and Instagram feeds

In total we received comments from seven separate respondents.

Following the closure of the consultation on the draft Drought Plan we submitted a revised draft Drought Plan together with our Statement of response to Welsh Government. We have now received the 'Final Advice Report' from NRW and the changes made in this Plan are in response to the recommendations in NRW's advice report so that Welsh Government can be satisfied to direct us to publish our Plan as Final.

1.3.1. Links to other Welsh Water Plans

The Drought Plan is produced specifically to act as a tactical response plan for use during drought. This Plan sits between our Water Resource Management Plan, which looks at the long term water resource requirement and the investment needed to secure water resource resilience, and our 'Emergency Plans' which are solely concerned with how we would maintain supplies to our customers following the loss of water supplies. The actions taken, and the timeframes in which they are enacted are very different to those set out in a drought plan and so there are no real linkages between our drought and emergency plans.

1.4.Our Drought Plan 2020

We appreciate that some of our customers and stakeholders would like to understand our proposals for managing water supplies during a drought and particularly how a drought might impact upon them and how we will communicate messages to them during periods of prolonged dry weather. Drought Assessment is a technical subject, but in order to ensure the broadest possible understanding, we have written this Plan with customers, stakeholders and our regulators in mind. The latter require sufficient technical detail to understand the level of risk, if any, to our customers during drought and to be satisfied that our drought plans are rigorous and achievable.

This introduction provides the context for our Drought Plan and introduces some of the concepts involved in drought planning. This includes a background to the droughts that we have experienced historically, including that of 2018 and the lessons we have learnt from that particular event.

Of importance to our customers is the impact that a drought might have on them and in particular their expectation of how we might restrict water use through our powers to impose hosepipe bans (in legal terms, known as Temporary Use Bans (TUBs)) or more stringent measures such as Non-Essential Use Bans (NEUBs). We have engaged with our customers to understand their expectations and the findings of this work are presented later in this chapter.

The technical part of our Plan is held in Chapters 2, 3, 4 and 5 which mirror our activities as dry weather is encountered. Chapter 2 details the information that we track to understand the onset and growing severity of a drought.

Our drought plan needs to be flexible in its approach as each drought is different in terms of its duration, severity and the areas it affects. It is not necessarily the case that all parts of Wales would experience a drought at the same time, however we plan for a scenario where all our systems are under stress. Chapter 3 describes our drought management team structure and how we will work with stakeholders and regulators to ensure effective management during a drought. Our experiences of managing operational incidents in 2018, including drought, has provided us with a management structure that has proven to be effective. Our operational response has been improved following our experiences in 2018 as we now have better knowledge of the risks around any changes to our operations e.g. catchment raw water quality, customer network risks.

The chapter then details the actions that we will take to help manage water demand, for example through our enhanced leakage activity and customer messaging. It also clarifies how our customers could be affected if we need to use our powers to restrict types of water use.

To improve our understanding of when actions are required during a drought, we have undertaken work to update some of our drought triggers. We now have a set of drought action zones for our North Eryri Ynys Mon zone which looks at the combined storage position in Llyn Alaw, Llyn Cefni, Llyn Cwellyn and Llyn Ffynnon Llugwy. We have produced a combined set of control lines for our Elan/Builth and Llyswen zones and have also now combined drought triggers for our Hereford, Ross on Wye, Pilleth, Vowchurch, Whitbourne and Monmouth zones. These changes all reflect our experiences from the 2018 drought where the delivery of new infrastructure and confirmation of our ability to mobilise a large number of water tankers, has made our supply areas more conjunctive. We have revised our Tywyn Aberdyfi drought triggers as we now have a much better understanding of what drives our drought risk in the zone.

A key improvement over our previous Plan is in our understanding of drought risk gained through the use of new statistical techniques. Chapter 4 details these new methods and summarises the findings for each of our WRZs. The chapter then describes how we have tested our Plan against a range of drought types so that we can develop the actions needed if we encounter droughts of different severities. The last part of Chapter 4 describes the actions we might have to take in the event of very extreme droughts that could require us to further restrict water use or to increase the supplies from the environment.

It is important that we plan for every foreseeable eventuality especially with the uncertainties associated with climate change. If we encounter an extreme drought then we may need to take more water than normal from the environment. To do this we need additional permits from our regulators and/or Government that will ensure our actions are undertaken with full knowledge of their environmental impact and that we will mitigate against these where possible. Chapter 5 details the options available to us and the work undertaken to prepare for such an event.

The risk of drought varies significantly across our operating area due to the hydrological conditions and the nature of our water supply systems. Annex 1 provides a high level operational overview of each WRZ and how we would manage the zone during drought. We have assessed the risk of drought for each zone, which provides us with the likelihood of needing to impose water use restrictions. We have further assessed the resilience of each area by modelling the impact of different types of drought and examining the impact on reservoir levels and the actions that we would take if we encountered drought. In this way we are testing the robustness of our plans.

Annex 2 provides further detail around our drought communication plan and the messaging to our customers to make them aware of the dry weather conditions and how they can work with us to preserve water in case these conditions continue. Annex 3 describes the improvements made to the environmental assessments undertaken of our twenty five Drought Permit/Drought Order options, as described in Chapter 5.

1.5.Customer Engagement

As the actions outlined in this Drought Plan have the potential to impact upon our customers, it is essential that we engage with them as fully as possible during its preparation. To support this, during the production of our 2019 Water Resources Management Plan (WRMP19) we sought our customers' (household and commercial) views on the frequency at which we may need to restrict their use of water, through the imposition of Temporary Use Bans (TUBs) and Non Essential Use Bans (NEUBs). We also asked for our customers' views on the level of resilience we currently offer to the risk of supply interruptions as a result of a severe drought.

Although our research partners Accent, who undertook the survey work, concluded the results were not statistically significant, their general view was that there is some positive WTP from customers for improvements in their levels of service. The results showed that customers were willing to pay £0.41 per year on top of their current bills, on average, for a reduction in the chance of a TUB from once every twenty years, to once every thirty years, and were willing to pay £0.62per year, on average, for a reduction in the chance of a TUB from once every twenty years, to once every forty years.

From the WRMP19 research, Figure 3 below shows that our customers would like to see an improvement to our resilience to a frequency of less than 1:100 years for the implementation of extreme drought measures - many customers attached a high value to the improvement in resilience from 1 in 100 years to 1 in 200 years. However, the results of our companywide survey work on our investment plans for 2020-2025 gave a mixed view on the acceptability by our customers of higher bills and so these particular results must be viewed in this context. The level of resilience we have as a company towards the implementation of these extreme drought measures is currently a key question that is being asked of us by Government and our regulators.

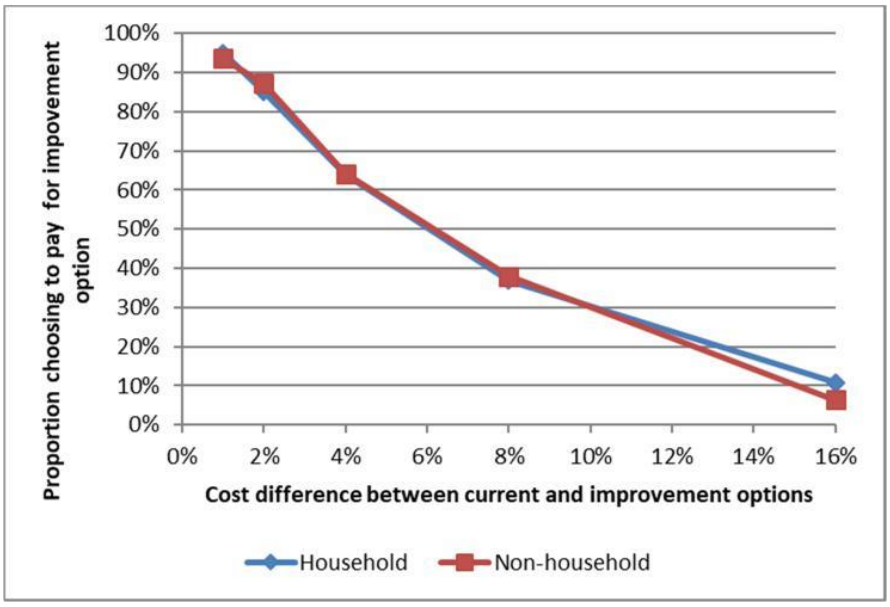


Figure 3 - Willingness to pay for improvements in resilience

Although not explicitly linked to drought, our engagement surveys found that customers across our supply area expect us to enhance biodiversity and the environment in general, not least as this contributes to the well-being of the communities we serve.

We are also mindful of the environmental legacy we will leave for future generations, as demonstrated in our Welsh Water 2050 long term vision. For the Drought Plan we try to minimise as far as possible any potential impact from our proposed options upon the natural environment in which we operate. Early and full consultation together with detailed assessment is key to ensuring this objective is met. Since the publication of our 2015 Drought Plan we have undertaken much work in better understanding the environmental impacts of our proposed actions, the results of which are described in Chapter 5.

1.5.1. Stakeholder Engagement and Pre-Consultation

To inform the development of this Plan we ran a formal pre-consultation exercise between June and September 2018. We contacted 56 consultees seeking their general views on what we should include in the Plan, alongside four specific questions designed to help us shape some of its key themes:

The questions we asked were:

- Do you agree with the factors that we need to take account of in the development of our Drought Plan for 2020?
- What are the key actions we should be undertaking to manage our supplies and our customers' demand for water during a drought?
- How can we try to ensure the environment is not negatively impacted during the implementation of our Drought Plan actions?
- Are there any issues or ways in which you feel we can improve on our current Drought Plan?

A summary of the main pre-consultation responses received is shown in Table 1. In response to the comments raised, we have completed a Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) on our Plan and Environmental Assessments of all our proposed supply side Drought Permit/Drought Order options. We have fully utilised the Drought Vulnerability Framework (DVF) methodology to provide us with a better understanding of our drought risk.

Throughout the Plan development we held regular meetings with Natural Resources Wales (NRW) and the Environment Agency (EA) as required, to keep them abreast of technical developments and outputs as these were progressed.

The SEA and HRA are themselves subject to their own pre-consultation process, further details of which are provided in Chapter 5.

Consultee Type	Consultee Number	Consultee Reply	Feedback Summary	Respondent
Government	5	1	Ensure SSSI protection, in combination assessment and HRA, prompt demand control. Provide details of extent of mitigation, end of drought impact on Usk and Wye and impact on brackish waters and other features. Consider previous consultations and Court of Justice of the European Union judgement on likely significant effects under the Habitats Directive.	Natural England
Councils	22	1	Considers proposed actions appropriate. Supports rainwater harvesting for water conservation purposes	Conwy Council
Regulators	8	2	Recommend compliance with WG/EA/NRW guidelines inc inclusion of DVF, SEA/HRA, EAR, in-combination assessment to consider bulk supply. Suggest that lessons learnt include freeze-thaw events and 5 yearly drought exercise be done. Promote ongoing communication, data exchange and consultation. Ensure consistency with WRMP19.	Natural Resources Wales, Environment Agency
Utilities	8	2	Shared details of drought options and approaches to bulk supplies and customer exemptions.	Severn Trent Water, Hafren Dyfrydwy
Other	8	1	Wishes for ongoing open communication	Canal & River Trust

Table 1 - Results of draft Drought Plan pre-consultation

1.6.Technical Assessments to Support the Plan

Effective drought planning relies on having a good understanding of the likely drought risk we have across our supply area. The bulk of the technical assessment work for the development of this Plan has been to improve our water resource modelling to a range of drought events more extreme than those we have in our historic records. To facilitate this, we have undertaken the following improvements:

Updates to water resources models

We currently utilise the software package WRAPsim to simulate the performance of our water supply systems under a range of historical drought events. Following our experiences during the drought of 2018, before any further modelling was undertaken for this Plan, our existing models were reviewed and changes made to reflect how our systems actually performed during 2018 and to account for any new assets that were put in place. This ensured that the results of our advanced modelling were more representative of operational reality and gave us confidence in our predictions of system performance during more extreme drought events.

We have made improvements to our SEWCUS, Mid & South Ceredigion, North Eryri Ynys Mon, Alwen Dee, Lleyn Harlech and Barmouth WRZ models. Updated Deployable Outputs as a result of these model changes will be reported in our 2019 Annual Review submission.

Updates to hydrological data

A key input into our water resource models are long term time series of hydrological data, principally inflows into our reservoirs and flows at our river sources. Our time series are generally around forty to sixty years in length and encompass the drought events of 1976, 1984, 1989 and 1995. Using industry leading statistical techniques, we have taken these existing rainfall and river flow records and extended them to produce up to 10,000 year records. Modelling these longer records allows us to test our systems against a wider range of more extreme drought events to help understand where we may encounter supply issues.

To facilitate the generation of these much longer time series, for a number of our WRZs we had to amend the method by which we generate our hydrological data. We have used the Catchmod software in four WRZs, namely Mid & South Ceredigion, North Eryri Ynys Mon, Lleyn Harlech and Barmouth, replacing the use of either the HYSIM software or the simple transposition of flows from a nearby gauging station. Details of the methodologies used to generate the new hydrology are provided in Appendix 2.

Drought Vulnerability Framework

As required by guidance, for this Plan we have utilised the UKWIR Drought Vulnerability Framework (DVF)[2] to improve our understanding of the level of drought risk that we face across our supply area. Building on the improvements made to our hydrological data, the Framework provides a methodology for quantifying the risk to a supply failure caused by drought, expressed as a probability return period in years ranging from 1:50 to 1:1,000 against a duration of failure, ranging from 1 day to 1 year. The results of the DVF assessment for all our WRZs are provided in Appendix 1 to this report.

'Smarter' environmental supply side options

The information gained from the above analysis has allowed us to better target where we need supply side options to mitigate the predicted risks from the more severe drought events we have assessed. Compared to previous Drought Plans, improvements have been made in two key areas for the assessment of our environmental supply side options:

1. For WRZs where we have identified there is no risk to customers' supply from a lack of water resource, we have been able to remove any supply side options that may have previously been included;

[2]Environment Agency/Natural Resources Wales 2017, UKWIR Report Ref. No. 17/WR/02/12

2. For WRZs where we have identified a risk from insufficient water resource, we have been able to analyse when these risks may occur and refine supply side options accordingly.

The approach in 2) above has meant that our environmental assessments (see Chapter 5) are more targeted in helping our understanding of the potential impacts as we are better able to define the likely timing and duration of the scheme being implemented. This in turn means that our assessment of environmental risks is greatly improved, so improving our ability to identify appropriate mitigation measures where required. Our improved analysis has also allowed us to redefine a number of options to improve the benefit we may gain during a drought.

1.7.Drought Plan terminology

Throughout this Plan, when referring to drought events we use the terms 'worst historic', 'severe' and 'extreme' to indicate differing levels of severity. Until recently, we generally planned on the basis of 'worst historic' i.e. the worst hydrological event, in terms of a shortage of rainfall, that we had in our records to ensure that if there were a repeat event, our water supply systems are resilient to these within the level of expectations of our customers.

Understanding of these events has formed the basis of our planned Levels of Service that we offer to customers, with our 'worst historic' event having an estimated return period of around 1:100. However, Government and regulators have challenged the industry to go further in the levels of drought resilience we provide to customers, and so for this Plan we have assessed our ability to cope with drought events having a return period of 1:200 ('severe drought') and 1:500 ('extreme drought'). As described above, we have generated longer hydrological time series with which to test our plans under these more extreme drought scenarios.

Following changes in legislation, the term "Temporary Use Ban" has now replaced a "Hosepipe Ban" to refer to a range of watering activities undertaken by households that we can now restrict during a drought. These terms are somewhat interchangeable as most of the water saving activities that we can impose on our customers involve restriction of hosepipe use, just for different uses. Our regulators also use the term "Extreme Supply Side Measures" to refer to actions we would take to ration our customers' use of water (e.g. widespread pressure management or water rationing) during a particularly serious drought in order to help preserve our supplies should the dry weather continue for much longer than expected.

1.8.Historic droughts in the Welsh Water region

Despite its relatively wet climate, Wales has suffered historically from a number of challenging drought events that have caused disruption to our customers. There has not been a hosepipe ban imposed since 1989, following those implemented in 1976 and 1984. Although 1995 saw an extremely dry summer and autumn, improvements made to our operational systems as a result of learning from the previous droughts, meant water supplies were maintained without the need for customer restrictions.

The drought of 1976 is generally seen as the worst experienced within Wales with around a million people in south east Wales subject to rota-cuts in order to ration supplies. This followed the implementation of a hosepipe ban and numerous drought orders that allowed us to take additional water from the environment. However, these were insufficient in providing enough water to meet demands and so the decision was taken to implement extreme measures that restricted supplies to customers for a few hours each day. This allowed the remaining reserves of water to be used until it finally rained in late September and began the refill of our reservoirs.

It is clear from our customer engagement that such measures are less acceptable nowadays and would be very difficult to undertake on a large scale. Network pressure management along with local water rationing activity has the potential to support demand management but extreme care would be needed to ensure that minimum supplies would be available to all, especially our vulnerable customers and that we continued to meet the high water quality standards required of us.

We utilise the data from these historic drought events within our water resource models to test our current capabilities and assess whether any further improvements are required in order to provide a better service to our customers. Our models tell us that if we were to experience a repeat of the 1976 hydrological conditions then we would not need to enforce any restrictions upon our customers other than a hosepipe ban in a handful of our 24 water resource zones. This is a much better position for our customers in that we can offer a good level of service even during drought events.

Whilst 1976 is the most severe event we have on record, these are relatively 'short' hydrological records and we are fully aware there are likely to be more extreme droughts that we either have not experienced or have no data for, hence why we have followed the DVF methodologies outlined in Chapter 4.

The 2018 Drought

Between April and July 2018 we experienced a very hot dry spell with rainfall around half of normal levels across most parts of our supply area. Temperatures were above average for most of this period, with Wales experiencing the hottest June on record, culminating in levels of demand from our customers of over 1,000 Ml/d; approximately 20% higher than normal. The highest demands occurred earlier than we have seen in previous dry summers. Potentially therefore, demands could have been even greater if high temperatures had continued through late July into August when we normally expect peak demands.

Rainfall from the end of April to the end of July was lower than experienced during 1976 across Wales as a whole, with parts of North and West Wales experiencing exceptionally low levels of rainfall, as shown in Table 2.

NRW Catchment	May-18	Jun-18	Jul-18	3 month average
Ynys Mon	67%	19%	84%	57%
Alwen	102%	23%	79%	68%
Dee	68%	41%	69%	59%
Clwyd	77%	20%	93%	63%
Valleys & Vale of Glamorgan	71%	18%	85%	58%
Usk	74%	15%	86%	58%
Pembrokeshire	80%	47%	108%	78%
North Ceredigion	62%	16%	72%	50%

Table 2 - May to July 2018 Rainfall as a % of Long Term Average[3]

By early July 2018, our routine water resource monitoring was showing a consistently dry picture across Wales. In response to this, and in order to ensure that our water resources were managed in the best way possible to minimise the need to introduce hosepipe bans during 2018, we convened our Gold Command centre, and proactively managed our activities affecting the supply of, and demand for water, while increasing communications with customers to encourage water efficient behaviour

[3] https://naturalresources.wales/guidance-and-advice/environmental-topics/water-management-and-quality/resources/water-situation-report-2018/?lang=en

and regulators to ensure consistent messaging and understanding of risk. The timely implementation of our actions to manage both peaks in demand and the preservation of resource meant that our overall drought status remained as 'normal'.

This company-wide response resulted in a great deal of learning about the best ways to manage drought, as well as revealing capability within our network that had never previously been tested. The learning that we gained has been incorporated into the development of this drought plan, and reference is hence made throughout this document to 2018.

1.8.1. Lessons Learnt

Water Resources Management

We recognise that some of our triggers for taking operational drought action need some improvement in light of the 2018 drought and this is a piece of work that we will progress as a priority. We have amended our drought triggers for our North Eryri - Ynys Mon for this Plan.

As mentioned earlier in the report, the lack of zonal connectivity can restrict zonal resilience. The linking or merging of zones will increase overall resilience to drought and outages as available water resource can then be shared between the zones.

The dry weather in 2018 was particularly acute in north and west Wales and we needed to respond rapidly to balance water resources. In our North Eryri - Ynys Mon zone we needed to significantly reduce demand on the Cwellyn reservoir using existing links but also developing new temporary connections within the zone. This allowed water from our Alaw reservoir to meet additional demand on Anglesey which in turn enabled water from the Cefni reservoir to be pumped through temporary network connection to the north Wales mainland. In addition, we made further links to support Cwellyn treatment works from Mynydd Llandegai treatment works and allow us to balance the resource between Llyn Cwellyn and Llyn Ffynnon Llugwy. These actions significantly increased the resilience and conjunctive nature of the zone and has given us confidence in our operations whilst maintaining good water quality to our customers. We are planning to make these network enhancements permanent over the next few years with the knowledge that the temporary works can be reinstated at any time if needed.

In a similar way, we added connectivity between our Lleyn Harlech and Barmouth zones and our Alwen Dee and Clwyd Coastal zones. Some innovative thinking allowed water from our Cilfor water treatment works in the Lleyn Harlech zone to feed water southwards, supporting the Rhiwgoch treatment works in delivering water to the Barmouth zone. We will now merge these two zones within future Plans and have shown the increased resilience that this provides within the risk sections of this report.

A number of network enhancements were made between the Alwen Dee and Clwyd Coastal zones during the 2018 drought. These will again be made permanent and we will look at whether we can consider these zones as one into the future given the definition of a WRZ. These additional links are relatively small, so this may not be possible.

In south west Wales we reinforced a key network link across the Cleddau bridge in our Pembrokeshire zone to make sure that we could meet peak demands in that area if these had increased through the holiday period.

Drought Risk Understanding

Our prediction of reservoir levels using our water supply models generally performed well, although there are a couple of zones where we identified concerns with observed reservoir drawdowns being more severe than those predicted by our models, and so we will continue to improve the hydrological representation within our models.

Demand

The drought of 2018 has reinforced our understanding of the peaking in demand by around 200 Ml/d above normal levels during hot, dry years. We are analysing the 2018 data to understand if this is a more representative 'dry year' profile of demand to use when forecasting how our customers' water use may change in response to increased temperatures.

However, it has been difficult to gain information regarding the impact of our customer communications in helping to manage demand. We are currently part of a national study which aims to explore whether better understanding can be gained from the demand data collected by companies across Wales and England. This study will report on its findings in the summer of 2019.

Environmental Response

We fortunately had no requirement to take additional water from the environment beyond our permitted levels, although as a precaution we did commence some environmental monitoring at the sites of greatest concern. We have updated our Environmental Assessment Reports based on the learning from 2018, and in sharing experiences with other water companies, have a better understanding of the likely timelines involved for implementation.

Customers

With no disruption to our customers, the 2018 drought was successfully managed. However, we have identified ways we can improve our communications to customers. Fuller details are set out in Chapter 3 but a few examples are the way we enhanced the water efficiency messaging on our website and also 'letter dropping' customers in areas where we had the highest concern for future water resource levels.

Operational

During Storm Emma in 2018 a number of our customers faced a prolonged and highly regrettable period of service disruption. We identified that our remote network monitoring in rural areas was not consistent. This led us to invest in the implementation of monitors across the whole network, down to hamlet-sized residential areas: implementation is currently in progress.

Our response to the 2018 drought was highly adaptable to the changing circumstances by using our tanker fleet and deploying an extra 150 contract staff to undertake this work to ensure other day to day tasks were not impacted. We were the first company to provide drinking water to people not connected to the mains in a drought event, working in partnership with the Local Authorities who distributed bottled water provided by us. As well as this, we have a new communications role in our Silver Centre teams with a focus on identifying problem areas from social media traffic.

During the drought, we were able to mobilise significant additional staff from across the business functions to directly support our operational activity where needed. Much of this learning came from our response to Storm Emma earlier in the same year.

1.8.2. Testing of the Drought Plan

The drought of 2018 provided us with a first-hand opportunity to test our existing Drought Plan and this updated Drought Plan reflects all of the learning that we gained. We previously ran a drought exercise in 2014, the recommendations from which were incorporated into the 2015 Plan. In the absence of a drought event between now and the next update to our Drought Plan in 2024, we will review the need for a drought exercise to ensure that our Plan remains current and up to date.

1.9. The 2020 Drought

As in 2018, we experienced a relatively short but incredibly intense drought event during 2020 which was noteworthy due to its relatively early start in the year and the combined impact of the weather and the Coronavirus pandemic. The dry weather started during the last two weeks of March with high pressure sitting across the UK for most of April and May, bringing unseasonably high temperatures. The UK had the sunniest April on record since 1929 with Wales having both the 3rd sunniest and the 3rd warmest since 1884 (Met Office). Met Office statistics show that May was the 2nd driest on record for Wales as a whole with just 17% (14.3mm) of the long-term average rainfall and it was also declared by the Met Office as the "sunniest calendar month on record". The three-month period March to May saw Wales receive just 53%[4] of the long-term average rainfall

Following the approach set out in the draft version of this Drought Plan and building on our experience gained from 2018, we put our Silver and Gold incident management structures in place in April to ensure fast and effective management and to facilitate the delivery of our dry weather action plans. These included a large number of operational actions designed to preserve water stocks and maximise water resource availability. We also put our communications plan into action using targeted social media delivery as well as more blanket coverage through the more conventional radio and television routes. Despite this effort, we still saw unprecedented levels of demand (a peak of 1,050 Ml/d was recorded at the beginning of June) as a result of the very high temperatures in combination with the national lockdown.

With effective management of water resources and concerted efforts to limit water demand, we did not need to impose any formal customer restrictions or have recourse to go to the environment for additional water through the use of drought permits or orders. We did, however, begin to make the necessary preparations for a handful of drought permits for those zones where our resource modelling indicated a potential risk.

We do not propose to adjust our Final Drought Plan as a result of our experiences in 2020 as we feel that the protocols and actions described here were broadly effective in managing the situation. We have however undertaken a review of the event, and updated the detailed operational plans including the preparations that we make each year for continuous improvement.

The drought raised some interesting questions around the long-term need and benefit of customer side restrictions (such as TUBs) and some additional drought options that we considered during the period. We will continue to discuss the above with both Welsh Government and Natural Resources Wales with our thoughts developed through the forthcoming Water Resources Management Plan and subsequent Drought Plans. For now, we are content that we have a robust and flexible Drought Management Plan.

[4] nora.nerc.ac.uk/id/eprint/527958/1/HS_202005.pdf

2. What Happens in a drought

2.1.How we know a drought is happening; Drought Indicators

Droughts are a prolonged period of little or no rainfall which, particularly when combined with hotter temperatures, put severe pressure upon our water resources and our ability to meet high customer demand for water. This Chapter details how we know when we are in a drought, demonstrated by our experiences during 2018.

Droughts by their very nature are highly variable in terms of their timing, duration and severity but they all begin in the same way with a period of below average rainfall that continues for longer than expected. There are a number of indicators that show when a drought is developing and an important requirement of a drought plan is to identify those that we will monitor and use to trigger drought action. We use the following indicators across our water resource zones;

- Rainfall
- River flows
- Reservoir storage
- Level of demand

Our regional water situation is monitored on a weekly basis and provides both rainfall and reservoir storage data. This is circulated widely both within Welsh Water and shared with external stakeholders, including Natural Resources Wales (NRW) and Environment Agency (EA). Routine hydrometric monitoring is also carried out by these two organisations and they share with us relevant data for rainfall and river flows. We also track zonal and sub-zonal demand across our water supply network on a daily basis.

A comparison of these indicators under current conditions against historical norms provides a measure of the drought severity. Section 1 of each individual water resource zone summary in Annex 1 details the triggers we would use to identify the drought status and ensure the necessary actions are taken at the appropriate time. It is the status of our water resource/demand position that we use to identify a developing drought rather than rainfall or river flows. These measures are indicators of an 'environmental drought' which although can be related to water availability may not directly align with a water supply drought.

2.1.1. Rainfall

The amount of rainfall that we receive affects the performance of our raw water resources and so we closely monitor the quantities that land in our reservoir and river catchments. Lower than average rainfall is an indication that our supplies may come under stress and will provide less water than normally available. One or two consecutive months of below average rainfall will not cause water supply issues but as in the drought of 2018, this will raise significant concerns in case the dry weather continues.

The assessment of rainfall data helps us to understand the severity of the drought event we are facing and we feed this information into our water resource models to gain a prediction of the likely impacts upon our supplies. Figure 4 is an example taken from NRW's Monthly Water Situation report[5] which

[5] https://cdn.naturalresources.wales/media/685980/nrw-monthly-water-situation-report-june-2018_english.pdf?mode=pad&rnd=131755964040000000

shows the rainfall for June 2018 across Wales, as a percentage of the long term average, highlighting the severity of that particular month with rainfall volumes being some of the lowest on record.

