Hafren Dyfrdwy Drought Plan 2020 - 2025

Main Report

In this Drought Plan Hafren Dyfrdwy sets out its approach to managing its supplies of water to its customers during a drought event. This Drought Plan has been prepared on the basis of the guidance contained in the Natural Resources Wales Water Company Drought Plan Technical Guideline issued in December 2017 and the associated guidance notes. This Plan provides a comprehensive overview of the triggers and their corresponding drought management actions that will be carried out in the event of a drought.

Executive summary

Introduction

Hafren Dyfrdwy is a water and wastewater company which provides around 58 million litres of water per day, to a population of approximately 220,000 in the area of mid and north east Wales. Our customers comprise approximately 97,000 households and 8,000 business customers. Dee Valley Water became part of the Severn Trent group in February 2017. Hafren Dyfrdwy was launched on 1st July 2018 following Ofwat's approval to align the boundaries of Severn Trent and Dee Valley Water to the national boundaries of Wales and England.

Our objective is to maintain a consistent supply of wholesome water that gives customers good value for money, during both normal operation and during a drought situation. Not only is this our statutory obligation, but it is what our research has shown customers expect.

This is the final version of Hafren Dyfrdwy's statutory drought plan 2020 - 2025. It is an update to the plan we published in July 2015. We produce drought plans to explain how we will manage both supplies and demand for water during a drought in our region. Our plan aims to balance the interests of customers, the environment and the wider economy. The plan helps us and our stakeholders to make the right decisions at the right time and shows how we will provide a continuous supply of water to our customers during a drought. Development of the Drought Plan includes consulting with our customers and other main stakeholders on how we propose to manage the service we provide during a drought situation.

Towards the latter part of 2018 we carried out a pre-consultation process with our main stakeholders to ask them for their views on our previous plan so that we could use these to shape and improve our new Drought Plan. Following the pre-consultation we produced a draft Drought Plan incorporating the representations we received and other updates.

In July 2019 the draft Drought Plan was published on our website for further consultation. This time the consultation process was much wider, we sent out emails and put out press release asking customers and stakeholders to review our plan and respond with representations.

In light of the responses we received to the consultation, we made some changes and reissued our draft Drought Plan, we also published a list of the representations that we received along with our response. The changes we made were to provide further clarity and detail to the Plan, none of them were material to its function. The Welsh Government have now given their consent for us to publish our final Drought Plan along with supporting documents.

Droughts are naturally occurring events and we cannot plan to prevent them from happening. Instead, we plan to minimise the impacts of droughts when they do occur. All droughts differ in severity, extent and duration. As a result, whether the effects of any particular drought are focused primarily on the environment, on public water supply or on other water users in the wider economy will depend on the individual characteristics of each drought.

The sections below provide an overview of how we intend to manage our supplies of water during a drought and how we will communicate this process with our customers and other stakeholders.

Changes since the last Drought Plan

A number of improvements have been made to this Drought Plan to reflect legislative and regulatory changes that have occurred since the previous plan, and to comply with the latest guidelines and codes of practice. These changes include:

- Revisions to reflect the latest NRW Water Company Drought Plan Technical Guideline issued in December 2017 and the associated guidance notes.
- Revisions to reflect the geographical area supplied by HAFREN DYFRDWY and our new water resource zones.
- Updates to control curves for our upland reservoirs in the Wrexham water resource zone (WRZ), which was carried out in line with our WRMP19.
- The improvement of our proposed communication plan. This details how we will communicate with our customers and other stakeholders during a drought situation.
- Updates to our Strategic Environmental Impact Assessment Screening Report and a Habitats Regulations Assessment Screening Report to identify any potential adverse effects that the drought options we have considered may have on the environment.

We have also expanded this Executive Summary to make our plan more accessible to a wider audience.

Drought triggers

Drought triggers indicate when a drought situation is developing and are used as decision making stages to assist in drought management. The drought triggers for the Wrexham WRZ are dictated by the availability of water within the Dee Storage System. Thus, most of our drought management actions in the Wrexham WRZ are dictated by the Dee General Directions which govern the Dee Storage System. Drought trigger levels for Llandinam and Llanwrin WRZ have been derived on a pro-rata abstraction licence basis of the combined annual licenced volume.

The River Dee provides 61% of the water we require, the remainder being supplied from upland reservoirs in the Wrexham WRZ and groundwater sources. The River Dee is regulated by Natural Resources Wales (NRW) using reservoirs in the Welsh hills, according to the Dee General Directions[1]. For severe droughts, the General Directions define the drought triggers and the actions that we are required to take in response to these triggers. The triggers are associated with the amount of water available in the Dee Storage System. As stocks decrease, trigger points are crossed which prompt drought management actions to be taken.

Our upland reservoirs in the Wrexham WRZ provide only a small contribution to the overall supply. These reservoir systems are managed using control curves, which help us to take appropriate drought management actions at the correct time. The control curves are used to constrain the output of a source depending on the storage relative to the specified curve. When storage falls below the relevant curve the maximum allowed abstraction from the reservoirs will be equal to a specified below curve take.

[1] The Directions are subject to the approval of the Dee Consultative Committee which comprises NRW, EA, United Utilities, Hafren Dyfrdwy, Severn Trent Water, Dŵr Cymru Welsh Water, Canals and Rivers Trust.