Within our weekly water situation reporting we monitor and track daily rainfall totals for a number of rain gauges across our operating area. In our previous Drought Plan we used these as an indicator of drought severity however the improved rainfall data that is available, in particular the CEH SPI portal, provides us with a more robust assessment of this that we can use to better understand the prevailing drought situation. This allows us to demonstrate how the drought situation is impacted by a significant shortage of rainfall.

Figure 5 is taken from the Centre for Ecology and Hydrology (CEH) UK Drought Portal[6] which looks at the severity of rainfall events at durations of 1, 3, 6, 12, 18 and 24 months on a specified month ending basis, compared to the long term average for the corresponding period.

In contrast to Figure 4 which shows just how dry the month of June was, Figure 5 shows that rainfall totals for the three months cumulatively (April, May, June) were just below the long term average for that particular period.

Assessment of rainfall is crucial in helping us to manage a drought. Its uses are as follows:

1) It aids with our communications to customers if we are encouraging them to conserve water. This is where Figure 4 is particularly useful.

2) We can compare the current rainfall conditions to historic records to help identify relevant forecast scenarios to run through our water supply models.

3) If we apply for Drought Permits/Drought Orders to help maintain storage then we need to demonstrate to our Regulators and Government we are experiencing “an exceptional shortage of rain (ESOR)”. The type of rainfall analysis presented in Figure 5 provides a good example of this and will form the basis of our assessment of ESOR to support any Drought Permit/Drought Order application.

[6] https://eip.ceh.ac.uk/apps/droughts/

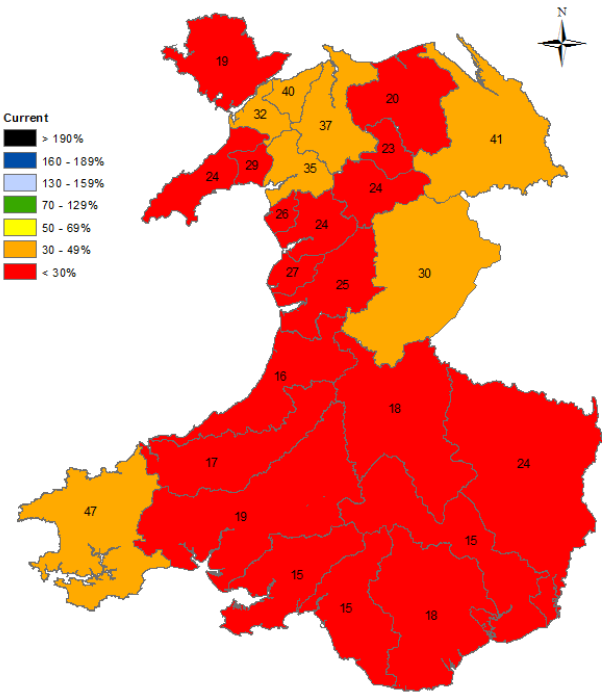


Figure 4 - Calculated catchment average June rainfall totals as a percentage of the 1961-90 June long term average[7]

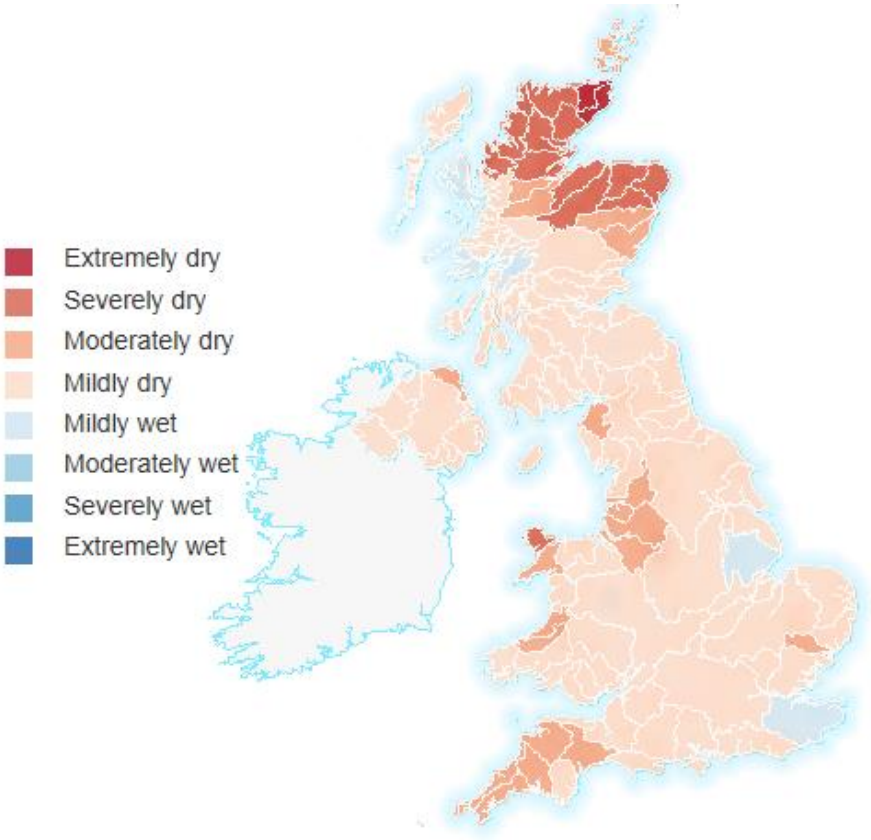


Figure 5 - CEH, Standardised Precipitation Index (SPI), three months ending June 2018

[7] for Natural Resources Wales catchments, using NCIC (National Climate Information Centre) data (Source: Met Office © Crown Copyright).

2.1.2. River flows

We take significant quantities of water from more than 20 river abstractions that operate either in conjunction with impounding reservoirs to provide a zone's water supply or are the entire source of supply for a zone. It is important therefore that we monitor the river levels upstream of our abstraction sites to be certain that the assumptions we have made regarding water availability are accurate. Many of our river abstractions have licence conditions that restrict the volumes we can take during periods of low river flow. It becomes more critical during a dry period when flows are low and the riverine ecology is placed under environmental stress, that we maintain compliance with our abstraction licence conditions so as not to worsen the situation. Table 3 below sets out the sites where we monitor and track river flows to understand any risk to our supplies.

Station name	River	Water Resource Zone	Area
Redbrook	Wye	SEWCUS	South East
Trostrey Weir	Usk	SEWCUS	South East
Moorhampton Bridge	Dore	Vowchurch	South East
Tenbury	Teme	Whitbourne	South East
Capel Dewi	Tywi	Tywi CUS	South West
Canaston Bridge	Eastern Cleddau	Pembrokeshire	South West
Pont Hywel	Eastern Cleddau	Pembrokeshire	South West
Treffgarne	Western Cleddau	Pembrokeshire	South West
Dolwen Bridge	Syfynwy	Pembrokeshire	South West
Fathew intake	Fathew	Tywyn Aberdyfi	North
Braich y Rhiw intake	Braich y Rhiw	Tywyn Aberdyfi	North
Bryn Aled	Aled	Clwyd Coastal	North
Dolbenmaen	Dwyfor	Lleyn Harlech	North
Pont y Cambwll	Clwyd	Clwyd Coastal	North
New Inn	Dee	Alwen Dee	North
Ffynnon Asaph	Afon Ffyddion	Clwyd Coastal	Ffynnon Asaph
Dyserth	Afon Ffyddion	Clwyd Coastal	Dyserth
Cynefail	Gelyn	Alwen Dee	North
Bodffordd	Cefni	North Eryri Ynys Mon	North

Table 3 - River flow monitoring sites

2.1.3. Reservoir storage

Although rainfall and river flows are a primary indicator of drought these can only provide an understanding of current hydrological conditions and not the complete water resources situation, which is also dependent upon water captured within our reservoirs. Reservoir storage levels are monitored through our regional telemetry system and reported on a weekly basis in the water resource situation report.

Most of our reservoirs are managed by operating control lines that indicate when storage levels are below normal for the time of year. These are used each year to trigger normal operational changes in order to optimise the use of stored water and to balance reservoir storage. Under normal water resource conditions and reservoir operation, the amount of water in storage in our reservoirs declines during the summer months and recovers again over the winter period.

In addition to the operating control lines, Drought Action Zones have been developed for reservoirs across our WRZs. These action zones indicate when storage levels are reduced to a volume that may require the implementation of drought actions to preserve water supplies. The control lines are used as triggers for implementing these (see section 2.2).

2.1.4. Groundwater levels

Although groundwater accounts for less than 5% of our total water supply, locally it is often 100% of the zonal supply. Using our network of observation boreholes, we monitor levels in and around our abstraction site to assess any risks from depleted groundwater levels which may impact the volumes that we can pump from our boreholes. Figure 6 is an example of how we tracked and reported on groundwater levels during 2018 at one of our production boreholes in the Vowchurch WRZ. We have no evidence to suggest that the supply from our groundwater sources have been impacted historically but the evidence for this is limited. Table 4 below sets out the production borehole (PBH) sites where we have groundwater level monitoring in place.

Site name	Water Resource Zone	Area
Pilleth – PBH 2, 3, 4	Pilleth	South East
Vowchurch PBH 1,4,5	Vowchurch	South East
Brecon – PBH B, C D	Brecon Portis	South East
Dunfield – PBH 1,2,3	Hereford	South East
Leintwardine – PBH 1, 2	Hereford	South East
Biglis Well (non potable)	SEWCUS	South East
Lovesgrove – PBH 1	North Ceredigion	South West
Llanerch Park	Clwyd Coastal	North

Table 4 - Groundwater monitoring sites

We have determined the Deepest Advisable Pumped Water Level (DAPWL) of our boreholes in accordance with UKWIR guidance[8]. Where known, we set the DAPWL at pump cut-outs or physical features of the boreholes that should not be dewatered (e.g. adit levels or significant inflow horizons). Where information is sparse or uncertain, we set the DAPWL at 70% of the saturated aquifer thickness and use a level of 50% as an indicator level.

[8] UKWIR (2002). A Methodology for the Determination of Outputs of Groundwater Sources. Report ref:95/WR/01/2

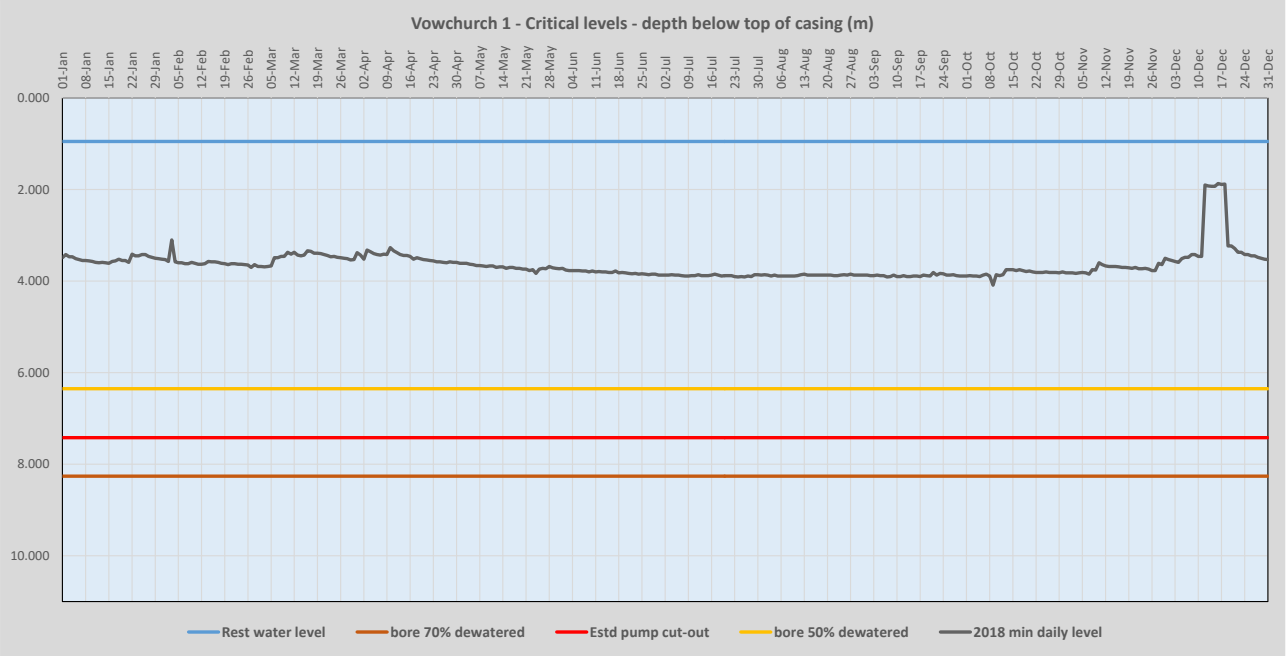


Figure 6 - Monitoring of Vowchurch borehole levels during 2018

2.1.5. Demand and abstraction

During dry weather conditions, customer demand increases. As demand increases, so does the pressure on our water resources. Abstraction and demand can therefore be used to indicate when our supply systems are being stretched. This is particularly important in WRZs where there is no reservoir storage as demand should not exceed the capability of the supply system in these zones.

In accordance with our abstraction licence conditions, we record the volume of water abstracted from each of our sources. Additionally, we continuously monitor the demand from our water treatment works and report this data on a daily basis using our telemetry network. In WRZs without impounding reservoirs, triggers are set in relation to supply capability in order to ensure that demand management activity is undertaken where necessary if developing drought conditions occur (see section 2.2).

2.2.When we take action in a drought; Drought Triggers

It is important to establish when action should be taken during droughts to protect public water supply. We have developed drought triggers to identify when we should consider implementing specific drought actions to reduce demand and, if necessary, obtain additional water resource. These triggers are used as decision making tools as part of the overall drought management process through our internal 'Gold' and 'Silver' command centres and external 'Drought Liaison Group' governance. In a drought situation, professional judgement, drought scenario modelling and available data and information in the form of the drought indicators discussed above, will also be used in the drought management decision making process.

Drought indicators have been developed to identify when the water resource situation is moving into a drought. Drought trigger levels have been defined, aligned with drought guidance, to ensure that that drought actions are proportionate to the level of drought risk. These are:

- Stage 1 - Normal operation
- Stage 2 - Developing drought
- Stage 3 - Drought
- Stage 4 - Severe drought
- Stage 5 – Emergency Measures

This section describes the trigger levels we use, based upon reservoir storage and water demand.

2.2.1. Reservoir drought triggers

With the majority of water supply originating from our impounding reservoirs, the monitoring of storage levels is critical in assessing our capability at any point in time to meet customer demands if drought conditions prevail. We track the levels in each of our reservoirs, as shown by the black line in Figure 7, against a series of pre-defined "drought control lines". These help us to understand our level of risk and the actions that we should be taking. These actions are described further in Chapter 3.

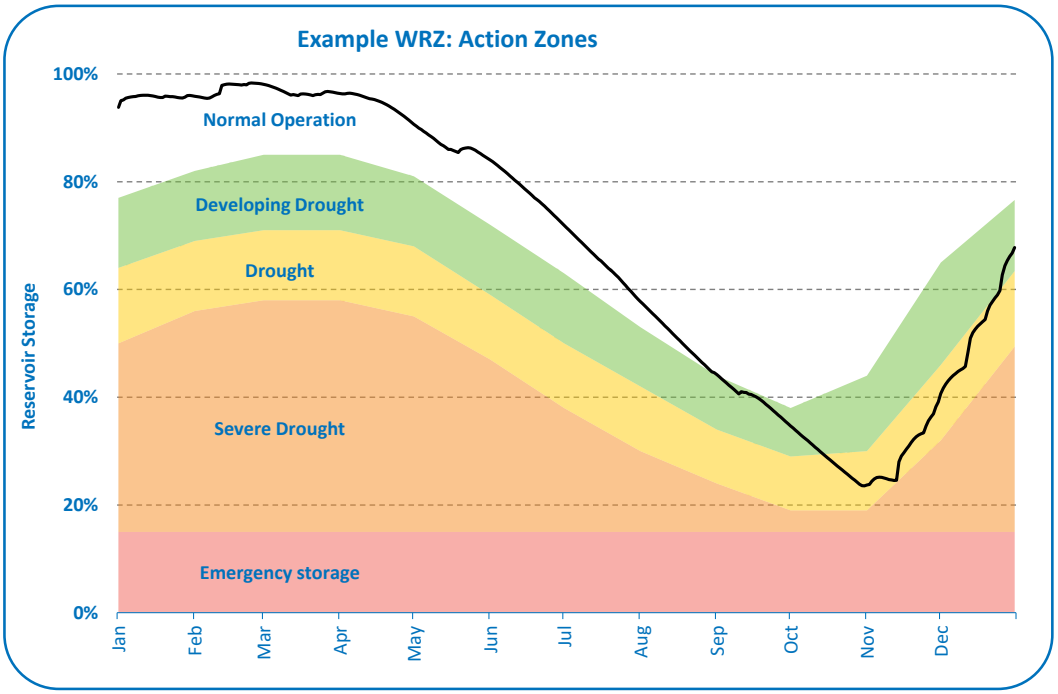


Figure 7 - Example WRZ Drought Action Zone Plot

Normal Operation

Over the late Autumn/Winter period our reservoirs will typically fill and overtop due to the higher volumes of rainfall we generally receive at this time. It is important that we make best use of our cheapest and environmentally preferred water sources during this period which are predominantly our impounding reservoirs. This is due to the lack of pumping needed with stored water treated in upland areas and gravitated down to customers.

We use our lower level, geographically speaking, river sources under these conditions but they are operated below their peak capacity. If reservoir storage levels are 'high' then we will look to use our supply systems as cost efficiently as possible but in line with operating rules that are designed to not overdraw the resource and leave us vulnerable to dry weather.

As storage levels fall we start taking action to maximise the amount of water resource by increasing the use of the lowland river and stream sources which in turn preserves our upland storage in case of drought.

Developing Drought

As we encounter a drought our reservoir storage will fall below that normally expected for the time of year. This is because less water than normal will be captured by reservoirs under dry conditions whilst the water demand leaving the reservoir stays the same or increases. We monitor this position and, as we move towards the 'Developing Drought' action zones of our reservoirs, the focus of operation switches to not only preserving and balancing water resource but to actions that will manage demand.

In general, we continue to reduce the amount of supply from our more vulnerable sources (generally our smaller, upland impounding reservoirs) and increase the supply from our lowland river sources or those impounding reservoirs with larger storage.

This full maximisation of preferred resources can require significant adjustments to our treatment works output and the reconfiguration of our trunk mains networks, and so great care and planning is needed to ensure that the transition to this new configuration is, from our customers' perspective, seamless. We may also look to deliver new infrastructure schemes or use water tankers to resolve any localised issues.

At this stage we will be increasing our demand management effort through increased and targeted leakage control and/ or pressure management. We will also be increasing our messaging to inform customers of the current water situation and the need to protect water supplies and the environment.

It is therefore, essential that our 'Silver' and 'Gold' command centres are established to manage this change process. We will also make our regulators aware of the situation and form appropriate lines of communication with Government, industry groups and our regulators. The 'Gold' and 'Silver' command centres manage the development and delivery of action plans with the objective of maximising the water resource available to meet customers' need whilst taking a measured response to managing customer demand.

Drought

If dry weather conditions persist, we will be aware through our water situation monitoring that we are encountering an exceptional drought event. For our systems this will be an event that is likely to occur greater than one in every 20-60 years dependent upon the Water Resource Zone.

Our storage levels will continue to decline into the "Drought" action zone and alongside our operational actions, we will take further action to preserve storage until levels recover back to normal. We will have introduced all supply side measures that do not need to take more water from the environment than our legal entitlement and will also have maximised our effort on network leakage reduction.

The next stage in this process is to seek to implement a Temporary Use Ban across pre-defined zones (see Chapter 3), which will restrict certain uses of water. This is inevitably a difficult decision as this will impact directly on some of our customers, but once made we will work with Welsh Government and Natural Resources Wales to effectively communicate the need to increase demand management.

Within this "Drought" action zone we may also submit applications to our environmental regulators (Natural Resources Wales and the Environment Agency) to allow us to gain additional water over that currently permitted, as described in Chapter 5.

It will be clear to the general public at this stage that water supplies are under stress and this will doubtless attract both media and Government interest.

Severe Drought

There would need to be very dry weather patterns for an exceptionally long period for reservoir storage levels to fall in to the 'Severe Drought' action zone. Our actions will be proportionate to such severe weather and we would seek further help from our customers, both domestic and non-domestic through implementation of a 'Non Essential Use Ban' to restrict certain public and commercial uses of water. Assuming our Drought Permit/Drought Order applications have been successful we would implement these schemes immediately. We note the current work ongoing to look at additional actions that could be taken at this stage, such as the removal of all TUB and NEUB exceptions, in order to delay the need for extreme measures. We will give consideration to the implementation of any of these potential actions as we move into the Severe Drought action zone.

Emergency Measures

Our planning for drought includes a reserve supply of water known as 'Emergency Storage'. This volume is designed to meet around 30 additional days of customer demand, as well as meeting any environmental requirements. Reaching the stage where this is the only storage we have remaining in our reservoirs is an indication that we are in an exceptional drought event and we may need to implement extreme supply side measures such as water rationing in order to preserve supplies for as long as possible.

Generally across our supply area it would take an extremely rare drought event to cause our storage levels to fall to the point where we only have 30 days of supply available. As shown in Table 16, we estimate the drought event would need to be in excess of a 1:200 return period before we would reach our 'Emergency Storage'.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

Of our twenty four WRZs, the drought status of fourteen is based wholly upon our reservoir storage position, as shown in Table 5.

Water Resource Zone	Reservoirs with Drought Action Zones
North Eryri/Ynys Mon	Llyn Cefni, Llyn Ffynnon Llugwy Llyn Alaw, Llyn Cwellyn (all combined)
Clwyd Coastal	Llyn Aled & Aled Isaf combined
Dyffryn Conwy	Llyn Conwy, Llyn Cowlyd
Alwen Dee	Alwen
Bala	Llyn Arenig Fawr
Blaenau Ffestiniog	Llyn Morwynion
Barmouth	Llyn Bodlyn
Lleyn Harlech	Llyn Cwmystradllyn & Tecwyn Uchaf combined
South Meirionnydd	Llyn Cynwch
North Ceredigion	Llyn Craig y Pistyll & Llyn Llygad Rheidol combined
Mid & South Ceredigion	Llyn Teifi Llyn Egnant & Pondygwaith combined
Pembrokeshire	Llysyfran, Rosebush
Tywi Gower	Llyn Brianne, Ystradfellte, Crai
SEWCUS	The 'Big 5' – (Taf Fawr, Taf Fechan, Usk, Llandegfedd, Talybont all combined)

Table 5 - WRZs that use reservoir storage to indicate drought status

2.2.2. Abstraction and demand triggers

In a number of Water Resource Zones, our primary concern is about the capacity of our infrastructure to meet increased demand from customers, rather than the availability of the raw water. Our Water Resources Management Plan and annual performance data looks at the capability of our systems to meet peaks in demand. It is therefore unlikely that we will encounter such difficulties but to be prudent, in case customer behaviour is outside of our planning assumptions, we have set water demand related triggers.

As an example, Figure 8 shows the increased demand experienced during summer 2018 compared to the maximum treatment capability we had available to us, in our Llyswen WRZ. Demands peaked around 3.4 Ml/d in June 2018, compared to a potential limit of 4 Ml/d. The Llyswen WRZ is supplied from an abstraction point on the River Wye and Figure 9 shows that at the nearest gauging station a few km upstream at Erwood, the minimum flows recorded in the River Wye at that point are around 289 Ml/d. Therefore, water resource availability is never going to be a constraining factor in the Llyswen zone, only the limitations of our assets in the event that customer demands increase above our infrastructure's design capability.

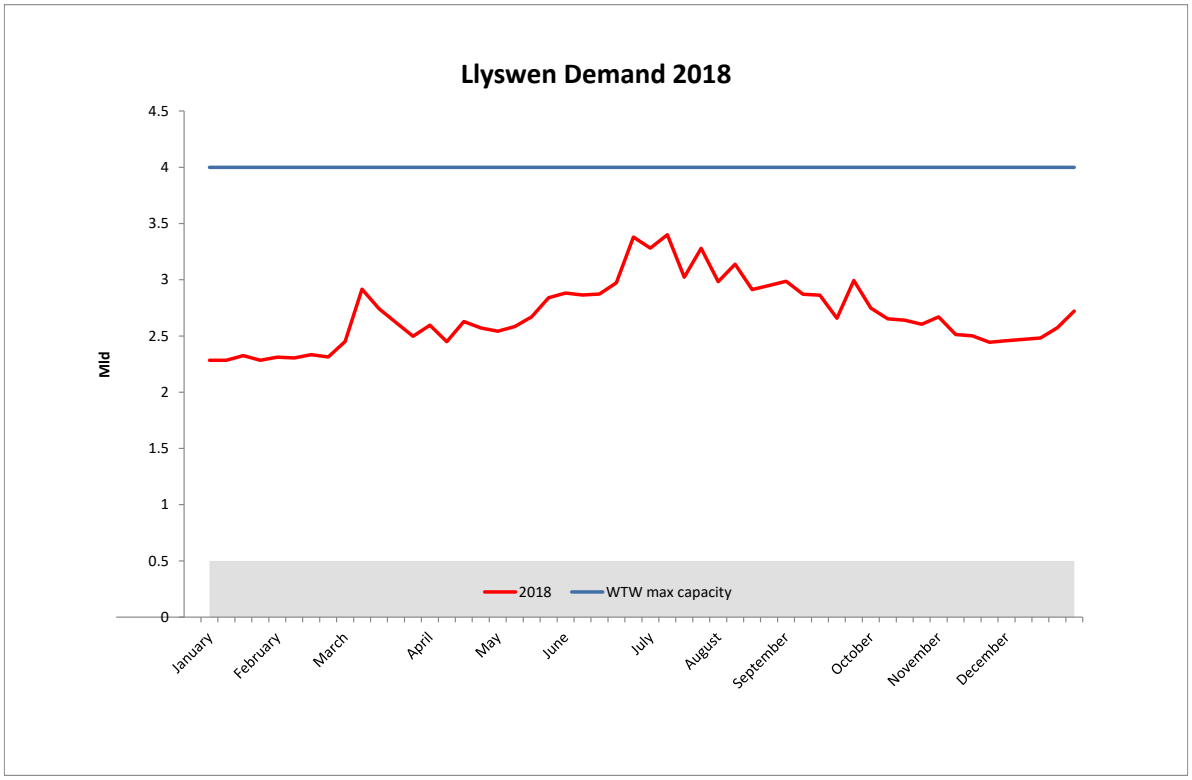


Figure 8 - 2018 Demand for the Llyswen WRZ vs maximum treatment capability

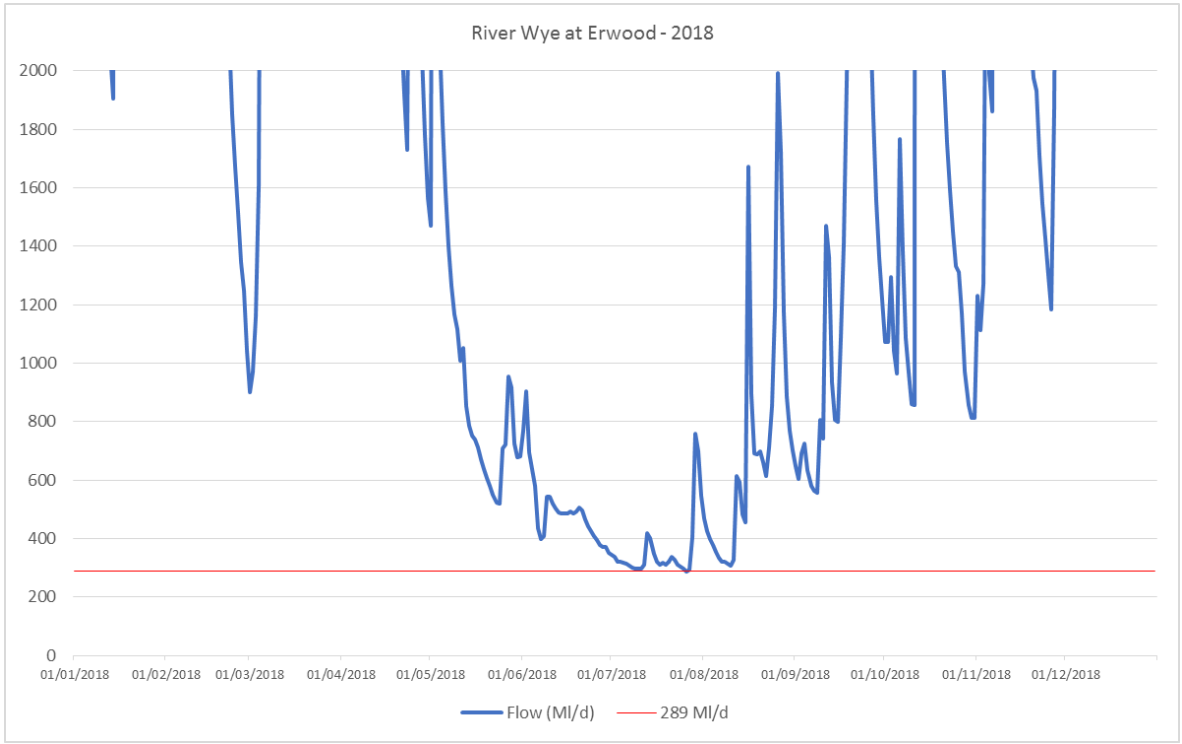


Figure 9 - River Flows at Erwood gauging station (data from NRW)

We have therefore looked at our peak supply capability for the zones that do not have significant reservoir storage and developed demand triggers for action to mitigate against meeting unprecedented levels of demand. Figure 10 is an example of these triggers that have been produced for our Elan/Builth and Llyswen zones combined, with the dashed blue line representing our current limit of water treatment works capability - if demands are reaching this level then we need to take actions to address this.

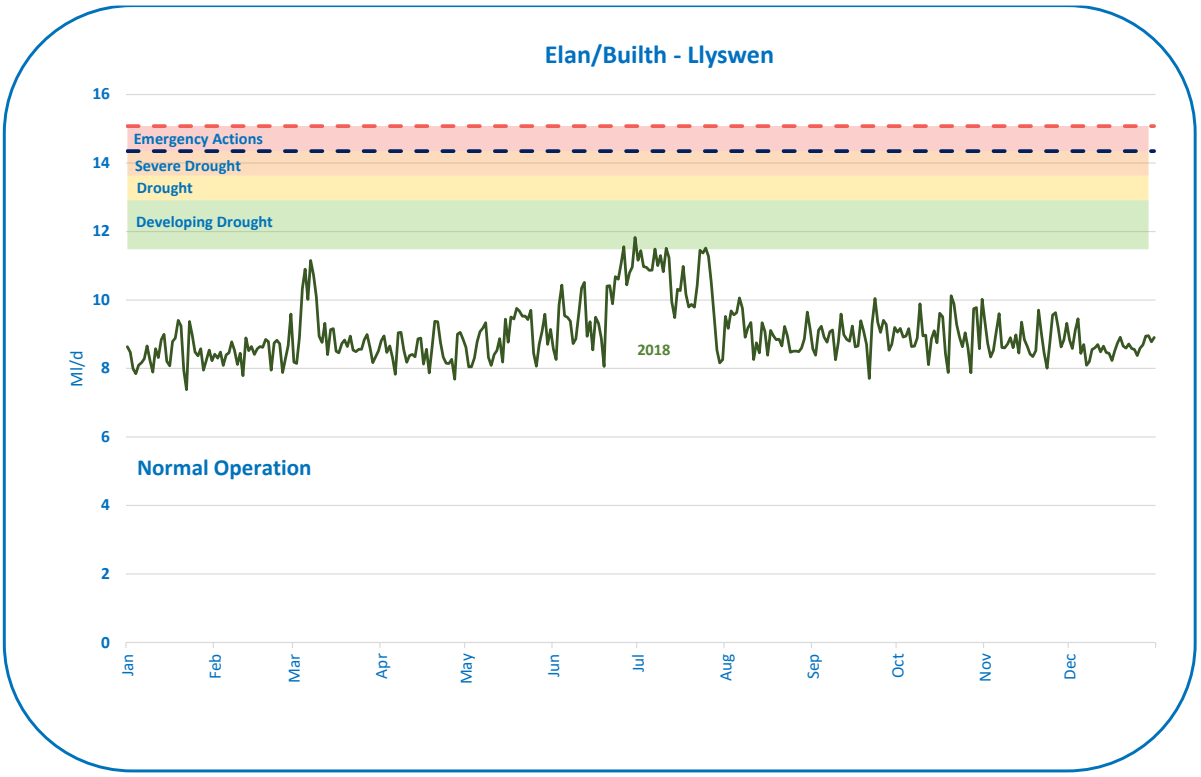


Figure 10 - Elan/Builth-Llyswen Drought Action Zones

In terms of monitoring, as discussed earlier in this Chapter we continually track our demand levels and from experience, the point at which action might be needed to manage peaks in demand is mid-June. However, from the spring bank holiday in late May we review the current and forecast weather information and examine the associated increases in demand against our trigger levels.

The next key date in monitoring demand and preparing to manage peaks is the first week of July, which is approximately two weeks in advance of the start of the school summer holidays. This date is important as we anticipate a lead in time of about two weeks once a media campaign is started, before it impacts demand. Hence, starting a campaign two weeks before the beginning of the summer holidays affords us enough time to reduce the summer peak. If weather driven demand has remained high to the end of June, a media campaign would be started in July along with a two week consultation on how we propose to implement TUBs.

Throughout July, we would closely monitor the impacts of the media campaign on demand and track any savings. If demand remains high through this period, then the end of July would mark the point at which we would implement TUBs.

Table 6 below shows these WRZs and the type of source. There are times in the year when demand rises predictably, such as summer holidays and so it is important to monitor customer demand to ensure that normal hot weather isn't misinterpreted as developing drought.

Water Resource Zone	Source of Water
Tywyn Aberdyfi	River
Ross on Wye	River (technically a bulk import of treated water)
Elan / Builth	Combined river and reservoir
Hereford CUS	Combined river and groundwater
Llyswen	River
Monmouth	Combined river and groundwater
Pilleth	Groundwater
Brecon / Portis	Combined reservoir and groundwater
Vowchurch	Groundwater
Whitbourne	River

Table 6 - Non-storage zones and source types

Using the example in Figure 10 we have produced four drought action zones for the above ten zones. As Tywyn Aberdyfi is a relatively isolated zone and the main drought risk relates to availability of raw water, the drought action zone has defined triggers based on flows in the Afon Fathew. We have developed a standalone set of Drought Action Zones for our Brecon-Portis WRZ as support could be provided from either our Tywi or SEWCUS WRZs, should customer demands exceed our treatment capability and tankering of additional supplies is required.

We have produced a combined set of triggers for the Elan-Builth/Llyswen WRZs as their geographic proximity to each other means that tankering support would be provided to and from these zones as required. Using the same principle but on a larger scale, we have developed a combined set of triggers for our Hereford/Monmouth/Ross/Pilleth/Vowchurch/Whitbourne zones as their geographic locations means that tankering support would be provided from within this group, principally from our Broomy Hill treatment works in Hereford.

2.2.3. End of Drought

Although not a formal drought stage, we will use the same triggers as those set out above to identify when our reservoir levels are recovering such that we can lift any customer restrictions that are in place and remove any drought permits/drought order that are in operation. The initial recovery out of the 'emergency storage' and 'severe drought' action zones is unlikely to be the point at which measures would be lifted as we need to be confident of the longer term prospects for our resource recovery. Fuller details of our approach to declaring the end of a drought are set out in Section 6.

3. Managing a Drought

3.1.Introduction

Chapters 1 and 2 illustrate how we will know when we are in or approaching a drought, together with our approach to triggering drought actions. This Chapter details how we will mobilise in response to a drought event, including how we will communicate to our customers, building on our 2015 Plan and our experiences of the 2018 drought.

The approach we take within Welsh Water to managing all incidents, whether they are short term events such as a large water supply main burst, or longer term events such as a significant asset outage, is to try and safeguard our customers' supplies whilst ensuring that our actions have minimal, if any, effects upon the environment.

Applying this approach during a drought event means we firstly take actions to preserve resource that are immediately available to us, such as reconfiguring our supply networks and increasing our leakage activity.

We escalate communications activity when incidents or our actions in response to these, impact upon our customers. In the case of drought, we escalate communications activity to ask for our customers' support in using water wisely or to inform them of water use restrictions.

Given the relatively wet climate of Wales, we know that an initial spell of dry weather can quickly be replaced with rainfall and so we need to exercise some caution before conveying these concerns to our customers.

As described in Chapter 2, our actions should be proportionate to the level of risk that our customers face. Our approach will ensure that we only seek additional water from the environment, via the use of Drought Permits/Drought Orders, once all other options have been exhausted and appropriate customer demand restrictions are in place.

When we encounter local issues particularly in our smaller zones, our experiences during summer 2018 have given us confidence that we are able to use road tankers to move water between our supply systems to support zones experiencing high demands or low water resources.

We are also able to quickly mobilise delivery of new infrastructure to, for instance, improve our network connectivity. As an example, we enhanced the connectivity between Anglesey and the mainland in North West Wales in the drought of 2018, to help better manage our supplies and reduce the risk of customer and environmental impact. We have taken forward the learning gained from our management of the 2018 drought and this improved approach is set out in the following sections.

3.2. Drought Management Structure

We recognise that multiple events occurring simultaneously increase the magnitude and severity of an emergency situation. Droughts are normally widespread and can involve complex operational changes across our region. In an incident, our procedures require the separate but integrated operation of the following internal command centres:

Centre	Purpose
Retail Centre	for customer communications
SMART 'HUB'	for operations communications and real-time operations data
Silver Centre Command	for local tactical and operational management and response
Gold Centre Command	for strategic response and management
Crisis Management Team	for executive management and external agency support

Table 7 - DCWW Incident Centre Setup

The management structure set up during the summer of 2018, as shown in Figure 11 drew on our experience of managing the February/March 2018 so-called 'Beast from the East' event. This provided effective coordination and management of all internal and external activities so we are therefore confirming this as the approach we would take during future drought events.

During the drought of 2018 one of our key external activities (in accordance with the NRW Drought Plan) was to provide representation on the "All Wales Drought Liaison Group". This group was led by Welsh Government and attended by Natural Resources Wales together with representatives from other relevant sectors. The Group met weekly to discuss the current drought situation, the actions that were being taken by all organisations including customer and stakeholder communications, and where support could be provided across sectors. The establishment of this Group provided a key focal point for drought management in Wales and at each meeting our Managing Director of Water Services was able to provide reassurance that all necessary actions were being taken to maintain customer supplies whilst safeguarding the environment. Welsh Government coordinated the interactions between this Group and Local Resilience Forums. The Drought Liaison Group would also be used to convene locally based drought groups, such as the Dee Consultative Committee, to support strategic level decision-making.

In addition, and in accordance with the Environment Agency Drought Plan, we provided representation to England's "National Drought Liaison Group" although this was less frequently attended as we were not suffering from any form of drought in our English supply areas in 2018. We recognise that in future droughts this may not be the situation and so representation on this Group provides an important forum for us to raise any concerns in the border areas of Herefordshire and Deeside that we supply.

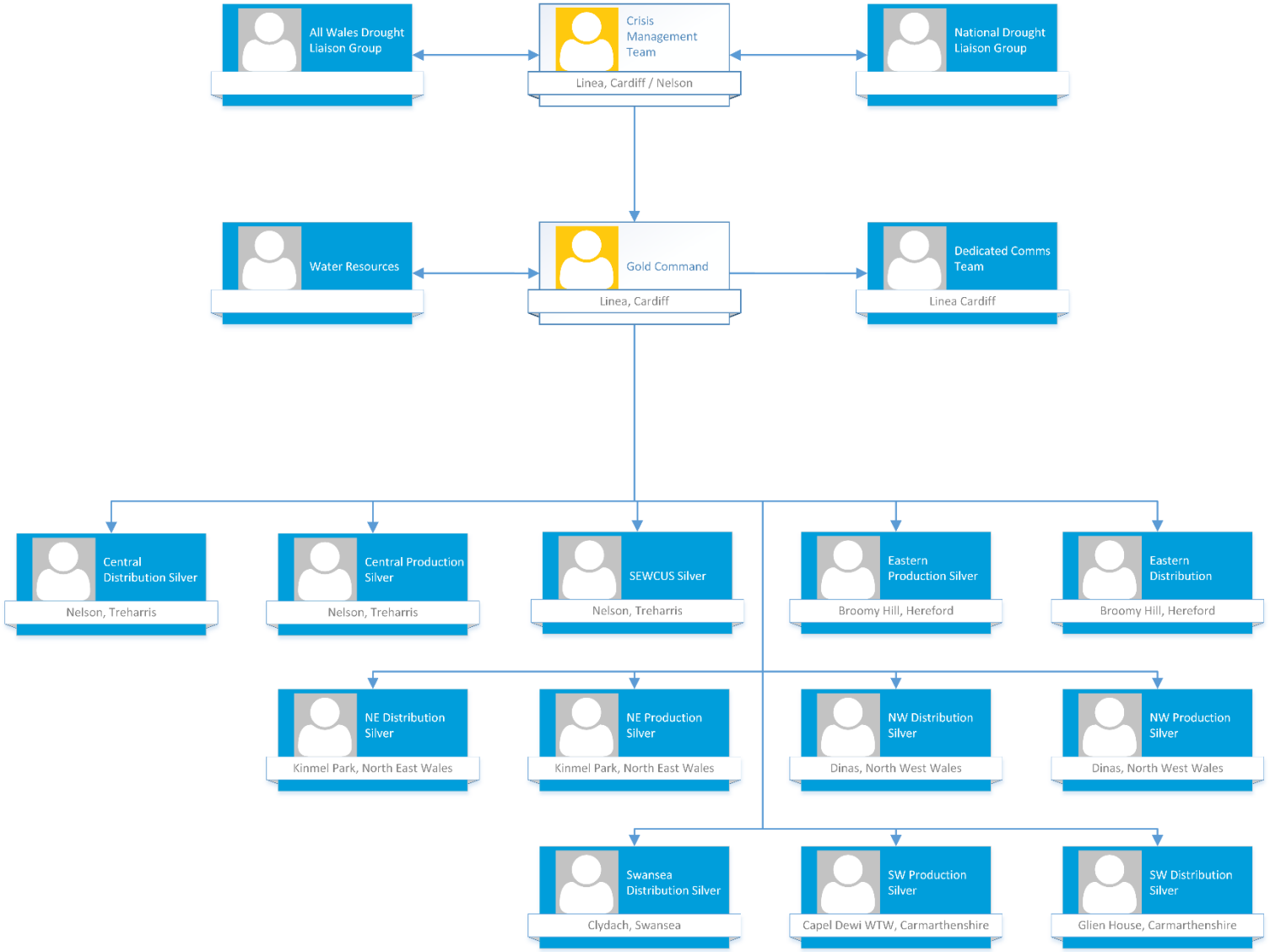


Figure 11 - Welsh Water Internal Drought Management Structure

Table 8 below identifies the core group of the Welsh Water Executive that would form the 'Crisis Management Team' with specific expertise from within or outside the business invited to join if required.

The Crisis Management Team will be responsible for:-

- High level liaison with external bodies e.g. Welsh Government.
- The strategic co-ordination of companywide emergencies
- Fast track approval of major funding
- Large scale media response
- High level decision making

Job Title
Chief Executive Officer
Managing Director Water Services
Managing Director Wastewater Services
Managing Director Household Customer Services
People and Change Director
Director of Customer Strategy and Communications
Director of Capital Delivery

Table 8 - Welsh Water Crisis Management Team

Table 9 identifies the leadership staff that would form the 'Gold' centre incident management team. The Gold Command centre is responsible for providing a strategic overview of drought management across our three operational areas (North, South West, and South East) and is the focal point for external liaison with Government and regulators. The overall function of the Gold Centre during a drought event is to give direction to our operational and capital delivery teams on which actions to take within each supply area such as setting water production targets, the re-configuration of our supply network, establishing the focus of our leakage effort and the delivery of any schemes necessary to augment our existing water supplies. The Gold Centre will direct on the level of communication activity required with our customers and also represents Welsh Water on the "All Wales Drought Liaison Group" and the Environment Agency led "National Drought Steering Group" for England.

Area of Responsibility	Job Title	Department
Drought Management	Managing Director of Water Services	Water Services
Water Resources	Head of Water Resources	Water Services
Demand Management	Head of Water Engineering	Water Services
Communications	Head of Strategic Communications	Communications
Water Production	Head of Water Production	Water Services
Water Distribution	Head of Water Distribution	Water Services
Water Quality	Head of Water Services Science	Water Services
Scheme Delivery	Head of Alliance Water Programme	Capital Delivery
Reservoir Management	Head of Dam Safety	Water Services
Emergency Planning	Director of Operational Services	Water Services

Table 9 - Welsh Water Gold Centre Drought Management team

3.2.1. Silver Command Centre

Reporting directly in to the Gold Command Centre are seven Silver Command Centres that are responsible for undertaking the necessary supply side actions within their area. As shown in Table 10, for management purposes our three operational areas are further subdivided to create more localised centres that can respond quickly to the drought as it progresses and deliver the necessary actions.

Area of Responsibility	Job Title	Department
Water Resources	Area Water Resources Manager	Water Services
Water Production	Production Manager	Water Services
Water Distribution	Distribution Manager	Water Services
Treated Water Quality	Process Science Manager	Water Services
Raw Water Quality	Catchment Risk Coordinator	Water Services
Demand Management	Leakage Delivery Manager	Water Services
Scheme Delivery	Capital Delivery Lead	Capital Delivery
Reservoir Management	Dam Safety Engineering Manager	Water Services

Table 10 - Welsh Water Silver Centre Drought Management Team

3.2.2. Welsh Water Drought Responsibilities

Operational Services

To effectively manage any incident it is vitally important that we have robust, up to date information on our operational systems. Our Operational Services team ensures the provision of continuous monitoring of our water treatment works and network for management and control of our water supply systems. Our Smart Hub monitors the telemetry systems across all our sites and escalates any warning alarms to our Water Production and Distribution teams so they can respond accordingly. They are responsible for control centre management and the links to our call centres dealing with day to day customer care.

To support the management of an incident, our Emergency Planning Team supports our incident centres, manages our road tanker fleet, the distribution of bottled water and any other support that may be required to help maintain customer supplies.

Water Services Science

Our Water Services Science Team (which includes our Catchment and Process Science teams) is responsible for ensuring, as far as possible, the quality of raw water that comes into our water treatment works and the quality of the water received by our customers. Should any standby or new sources of raw water be brought into operation during a drought, our Catchment Team will ensure that sufficient sampling and risk assessment (through the form of a Drinking Water Safety Plan) is in place prior to us starting to use these new supplies. The Process Science Team gives advice on any adjustments required to the treatment processes (e.g. increased chemical dosing) to ensure that we continue to supply high quality drinking water even if the quality of the raw water supplied to the works has been changed.

Water Resources

The Water Resources Team is responsible for tracking the water situation during a drought and providing short term (week to 6 month) forecasts of the likely water resource position. Reports are produced weekly for the Gold Centre to review and then instruct the Silver Centres on the actions to be taken in response to the updated forecasts.

These reports will advise on the quantity of raw water available and how this is forecast to change through the drought. The Water Resources Team will also lead on the application process for our Drought Permit/Drought Order schemes and will act as the key point of contact with local NRW and EA staff, together with overseeing any environmental monitoring and mitigation activities that are required.

Dam Safety

The Dam Safety Team will be responsible for any adjustments required to the valves that control both the releases we make to the downstream river (compensation and regulation) and those that control the supply of water into our treatment works. Given the importance of our impounding reservoirs for public water supply, it is crucial that any change in their operation (e.g. change in the point of abstraction to the treatment works) is carefully managed to ensure no risk to the integrity of the dam structure.

Water Production

The Production Team operate our 62 water treatment works (WTW) and associated raw water pumping stations. During a drought they are responsible for increasing/decreasing the amount of water produced at our WTW in response to the changing raw water resource position and ensuring that the water into our network is maintained to high standards.

Water Distribution

The Water Distribution Team is responsible for managing and operating our network of 27,400km of water mains. This network also includes around 570 treated water reservoirs and 700 water pumping stations. The Water Distribution Team will undertake the series of actions in our network that effectively re-zone supplies, changing the source of supply to our customers. Changing the operation of a water supply network can lead to water quality issues if it is not managed correctly and so our Water Distribution Teams ensure these activities are undertaken during a drought with no impact to customers.

Water Engineering

Within Welsh Water, responsibility for delivering our demand management activities sits with the Water Engineering team. During a drought they are responsible for increasing and focusing our leakage detection and repair activity and enhancing water efficiency effort, focussing on those areas experiencing high demands and/or reduced water resource.

Capital Delivery

During the summer of 2018 our Capital Delivery team played a key role installing new assets (water mains, pumping stations) that enabled us to better utilise our existing supplies. Any schemes that require new or upgraded infrastructure will be identified by the Water Resources/Water Production/Water Distribution teams and our Capital Delivery team will manage the construction and installation works.

3.3.Managing Water Demand in a Drought

In order to assess the risk of needing to implement temporary use bans, non-essential use bans, options which take more water from the environment, or, as a last resort, water rationing, we make assumptions around the amount of water used during a drought. If water demand is greater than our assumptions, the risk of having to implement any of these options is higher than in our assessment. Furthermore, peaks in demand may also cause water supply difficulties if infrastructure outages occur. It is therefore prudent to manage water demand during a drought as this will help to ensure adequate water supplies will be available and that any risk to the environment is properly understood and minimised.

We manage demand in two ways, firstly by limiting the wastage from our systems through increased and targeted leakage reduction effort and secondly, by influencing customer behaviour so that they use less water. The main actions available to us to affect customer behaviour are:

1) Advising customers on water efficiency

2) Imposing Temporary Use Bans

3) Imposing Non-essential Use Bans

4) Directly constraining the amount of water that can be taken by customers through more 'Extreme' measures.

These measures are increasingly restrictive on our customers and we time their implementation proportionately to water supply risk faced during a drought through the use of the triggers described in Chapter 2. The following sections provide background to our thinking and how these measures will be implemented and communicated to our customers. As required by the Drought Plan guidelines we have completed the Appendix F forms that provide a high level overview of our demand-side drought management actions.

3.3.1. UKWIR Code of Practice

An UKWIR project was completed in 2013 to provide a voluntary Code of Practice (CoP) and guidance to water companies on the implementation of TUBs and NEUBs. It provides advice on a potential staged approach to the implementation of restrictions with the aim of creating a more consistent approach between water companies across the Wales and England. This general approach seeks to minimise the social and economic effects of water use restrictions, with restrictions placed initially on domestic customers before affecting commercial customers.

This CoP was produced in collaboration with, and supported by representatives from regulators, consumer groups, trade bodies and customers. In order to collate an evidence base of the impact of the 2012 restrictions upon commercial customers, certain stakeholder organisations and industry groups were consulted to gain their views. The selection was made from a list of contacts that had made representations on the previous CoP, Company Drought Plans, and the imposition of restrictions in early 2012.

These can provide evidence on the impact of the drought on businesses, and feedback on the nature and phasing of communications that occurred. Discussions with the consultees centred on the potential impact that water use restrictions could have upon that particular commercial industry or sector, the concerns of the industry/sector and the desired outcome. The consultees that were contacted and provided feedback are as follows:

- Car Wash Association;
- Federation of Window Cleaners;
- Horticultural Trades Association and Turf Grass Growers Association;
- National Farmers Union;
- Racecourse Association;
- Kent Cricket Board;
- England Golf;
- Wandsworth Borough Council; and
- British Swimming Pool Federation.

The responses to consultation are provided in the CoP. We have signed up to this CoP. We agree with the four principles outlined in the CoP and have retained this thinking in our updated Plan. These are:

- Ensuring a consistent and transparent approach
- Ensuring that water use restrictions are proportionate
- Communicating clearly with customers
- Considering representations in a fair way

The CoP sets out how water companies can grant exemption from TUBs and NEUBs to certain customers. Customers who meet the criteria for these exceptions can continue to use water without restriction and do not need to make a representation to Welsh Water. The Code also endorses the use of representations whereby customers may make a case for not having to adhere to restrictions. Our proposals on representations are given later in this section. There are also five actions set out in the CoP that have been developed to help establish a more consistent approach in terms of implementing water use restrictions. These are:

- For water companies, regulators and government to work together
- To coordinate communications
- To adopt a common phased approach, considering socio-economic factors
- To adopt a common approach to exceptions
- To promote understanding and good practice

We will endeavour to work to these and in the summer of 2018 we maintained close liaison with Welsh Government and Natural Resources Wales as the dry weather continued. Although we believe that the core aspects of the CoP are still relevant, we recognise that the expectations of the water industry and our customers are changing over time. The code is likely to be updated in the future and, when that happens, we will take a view on any changes suggested and discuss them with our stakeholders.

3.3.2. Customer Research

During the preparation of our WRMP19, we undertook research[9] to measure customers' views on the types of water use restrictions that we should employ as part of either a TUB, for households, or an NEUB, for non-households. The output was a measure of their relative acceptability to customers.

The potential water use restrictions tested were directly based on those listed in section 76 of Water Industry Act 1991 (as amended by the Flood and Water Management Act 2010) in the case of TUBs, and on those in the Drought Direction 2011 in the case of NEUBs. Table 11 shows the water use restrictions tested in the research, by customer type.

[9] Dŵr Cymru Welsh Water WMRP Research, Final Report, Accent/PJM Economics, December2017

Household Customers	Non-Household Customers
Watering a garden using a hosepipe	Watering outdoor plants on commercial premises
Cleaning a private vehicle using a hosepipe	Filling or maintaining a non-domestic swimming or paddling pool
Watering plants using a hosepipe	Filling or maintaining a pond
Cleaning a private leisure boat using a hosepipe	Operating a mechanical vehicle-washer
Filling a swimming pool or paddling pool with a hosepipe	Cleaning any vehicle, boat, aircraft or railway rolling stock
Drawing water using a hosepipe for recreational use	Cleaning non-domestic premises
Filling or maintaining a pond using a hosepipe	Cleaning a window of a non-domestic building
Filling or maintaining an ornamental fountain	Cleaning industrial plant
Cleaning household walls or windows using a hosepipe	Suppressing dust
Cleaning paths, patios or outdoor surfaces using a hosepipe	Operating a cistern in any building that is unoccupied and closed.
Cleaning other artificial outdoor surfaces using a hosepipe	

Table 11 - Water use restrictions tested in the customer research

Customer Survey Results

The results are similar to those collected prior to our 2015 plan. They show that the restrictions that customers are most willing to pay to avoid are those which offer the greatest potential savings of water, namely bans on the use of hosepipes for garden use and car washing. The results for Temporary Use Bans are presented in Figure 12 and in Figure 13 for Non Essential Use Bans below.

3.3.3. Enhanced leakage reduction

Normal conditions

During normal weather conditions, our leakage strategy is based upon each Water Resource Zone achieving the targets laid out in our Water Resources Management Plan, based upon achieving the Sustainable Economic Level of Leakage (SELL) for the zone and our stakeholders' views. Company leakage is calculated on a daily basis and summarised into weekly, monthly and yearly values to enable an assessment of performance to be made and interventions to be implemented if required.

Drought Conditions

Our internal process to increase our leakage management as drought conditions continue is set out below. We will:

- Target leakage reductions beyond the levels agreed with our regulators.
- Increase our leakage detection and repair activity to reduce leak run times and increase targeting of customer side leakage.
- Increased customer communications to encourage the reporting of potential leaks either on the distribution network or customer side.
- Enhance our pressure management activity which will also include a review of existing levels of water pressure being delivered to customers and whether these can be reduced lower to deliver minimum levels of service, and beyond in cases of severe drought.

- Accelerate the delivery of new leakage repair schemes ahead of planned schedule.

Alongside our enhanced leakage activity we will increase our offering and distribution of water efficiency products using our existing engagement streams to encourage interest, such as our website and water efficiency portal. The website and portal would also inform customers of water saving tips. Our 'Cartref' project (summarised below) will also be targeted at customers in zones where there are concerns over the water resource position.

3.3.4. Influencing customer water efficiency

Welsh Water has already made a long term commitment to help reduce the amount of water used by our customers, called per capital consumption, which is outlined in our WRMP19. In order to achieve these reductions we have a programme of water efficiency projects which seek to deliver both messaging and physical interventions. The projects are targeted at an individual, community, regional or national level, dependent upon their nature. The projects include;

- Water audits - empowering customers to make a real difference to water usage. This might be through a DIY survey approach or physical presence in the property.
- Welsh Water's 'Cartref' initiative – providing targeted interventions, to improve water efficiency and product installation at a domestic level and targeting internal plumbing losses.
- Our award winning Schools Outreach Programme - the aim is for every student from age 5-11 to have some exposure to the water efficiency message.
- Product distribution – supplying our WRAS (Water Regulations Advisory Service) approved, water saving devices to targeted customers and at national events such as the Eisteddfod and Royal Welsh Show.

In addition, we have a programme of customer messaging each year to remind customers that using water wisely is the right thing to do as it helps us to maintain affordable customer bills and reduces our impact upon the environment.

We reinforce this work during a drought by enhancing our customer messaging and asking for voluntary restraint and supporting this through greater provision of water saving devices. This work is explained in greater detail in the section below on customer communication.

3.3.5. Temporary water use restrictions

The Water Use (Temporary Bans) Order 2010 provides water companies with powers to impose a range of temporary use bans of water by our domestic customers during a drought, without requiring a drought order (under section 76 of the Water Industry Act 1991). The Drought Direction 2011 sets out the range of non-domestic water uses that can be restricted under an Ordinary Drought Order (commonly known as a non-essential use ban (NEUB)).

3.3.6. Temporary Use Bans (TUBs)

During the initial phase of drought, our actions are intended to reduce demand by encouraging voluntary customer restraint on water use and enhanced leakage management. As we meet our 'Drought triggers' TUBs on water use may then be imposed following advertisement.

The results of our WRMP19 household customer research are presented in Figure 12 which shows our customers' willingness to pay to avoid these restrictions. This indicates which measures our customers are least happy to restrict relative to each other.

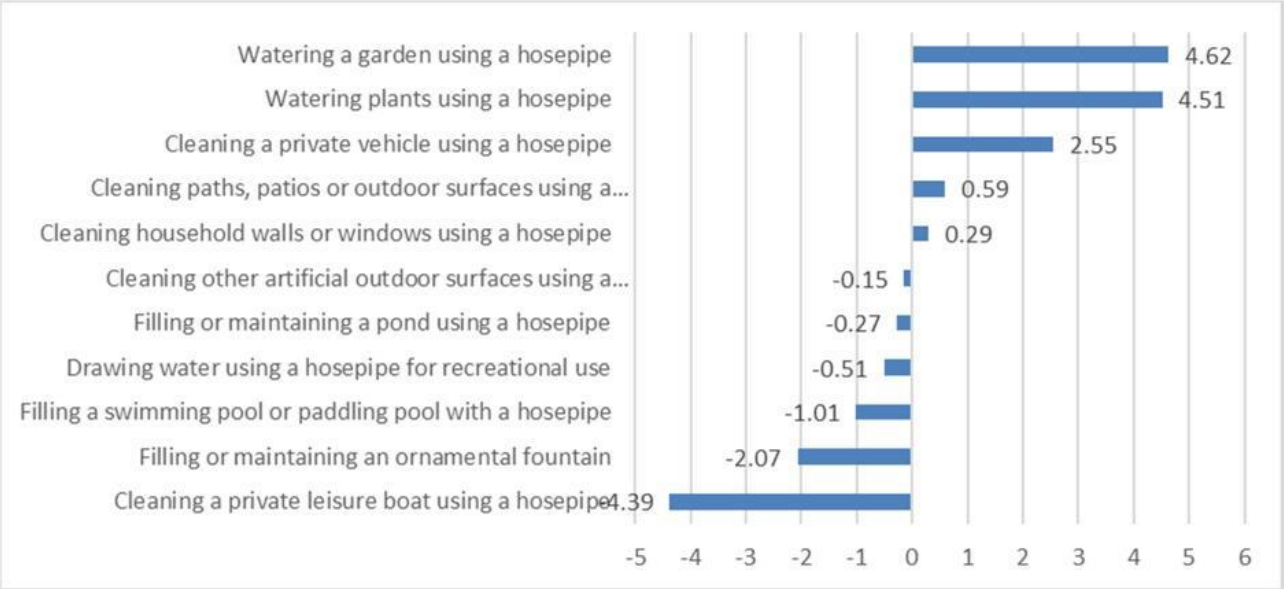


Figure 12 - WTP for water use types to be allowed during TUB -households

Our view has not changed that if restrictions are needed to be put in place then all of the allowable restrictions should be applied at the same time. This approach has the benefit of not discriminating between the uses our customers make of hosepipes and also avoids any confusion over the activities that are being restricted. This in turn will aid communication and provides the highest chance of managing customer water use which we believe is reasonable during very infrequent drought events.

Legislation sets out specific requirements for notifying the public prior to the introduction of the new TUB measures. Section 76B of the Water Industry Act 1991 (as amended) stipulates:

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

In regard to the phasing of Temporary Use Bans, we will look to retain maximum flexibility in terms of the activities we restrict and their timing and duration, together with the extent of implementation across our supply area. We need to ensure that any restrictions are effective and do not unnecessarily impact our customers for little or no benefit to our water supply.

We recognise that there is some merit in looking for consistency in imposition of TUBs between water companies, which is why we have signed up to the CoP covering these actions. However, all companies have also expressed the need for a flexible approach given that each drought is different and conditions across each company's supply area may be different. The industry CoP identifies 3 types of exceptions whereby customers would not be restricted during the implementation of TUBs. These are:

- Statutory Exceptions that must be made to restrictions. These are specified through legislation and exempt restrictions for commercial uses of hosepipes, and on health and safety or environmental grounds.
- Discretionary Universal Exceptions agreed in line with the CoP to ensure a consistent approach to imposition of restrictions. These primarily relate to exemption of blue badge holders.

- Discretionary Concessional Exceptions which are granted by individual water companies. We will grant concessions on the grounds of protection of the environment and for those on our Vulnerable Customer list.

We have adopted a policy to maintain all exceptions once Drought Orders are in place to maintain clear and consistent messaging to our customers on water use restrictions, except in extreme drought circumstances where rescinding of certain concessions may be required.

In relation to cases of non-compliance with TUBs, any enforcement strategy or legal action would be subject to Welsh Water's Enforcement and Prosecution Policy, which takes a number of factors into consideration. When considering a matter for prosecution, Welsh Water complies with the Code of Crown Prosecutors. If customers wish to appeal in relation to the implementation of TUBs they are able to do so by application for Judicial Review of the order. Any customer wishing to pursue this route must take their own independent legal advice.

3.3.7. Non-essential Use Bans (NEUBs)

If the severity of the drought continues to increase following the implementation of TUBs, we may need to apply for an ordinary Drought Order to further restrict water use through the implementation of our non-domestic customers as allowed for under the Drought Direction 2011, commonly referred to as Non Essential Use Bans (NEUBs). The likelihood of needing these is set out in Chapter 4 but generally these restrictions would be imposed extremely infrequently with a 1 in 100 year drought return period or even rarer event being needed to trigger them.

The results of our WRMP19 household customer research are presented in Figure 13 which shows our customers' willingness to pay to avoid these restrictions. This indicates which measures our customers are least happy to restrict relative to each other.

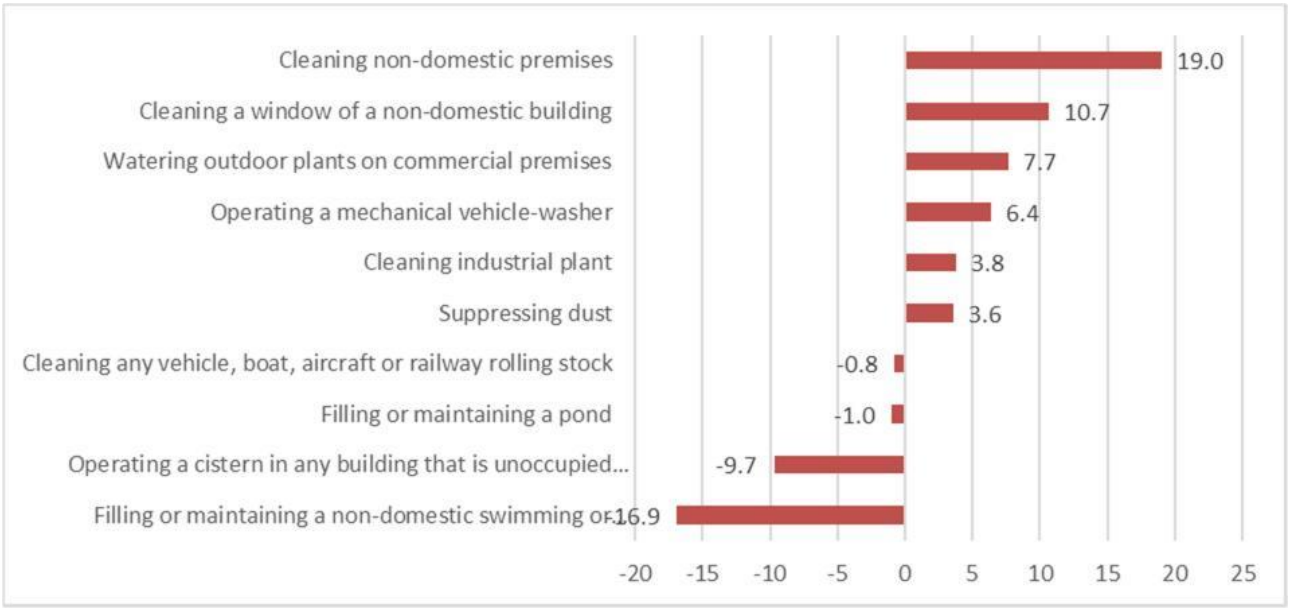


Figure 13 - WTP for water use types to be allowed during NEUB - non-households

Our view has not changed that if restrictions are needed to be put in place then all of the allowable restrictions should be applied at the same time. This approach has the benefit of not discriminating between the various non-essential uses of water, and also avoids any confusion over the activities that are being restricted. This in turn will aid communication and provides the highest chance of managing customer water use which we believe is reasonable during very infrequent drought events.

As per our approach to TUBs, we will look to retain maximum flexibility in terms of the activities we restrict and the timing and duration of these, together with the spatial implementation across our supply area. We will grant limited exceptions to Non-Essential Use Bans. The main concessions granted are:

- Concessions on the grounds of protection of the environment (relating specifically to the spread of non-native and/or invasive species)
- Concessions for those on the Welsh Water Vulnerable Customer list
- Concessions for small businesses which may be affected (on a case by case basis)

Discretionary concessional exceptions will require customers to write or make representation to us in order to obtain permission as set out later in this Chapter.

3.3.8. More extreme measures

Water rationing through the use of widespread enhanced pressure management or localised use of standpipes would only be employed in very exceptional circumstances under an emergency drought order and are viewed as an unacceptable practice for anything other than the most exceptional emergency circumstances. Within this Plan we have demonstrated that for the majority of our supply area it would take a drought event in excess of a 1:500 year return period to cause us to reach the point where we could run out of water to meet our customers' needs.

3.3.9. Potential demand savings

The savings in water use that we might make from demand management activities are difficult to estimate. In our 2015 Plan, we referred to a number of historic UKWIR reports. We have not had to employ drought measures in our supply area since 1990 and so we have little substantive data with which to quantify the impacts of these measures.

Although there is little data available from previous drought incidents within our area, best available information has been used to support our estimate of demand savings including guidance from Ofwat, Waterwise and UKWIR where possible. This reflects the requirements within guidance and legislation as best practicable.

A national study was commissioned to examine the data from the 2018 drought across Wales and England and has recently produced a draft report[10] of its findings. As no Temporary Use Bans were implemented in 2018 the report has concluded that for now, information gathered from 2006 still provides the best available evidence on likely savings. The report has recommended that research is required in three areas that would specifically addresses these uncertainties:

1) *"Further research into TUBs (temporary use bans) and their impact on peak demand, including customer research on attitudes to TUBs"*

2) *"Social science research into which practices, behaviours or infrastructures result in weather driven peaks in consumption"*

3) *"Estimate the benefits of customer communication, calls for restraint and restrictions on consumption"*

Given this lack of additional information we continue to assume that TUB's aligned with customer messaging could reduce demand by the order of 5% with the addition of NEUB measures in place reducing this by a further 5% to 10%.

3.3.10. Compensation and Enforcement

The compensation payments that we make to customers for interruptions to their supplies are specified in our publications 'For You Not For Profit 2018-19' and 'For You Not For Profit – for metered customers 2018-9' available at https://www.dwrcymru.com/en/Reading_Room_Library/Leaflets-and-Publications.aspx The documents outline compensation to household customers (whilst not including hosepipe restrictions) and business customers as below:

[10] Water demand insights from summer 2018 Summary Report (Artesia, 2019)

'We will compensate you if your water supply is interrupted due to drought. We will give household customers £10 per day or part day (up to the limit of last year's average household bill) and business customers £50 per day or part day (up to the limit of last year's water charges for the premises or up to £500 if you were not liable for last year's charges).'

Anyone who is affected by the taking of water under a Drought Order may make a claim, which must be made within six months of the date of expiry of the Order according to the rules which are set out in Schedule 9 to the Water Resources Act 1991.

We are not required to pay compensation to customers if the circumstances are so exceptional that, in Ofwat's view, it would be unreasonable to expect the interruption to supply to be avoided. Under the Water Resources Act 1991, customers are not entitled to compensation in respect of loss or damage sustained as a result of the implementation of Drought Permits/Drought Orders.

Further information on the guaranteed standards scheme (GSS) payments is available from the Ofwat website (https://www.ofwat.gov.uk/wp-content/uploads/2017/03/The-guaranteed-standards-scheme-GSS-summary-of-standards-and-conditions.pdf).

In June 2018 Ofwat issued their report "Out in the Cold" following an investigation into how water companies in England and Wales responded to the impact of the "Beast from the East". It stated that the current GSS scheme was not fair, fast or hassle free for customers and Ofwat subsequently put out a call for evidence to determine how to make things right. In late November 2018 Ofwat published recommendations to the UK and Welsh Governments regarding changes to the GSS scheme, suggesting a twin-tack approach, with some changes being made now to address key issues and for Ofwat and Government to consider further potential changes in other areas over the longer term.

The immediate changes Ofwat has recommended are:

1. Increase the amounts of compensation customers receive for supply interruptions.

2. Reduce the time between additional compensation payments for longer supply interruptions

3. Remove the reference to supply interruption on 'strategic mains' which currently delays payments to customers

4. Make all GSS payments automatic

5. Review GSS payment amounts when cumulative inflation exceeds 10%

The proposed changes under points 1 - 3 above will result in an increase in payments of £30 to household customers for every 12 hours they are without water (currently this is £20 after 12 hours, or 48 hours if the problem is on a 'strategic main', and a further £10 for every additional 24 hours they do not have water). For non-household customers the payment should increase to £75 for every 12 hours they are without water.

Ofwat has stated that while the changes are being considered by both Governments, they expect all companies and retailers to reflect on the recommendations when setting their own compensation schemes. We are therefore making the changes to our GSS scheme from 1 April 2019, so the new amounts are being reflected in our annual billing publications printed in January 2019.

3.4. Communicating with our customers and stakeholders

Welsh Water's Drought Communications Plan (DCP) has been developed to ensure the effective flow of information to customers and stakeholders during the various stages of a drought. The strategy is designed to ramp up in response to the escalating stages of drought and trigger behavioural changes from customers to help conserve water supplies. While we have not had a hosepipe ban for many years, and have successfully reduced our leakage rates, as a company we fully appreciate how impacted we can be by events such as the hot summer experienced in 2018. Our updated DCP will ensure we are in a position to respond immediately in the event of similar conditions occurring in the future.

Key to the effective management of any drought situation will be engagement with customers and stakeholders. Their cooperation during such times is essential to help protect water resources. To achieve this, we will need to ensure our communications are effective – particularly to generate understanding of the situation and actions we require them to take. We cannot however expect customers to play their part without also being explicit about all of the activities we undertake to keep them in supply: this forms an important part of our messaging.

Our communications strategy also has flexibility to adapt to varying drought situations by using appropriate communication techniques and messaging. Multiple communication channels are utilised to ensure the most appropriate is used for the targeted audiences. This also includes ensuring communication is fully bilingual to cater for our customers' language of choice.

In developing our DCP we have considered the conclusions of the Consumer Council for Water's report 'Understanding drought and resilience'[11] and also the findings in the UKWIR report 'Drought and demand: potential for improving the management of future drought'[12]. The company has also incorporated learning from the 2018 summer into the DCP.

3.4.1. Approach

Our overarching guiding principle in developing the DCP is to ensure that the water situation information we provide is timely and accurate. It is also essential that it offers advice and guidance explaining how the particular audience group we are targeting can play their role in helping us conserve water supplies to manage the situation. Our objectives are to:

- Nurture a culture of water efficiency and promote water efficiency messages to customers during normal weather conditions
- Encourage behavioural changes from customers to help conserve water supplies to minimise risk of restrictions during drought conditions
- Inform customers and stakeholders of the various stages of drought and associated impacts on their supplies
- Inform customers and stakeholders about the actions Welsh Water is taking to maintain supplies i.e. increased water treatment, increased leakage detection
- Align activity and messaging with regional or national initiatives to conserve water supplies i.e. Welsh Government's 'Water Strategy for Wales', Consumer Council for Water's water efficiency advice and also Waterwise activity.

[11] Consumer Council for Water Understanding drought and resilience. YouGov, prepared for Consumer Council for Water, March 2013.
[12] DROUGHT AND DEMAND: POTENTIAL FOR IMPROVING THE MANAGEMENT OF FUTURE DROUGHTS, UKWIR Report Ref. No. 07/WR/02/2

- Provide information on how to prepare for, adapt to and mitigate water usage restrictions

While these objectives form the core of our strategy, tailored communications plans will be implemented to meet the requirements of an escalating drought situation. More information on this is detailed below.

The need for reliable and accurate information is essential during drought conditions – particularly as the heightened media interest can generate misinformation. This easily leads to undue concern amongst customers. Our approach to customer communication is therefore governed by the need to reassure customers by keeping them informed of the current situation and importantly what this means for them. For this reason we will ensure that the tactics and tone of messaging we use is appropriate to the situation we are in.

3.4.2. Background Campaign

One of the main challenges the company faces in managing customer expectations around drought risk is the perception that our supply area, particularly Wales, is awash with water. The truth is that water is equally as finite a resource in Wales as anywhere else.

As a responsible water supplier committed to preserving water and promoting water efficiency, the company runs its 'Love Dŵr' campaign throughout the year. The main thrust of the campaign is to encourage customers not to waste water with the strapline being – 'use as much water as you need but please don't waste it.' To achieve the objectives of the campaign, Welsh Water promotes messaging throughout the course of the year which includes:

- A dedicated area of our website with simple hints and tips on ways to save water around the home and garden
- Social media activity to promote water saving techniques for customers
- Films, infographics and animations which promote water efficiency and can be spread through social media and other digital platforms
- Working in partnership with Eco-Schools to promote sustainable water use in schools
- Delivery of water efficiency lessons at our Environment Education Centres across Wales and through lessons delivered by our peripatetic teacher at schools across our whole operating area
- Discounted water butt offers through website and social media competitions
- Use of regional and local media outlets to inform and remind customers about the campaign
- Offering water efficiency audits to identify where we can offer our free repair scheme for leaks on private supply pipes
- Promotion of water efficiency information at national and regional shows and also at local community events

3.4.3. The Communication Strategy

Before describing the means of communication and messaging that will be implemented at each drought stage, the following two points should be noted which are intended to assist in the successful implementation of the DCP.

Regional Flexibility

In developing the DCP, careful consideration has been given to ensuring it can be operated on three levels. On one level it will be possible to implement the DCP across our whole operating area to address a widespread drought. On another level, the DCP has the ability to respond to regional variations in drought conditions. On a third level, it will be flexible enough to operate for a single water resource zone. To achieve the flexibility required we propose that our operating area is split to mirror the geographic areas covered by the relevant regional media. It is proposed therefore that our operating area is split as follows and shown in Figure 14:

- Hereford
- South East Wales
- South West Wales
- North West Wales
- North East Wales
- Mid Wales

Figure 14 - Drought Communication Plan - Regional Communications Areas

Joint working

Our operating area adjoins the operating areas of a small number of other water companies. These include Severn Trent, Hafren Dyfrydwy and United Utilities. We receive bulk-supply imports from Severn Trent Water

mainly into the Ross-on-Wye WRZ (allocation of up to 9 Ml/d in the licence) and a small volume into the South Meirionnydd WRZs. Discussions between our two companies have confirmed that these supplies would remain secure. A summary of all external transfers are shown in Table 12 below. Apart from the transfer to the Ross zone, these are all relatively small potable water supplies. The maximum quantities identified are those that can be provided under drought conditions with agreements in place for the external transfers which guarantees these volumes. The quantities transferred are generally limited by infrastructure constraints and so new asset would be required to increase the maximum volumes. The transfers are all single direction with no ability to reverse the flow.

Export from	Import to	Maximum volume (Ml/d)	Description
Alwen Dee WRZ	Dee Valley Water	0.16	DCWW export a small amount of water to Dee Valley Water in the lower part of the Dee system.
South Meirionnydd WRZ	Severn Trent Water	0.12	DCWW and Severn Trent exchange water across the boundary of South Meirionnydd due to the limited supplies in the area.
Severn Trent Water	South Meirionnydd WRZ	0.45	DCWW and Severn Trent exchange water across the boundary of South Meirionnydd due to the limited supplies in the area.
Severn Trent Water	Ross-on-Wye WRZ	9	DCWW imports all of the water for this WRZ

Note: Elan Builth WRZ exports raw water to Severn Trent Water (up to a maximum of 381 Ml/d). However since this is fully under the control of Severn Trent Water it is excluded from this table.

Table 12 - External Transfers of Water

There are also agreements in place to supply inset appointees which are contracts that could supply commercial or domestic properties. A drought situation affecting our region may well also be affecting an adjoining water company. For this reason, we will ensure we work closely with those adjoining companies.

During the development of our Draft Drought Plan we consulted with both Albion Eco and SSE Water (now Leep Network (Water)) as the only two water New Appointments and Variations (NAVs) within our supply area. We do not have specific agreements with the Retailers operating in our area but within Section 12.9 “Droughts or dry weather conditions (Process E6)” in our ‘Open Water Operational Code’ (Welsh Water, 2017) we state the following:

- DCWW is required to develop and maintain long term drought plans. This process sets out the operational arrangements that DCWW and Retailers will follow in relation to specific drought or dry weather events whose management is not set out in detail in DCWW’s drought plans.
- DCWW and Retailers may agree to follow any industry guidance or other code of practice regarding communications; including with non-household customers, in relation to drought or other dry weather conditions.
- DCWW will inform Retailers when it considers a drought/dry weather condition to be developing/escalating and when DCWW are giving particular consideration to any restriction/ reduction in water services.
- DCWW will confirm to Retailers the process it intends to use to manage the drought or dry weather conditions and any reasonable message DCWW wishes the Retailer to convey to its non-household

customers and DCWW will respond to and consider any question, information or representation which the Retailer makes.

- DCWW expects Retailers, to follow any instructions it gives, for example asking non-household customers to reduce their demand for water.
- If DCWW intends to issue a temporary ban on usage relevant to the Retailer's non-household customer's activities or DCWW intends to seek any drought order or permit, DCWW will consult the Retailer.
- When DCWW issues any ban or obtains an order or permit, DCWW will inform Retailers and keep them informed of any change to terms.
- DCWW will inform Retailers whenever it considers a drought or other dry weather event to be subsiding and when any temporary ban, order or permit has been lifted.

Our unplanned and planned incident process reflects the Good Practice Guide published by the Retailer Wholesaler Group. We are aware that this group will review what good practice looks like in drought / dry weather conditions and will amend our process accordingly in line with any new recommendations.

Joint working will help ensure best practices, along with lessons learnt, are shared between companies which ultimately will assist with the effective management of drought situations. It will also ensure consistency of messaging for customers - conflicting messages could confuse customers at a time when we need them to fully understand the situation.

Joint working might also include:

- Joint press releases
- Specific area on websites of each company dedicated to any joint working
- Joint press conferences
- Joint advertising campaigns
- Joint stakeholder briefings and newsletters.

During a drought, Welsh Water would undertake joint working with Natural Resources Wales and Environment Agency to promote appropriate messaging. As an example of this, during summer 2018, Welsh Water and Natural Resources Wales issued a joint press release urging people to use water wisely to help conserve supplies and also to help protect the environment.

3.4.4. Consultation on implementation of temporary use restrictions

Water companies now have extended powers which will allow them to introduce temporary water use restrictions use without the need for a Drought Order. It should be noted that during the stages of a drought, customers and interested parties will be given the opportunity to make representations prior to any temporary use restrictions being implemented. While a 14 day consultation period will apply, the introduction of any temporary use restrictions is unlikely to come as a total surprise to customers. Our communications techniques will already have raised awareness amongst customers of the severity of the water resource situation.

The company will work to raise awareness amongst customers about its new powers at roadshows and other customer facing events it features in. With regard to the 14 day in-drought consultation period about temporary use restrictions, this opportunity to comment will be widely communicated to customers. This will be done through:

- Customer letter and associated information leaflet
- Notices in local newspapers and via local broadcast media
- Company website
- Company's social media channels

3.4.5. Representations

As discussed above and detailed within the CoP, customers may be granted exemption from TUBs and NEUBs. Customers who meet the criteria for statutory and discretionary universal exceptions can continue to use water without restriction and do not need to make a representation to us.

A clear deadline will be included for representations. Customers will have the option of either emailing or writing in with their representations. We will compile all representations received and present them to the Gold Centre for consideration. The introduction of any temporary use restrictions will be publicised before they are implemented.

With regard to discretionary concessional exceptions, customers will need to make a representation to enable them to continue to use water for the specific purposes laid out in Table 11. These will only be granted to individual users on a case by case basis and on their individual merit via our representation process. Our customers should contact us to seek more information on the imposition of demand restrictions, or request specific exceptions when we advertise that we intend to impose water use restrictions. We would also review whether it is appropriate for us to vary our exception policy in light of representations received. When representations are received we will:

- Log the receipt of the representation and acknowledgement to the customer;
- Review the representation against our policy based upon table 13 and 14 in line with the CoP;
- Representations that meet the criteria of our policy will normally be granted an exception from the restriction: this will be logged and the customer informed of this decision;
- More complex or higher water demand impact representations will be highlighted, logged as such and taken forward for consideration by a review panel; the customer will subsequently be informed of the review decision and reason for this.

Representations may be made in Welsh or English and should be made in writing to either:

Water Use Restriction Exceptions
The Drought Co-Ordinator
Dwr Cymru Welsh
Ty Awen
Spooner Close
Celtic Springs Business Park
Newport
NP10 8FZ

Or via email to **water.resources@dwrcymru.com** citing 'Water Use Restriction Exceptions' in the subject line.

3.4.6. Employee Information Programme

At every stage, all of our employees – both customer facing and those that do not usually deal directly with customers - will be fully briefed to ensure full awareness of any emerging drought situation. It is important that employees are fully briefed as most of them live in the communities which we serve. They can therefore

be advocates for the company in these areas and help disseminate information - particularly linked to saving water techniques. Keeping staff informed will be done through a variety of techniques which will include:

- Colleague intranet
- Internal emails, newsletters
- Text messages to mobile phones
- PC Screen savers
- Welsh Water internal television system
- Chief Executive company-wide conference calls
- Social media

Table 13 below clarifies who our target audiences are. Detail as to the timing and means of distribution of different messages and activities we would take as part of our DCP are contained in Annex 2. The level of activity and tone of messaging is intended to adapt to the different stages of drought and post-drought.

Audience	Constituents
Customers	• Domestic • Business – i.e. caravan parks • Open Water customers (to communicated with via Wholesale Services)

Audience	Constituents
Stakeholders	Statutory • Welsh Government Environment Minister • Welsh Government Drought Liaison Group • Natural Resources Wales • Defra • Environment Agency • Dee Consultative Committee • Ofwat • Consumer Council for Water Wales • Drinking Water Inspectorate • Water UK Non-statutory • Political representatives e.g. MPs, AMs, MEPs, local councillors, community councils • Local Authorities • Public Service Boards • National Park Authorities • Fire Services • Natural England • NFU Cymru / FAW • RSPCA • Neighbouring water companies • Navigation Authorities • Wider interest groups i.e. environmental groups **Other** • Press and Media
Other water users	• Day visitors to area • Holidaymakers
Staff	• Direct employees of Welsh Water • Contractors providing services to Welsh Water

Table 13 - Target audience for drought messaging

A robust evaluation of the management of a drought situation can only be undertaken once drought conditions have subsided. The recovery or potential recovery from a drought will be monitored by the Communications, Water Resources and Water Demand teams. It is imperative that any lifting of drought actions is only taken when there is certainty that water resources have sufficiently recovered. The early lifting of drought actions before the resource situation has fully recovered and issues still persist could be counterproductive and result in reputational damage.

Our Drought Communications Plan has been updated in light of learning from the 2018 drought event. We will undertake a similar post drought review as we encounter future droughts, the high level objectives being to:

- Evaluate effectiveness of information being passed to the Communications team about emergence and development of a drought situation.
- Evaluate the communication tools that worked well / not so well during drought.
- Evaluate the effectiveness of reaching target audiences with key messages.
- Measure success of the DCP in reducing demand, and
- Obtain feedback from customers and stakeholders on the communications methods used and their effectiveness. Will also include measurement of clarity of messages.

To evaluate the effectiveness of the DCP we would:

- Assess any level of reduction seen in water use as drought actions were put in place and compare this against expected normal use for time of year
- Undertake surveys amongst customers living in affected regions - during and post drought - to establish effectiveness of communication techniques / clarity of messaging
- Conduct post drought workshops with statutory and non-statutory stakeholders to canvass views on management of plan and clarity of messaging
- Conduct brand evaluation exercise (either across entire operating area or in regions affected) to assess impact of drought / management of situation on company's brand
- Compare experiences with neighbouring water companies to gauge level joint working proved effective / where modifications could enhance effectiveness of DCP.

3.4.7. Lessons Learnt from the summer 2018

The summer of 2018 was the first year in which our DCP has been put into action. In reviewing the implementation of the DCP and its effectiveness, the following learnings were identified:

- For social media, subtitled video content proves particularly effective in reaching a large proportion of our customer base with water efficiency information.
- Producing regionalised film content and graphics increased the impact of social media activity, particularly when it was targeted to those areas.
- Producing simple infographics and animations helped put the situation into context for customers i.e. an animation to explain how reservoirs work and also an infographic on number of bursts we had identified and repaired, proved effective.
- Importance of adhering to agreed company messaging despite ever increasing media frenzy and also developments elsewhere in UK i.e. when a neighbouring water company announced its intention to introduce a temporary use ban.
- Importance of driving the news agenda and promoting the positive activities we are taking to manage the situation e.g. announcement of number of leaks being repaired, support we were offering to emergency services to tackle forest fires.
- Importance of continuing to promote water efficiency messages even when weather conditions change as likely will take time for reservoirs to recover.
- Need to be clearer on link between using less water and benefits this will have on the environment – both in terms of aquatic life in rivers and also reduced carbon emissions due to our need to treat less water.

3.4.8. Data Exchange

In order for us to accurately monitor and track how a drought event is progressing we rely on a variety of data, as outlined in Section 2. Then majority of data required either comes from our internal data systems or from publicly available data sources, such as the CEH SPI data portal. We have not put in place any formal data exchange agreements between ourselves and Natural Resources Wales and the Environment Agency as we currently feel that the data we need for our management actions is readily available. However, we will discuss further with both organisations to understand if there are benefits to be gained from formalising sharing data agreements. We are always happy to respond to data requests and will provide the required data, in line with legislative constraints, as soon as we are able to.

3.5. Supply side options

The way in which we maximise our water resources is provided in Chapter 2 with the timing of these measures triggered as we moved from normal weather conditions into drought.

Much was learnt during the summer 2018 about our ability to rezone our network through the operation of strategic valves and the use of new connections. These operations were managed through our Silver command centres to ensure that customers' supplies were not impacted as changes were made.

These operations have now been documented and where appropriate, have become part of our dry weather planning options. In addition, we successfully managed the operation of 40 road tankers in our North West supply area this year and this learning has been built into our existing tankering plans.

Annex 1 to this report provides additional detail on these activities within each of our 24 Water Resource Zones and the learning taken from the drought of 2018.

Our 2019 Water Resource Management Plan (WRMP19) sets out how we will ensure that our water supply capability is sufficient over the long term to meet customer demands and the needs of the environment, during the most severe historic droughts. However, as described in Chapter 4, we need to ensure that we are resilient to droughts more extreme than those we have historically experienced. Our analysis suggests there are a number of water resource zones where there is a water resource risk during the most extreme droughts scenarios.

In response, we have identified the options available to us that we would not consider using during everyday operation but may have to turn to in exceptional circumstances.

These schemes fall into two categories:

1. Water sources that we still retain for emergency use, which could be brought back into supply but with considerable effort to maintain good water quality.

2. Options that would need further legal provision to enable us to abstract water e.g. greater levels of abstraction than currently permitted or third party sources not currently used for public water supply for which we would need to obtain drought permits or drought orders from our regulators and/or Government during a drought

Our priority is always to maintain wholesome water supplies to customers, so we will need to take a flexible approach to the timing and use of any standby sources, given that their lack of recent use may affect the water quality they can provide at first. We will ensure that all of the sources that we might potentially use are sampled for water quality ahead of time to assess water quality risk through our Drinking Water Safety Planning process.

In terms of either taking greater quantities of water from our existing sources or retaining more water within our reservoirs by reducing the amount of water leaving them, as required under our abstraction licences, this can only be done through the application for Drought Orders or Drought Permits. The options for these and how we can mitigate any adverse impact on the environment is reported in Chapter 5.

In principle we would plan to use our permitted sources where practicable before turning to supply side options requiring drought permits or drought orders so that we minimise any negative environmental effects. Given the lead times for bringing some supply side options online, temporary use bans may be required in advance of these coming into supply.

Further detail on how we would manage our water supply systems during a drought is provided for each of our twenty four WRZs within Annex 1 to this main report. These describe how each WRZ operates during normal and drought conditions and sets out the options available to us to increase our supply capability.

Table 14 below provides a summary of our drought response actions against drought action zones.

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
Normal	Weekly monitoring of rainfall, reservoir and river levels. Optimise sources to minimise the costs of operations whilst remaining within licence, operation and quality constraints	Daily and weekly monitoring of demand levels including leakage and review of supply/demand situation.	**Use the water that you need but please don't waste it.** General Water Efficiency Campaigns via: • **Company website water efficiency page** • **Social media** • **Press Releases** • **Organised events** • **Education Centres**
Developing Drought	Targeted leakage management. Convene 'Gold incident' command centre. Implementation of dry weather operations to optimise water supply. Liaison in line with Management and Communication Plan	Continuous monitoring of demand levels including leakage and review of supply/demand situation. Implement demand side options: • 'Media Campaigns with Water Efficiency Device Offering' • 'Enhanced Leakage Management'	**Weather has been drier than normal therefore reservoir levels aren't where we would expect them to be for time of year.** **Introducing temporary use restrictions is a last resort. We would like to avoid this so are asking customers to work with us to help conserve water resources.** **Continuation of Normal Activities plus:** • **Website – dedicated web page ready to go live as soon as required** • **Welsh Water spokesperson film clips** • **Targeted social media** • **Press releases - to be issued to relevant media.** • **Paid for adverts - to appear in relevant media** • **Letters to customers** • **Roadshow / local exhibition** • **Face to face meeting with stakeholders**

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
Drought	Continue to optimise current dry weather operational activities to preserve resource. Review feasibility of bringing mothballed sources back in supply. If applicable: Preparation of supply side application for drought order from NRW. Commence baseline environmental monitoring	Continuation of preceding actions. Effectiveness of demand side measures estimated. Preplanning for the implementation of Temporary Use Bans. If applicable: Implement demand side options: • Temporary Use Bans (Saving of up to 5% of demand anticipated).	**Weather has been drier than normal therefore reservoir levels aren't where we would expect them to be for time of year.** **Introducing temporary use restrictions is a last resort. We would like to avoid this so are asking customers to work with us to help conserve water resources.** **We may have to introduce a temporary hosepipe ban as a last resort to help conserve water supplies.** **Continuation of Developing Drought Activities with enhanced messaging plus:** • **Media interview with senior managers** • **Water efficiency lessons** • **Billing call centre recorded messages**
Severe Drought	Continuation of preceding actions. Bring mothballed sources back in supply where feasible. If applicable: Implement supply side options.	Continuation of preceding actions. Implement demand side options: • Temporary Use Bans (Saving of up to 5% of demand anticipated). Preplanning for the implementation of Non Essential Use Bans. Preplanning for the implementation of Emergency Drought Order. If applicable:	**Weather has been drier than normal therefore reservoir levels are exceptionally low for the time of year.** **Temporary use restrictions are in place. We thank customers for observing these and protect water supplies.** **We may have to introduce a non-essential use ban as a last resort to help conserve water supplies.** **We may have to implement alternative water supply options under drought permit/order.**

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
		Implement demand side options: • Non Essential Use Bans (Saving of up to 10% of demand anticipated). • Emergency Drought Order (Saving of up to 17.5% of demand anticipated)	**Continuation of Drought Activities with enhanced messaging, details below:** • **Website – dedicated web page ready to go live as soon as required** • **Welsh Water spokesperson film clips** • **Targeted social media** • **Press releases - to be issued to relevant media.** • **Paid for adverts - to appear in relevant media** • **Letters to customers** • **Roadshow / local exhibition** • **Media interview with senior managers** • **Water efficiency lessons** • **Billing call centre recorded messages** • **Face to face meeting with stakeholders**
Emergency Measures	Customers Other water users	Emergency measure activities will be fully coordinated with external party activities through the Drought Liaison Group and Local Resilience Forum's as needed. Radio / TV advertising / bill board notices – these can be tailored to relevant areas or be applicable to the entire operating area. Website – as above Social media activity – including social media site advertising	**Despite ours and our customer's best efforts, water resources have continued to fall** **They have now reached levels where it is impossible to maintain a regular supply to customers therefore emergency measures need to be implemented** **This could include the use of standpipes and timed cuts to water supplies or widespread pressure management whilst fully taking into account the potential impact on water quality within specific areas of our water supply network**

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
		Welsh Water spokesperson film clips – will be broadcast on company website and through social media channels Letters to customers – where a water resource issue is relevant to a confined area in our operating area, letters will be issued advising of this and asking customers to help conserve water by using it wisely. Press Releases – as above and with appropriate messaging (see next column) Media interviews with senior managers – as above Paid for adverts – as above and with appropriate messaging (See next column) Presence at organised events e.g. Royal Welsh Agricultural Show, National Eisteddfod Water efficiency roadshows at shopping centres etc. Billing call centre messages / recorded messages	**This is a last resort however is essential to ensure there is enough water to protect public health** **We are ensuring that provisions are being made for people registered with additional needs**

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
	Stakeholders	Regular face to face briefings set up across impacted geographical areas – to follow same format as above Direct Mailing – as above Social media activity	**Despite ours and our customer's best efforts, water resources have continued to fall** **They have now reached levels where it is impossible to maintain a regular supply to customers therefore emergency measures need to be implemented** **This will include the use of standpipes and timed cuts to water supplies or pressure management** **This is a last resort however is essential to ensure there is enough water to protect public health** **We are ensuring that provisions are being made for people registered with additional needs.**
End of Drought	Customers Other water users	Website update Social media activity – including social media site advertising Welsh Water spokesperson film clips – will be broadcast on company website and through social media channels Letters to customers - in areas where a water restriction been in place.	**By working together during exceptionally challenging weather conditions, able to announce that the area is now out of drought conditions.** **Therefore able to lift temporary restrictions which have been put in place.** **Would like to thank customers for their cooperation during the drought and appreciate the inconvenience that they have faced.** **Although area is out of drought, remind everyone of the need to always use water wisely to ensure supplies have time to fully recover.**

Drought Action Zone	Supply Side Actions	Demand Side Actions	Communications Key Messages
		Press Releases – as above and with appropriate messaging (see next column) Media interviews with senior managers – as above Billing call centre messages / recorded messages	**Also reminder always important for everyone to be considerate of not wasting water at any time of the year.** **Advise that a review of the drought is being undertaken (details below) and that findings and any recommendations will be made available for inspection (within a defined period of time).**
	Stakeholders	Face to face briefings Direct Mailing Social media activity	**By working together during exceptionally challenging weather conditions, able to announce that the area is now out of drought conditions.** **Therefore able to lift temporary restrictions which have been put in place.** **Advise we are undertaking full review of the drought (details below) to identify cause and any recommendations to mitigate risk in future.** **Findings will be available (within defined period of time) and happy to offer full briefing at convenient time.** **Are grateful to customers for their cooperation during the drought and appreciate the inconvenience that they have faced.** **Although area is out of drought, remind everyone of the need to always use water wisely to ensure supplies have time to fully recover.** **Also reminder always important for everyone to be considerate of not wasting water at any time of the year.**

Table 14 - Drought action sequence of events

4. Understanding our Drought Risk

Chapter 2 has described how we will know when we are in a drought and how we assess the effects of this upon our water resource position. Chapter 3 then sets out the actions that we can and will take to ensure that we meet our customer's expectations in dealing with a drought period. Further to this we need to test our plan to confirm our level of drought risk and to ensure that the actions available are sufficient. This Chapter describes the overall process for understanding our drought risk and summarises at a high level the results of our drought scenario testing. Annex 1, to this report details the drought risk within each specific water resource zone and shows the results of plan testing.

4.1.Background

Within our Water Resources Management Plan we set out our long term plans for maintaining customer's supply during a drought event. Our previous plans have been tested against historic events whereby, we have demonstrated that our systems and responses are resilient to 'worst historic' droughts.

For Wales this is generally the 1976 drought where large parts of south east Wales saw severe disruption to their supplies via the implementation of rota cuts to ration the water available. We have now been able to estimate that the 1976 event has a return period of the order of a 1:100-1:150, that is to say that this event is only likely to occur at this frequency. This infers that our water supply systems can cope with droughts of at least this order of magnitude with drought management actions in place. For many zones we know that are resilient to worse droughts, we were unable to say how much more.

The view from Government is that our systems should be resilient to at least a 1:200 drought event before we take extreme measures are taken to manage demand. The National Infrastructure Commission for England's "*Preparing for a drier future: England's water infrastructure needs*" report[13] suggest that water company systems should be resilient to at least a 1:500 drought event, given the economic cost from significant disruption. Government needs to consider the findings of this report and whether further work specifically for Wales should be undertaken

It is clear however, that we should understand the level of drought severity that could impact our customers and the likelihood or frequency at which we might impose customer restrictions on their water use.

4.2. Drought Vulnerability Assessment

In order to answer the question on the level of drought resilience we can provide to our customers, we have undertaken drought vulnerability assessments for all of our WRZs, in accordance with the Drought Vulnerability Framework (DVF) guidance that was jointly published by Natural Resources Wales (NRW) and the Environment Agency (EA) in 2017.

This drought analysis work is relatively complex but the results are extremely useful and can be conveyed in reasonably simple terms. The concepts behind the DVF are fully described in the 2017 guidance report, but essentially it is an evaluation process that seeks to identify the level of drought risk that is faced by a WRZ across a range of drought scenarios of varying durations and severities. The DVF is a risk based approach with the initial phase of the assessment to screen out zones of low risk.

[13] https://www.nic.org.uk/publications/preparing-for-a-drier-future-englands-water-infrastructure-needs/

4.2.1. WRZ Risk screening

As set out in our 2019 Water Resources Management Plan (WRMP19), the majority of WRZs are forecast to have a healthy supply/demand surplus throughout the planning period 2020 to 2050.

Alongside this, an initial assessment of drought resilience undertaken for the WRMP19 demonstrated that there are a number of WRZs where there is no risk of a failure of the emergency storage provision occurring under any statistically plausible drought events. The DVF manual contains some general guidance on identifying those WRZs where DRS analysis should be applied. We have discussed the reasons for not undertaking this work for some zones with NRW and gained their agreement to adopt this 'risk based' approach.

Following this confirmation from NRW, an initial screening process has been applied to all our WRZs. The exclusions have been based on the following two criteria:

- For WRZs where the Deployable Output (DO) varies according to drought severity (i.e. they are hydrologically vulnerable), the amount of 'surplus' from the WRMP19 supply demand balance has been compared against the calculated value for Target Headroom. Target Headroom is a planning allowance that is used to account for uncertainties in the calculation of our supply demand balance forecasts. For those WRZs where the amount of 'surplus' in the zone is more than twice our Target Headroom allowance, then the WRMP19 resilience analysis was reviewed to determine the level of estimated resilience risk for that WRZ. If this was found to be high, i.e. beyond a 1:200 return period, then the WRZ was excluded from requiring a full DRS assessment, unless specific concerns warranted further investigation.

- For WRZs where the sources are not drought vulnerable then these were excluded provided there are no significant 'unknowns' or concerns about the nature of those resources. As an example, in our Llyswen WRZ we are licensed to abstract up to 5 Ml/d from the River Wye, with demands generally around 4 Ml/d. The nearest gauging station to our abstraction at Llyswen is the River Wye at Erwood. In 2018, data from NRW shows that lowest flows fell to at this station were 80 Ml/d and so there are no realistic drought scenarios where we would see a shortage of rainfall that would cause this to fall below 5 Ml/d. Hence the Llyswen WRZ has been screened out as low risk and so doesn't require a DRS assessment.

The results of the screening process are provided in Table 15 below. WRZs that were definitely screened out of the analysis have been colour coded in green, and WRZs where a detailed drought risk assessment was required are colour coded in red. WRZs where there is some risk and so a simpler drought risk assessment method was required are coloured in yellow.

WRZ	Outcome of Screening	Comments
NEYM	Full assessment required	Although the supply demand balance is in surplus there were concerns about the resilience of our mainland reservoirs.
Tywyn Aberdyfi	Full assessment required	Higher risk WRZ which is forecast in WRMP19 to have a supply demand shortfall.
Clwyd Coastal	Medium assessment required	Although the supply demand balance is in surplus, there are concerns about the drought risk at some of our reservoir sources.
Alwen Dee	Medium assessment required	The supply demand balance shows a relatively small surplus but the water resource position is considered to be robust.
Bala	No assessment required	The supply demand balance shows a relatively large surplus and so there is no risk of emergency storage breach under plausible drought scenarios.

WRZ	Outcome of Screening	Comments
Blaenau Ffestiniog	No assessment required	Drought resilience testing for WRMP19 indicates minimal risk and the WRZ has a relatively large supply demand surplus.
Barmouth	Full assessment required	Drought resilience testing for WRMP19 indicated some risk and there were some concerns raised during the 2018 drought.
Lleyn Harlech	Full assessment required	Although the supply demand balance shows a healthy surplus, some risk was indicated in the resilience testing for WRMP19, and there were some concerns raised during the 2018 drought.
Dyffryn Conwy	No assessment required	The supply demand balance shows a relatively large surplus and so there is no risk of emergency storage breach under plausible drought scenarios.
South Meirionnydd	No assessment required	WRMP19 drought resilience testing indicates there is no risk of emergency storage breach under plausible drought scenarios.
Elan Builth	No assessment required	Although drought can affect the Elan Valley system, this affects the main supply to Severn Trent, and there is no risk to our abstraction. For the Builth abstraction, there is no plausible drought scenario under which flows in the River Wye would fall below the abstraction licence.
Hereford CUS	No assessment required	No plausible drought scenario under which flows in the River Wye would fall below the abstraction licence.
Llyswen	No assessment required	No plausible drought scenario under which flows in the River Wye would fall below the abstraction licence.
Monmouth	No assessment required	No plausible drought scenario under which flows in the River Wye would fall below the abstraction licence.
Brecon Portis	No assessment required	No plausible drought scenario where Usk reservoir could not meet the required abstraction at Portis or provide enough regulation water to support our abstraction at Brecon.
Ross on Wye	No assessment required	The risk entirely depends on the Severn Trent bulk supply, which is from the River Wye and so not drought vulnerable.
Pilleth	No assessment required	Relatively large supply demand surplus and no evidence of drought risk in the WRZ.
Vowchurch	Full assessment required	The WRMP19 resilience testing indicated there are large uncertainties, primarily because the highest risk occurs during events such as 2003 when dry periods extend into September/October.
Whitbourne	No assessment required	No plausible drought scenario under which flows in the River Teme would fall below the abstraction licence.
SEWCUS	Full assessment required	Higher risk WRZ with a relatively small supply demand balance surplus.
Tywi CUS	Full assessment required	The risk is fairly marginal given the level of supply demand surplus in the WRZ, with possible failures at return periods > 1 in 500 when demand is equal to DO.
Mid & South Ceredigion	Medium assessment required	The WRMP19 resilience testing showed that, even where the demand is set to equal DO, it is unlikely that there would be any deficit unless extremely high drought return periods are tested.
North Ceredigion	No assessment required	Relatively large supply demand surplus so a simpler risk assessment method is appropriate.
Pembroke-shire	Full assessment required	Higher risk WRZ with a supply demand balance deficit identified in WRMP19.

Table 15 - Results of the DRS Screening Exercise

4.3.Drought scenario testing

For the zones that have not been identified as low risk we have used water supply system simulation models to look at the performance of the system under more severe drought events to those seen in our historic record. Our models reflect current operational constraints of our systems such as pumping and treatment capabilities, abstraction licence conditions, reservoir storage capacities, etc.

We have run simulations that use anticipated demand in a dry year with river flow and reservoir hydrology time series varied to simulate the operation of our current water supply systems if the historic weather patterns were experienced again.

We have used statistical techniques to produce hydrological records that still reflect the climatic conditions of the 20th Century but include more extreme events than we have seen recently. Using sampling techniques, we have generated 'Drought Libraries' that contain numerous drought events of known duration and severity with which we can test the response of our supply systems through our models.

The model output has been assessed in in two ways. We have initially run key drought years of known severity through our models to gain a detailed understanding of the response of resources within a zone to various types of drought, this is 'Scenario Testing'.

For zones where scenario testing has shown that there is a zonal risk to sever drought or worse then, we have analysed our systems response to the full drought library to provide a more complete picture of the types of drought that our systems are sensitive to. These are plotted as 'Drought Response Surfaces' (DRS) and are described in the next section of the report. The results of scenario testing and DRS analysis where undertaken are provided in Annex 1 for individual zones.

Figure 15 below, shows an example of our scenario testing for the Tywi Gower Water Resource Zone. We have plotted the estimated system response if the hydrology of 1975/76 and 1995/96 were to be repeated. This shows that we would expect our Tywi Gower zone to almost meet the developing drought trigger but we would not have to impose drought measures.

However, when tested against stochastically generated inflows, a 1:200 year drought (a drought with a 0.5% chance of occurring) may require Drought measures, whereas a 1:500 year type of drought certainly would with reservoir levels approaching Emergency Storage. This indicates that the zone maintains a good level of resilience up to around a 1:500 year event. This analysis is relatively new and some caution must be taken so that results are not oversimplified. This is a good indicative result which in this case adds confidence that the Tywi Gower zone is resilient to droughts certainly beyond 1:200 and possibly to events of the order of 1:500. Going forward we will continue to build on the work undertaken for this Plan.

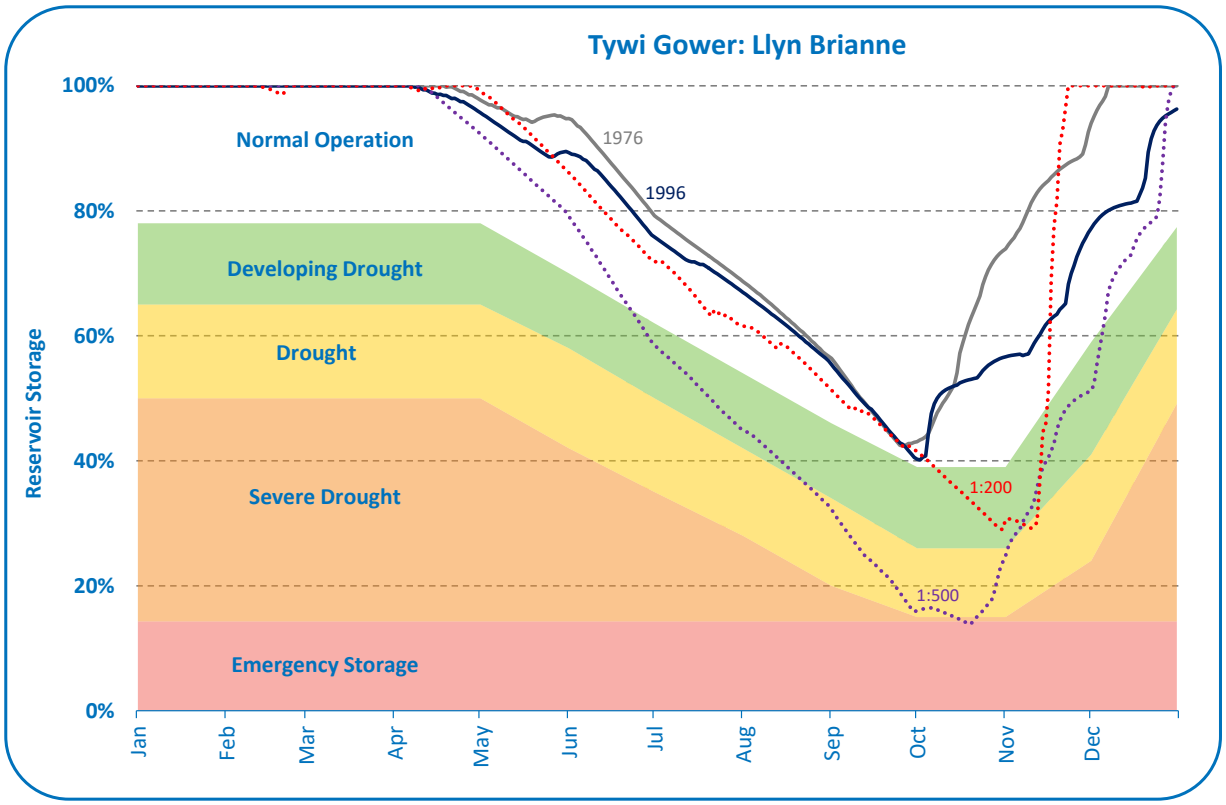


Figure 15 - Llyn Brianne Reservoir Drought Action Zones showing the results of scenario testing

4.4.Drought Response Surfaces

Each scenario, as described above, is an estimate of our water supply system response to a specific combination of drought duration and level of rainfall compared to the long term average. Of particular importance to Government is our system's performance to the most extreme droughts and new targets have been set to ensure that water supplies are resilient to droughts that might be expected one in every 200 years or 0.5% likelihood. For zones where there is a risk of not achieving this, we have undertaken further work to understand the types of drought that are cause for concern and the likelihood that our systems may fail to meet this target.

We have defined a failure in our models as the point at which we can no longer meet the demands of our customers without the imposition of extreme demand management measures. This is the point on our reservoir drought control charts at which only 'Emergency Storage' is available to us, a position that we would never want to reach as this is an unacceptable risk to our customers. The extent of failure is how long we would remain in this position of relying on 'Emergency Storage'.

The water industry has developed a standard way to show this information called a Drought Response Surface (DRS) chart. This collates the output of the assessment and helps in communicating the findings.

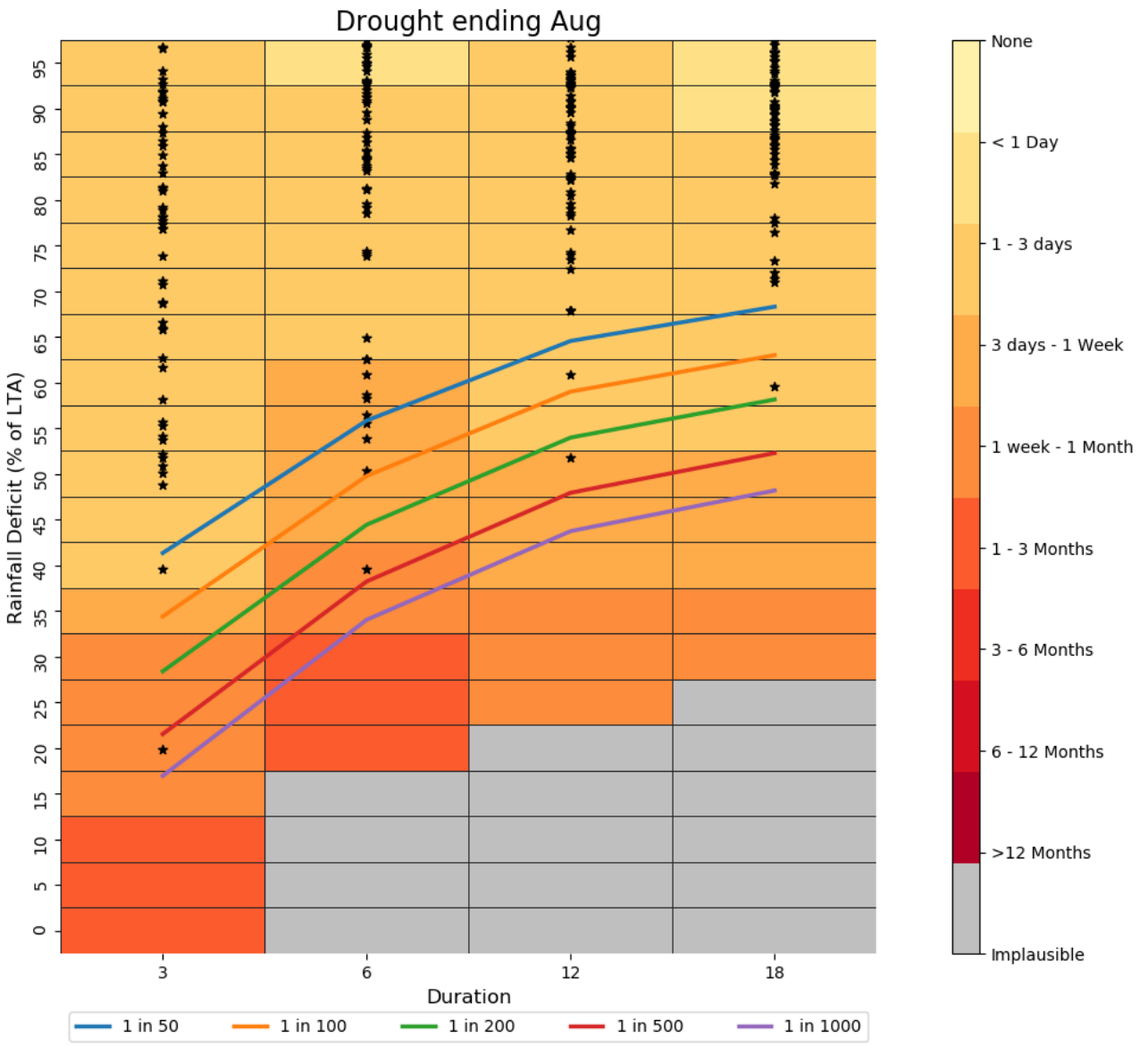


Figure 16 - Example Drought Response Surface chart for the Vowchurch WRZ

A drought response surface (Figure 16) is a visual presentation of the sensitivity of a Water Resource Zone to a range of droughts. Each drought is expressed in terms of rainfall deficit as a measure of drought severity (defined as the percentage of Long Term Average Rainfall), and shown on the y-axis, and the duration of the drought assessed in 6 monthly intervals on the x-axis of the chart. Two types of information are then overlaid:

(1) The system response within each water resource zone for a given combination of rainfall deficit and drought duration. The system response is represented as a shaded cell, with the shading indicating the number of days that reservoir stocks are likely to be within the 'emergency storage' Drought Action Zone for each type of drought event. This metric is analogous to the number of days that widespread pressure management and local water rationing options are likely to be required, and hence conveys the risk of customer impact for a given event.

(2) The likelihood of a drought for each combination of rainfall deficit and drought duration. The likelihood is visually represented as a series of stacked lines, each one showing a given return period of a type of drought event. As the deficit and duration increase, the likelihood of the event decreases; combinations of deficit and duration which are considered statistically implausible are greyed out and the system response to these sorts of events hasn't been assessed.

Plotting this information then shows the system response to the drought return period which is the sensitivity of a Water Resource Zone to certain types of drought i.e. the drought intensity that the zone is more sensitive to, ranging from short (6 month, single season), intense droughts, to long (60 month, multi-year) droughts. Furthermore, for each type of drought, the DRS shows return period of that particular event hence enabling us to estimate the level of resilience that the zone has.

4.5.Results

Table 16 below provides a high level summary of the estimated risk for each WRZ of needing to implement customer water use restrictions and utilising any drought permit or drought order schemes. The return periods are not exact but are based on the results of our drought risk analysis, we have tried to interpret these into a 'simple' figure to present a high level view. Further detail on the zonal drought risk is provided in Annex 1.

WRZ	Temporary Use Ban – 'Drought' Action Zone	Non Essential Use Ban/Drought Permit/Drought Order – 'Severe Drought' Action Zone	Extreme Measures – 'Emergency Storage' Action Zone
North Eryri Ynys Mon	Around 1:200	Around 1:200 to 1:500	>1:500
Clwyd Coastal	<1:200	Around 1:200 to 1:500	Around 1:500
Alwen Dee	Around 1:200	Around 1:500	>1:500
Bala	>1:500	>1:500	>1:500
Tywyn Aberdyfi (without planned WRMP19 scheme)	<1:20	<1:40	<1:50
Tywyn Aberdyfi (with planned WRMP19 scheme)	Around 1:200	Around 1:200 to 1:500	Around 1:500
Blaenau Ffestiniog	Around 1:200	Around 1:200 to 1:500	>1:500
Barmouth (As now connected to Lleyn Harlech)**	<1:200	Around 1:200	Around 1:200 to 1:500
Lleyn Harlech (As now connected to Barmouth)**	<1:200	Around 1:200	Around 1:200 to 1:500
Dyffryn Conwy	<1:200	Around 1:200 to 1:500	>1:500
South Meirionydd	Around 1:200	Around 1:200 to 1:500	>1:500
Ross on Wye	N/A*	N/A*	>1:500
Elan Builth	N/A*	N/A*	>1:500
Hereford	N/A*	N/A*	>1:500
Llyswen	N/A*	N/A*	>1:500

WRZ	Temporary Use Ban – 'Drought' Action Zone	Non Essential Use Ban/Drought Permit/Drought Order – 'Severe Drought' Action Zone	Extreme Measures – 'Emergency Storage' Action Zone
Monmouth	N/A*	N/A*	>1:500
Pilleth	N/A*	N/A*	>1:200
Brecon Portis	N/A	N/A*	>1:500
Vowchurch (without planned WRMP19 scheme)	N/A*	N/A*	<1:100
Vowchurch (with planned WRMP19 scheme)	N/A*	N/A*	Around 1:500
Whitbourne	N/A*	N/A*	>1:200
SEWCUS	Around 1:200	Around 1:200 to 1:500	Around 1:500
Tywi CUS	Around 1:200	Around 1:200 to 1:500	Around 1:500
Mid & South Ceredigion	Around 1:200	Around 1:200 to 1:500	Around 1:500
North Ceredigion	Around 1:200	Around 1:200 to 1:500	Around 1:500
Pembrokeshire (without planned WRMP19 scheme)	<1:100	<1:100	<1:100
Pembrokeshire (with planned WRMP19 scheme)	Around 1:200	Around 1:200 to 1:500	Around 1:500

*The WRZ has sufficient water resource and the trigger for action is on levels of demand. We are only likely to impose TUBs and NEUBs in line with actions in the wider region, principally the SEWCUS zone.
**This high level of resilience is based on the temporary schemes from the 2018 drought being made permanent and the two zones are joined together.

Table 16 - Summary results of the Drought Vulnerability Assessment for all 24 WRZs

Although these results indicate a high level of drought resilience, especially against the need for implementation of extreme supply side measures such as widespread pressure management or water rationing, we need to be mindful of the processes behind the generation of these results and the inherent uncertainties contained within them. These results provide a 'high level' view of a zones' resilience and we can use them to indicate where actions may need to be taken earlier in some zones when compared to others. The key areas of uncertainty to note within this process are:

1) Water resource models – We currently utilise the software package WRAPSIM to simulate the performance of our water supply systems under a range of historical drought events. We are in the process of moving across to the AQUATOR modelling platform which will allow us to greatly improve the representation of our water resource zones and their behaviour during extreme droughts. Going forward we will use these new models to repeat the analysis undertaken for this Plan which will help us to refine the assessment of drought resilience.

2) The modelling undertaken for this Plan has assumed that a number of temporary schemes installed during the summer of 2018 to improve the connectivity within and between our zones, will be made permanent.

In our PR19 submission to Ofwat we have requested £15 million to allow us to deliver these and so the levels of drought resilience presented here, particularly for the North Eryri Ynys Mon, Lleyn Harlech and Barmouth zones, will be much lower if these schemes are not completed.

3) We are using industry leading techniques in order to generate these more extreme drought events that we are testing our systems against. Whilst the science underpinning this approach is robust, it is still quite a leap to make in turning a 40 year data record into a 10,000 year data record. We therefore need to appreciate that the margin of error on these results is potentially quite large and that quoting resilience to a "1:500" year drought event could mean that in reality, we are resilient to between a 1:250 and 1:750 year drought event.

This uncertainty is highlighted in Figure 17 below which shows the simulated drawdown in our Llyn Aled/Aled Isaf reservoirs in the Clwyd Coastal zone, under a range of droughts that vary between a 1:100 and 1:5,000 year return period. It can be seen that the lowest simulated drawdown occurs under the 1:500 year scenario and not the 1:5,000 year scenario. The droughts simulated are of the same duration and timing i.e. they are 6 month events that begin in May and end in October, and the total rainfall deficit for the period corresponds to the return period for the total event, but it is the pattern of rainfall within those 6 month events that is very different and which has produced the variations in drawdown. This illustrates the caution that is needed when interpreting the results and assigning a 'level of resilience' to a particular zone.

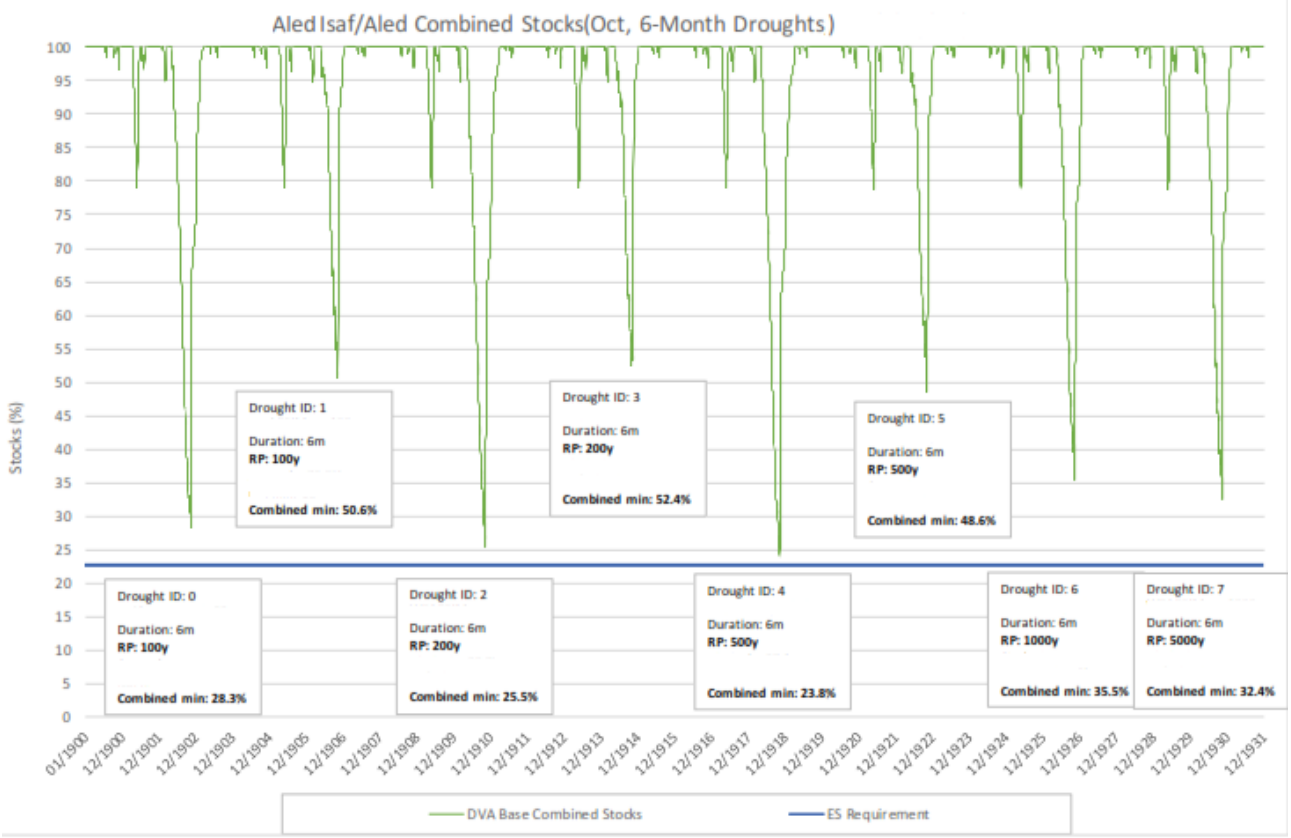


Figure 17 - Outputs of drought scenario testing

Overall then our current drought resilience is high with there being very little chance of us needing to implement standpipes and rota cuts to ration customer supplies. As shown in Figure 18 we have identified three zones (Pembrokeshire, Vowchurch, Tywyn Aberdyfi) where we would need to implement extreme supply side measures during drought events less severe than a 1:200 return period drought event. However, once our planned capital schemes are delivered in AMP7 then we will be resilient in these zones to drought return period events greater than a 1:500.

To better understand this risk we undertook climate change analysis utilising both a baseline (2019) analysis and a 2030 position within our drought vulnerability assessment. Climate change is excluded from the baseline scenario so that the expected impact in the 2030 scenario can be clearly seen. Climate change was included in the drought vulnerability assessment through the following approach:

- The percentage deficit bands in the Drought Response Surface (DRS) charts still represent the deficit from the 1961-1990 baseline period.
- The return period estimates of each deficit/duration band were adjusted according to climate change - i.e. where climate change reduces rainfall for a given duration, then the return period of a given deficit becomes smaller than in the baseline assessment. For example, for a 12-month duration a 40% rainfall deficit may have a return period of 1 in 100 years in the baseline, but under climate change this could reduce to a 1 in 50 event, so would lie on the 1 in 50 line for the 2030 DRS.
- The climate change scenario was based on the 50th percentile UKCP09 projections or Future Flows scenario from the WRMP19 climate change assessment i.e. it reflects the central estimate of climate change.

We are mindful that the effects of climate change will lessen our drought resilience and this is borne out by the results of drought scenario testing shown in Figure 19 whereby an additional three zones (North Eryri Ynys Mon, Clwyd Coastal and Tywi Gower) may require extreme supply side measures under a 1:200 year drought event, once the effects of climate change are taken into account. This means that we will potentially need to invest in the future to maintain our current level of resilience, as the impacts of Climate Change develop.

The advanced statistical approaches we have used for this testing are very new to the industry and further analysis of the data we have undertaken outside of this Plan indicates there is some uncertainty that we should be mindful of.

For those WRZs that are showing a risk of very low reservoir levels/river flows as a result of testing against these more severe droughts, then we have retained a number of environmental supply side options to guard against the risk of interruption to customer supplies should our systems respond differently than we would currently expect.

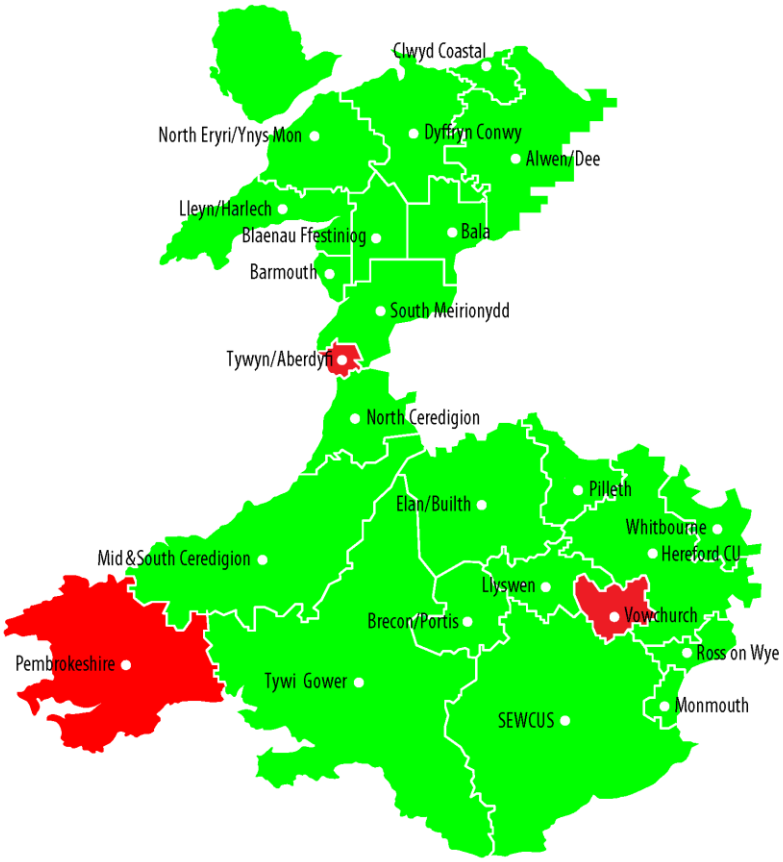


Figure 18 - Results of 1:200 drought scenario testing

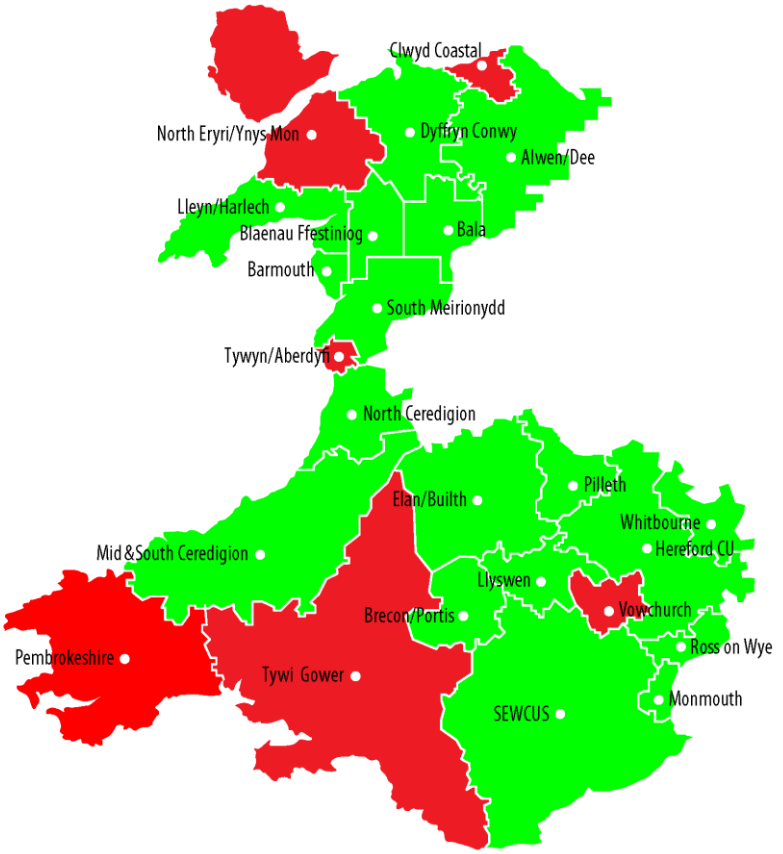


Figure 19 - Results of 1:200 drought scenario testing with climate change at 2030

5. Environmental monitoring and assessment

As described in Chapter 4, we have looked at options that we have available under severe drought conditions where we may have to take more water from the environment than we are normally permitted. Given the potential impact that this might have on the environment we would only do this once all the other Drought Plan options to both increase our existing supplies and to manage demand downwards have been exhausted.

For good reasons, the process by which we obtain this additional water is tightly controlled by legislation and enforced by our environmental regulators, Natural Resources Wales (NRW) and the Environment Agency (EA), with a formal process that we have to follow. Using the drought indicators defined in Chapter 2, we have to firstly confirm that our need for extra water is due to the effects of drought and not through any sub-optimal use of our existing supplies. Once this is confirmed, we will then submit either a Drought Permit application to NRW or the EA or a Drought Order application for the more ecologically sensitive sites, to Welsh Government or Defra.

This Chapter describes how we have generated options to take additional water from the environment during a drought. It also outlines the assessment work that we undertake to support our applications to our regulators and/or Government.

5.1.Legal Background

If our supply side options require us to operate outside of our standard abstraction licence conditions we will have to apply to NRW/EA and/or the Welsh Government/Defra for either a drought permit or drought order as appropriate.

In accordance with the requirements of Natural Resources Wales' 'Water Company Drought Plan Technical Guideline 2017' ('NRW DPG'), we have fully assessed the potential environmental impact of these options. The assessments take account of environmental legislation such as the Conservation of Habitats and Species Regulation 2017, Wildlife and Countryside Act 1981 & Countryside and Rights of Way Act 2000, Water Framework Directive, Habitats Directive and the Environmental Assessment of Plans and Programmes (Wales) Regulations 2004. In order to comply with these requirements we have produced the following environmental assessments to support our Drought Plan submission:

- Strategic Environmental Assessment of the Drought Plan
- Habitats Regulations Assessment of the Drought Plan
- Environmental Assessment Reports (incorporating Environmental Monitoring Plans)

5.1.1. Other Permissions

Through our environmental assessments we have identified those drought options where additional permissions, other than a drought permit/drought order, are required to enable their implementation. These additional permissions include those that allow us to:

1) Gain access to the site/waterbody in order to undertake any necessary construction works and to operate the drought scheme

2) Undertake the necessary environmental monitoring pre, during and post drought option implementation

3) Implement any required mitigation measures that offset the identified environmental impacts from use of the drought option.

Table 17 below provides a high level overview of the sites where additional permissions are required to allow us to implement our drought options. The vast majority of these are 'standard' consents and we are fully aware of the process involved to obtain these from NRW. We would begin discussions in good time with NRW, likely as we move into the 'Developing Drought' action zone, to work towards obtaining these ahead of our drought status moving in to the 'Severe Drought' action zone.

WRZ	Option	Monitoring	Mitigation	Access
North Eryri/Ynys Mon	8001-2 (Llyn Cwellyn)	X		
	8001-3 (Llyn Alaw)	X	X	
	8001-4 (Ffynnon Llugwy)	X	X	
	8001-5 (Llyn Cefni)	X	X	
Clwyd Coastal	8012-2 (Aled Isaf)	X	X	
	8012-4 (Afon Aled)	X	X	
	8012-5 (Llannerch)	X	X	
	8012-6 (Aled Isaf to Llyn Aled)	X	X	
Tywyn/Aberdyfi	8021-1 (Afon Dysynni)	X		X
Barmouth	8033-2 (Llyn Bodlyn)	X		
Lleyn/Harlech	8034-1 (Afon Dwyfor)	X		
SEWCUS	8109-1 (Llwynon)	X	X	
	8112-1 (Afon Rhondda Fawr)	X	X	X
	8116-3 (Talybont)	X		
	8119-1 (Pontsticill)	X	X	
Tywi C.U. Area	8201-3 (Nantgaredig)	X	X	
Mid & South Ceredigion	8202-1 (Llechryd)	X		
North Ceredigion	8203-2 (Nantymoch)	X		X
Pembrokeshire	8206-1 (Crowhill)	X	X	
	8206-2 (Preseli)	X	X	
	8206-7 (Llys y Fran)	X		
	8206-8 (Canaston)	X	X	

Table 17: Summary of permissions required for each drought option

The individual option tables (Appendix G forms) in Section 1.5 of the relevant WRZ summaries (Annex 1) as well as the Environmental Assessment Reports (Appendices 5 to 24), include more information on the permissions required in points 2 and 3 above. To gain the necessary permissions required in point 1 above, we have identified the following:

Flood Risk Activity Permit (FRAP)

We would need to apply to NRW for a FRAP for options 8021-1 (Afon Dysynni) and option 8112-1 (Afon Rhondda Fawr) as these schemes involve the construction of a temporary river intake to enable us to abstract water. We have applied for FRAP's at other schemes within Welsh Water and our experience is that these are generally turned around fairly quickly by NRW within a number of weeks but acknowledge that it could be longer and so we would ensure that we apply in good time during a developing drought situation.

Land Access Permissions

For option 8201-1 (Afon Dysynni) we will need land access to the river frontage. Our preferred access point is at the NRW depot at Pont y Garth. We have held informal discussions with NRW previously in relation to this which have been positive and so post the finalisation of this Drought Plan we will look to firm up on these to ensure our scheme is deliverable.

For option 8112-1 (Afon Rhondda Fawr) we have provisionally identified an access point to the river within the vicinity downstream of the NRW river level station at Ty Newydd. We have not progressed further in understanding whether there are any permissions required as we have not finalised our preferred location but initially chose this point owing to its proximity to a footpath that leads to the river, which should mean public access is available.

Commercial Agreement

In order to abstract water from the Nantymoch hydroelectric power reservoir (Option 8203-2) we would need to put in place a commercial agreement with its owner Statkraft. We have previously held discussions with the reservoir owners but do not have formal arrangements in place to date. We will seek these following the publication of our Final Plan.

5.2.Environmental Supply Side Options

5.2.1. Updates since 2015 Drought Plan

Since publication of our 2015 Drought Plan, we have undertaken further work to better understand the level of drought risk across all our WRZs and confirm the potential need for any drought permits/drought orders. We have continued to work through and produce updated Environmental Assessment Reports (EARs) and have presented these to NRW and EA for review. The feedback on these EARs has helped to identify those options that could have the most ecological impact were they to be implemented during a drought. In this Plan we have therefore tried to remove the most damaging, particularly those that had the potential to affect internationally designated sites such as Special Areas of Conservation (SAC). There are some exceptions in those zones where our investigations have identified a significant drought risk and there are no feasible alternative options available.

Figure 20 shows the screening process undertaken to move from the list of environmental supply side options that were in the 2015 Drought Plan to those that are included in this Drought Plan.

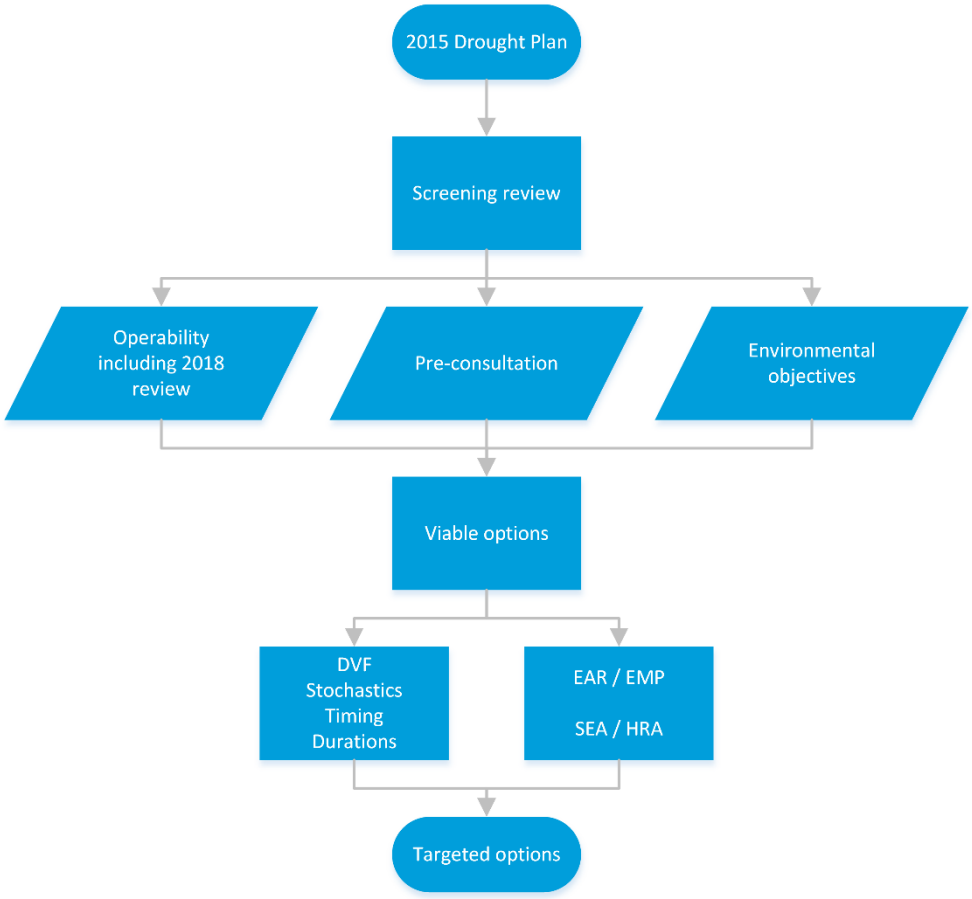


Figure 20 - Screening process to generate Drought Plan 2020 options

5.2.2. Results of Options Screening

Starting with our list of environmental supply side schemes that were in our 2015 Drought Plan, we have followed the screening process outlined in Figure 20. For those WRZs where the results of our scenario testing and drought risk assessment have indicated low risk, and we have high confidence in these results, we have generally removed all our drought permit/order options. We have also removed the majority of our options that would potentially impact an environmentally sensitive site, such as a SAC as we know our Drought Order applications for these options are unlikely to be granted without recourse to a public inquiry and likely need to demonstrate "Imperative Reasons of Overriding Public Interest".

There are some exceptions such as our Pembrokeshire zone, where we know that until our WRMP19 scheme is delivered in AMP 7, we are running an unacceptably high drought risk and so we have retained a number of options to provide us with the reassurance that additional water is available if needed. However, we acknowledge these schemes may impact upon the designated environmental features of the Cleddau Rivers SAC and so we have agreed to work with NRW to understand the findings of our environmental assessments and identify suitable mitigation and compensation measures that should be put in place.

Our experiences of managing our supplies through the drought of 2018 have provided valuable insight into the viability of a number of options that were included in our 2015 Plan. Long lead times and/or concerns over the water quality that we would be able to provide to our customers has meant that a number of options are no longer regarded as viable as a short term drought measure. Table 18 lists the options that have been removed from the Drought Permit/Drought Order process whilst Table 19 lists those that have been retained.

WRZ	Option	Reason for removal
North Eryri Ynys Mon	Transfer of water from Marchlyn Mawr (the Dinorwig System) to Marchlyn Bach	Raw water quality concerns
North Eryri Ynys Mon	Abstraction from Llyn Cwellyn below the pump intake level	Option is environmentally impactful and not a viable scheme within a short timeframe.
Clwyd Coastal	Transfer water from Llyn Bran to Afon Aled	Raw water quality and cross catchment transfer concerns
Clwyd Coastal	Pump water from Llyn Aled 'dead' storage	Drought Permit not required.
Alwen Dee	Cutback in compensation release from Alwen Reservoir	Covered under Dee Regulations.
Alwen Dee	Utilisation of Llwyn Isaf with temporary WTW	Not viable scheme within a short timeframe.
Alwen Dee	Bretton Pumpback	Drought Permit not required.
Alwen Dee	Reinstate Llyn Bran with temporary WTW	Not viable scheme within a short timeframe.
Bala	Transfer of water from Llyn Conwy system (Dyffryn Conwy WRZ)	No drought risk
Tywyn Aberdyfi	Relaxation of annual licences on the Afon Fathew and the Nant Braich Y Rhiw	Concern is peak daily demands not annual licence volume.
Lleyn Harlech	Pumped abstraction of dead storage from Llyn Morwynion and increase annual abstraction licence to fully utilise Emergency Storage Volume	Option is environmentally impactful.
Barmouth	Pumped abstraction of dead storage from Llyn Bodlyn	Option is environmentally impactful.
Lleyn Harlech	Reduce compensation flow releases from Llyn Cwmystradllyn	An environmentally better alternative option is available.
Lleyn Harlech	Extension of the syphon arrangement to exploit the dead storage in Llyn Tecwyn	Drought permit not required.
Dyffryn Conwy	Increase the daily and/or annual abstraction licences from Llyn Cowlyd	Sufficient resource in Llyn Cowlyd within existing licence.
South Meirionydd	Increased abstraction from Llyn Cynwch Penycefn WTW to support tankering to outlying source areas	Enough capacity within existing licence to support tankering.
Ross on Wye	Exchange of spare Wye Regulation water to Severn Trent Water's Lydbrook abstraction point	WRZ not licence constrained during a drought.
Hereford CUS	Increase the abstraction at Broomy Hill by 3 Ml/d	WRZ not licence constrained during a drought.
Hereford CUS	Increase the abstraction at Leintwardine by 0.1 Ml/d	WRZ not licence constrained during a drought.
Hereford	Reinstate mothballed Byton (River Lugg)	WRZ not licence constrained during a drought and not a viable scheme within a short timeframe.
Llyswen	Increase the abstraction at Llyswen	WRZ not licence constrained during a drought.
Pilleth	Increase the authorised Pilleth abstraction	WRZ not licence constrained during a drought.

WRZ	Option	Reason for removal
Brecon Portis	Maintain/implement a reduced Usk compensation discharge of 5.7Ml/d and relax the requirement to ensure the average compensation discharge of 9Ml/d for the year.	Option is environmentally impactful and WRZ has high drought resilience.
Brecon Portis	Reinstate mothballed Trinant Stream intake	WRZ has high drought resilience.
Brecon Portis	Reinstate mothballed Usk at Brecon	WRZ has high drought resilience and not a viable scheme within a short timeframe.
Vowchurch	Removal of flow condition on the River Dore	WRZ not licence constrained during a drought.
Whitbourne	Removal of flow condition on the River Teme	WRZ not licence constrained during a drought.
SEWCUS	Further reduction in Talybont compensation water release and reduction of residual flow condition on Nant Clydach	Option is environmentally impactful and WRZ has high drought resilience
SEWCUS	Reduction in the Cwmtillery Reservoir compensation water release	Option provides insufficient yield during a drought and WRZ has high drought resilience.
SEWCUS	Unsupported abstractions from the River Usk at Prioress Mill	Option is environmentally impactful and WRZ has high drought resilience.
SEWCUS	Unsupported abstractions from the River Wye at Monmouth	Option is environmentally impactful and WRZ has high drought resilience.
SEWCUS	Use Grwyne Reservoir, as a regulating reservoir, to support abstraction at Prioress Mill or Llantrisant	Option is environmentally impactful and WRZ has high drought resilience.
SEWCUS	Reduce the compensation water releases from the Elan Reservoirs	Option is environmentally impactful and WRZ has high drought resilience.
SEWCUS	Utilise Grwyne Reservoir for direct supply	Scheme not viable within short duration of a drought.
SEWCUS	Compensation water reduction of 50% at Lower Carno Reservoir	Option provides insufficient yield during a drought and WRZ has high drought resilience.
SEWCUS	Reinstate mothballed Rogerstone Grange	Scheme not viable within short duration of a drought.
SEWCUS	Emergency abstraction from the Afon Lwyd at New Inn	Option may be environmentally impactful in its current form. Work is continuing to look at the sustainable abstraction from the Lwyd.
Tywi Gower	Reduce Ystradfellte compensation flow by 50%	Option is environmentally impactful and WRZ has high drought resilience.
Tywi Gower	Reinstate mothballed Llygad Llwchwr	Scheme not viable within short duration of a drought.
Tywi Gower	Reinstate mothballed Parkmill	Scheme not viable within short duration of a drought.

WRZ	Option	Reason for removal
Tywi CUS	Reduce Brianne compensation flow by 50% - Winter refill only	Option as currently defined does not provide water in a drought so further work required to revise the option post Final Plan.
Tywi CUS	Reduce Crai compensation flow by 50%	Option may be environmentally impactful and WRZ has high drought resilience.
Mid & South Ceredigion	Increase the Teifi Pools annual abstraction licence to fully utilise the Emergency Storage volume	If needed we would apply for a time limited licence variation at the time.
North Ceredigion	Increase the annual abstraction quantity from Llyn Llygad Rheidol	Licence change already in place.
North Ceredigion	Reduce the compensation release from Llyn Craig Y Pistyll by 50%	Option provides insufficient yield during a drought and WRZ has high drought resilience.
Pembrokeshire	Increase the direct abstraction from Llys-y-fran reservoir and remove the 59.1 Ml/d regulation requirement and the section 158 restrictions, if applicable	A permanent scheme to increase the abstraction is being delivered.
Pembrokeshire	Reduce the prescribed flow required at the Pont Hywel abstraction	Option is environmentally impactful and provides insufficient yield during a drought.
Pembrokeshire	Abstraction from the Afon Taf	Scheme not viable within short duration of a drought.
Pembrokeshire	Reinstate mothballed Middle Mill	Scheme not viable within short duration of a drought.

Table 18 - Options removed for this Drought Plan

This significant reduction in the number of Drought Permits/Orders will materially reduce the overall environmental effect of our Drought Plan across our supply area, including effects on various environmentally-sensitive river systems within international and/or nationally important conservation areas.

For the Drought Permits/ Orders included in our Plan, we closely examined the environmental effects, taking account of the different life-cycle stages of relevant aquatic plants and animals through the calendar year, to see whether we could reduce the duration and/or period of the year during which each Drought Permit/Order may be required. Where feasible, we then sought to avoid those months where the environmental effects of each Drought Permit/Order would be greatest. We also considered what mitigation measures would be needed to address the identified environmental effects for the remaining months when each Drought Permit/Order may be required. We adopted the same assessment approach for the new Drought Permits/Orders that are included in this Plan.

Following our updated assessment of drought resilience risks for each of our Water Resources Zones, we have also been able to reduce the risk of requiring the implementation of Drought Permits/Orders, helping to reduce the frequency of any temporary adverse effects on the environment.

By reducing the implementation frequency and duration of Drought Permits/Orders and optimising the time of year for their implementation as far as possible, we have been able to reduce the overall environmental effects of the Drought Plan. Further details of the improvements made to our environmental assessments and the benefits these have for our Drought Permit/Drought Order options are provided in Annex 3.

WRZ	Scheme	Reason for retention
Clwyd Coastal	Reduction of the regulation release from Aled Isaf	Drought scenarios indicate we could cross into Severe Drought
Clwyd Coastal	Relaxation of the annual licences on Afon Aled and the Plas Uchaf and Dolwen Reservoirs	Drought scenarios indicate we could cross into Severe Drought
Clwyd Coastal	Relaxation of the Llannerch boreholes annual licence	Drought scenarios indicate we could cross into Severe Drought
Clwyd Coastal	Pumped (winter) refill from Aled Isaf to Llyn Aled	Drought scenarios indicate we could cross into Severe Drought
Tywi CUS	Relax the maintained requirement below the Nantgaredig intake on the River Tywi.	Drought scenarios indicate close to crossing Severe Drought
Tywi CUS	Reinstate mothballed Schwyll Well	Drought scenarios indicate close to crossing Severe Drought
Mid & South Ceredigion	Increase the Llechryd abstraction from 19 Ml/d to 21 Ml/d and obtain variation of annual licence amounts	Summer 2018 highlighted some drought risk so this option retained
Mid & South Ceredigion	Reinstate mothballed Aeron Borehole	Summer 2018 highlighted some drought risk so this option retained
North Ceredigion	Pumped abstraction from Nantymoch (a HEP reservoir operated by Statkraft) into the raw water main between Llyn Llygad Rheidol Reservoir and Bontgoch WTW	Summer 2018 highlighted some drought risk so this option retained
NEYM	Removal of Llyn Cwellyn 10 Ml/d abstraction limit	Although low drought risk for the zone, some local resilience risk identified
NEYM	Reduction of Alaw compensation water	Although low drought risk for the zone, some local resilience risk identified
NEYM	Reduction of Ffynnon Llugwy compensation water	Although low drought risk for the zone, some local resilience risk identified
NEYM	Reduction of Cefni reservoir compensation water	Although low drought risk for the zone, some local resilience risk identified
NEYM	Reinstate mothballed Afon Rhythallt	Although low drought risk for the zone, some local resilience risk identified
Barmouth	Reduce compensation water releases from Llyn Bodlyn	Summer 2018 highlighted some drought risk so this option retained
Lleyn Harlech	Reduce regulation releases from Llyn Cwmystradllyn	Drought scenarios indicate we could cross into Severe Drought
Pembs	Reduce the Compensation release from Preseli Reservoir by 50%	DRS indicates significant drought risk until the WRMP19 scheme is delivered.
Pembs	Use of Llys y Fran freshet bank for public water supply	DRS indicates significant drought risk until the WRMP19 scheme is delivered.

WRZ	Scheme	Reason for retention
Pembs	Reinstate Milton Boreholes	DRS indicates significant drought risk until the WRMP19 scheme is delivered.
Pembs	Reduce the required prescribe flow below the Crowhill abstraction	DRS indicates significant drought risk until the WRMP19 scheme is delivered.
Pembs	Canaston 50% reduction in "hands off flow"	DRS indicates significant drought risk until the WRMP19 scheme is delivered.
SEWCUS	Emergency abstraction from the River Rhondda at Treherbert	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Utilise the dead storage in Talybont Reservoir	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Reduce compensation water releases from Llwynon Reservoir	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Compensation water reduction of 50% at Pontsticill Reservoir	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Reinstate mothballed Grwyne Fawr	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Reinstate mothballed Wentwood	Although low drought risk for the zone, some local resilience risk identified
SEWCUS	Reinstate mothballed Pant yr Eos and Ynys Fro	Although low drought risk for the zone, some local resilience risk identified
Tywyn Aberdyfi	Tankering raw water from Dysynni	DRS indicates significant drought risk until the WRMP19 scheme is delivered.

Table 19 - Options retained for this Drought Plan

5.2.3. Mothballed Sources

Within Table 19 we have identified seven raw water sources (Afon Rhythallt, Schwyll well, Aeron borehole, Milton boreholes, Grwyne Fawr reservoir, Wentwood reservoir, Pant yr Eos and Ynys y Fro reservoirs) that have not been operational for a number of years but which have been retained in good condition such that they could be utilised within a relatively short timeframe in order to provide us with additional water resource during a drought. To confirm there is no environmental impact from the use of these sources during a drought, primarily driven by the risk of 'deterioration' to water body status as defined by the Water Framework Directive, we will undertake environmental assessments to identify any potential risk. We will produce a programme for completing this work early in AMP7, setting out the level of assessment required and how we will address any potential 'in combination' environmental effects where these mothballed sources have to ability to operate in conjunction with either other mothballed sources or a drought permit/drought order scheme, thus compounding the environmental impact. As we have existing environmental knowledge on all of these schemes we initially anticipated that the assessments would be completed by the end of the first year of AMP7 i.e. March 2021, however it would be prudent to expect this

work to be delivered later into AMP7 given the current difficulties we have in undertaking site visits and getting this work delivered.

5.3. Drought Options Environmental Assessment

5.3.1. Introduction

To minimise any potential impact upon the environment, for each option listed in Table 19 we produce an Environmental Assessment Report (EAR) which provides an independent and robust assessment of the potential environmental effects of implementation.

During a drought when river flows are low and temperatures are high, the environment will already be under some level of stress. Our assessment is designed to determine the environmental impacts of the drought permit/drought order over and above any effects arising from natural drought conditions. Our assessments also look at the potential to mitigate the effects of the drought permit or drought order.

5.3.2. Environmental Assessment Reports

To fully assess the potential effects of our options, each EAR includes assessment of the following:

- the likely changes in river flow / water level regime due to implementing the proposed Drought Permit/Order option
- identification of the environmental features that are sensitive to these changes and the likely impacts on these features
- how the option may affect the environment in combination with the effects of existing abstraction licences, environmental permits and other relevant activities and plans.
- identification of mitigation measures that may be required to prevent or reduce impacts on sensitive features
- recommendations for baseline, in-drought and post-Drought Permit/Order monitoring requirements

Consideration within the EAR is also given to the potential impacts of Drought Permit/Order implementation on the features of statutory sites designated for their nature conservation importance. They include Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest, as well as sites identified under the Ramsar Convention.

Given the sensitivity of the environment during a drought, the assessments are precautionary. Having said that, the EARs can only produce a prediction of likely impacts; any definitive impacts will only become known when we are actually in a drought and are implementing drought orders or permits.

The EARs utilise all available data and follow best practice assessment methodologies to produce a current view of the likely impact at the time of implementation. Where the EAR concludes that an option is likely to impact upon a feature, we identify or have already identified, effective mitigation measures so that they can be put in place as quickly as possible. Examples of mitigation measures might include temporary physical in-river works such as channel narrowing, or the provision of refuge areas to help species to survive. Where mitigation measures are not possible, we will, in consultation with our regulators, provide compensatory measures for the environmental impact for example, re-stocking of fish in a river where the population has been affected by implementation of a Drought Permit/Order option.

The EARs are supported by Environmental Monitoring Plans (EMPs) which include details of the hydrology, water quality and ecological parameters required to be surveyed during the three stages of implementation of our drought permit/drought order options, namely:

- pre-Drought Permit/Order monitoring will assess the environmental conditions prior to implementation. This will inform the predicted impact from the option and any mitigation actions that may be required.
- in-Drought Permit/Order monitoring will assess the environmental conditions during the implementation of the drought option. Monitoring of sensitive habitats and features will provide early warnings of any unpredicted environmental impacts and ensure that mitigation actions are operating as designed.
- post-Drought Permit/Order monitoring will assess the recovery of any impacted environmental features following the cessation of our drought option. This will help identify whether any affected features have recovered to their pre-Drought Permit/Order option levels.

5.4.Improvements since Drought Plan 2015

We have continued to revise and update our EARs since the publication of our 2015 Drought Plan, taking on board the comments received from both NRW and the EA. To further improve the assessment of the options we have retained, we utilised the outputs of the Drought Vulnerability Framework to better understand the likely timing of scheme implementation given the seasonal life-cycle of the ecology present in our rivers and lakes. We have previously assumed that the option could be in operation at any time in the year. However, upon review of our water resource performance, as described for each zone in Annex 1, this is highly unlikely to be the case and so we have refined our assessment accordingly.

To illustrate the above, Figure 21 shows the simulated reservoir drawdown performance of Llyn Bodlyn against the various droughts generated in the 'Drought Library' stochastic time series for our Barmouth water resource zone. The orange line in the plot represents our 'Severe Drought' trigger line which is the point at which we would implement the option to reduce the Llyn Bodlyn compensation water release to the downstream Afon Ysgethin. It can be seen that there are a number of drought events in this record that cross the Severe Drought control line and so we have analysed the timing of these to understand when the reduced compensation flow is likely to occur. Figure 22 and Figure 23 provide two examples of these drought events in more detail which show exactly when reservoir storage crosses into the 'Severe Drought' action zone.

The timings from all the drought events in Figure 21 (three in total) that cross the Severe Drought line are presented in Table 20 alongside the features of interest that are present within the Afon Ysgethin. It can be seen for example, that the likely timing of implementation of the Drought Order to reduce the compensation water at Llyn Bodlyn would only affect the upstream Salmon and River Lamprey migration rather than downstream migration. This allows us to better target our monitoring and mitigation measures in order to understand any impacts and to mitigate against them at the time of implementation. The EARs produced for this Plan therefore presents a much more 'targeted' assessment than those in our 2015 Plan.

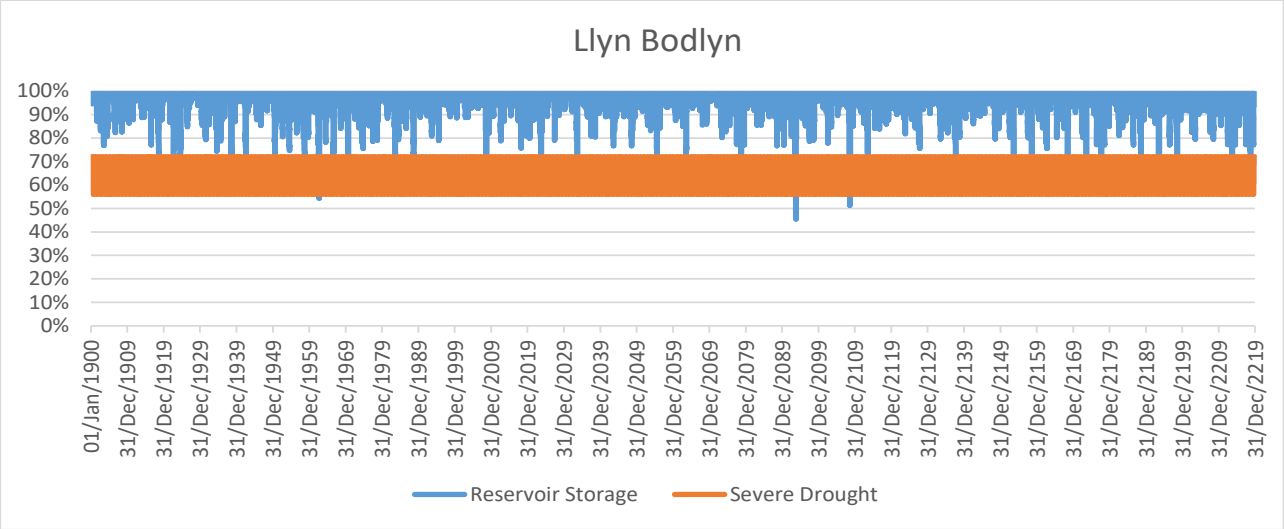


Figure 21 - Llyn Bodlyn simulated storage under the stochastic time series

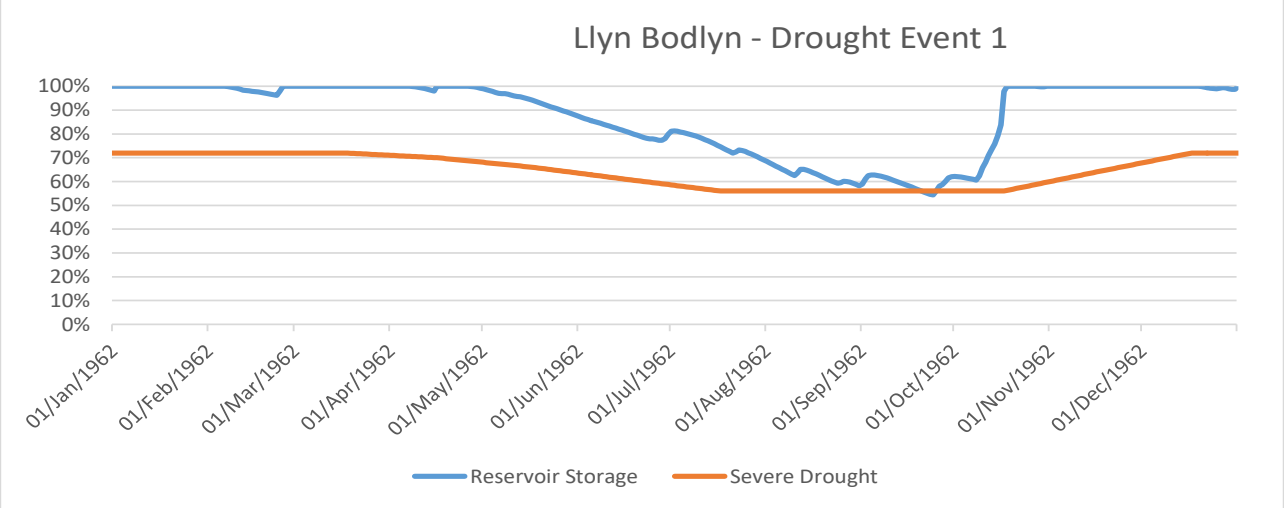


Figure 22 - Detailed view of Llyn Bodlyn Severe Drought failure 1

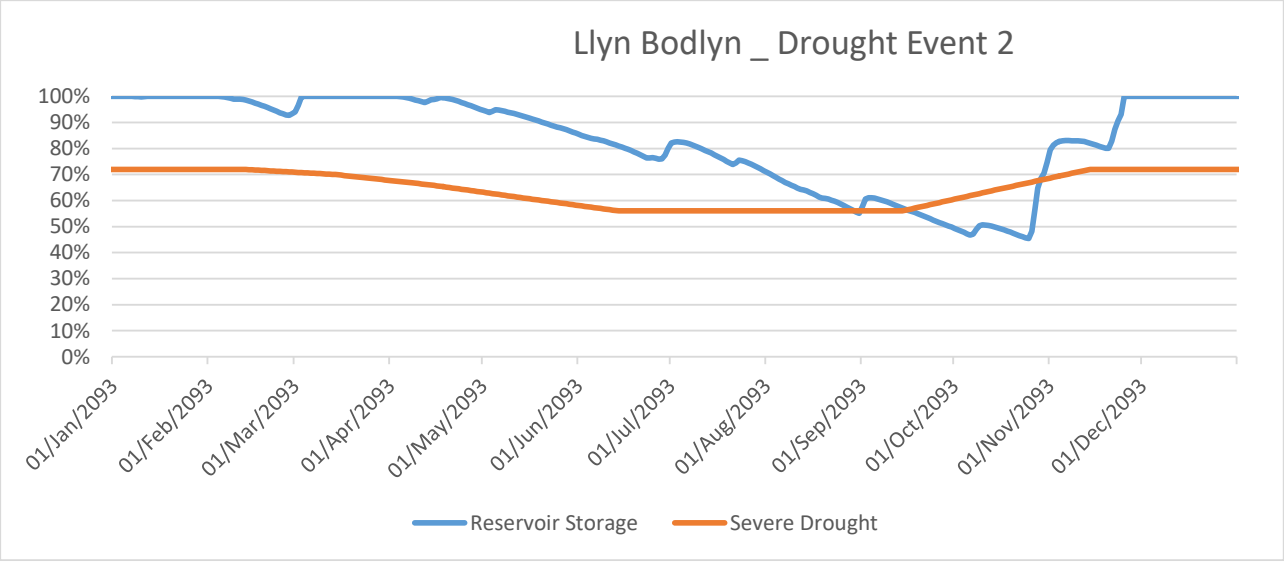


Figure 23 - Detailed view of Llyn Bodlyn Severe Drought failure 2

	EAR Risk	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Atlantic Salmon	Minor							Upstream migration					
Atlantic Salmon	Major	Downstream migration											
Atlantic salmon	Moderate	Year round juvenile habitat											
River lamprey	Minor				Downstream migration								
River/sea/brook lamprey	Major	Year round juvenile habitat											
Sea trout	Moderate				Upstream migration								
Sea trout	Moderate	Downstream migration											
Brown/Sea trout	Major	Year round juvenile habitat											
European Eel – other life stages	Negligible												
European Eel	Moderate						Downstream migration						
Phytobenthos	Minor	Communities											
Macroinvertebrates	Moderate												
Macrophytes	Moderate												
Bryophytes	Minor												
Drought Event 1							21/09 – 26/09						
Drought Event 2							16/09 – 29/10						
Drought Event 3						09/08 – 24/08							

Table 20 - Overlay of Severe Drought failures against environmentally sensitive features for the Afon Ysgethin

5.5.Timescales for our Drought Permit and Order Options

The outputs of the Environmental Assessment Reports indicate if an option is likely to impact upon the environment. Using this information and the available guidance[14] on applying for drought orders and drought permits, we have tried to estimate the time it may take for each of our applications to be determined, following the submission to either Natural Resources Wales/Environment Agency and/or Welsh Government/Defra. Understanding this timeline allows us to ensure that our drought triggers are set correctly to provide sufficient time to obtain the drought order/drought permit, before we cross in to the 'Severe Drought' action zone.

Figure 24 summarises our current understanding of the process and estimated associated timescales from the point at which we submit a drought permit/drought order application to the point at which it is determined. The flowchart essentially shows two key variables that influence the timescales:

1) Applying for a Drought Order involves a much longer timescale for a decision to be made.

2) If objections on an application are received, prompting the need for a public inquiry, this can add considerable delay to the process.

Table 21 shows that for the majority of our options, which either require a Drought Order or have been shown to have a 'Major' environmental impact and thus are likely to be objected to, the estimated timescales for the granting of these is at the longer end and could be around 35 days. The exact timings of a Public Inquiry are unknown but could conceivably mean the time taken to determine an application is longer than the assumed 35 days.

We will use the consultation process on this Drought Plan to work with NRW and EA to gain a better understanding of the timescales involved in determining a drought permit/drought order application and will revise our estimates accordingly. This potentially longer determination timescale means that in some zones we may have to revise our drought triggers so that applications are submitted as we are approaching the 'Drought' Action zone rather than when we are in it, as we currently assume.

[14] https://naturalresources.wales/permits-and-permissions/water-abstraction-and-impoundment/drought-permits-and-drought-orders/?lang=en

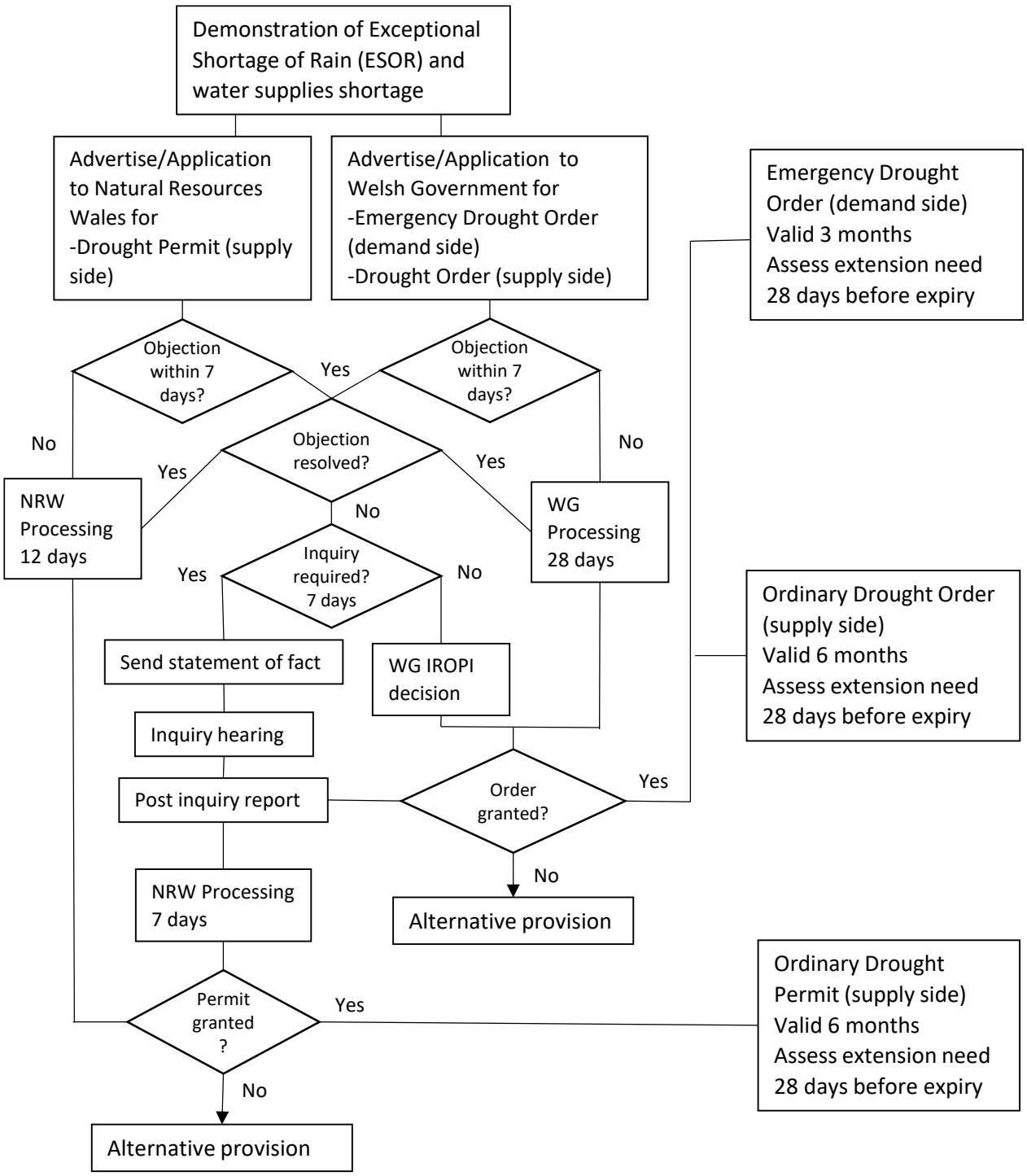


Figure 24 - Summary flowchart of the drought permit/drought order application process

WRZ	Drought Option	Hydrological Impact	Environmental Sensitivity	Permission Required	Indicative Timescale to implementation
North Eryri/Ynys Mon	8001-2 Removal of Llyn Cwellyn 10 Ml/d abstraction limit	Negligible	n/a	Drought Order	35 days
	8001-3 Reduction of Alaw Compensation water	Major	Minor to Major	Drought Permit	19 days
	8001-4 Reduction of Ffynnon Llugwy Compensation water	Moderate to Major	Moderate to Major	Drought Permit	35 days
	8001-5 Reduction of Cefni reservoir Compensation water	Major	Moderate to Major	Drought Permit	35 days
Clwyd Coastal	8012-2 Reduction of the compensation release from Aled Isaf and modification of the Hands Off Flow value at Bryn Aled	Moderate	Minor	Drought Permit	19 days
	8012-4 Relaxation of the annual licences on Afon Aled and the Plas Uchaf and Dolwen Reservoirs	Minor to Major	Moderate	Drought Permit	19 days
	8012-5 Relaxation of the Llannerch boreholes annual licence	Negligible to Moderate	Minor to Moderate	Drought Permit	19 days
	8012-6 Pumped (winter) refill from Aled Isaf to Llyn Aled	Moderate to Minor	Minor to Moderate	Drought Permit	19 days
Tywyn/Aberdyfi	8021-1 New abstraction (tankering) from Afon Dysynni (to Pen Y Bont WTW)	Negligible	n/a	Drought Permit	19 days
Barmouth	8033-2 Reduce compensation water releases from Llyn Bodlyn	Major to Moderate	Major to Minor	Drought Order	35 days
Lleyn/Harlech	8034-1 Reduce regulation releases in Dwyfor	Negligible	n/a	Drought Permit	19 days
SEWCUS	8109-1 Reduce compensation flow from Llwynon	Major	Major to Minor	Drought Permit	19 days

WRZ	Drought Option	Hydrological Impact	Environmental Sensitivity	Permission Required	Indicative Timescale to implementation
	8112-1 Emergency river abstraction on the Afon Rhondda Fawr at Treherbert	Major	Major	Drought Permit	35 days
	8116-3 Pump dead storage water from Talybont reservoir	Minor	Negligible	Drought Order	35 days
	8119-1 Reduction in compensation release from Pontsticill reservoir	Major	Major	Drought Permit	35 days
Tywi C.U. Area	8201-3 Remove the maintained requirement below the Nantgaredig intake on the River Tywi	Negligible to Minor	Minor	Drought Order	35 days
Mid & South Ceredigion	8202-1 Increase the Llechryd abstraction from 19 Ml/d to 21 Ml/d and obtain variation of annual licence amounts	Negligible	n/a	Drought Order	35 days
North Ceredigion	8203-2 Pumped abstraction from Nantymoch (a HEP reservoir) into the raw water main between Llyn Llygad Rheidol Reservoir and Bontgoch WTW	Negligible	n/a	Drought Permit	19 days
Pembrokeshire	8206-1 Reduce the required prescribed flow below the Crowhill Abstraction	Moderate	Minor to Major	Drought Order	35 days
	8206-2 Reduce the Compensation release from Preseli Reservoir by 50%	Major	Major	Drought Order	35 days
	8206-7 Llys y Fran Reservoir freshet	Negligible	n/a	Drought Order	35 days
	8206-8 Relax Canaston Hands-off flow	Major to Moderate	Major	Drought Order	35 days

Table 21 - Summary of EAR outputs and estimation of application timeframe

5.6.Strategic Environmental Assessment

One of the key mechanisms we have to ensure that our Drought Plan does not unnecessarily impact upon the environment during its implementation, is to undertake a thorough and robust Strategic Environmental Assessment (SEA) to identify any risks ahead of time. SEA became a requirement following the adoption of the European Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment. The Directive has been brought into national law by the Environmental Assessment of Plans and Programmes (Wales) Regulations 2004 and The Environmental Assessment of Plans and Programmes Regulations 2004 in Wales and England respectively.

The objective of the SEA Directive is:

"to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development…".

Throughout the course of the development of this Plan, the aim of the SEA has been to identify any potential impacts from the options we have proposed in terms of their environmental, economic and social effects. If any adverse effects are identified, these options can then either be rejected or modified to manage or mitigate adverse effects.

5.6.1. Applying SEA to Drought Plans

The SEA Directive requires "an environmental assessment … of certain plans and programmes which are likely to have significant effects on the environment" (Article 1). Plans and programmes are defined as those:

- "which are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government; and
- which are required by legislative, regulatory or administrative provisions" (Article 2(a)).

The Welsh Government guiding principles for a Drought Plan state that those responsible for preparing drought plans should carry out a SEA as part of the range of assessments required to inform their development.

Unlike plans such as transport or land use where there is the expectation that they will be implemented during their lifetime, the various measures put forward in a drought plan may never be actioned as there may not be drought conditions that would trigger the measures. As the timing, severity, duration, frequency and location of any drought that may occur during a plan's lifetime is not known, we cannot predict with certainty the measures that may need to be deployed in practice and, in turn, their effects on the environment. However, it is possible to assess the likely significant effects of the use of such measures should they be required. It should also be noted that the assessment considers the effects of the measures themselves, not the natural effects of the drought, which forms the baseline environment for the purposes of the assessment.

The outputs from the SEA of this revised draft Drought Plan are:

- to ensure that the likely significant potential environmental effects associated with the revised draft Drought Plan are identified, characterised and assessed;
- to help identify appropriate measures to avoid, reduce or mitigate adverse effects and to enhance beneficial effects associated with the implementation of the revised draft Drought Plan wherever possible;
- to provide a framework for monitoring the potential significant effects arising from the implementation of the revised draft Drought Plan measures;
- to give the statutory consultees, stakeholders and the wider public the opportunity to review and comment upon the effects that the revised draft Drought Plan may have on them, their communities and their interests, and to encourage and support them to make responses and suggest improvements to the draft Drought Plan;
- to demonstrate that the revised draft Drought Plan has been developed in a manner consistent with the requirements of the SEA Regulations; and
- to help inform Welsh Water's decisions on the final form of the Drought Plan.

5.7.Habitats Regulations Assessment

To complement our SEA, the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations') requires that competent authorities assess the potential impacts of plans and programmes on the Natura 2000 network of European protected sites to determine whether there will be any 'likely significant effects' on any European site as a result of the plan's implementation (either on its own or 'in combination' with other plans or projects); and, if so, whether these effects will result in any adverse effects on the site's integrity. The process by which the impacts of a plan or programme are assessed against the conservation objectives of a European site is known as Habitats Regulations Assessment (HRA).

We are aware that the 2017 regulations will be amended in a number of respects in the event of the UK leaving the European Union, but the requirement to undertake a HRA will continue.

Welsh Government and NRW guidance states that those responsible for preparing the drought plan "must ensure that the drought plan meets the requirements of the Conservation of Habitats and Species Regulations 2017, and must undertake a HRA on the effects of your plan on European sites, alone or in combination with other plans or projects (e.g. the effects of drought management actions on European sites)".

For each potential drought management measure, the HRA has considered whether there are any likely significant effects arising from construction or implementation activities and/or operation of the measure on one or more designated sites, including Special Protection Areas, Special Areas of Conservation and Ramsar sites (designated under international law to protect birds and their habitats). The HRA of our revised draft Drought Plan essentially follows four stages:

- A screening process is undertaken to identify whether each drought management action in this Drought Plan (either alone or in combination with other plans or projects) is likely to have any significant effects on designated sites.
- Where a likely significant effect cannot be ruled out (noting the precautionary principle), an Appropriate Assessment has been undertaken of the drought management action to determine whether this would adversely affect the integrity of the designated site(s), either alone or in combination with other plans and projects, taking into account available specific mitigation measures.

- Where adverse effects could not be ruled out at the Appropriate Assessment stage, alternative options have been examined to identify whether it is possible to avoid any potential significant effects on the integrity of the designated site.
- An assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest, and consideration of compensation measures it has been concluded that the Welsh Ministers should be asked to decide whether the Plan should proceed.

5.8.Scoping Consultation

To support the production of the SEA and HRA we issued two Scoping Reports to statutory consultees for a five week consultation period between 5th November and 7th December 2018.

Responses were received to the consultation from the following organisations:

- Natural Resources Wales
- Environment Agency
- Cadw

A meeting was held on 3rd December 2018 in support of the consultation, with all statutory consultees invited. It was attended by Natural Resources Wales and the Environment Agency. Feedback was received from NRW, Cadw and EA and their comments were integrated in the final Scoping reports issued in December 2018.

The SEA Environmental Report and the HRA Report were published for consultation in parallel with the draft Drought Plan to support its submission.

5.9.Environmental Assessment Updates Post Consultation

Natural Resources Wales have raised concerns that there are a number of our Drought Order options where our environmental assessments have been unable to conclude 'no adverse effect' upon the features of European Protected sites. Under the Habitats Directive this means that our Drought Plan as it currently stands cannot be finalised and given approval by Welsh Government to be published. The following sections set out how we have addressed this within our revised draft Drought Plan.

5.9.1. Drought Order options that have not concluded 'No Adverse Effect'

Our HRA screening identified several drought order options included in the draft Plan as having a likely significant effect on European sites and so these options were subject to an Appropriate Assessment. The provisional outcomes of the Appropriate Assessment determined that we could not conclude no adverse effects on site integrity of the following designated sites, taking account of provisional considerations of mitigation measures that might be feasible:

River Usk SAC

- 8201-1 Crai Reservoir

Cleddau Rivers SAC

- 8206-1 Crowhill
- 8206-8 Canaston

Following the consultation on our draft Plan, NRW agreed this conclusion for the above three options (Crai, Canaston, Crowhill) but also highlighted in their response that the Afon Lwyd drought order (option no. 8109-4) could have adverse effect upon the River Usk SAC and potentially the Severn SAC, whereas our assessment had concluded 'no adverse effect' based upon new evidence. Although we have not had time to review the additional evidence, other studies indicate that the Afon Lwyd option has low benefit during severe droughts.

Given that we are unable to conclude 'no adverse effect' for at least three options, as the Plan currently stands, NRW could not advise Welsh Government to direct us to publish our Drought Plan as Final, were these schemes to remain in their existing form. After detailed discussion with NRW we have identified three routes available to us under the Habitats Regulations to resolve their concerns:

1. Remove the four options from the plan
2. Amend the four options so that we can demonstrate no adverse effect
3. Follow the process set out in Article 6.4 of the Habitats Regulations to
    i. Ensure all financially, technically and legally feasible alternative solutions for all options where it has not been possible to rule out adverse effects on site integrity are given due consideration at plan level, including existing and new water sources;
    ii. Provide an IROPI case for all options where it has not been possible to rule out adverse effects on site integrity;
    iii. Develop and agree a credible compensation plan, to be delivered during the lifetime of the plan, for all options where it has not been possible to rule out adverse effects on site integrity

For options 8109-4 (Afon Lwyd) and 8201-1 (Crai Reservoir) we have reviewed the need for these schemes against the overall drought resilience of the SEWCUS and Tywi water resource zones respectively, we will follow Route 1 and remove them from our Drought Plan. Given the availability of other options in these zones we are confident that removal of these schemes from our Drought Plan will not pose us any additional drought risk and that we can maintain supplies to customers without interruption during a drought event of around a 1:500 year return period.

For options 8206-1 (Crowhill) and 8206-8 (Canaston) we know that our Pembrokeshire zone is currently vulnerable to drought as a result of reductions in the amount of raw water we can abstract, caused by amendments made to our abstraction licences by NRW in order to meet the requirements of the Habitats Directive. Investment is planned in AMP7 that will overcome the forecast supply demand balance shortfall and improve our drought resilience but until the scheme is delivered, we are running a greater drought risk which we will mitigate as far as possible through operational activities. We are therefore keen to retain these options and so following Route 1 is not a preferred course of action.

Working through the Habitats Regulation process, Route 2 is not viable as we are unable to amend the schemes such that they would not impact upon the designated features whilst providing us with useful volumes of water to help maintain supplies to customers during an extreme drought.

Following the process defined for Route 3, we have identified a number of alternative schemes which if constructed, would provide additional water to us during a drought. Table 22 below lists these schemes which are taken from our 2019 Water Resources Management Plan:

Scheme	Cost Est. (£m)	Yield Est. (Ml/d)	Lead in time Est. (Yrs)
Water efficiency	5.4	0.67	5
Leakage – trunk mains repair	1.53	0.1	5
Leakage – trunk mains renewal	48	0.14	6
Leakage – distribution mains renewal	96.1	5.26	35
Leakage – enhanced active leakage control	3.4	0.06	5
'Smart' metering all domestic customers	45.8	2.86	5
Dam raising Llysyfran	16.3	14	2-5
Reinstate Milton boreholes for industrial supply	1.25	2	2
Potable transfer from Tywi Gower zone	24	4.5	3
Desalination for industrial use	23.6	15	5
New abstraction from the Afon Taf	6.3	5	4

Table 22 – List of WRMP19 Options for the Pembrokeshire WRZ

Of the schemes listed, there are only five (highlighted in green) that would provide us with an equivalent yield to that we would gain from the Canaston and Crowhill drought options. The scheme with the shortest lead in time is the inter zonal transfer from the Tywi Gower zone, however the capital cost of construction is around £24 million. The most cost effective schemes are the dam raising at Llysyfran and the new abstraction from the Afon Taf. Both provide good value for the level of additional resource gained but the earliest these could be completed is 2024-25. We therefore acknowledge that there are financially, technically and legally feasible alternative solutions to the use of the Crowhill and Canaston options but would question whether it is 'reasonable' for us to invest in these schemes to overcome drought events that have an annual probability of occurrence of 0.5% or less.

In order to retain the potential for use of both the Canaston and Crowhill options whilst we complete our asset investments during AMP7, and acknowledging the potential for adverse effects on the Afonydd Cleddau/Cleddau Rivers SAC and the Pembrokeshire Marine SAC, we confirm that we will not implement the Canaston or Crowhill drought orders until HRA compensation measures for the relevant drought order have been agreed with NRW and secured in accordance with the timescales set out in the programme of work in the HRA of the Drought Plan. We confirm that we will commence delivery of the compensation measures to the target date set out in the HRA programme of work, acknowledging that this target date is dependent on the measures firstly being agreed by NRW and 'secured' in line with the dates in the HRA programme of work. It should be noted that if we achieve early delivery of any of the timescales set out in the HRA programme of works, we would look to progress to the next stage ahead of schedule.

5.9.2. Drought Order options that have concluded 'No Adverse Effect'

Our updated approach to the environmental assessments for this Plan has seen us better define the timing of implementation of our drought options, which allows for an improved consideration of potential ecological effects. NRW feedback has been positive on this but they noted that within the EARs and SEA/HRA our wording around the timing of use of these could mean that we would implement them outside of the defined periods. Within their consultation response, NRW therefore raised concerns around our conclusion of 'no adverse effect' upon European protected sites for four options. The following section details the NRW consultation feedback (stated in italics) and how within this revised Plan we have addressed the issue:

- 8201-3 Nantgaredig (River Tywi SAC and Carmarthen Bay Estuaries SAC)
    i. *Therefore, in order to have confidence in the conclusion of no adverse effects on the fish interest features, assurances are required from Dŵr Cymru that the option is restricted to between September and November only.*

To address NRW's concerns for option 8201-3 (Nantgaredig) and allow them to agree with our conclusion of 'no adverse effect' we confirm here, and in the relevant EAR and SEA/HRA that the option would only be implemented between the months of September and November. We have made the required changes to the EARs that were highlighted by NRW in their consultation response to our HRA and these are now included in the finalised versions submitted alongside this Plan.

- 8201-4 Llyn Brianne (River Tywi SAC)
    - i. *We therefore advise that the HRA and EAR (Appendix 22) need to include an assessment of the impact of the option on this group of bryophytes.*
    - ii. *In addition, the plan states that this option will 'most likely' be required between September and November, and if there is any possibility that it could be implemented outside of this period, especially during more sensitive periods (April, May and June), we would not agree with a conclusion of no adverse effects on site integrity….*

Upon review of option 8201-4 (Llyn Brianne) we have identified that the scheme is not adequately defined and may not provide us with significant additional water resource during a drought. The option needs to be reworked and so we propose to remove the option from this Plan but will continue work to develop the option post publication of the Final Plan and produce an updated EAR and SEA/HRA that will allow its use if needed.

- 8206-2 Preseli reservoir (Cleddau Rivers SAC)
    - i. *The EAR states that the "storage could potentially be increased by up to 166Ml over the six-month duration of the drought permit, which is over 25% of the total capacity of Preseli Reservoir". This is in direct conflict with a later statement in the EAR "The revised abstraction arrangements would legally be authorised for four months (August November)". We seek clarification from Dŵr Cymru as to which period is correct…*
    - ii. *We believe there is insufficient evidence to conclude no adverse effects on site integrity for fish interest features in the Afonydd Cleddau/Cleddau Rivers SAC, in particular for bullhead and brook lamprey.*

To address NRW's concerns for option 8206-2 (Preseli) and allow them to agree with our conclusion of 'no adverse effect' we confirm here, and in the relevant EAR and SEA/HRA that the option would only be implemented between the months of August and November. Discussions with NRW on this option following their consultation response has confirmed that after further review of the available evidence, they concur with our overall conclusion for this option of 'no adverse effect'.

- 8206-7 Llys-y-fran reservoir (Cleddau Rivers SAC)
    - i. *In addition, we advise that 570 Ml of water needs to remain in the water bank. In such a case, the proposal should be reduced from 425 Ml (as set out in the EAR) to 385 Ml.*
    - ii. *In addition, we seek assurances that Dŵr Cymru will only apply for the drought order during the period August to November (when accompanied by compensation flows).*

To address NRW's concerns for option 8206-7 (Llys-y fran) and allow them to agree with our conclusion of 'no adverse effect' we confirm here, and in the relevant EAR and SEA/HRA that the option would look to a maximum 385 Ml of the freshet bank and will only be implemented between the months of August and November. We have made the required changes to the EARs that were highlighted by NRW in their consultation response to our HRA and these are now included in the finalised versions submitted alongside this Plan.

5.9.3. Habitats Directive Stage 3 Alternative Options and Stage 4 IROPI

In accordance with the Conservation of Habitats and Species Regulations 2017, competent authorities cannot consent to plans, projects or operations if the Appropriate Assessment concludes that the plan, project or operations may have an adverse effect on the integrity of a relevant site. The Welsh Government / Natural Resources Wales Drought Plan Guideline (DPG) also indicates that a drought plan will not normally be enacted or adopted unless it can be shown that it would not have a likely significant effect on or an adverse effect on the integrity of a relevant site. The DPG also states that in exceptional cases, a plan or project can be enacted or adopted despite having an adverse effect on the integrity of a relevant site if it can meet the three sequential tests listed below:

- There must be no feasible, reasonable alternative solutions to the plan or project which are less damaging to the affected relevant site(s).
- There must be "imperative reasons of overriding public interest" (IROPI) for the plan or project to proceed – this must involve a balancing of factors such that the harm (or risk of harm) to the relevant site must be outweighed, or overridden, by the reasons for agreeing to the plan or project
- All necessary compensatory measures must be secured to ensure that the overall coherence of the network of relevant sites is protected.

5.9.4. Water Framework Directive (WFD)

We have assessed the potential for measures included in this Plan to result in deterioration of WFD status in certain river reaches. The potential for deterioration arises from the implementation of Drought Permit/Drought Order options. Where this potential risk arises, it has been described for each WFD status element (e.g. fish, macroinvertebrates) in the associated EARs and is summarised in Annex 1 (WRZ summaries) which contains information for each Drought Plan option together with a description of any risk assessment of its impact. The supply-side options where a risk to one or more of the WFD status elements has been identified are:

- 8001-3 Reduction of Alaw compensation flow
- 8001-4 Reduction of Ffynnon Llugwy compensation flow
- 8001-5 Reduction of Cefni Reservoir Compensation flow
- 8012-2 Reduction of the regulation release from Aled Isaf and modification of the Hands-Off Flow value at Bryn Aled
- 8012-5 Relaxation of the Llanerch boreholes annual licence
- 8012-6 Pumped (winter) refill from Aled Isaf to Llyn Aled
- 8033-2 Reduce Bodlyn compensation flow
- 8109-1 Reduce Llwynon compensation flow
- 8112-1 Emergency abstraction from the River Rhondda at Treherbert
- 8119-1 Reduce Pontsticill compensation flow
- 8201-3 Relax the maintained flow requirement below the Nantgaredig intake on the River Tywi
- 8206-2 Reduce the Compensation release from Preseli Reservoir

Any potential impacts would be short term, temporary and reversible and suitable mitigation measures have been identified in each corresponding EAR. Post the publication of our Final Drought Plan we will commence

work on the EARs for the options listed above, so that we can address the concerns that remain regarding their potential impact upon the WFD waterbody status. To improve our environmental assessments and ensure they are robust we will continue to work closely with NRW to address the concerns they have raised through their detailed review of our EARs, noting their particular concerns with our current EAR for option 8012-5 Llanerch boreholes.

5.10. Compensation to other abstractors due to a Drought Order

When a drought order is granted to us, other abstractors affected by that action can approach Welsh Water under Section 79(2) and Schedule 9of the Water Resources Act 1991, for compensation in particular circumstances for loss or damage sustained by reason of the taking of the water. Anyone wishing to claim compensation should refer to Schedule 9 of the Water Resources Act 1991 for details of eligibility. However, for clarity we outline some of the process below:

Those eligible to apply for compensation include owners and occupiers of the land affected by any drought order, owners of the source of water, all persons interested in the source of the water, owners of the place of discharge, all persons interested in the place of discharge.

A claim for compensation under Schedule 9 of the Water Resources Act 1991 can be made by serving upon the applicant (i.e. Welsh Water) a notice stating the grounds of the claim and the amount claimed. Claims for compensation must be made at any time not later than six months after the end of the period of which the order is effective.

Any claim for compensation would be reviewed by us on a case by case basis. Any question as to the right of a claimant to recover compensation, or as to the amount of compensation recoverable shall, in default of agreement, be referred to, and determined by, the Lands Tribunal.

6. Post-drought actions

6.1. Drought recovery

When wetter weather returns, this will reduce water demand but it can take a considerable amount of time for our reservoir stocks to recover to the position that we would normally expect them to be in. During this period, we will continue to undertake similar risk assessments as those made during the drought period but with greater attention to the longer term impact. We will look both at the prospect of the weather turning dry once again and the likelihood that our reservoirs will re-fill over the winter/spring period and not lead to further issues the following year. At this stage we will look at the need to apply for additional drought permits aimed at securing water supply for the following year. We have listed the sites where we might make such application in Chapter 5.

Our water resource zones have differing characteristics in terms of their resilience to varying types of drought, as discussed in Chapter 4, and more specifically to their ability to recover post drought.

Reservoirs such as Usk in the south east of our region can struggle to refill because the size of the catchment from which it receives its water is relatively small in comparison to the size of the reservoir and the volume of demand it has to meet. Other reservoirs such as Cwellyn in north-west Wales refill over the winter period as the opposite is the case.

For these reasons, the initial recovery out of the drought action zone would not typically be the point at which all measures would be lifted. A more likely point for declaring the end of a drought would be in the approach to the normal zone, when reservoirs are well stocked for the time of year and, in demand trigger zones, abstraction quantities fall below the developing drought trigger level.

There is a reputational risk if any drought actions put in place are lifted prematurely (i.e. in advance of imminent re-deterioration into drought conditions). Hence, caution will always be taken in deciding when, as conditions return to normal, any restrictions upon use can be lifted and appropriate communication issued to customers.

As with the onset of drought it is important that we take a flexible approach to the lifting of restrictions imposed on our customers or in taking additional water from the environment outside of our permitted volumes. We may also choose to lift restrictions on an area basis in a proportional manner. These decisions will be led by the Gold incident team and further discussed with government through the Wales Drought Liaison group and the National Drought Liaison Group. The factors that will be taken into account in making this decision will be:

- The results of risk forecasts for individual WRZs
- The time of year and anticipated savings from demand side measures
- Forecast weather conditions
- Natural Resources Wales and the Environment Agency environmental drought status

Throughout the post-drought stage as conditions recover, environmental monitoring will be undertaken as part of the suite of actions to ensure we have the fullest possible understanding of the impact that any supply side drought actions have had. This post-drought environmental monitoring also informs our decision making so that appropriate measures can be taken to support the recovery of the environment after a period of drought.

6.2. Post drought review

Once we are confident that conditions have recovered and we are able to 'stand down' our incident response teams, we will hold a number of internal meetings involving all the members of our Gold and Silver centres to review the drought event.

The extent of the review will be dependent upon the level of drought encountered. We will review the effectiveness of the drought management actions we took to understand any impacts to customers and the environment from their implementation. Separately we would also review how well our Drought Plan has performed, particularly in relation to:

- The appropriateness and efficacy of the hydrological triggers used to determine entry into drought, looking at where triggers gave early warnings, reliability of triggers, etc.
- An assessment, where possible, of the demand reductions resulting from the communications strategy.
- The effectiveness of demand management measures (e.g. leakage, active pressure management, etc.) in reducing demand, including variables impacting the savings achieved
- Outcomes of operational 'mop-up' sessions and workshops to identify unforeseen system constraints, etc.
- Capturing of operational learning from drought option delivery, including asset performance, operational restrictions, and procurement of service.
- Supply side measures, operational details around their implementation, including barriers to delivery, opportunities to streamline the process and where options should not be included in the future
- Review of the environmental monitoring of supply side drought options and the mitigation measures which were pursued
- The management and communications strategy adopted during the drought
- Cooperation during the drought between various key stakeholders, such as NRW, EA, other water companies, etc.

For more severe droughts where we have put TUBs in place, we will prepare a 'lessons learnt' report. We would look to produce this report within 6 months to allow enough time for staff recovery and the collation of all the require data.

Once we have completed our internal review we will issue the 'lessons learnt' report to Government and Regulators and follow this up with a meeting in order to review how effective they felt our drought management was, how well we worked together across organisations and whether improvements could be made, particularly in terms of communication and support to other sectors.

These discussions will inform and promote improvements in practice, to reflect the greater understanding of activities in a drought. This review process is outlined in Figure 25. Following the completion of our review and finalisation of the 'lessons learnt' report we will then update our Drought Plan and Water Resources Management Plan as required.

Figure 25 - Drought event review process

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APPENDICES

- Appendix 1 – Drought Vulnerability Framework: Final Project Report
- Appendix 2 - Drought Vulnerability Framework: Hydrological Update
- Appendix 3 – Strategic Environmental Assessment (SEA) of the Revised Draft Drought Plan 2020: Environmental Report
- Appendix 4 – Habitats Regulations Assessment (HRA) of the Revised Draft Drought Plan 2020: Habitats Regulations Assessment Report
- Appendix 5 Environmental Assessment Report Llyn Cwellyn (Option no. 8001-2)
- Appendix 6 Environmental Assessment Report Llyn Alaw (Option no. 8001-3)
- Appendix 7 Environmental Assessment Report Llyn Fynnon Llugwy (Option no. 8001-4)
- Appendix 8 Environmental Assessment Report Llyn Cefni (Option no. 8001-5)
- Appendix 9 Environmental Assessment Report Llyn Aled Isaf (Option no. 8012-2)
- Appendix 10 Environmental Assessment Report Afon Aled (Option no. 8012-4)
- Appendix 11 - Environmental Assessment Report for Llanerch (Option no. 8012-5)
- Appendix 12 - Environmental Assessment Report for Llyn Aled (Option no. 8012-6)
- Appendix 13 - Environmental Assessment Report for Dysynni (Option no. 8021-1)
- Appendix 14 - Environmental Assessment Report for Bodlyn (Option no. 8033-2)
- Appendix 15 - Environmental Assessment Report for Dwyfor (Option no. 8034-1)
- Appendix 16 - Environmental Assessment Report for Llwynon (Option no. 8109-1)
- Appendix 17 - Environmental Assessment Report for Rhondda (Option no. 8112-1)
- Appendix 18 - Environmental Assessment Report for Talybont (Option no. 8116-3)
- Appendix 19 - Environmental Assessment Report for Pontsticill (Option no. 8119-1)
- Appendix 20 - Environmental Assessment Report for Tywi (Option no. 8201-3)
- Appendix 21 - Environmental Assessment Report for Llechryd (Option no. 8202-1)
- Appendix 22 - Environmental Assessment Report for Nantymoch (Option no. 8203-2)
- Appendix 23 - Environmental Assessment Report for Preseli (Option no. 8206-2)
- Appendix 24 - Environmental Assessment Report for Llys y Fran (Option no. 8206-7)
- Appendix 25 - Environmental Assessment Report for Crowhill (Option no. 8206-1)
- Appendix 26 - Environmental Assessment Report for Canaston (Option no. 8206-8)