Drought management actions

Drought management actions comprise demand side actions and supply side actions, the implementation of which are determined by the triggers discussed above. Demand side actions focus on reducing demand for water from our operations or from our customers; whilst supply side actions are those that increase the availability of water.

For demand side actions, we will communicate with our customers at an early stage of a developing drought, carrying out additional water efficiency promotion and encouraging the efficient use of water.

We recognise that if we expect our customers to reduce the amount of water they consume then we should also go to similar efforts to reduce our level of leakage. We will do this by carrying out additional leakage detection and repair activities.

As the drought becomes more severe, we may have to introduce Temporary Use Bans and ultimately apply for Drought Orders in extreme situations.

Temporary Use Bans primarily restrict the use of water by domestic customers through banning hosepipes and sprinklers and are one of the most effective and significant demand side measures available. Before implementing a Temporary Use Ban we will publish information advertising the proposed actions in at least two newspapers circulating in the local area and on our website. These notices will be part of a larger communications strategy.

The activities prohibited under a Temporary Use Bans are listed in Section 36 of the Flood and Water Management Act 2010. These activities are:

- Watering a garden using a hosepipe
- Cleaning a private motor-vehicle using a hosepipe
- Watering plants on domestic or other non-commercial premises using a hosepipe
- Cleaning a private leisure boat using a hosepipe
- Filling or maintaining a domestic swimming or paddling pool
- Drawing water, using a hosepipe, for domestic recreational use
- Filling or maintaining a domestic pond using a hosepipe
- Filling or maintaining an ornamental fountain
- Cleaning walls, or windows, of domestic premises using a hosepipe
- Cleaning paths or patios using a hosepipe
- Cleaning other artificial outdoor surfaces using a hosepipe

To avoid any confusion to our customers, the above eleven activities will be implemented in a single phase.

Exceptions to Temporary Use Bans will be made according to the code of practice[2] and fall under three categories. These are:

- Statutory Exceptions – Specified through legislation and are on the grounds of health and safety, the environment or where businesses may be effected.

[2] United Kingdom Water Industry Research (UKWIR) 'Code of Practice and General Guidance on Water Use Restrictions

- Discretionary Universal Exceptions – Common to all water companies and primarily relate to Blue Badge holders.
- Discretionary Concessional Exceptions – Granted by individual water companies following the receipt of a representation. All exceptions are subject to our discretion and will only be granted if it is in the best interest of the community. We will consider granting an exception to customers on the company's Vulnerable Customers List, Water Sure List and to those whom have mobility issues but are not in possession of a Blue Badge. These exceptions will require customers to write or make representation to Hafren Dyfrdwy to obtain permission. A form to request an exception has been provided in Appendix H – Temporary Water Use Exception Form. More details on how to make a representation are given section 3.3.5.

There is no formal process for objecting to restrictions under a Temporary Use Ban, we will only introduce these measures in very extreme circumstances when it is in the best interest of both customers and the environment. Objections can be lodged as a judicial review under the Human Rights Act.

A Drought Order is one of the most extreme demand side action available to us. The aim of a Drought Order is to extend existing restrictions under the Temporary Use Ban to non-domestic customers. To implement a Drought Order, we must first apply to the Secretary of State and the Welsh Government which can be a lengthy process.

With regard to supply side actions, we only have one available to us, this is the support of the River Dee with water from our Lower Pen-y-Cae Reservoir. The volumes which we will transfer into the River Dee are determined by the Dee General Directions and are dependent on the trigger that has been crossed.

Enforcement of a Temporary Use Ban or drought order

The Water Industry Act 1991 and Water Resources Act 1991 states that anyone found guilty of breaching a Temporary Use Ban can be fined up to Level 3 (an amount of £1000 under the standard scale of fines for summary offences in the Criminal Justice Act 1982 section 32). Offenders breaching a Drought Order restriction are liable to a fine not exceeding the statutory maximum (which is an amount of up to £5000). Conviction on indictment renders an offender liable to a fine with no specified upper limit.[3]

Communications strategy

An essential part of the Drought Plan is the communications strategy that we intend to follow in the event of a drought. Effective communications can help to reduce customer demand, increase the available water for supply, reduce the impact on the environment and avoid confusion especially with respect to which activities are subject to water use restrictions.

In the event of a drought situation developing, we have a management structure that we will put in place to ensure effective implementation of the drought plan including the communications strategy. A key member of the management structure is the communications coordinator who will be responsible for ensuring that communications are

[3] Taken from the UKWIR document 'Code of Practice and General Guidance on Water Use Restrictions

carried out at the appropriate time using the appropriate methods and with the relevant stakeholders.

For domestic and commercial customers, the majority of our communications will be through press, radio and television adverts, our customer call centre, bulletins on our website, promotional events, text messaging, leaflets and posters. We have an additional channel of communication with our larger commercial customers via their accounts managers. Customers identified as vulnerable or Water Sure in our billing database will also be provided with an information pack. Prior to making any communications with our domestic and commercial customers, we will liaise with the Consumer Council for Water who is the independent customer representative.

Other stakeholders such as regulators, environmental groups and local representatives will be contacted using letters, emails or telephone conversations.

Section 5.3 summarises the main communication messages that we will deploy in the event of a drought situation and how these correspond to the drought triggers and actions.

Post drought actions

Temporary Use Bans will be lifted when the water resources have returned to their normal status. To determine this point, consideration will be taken of the actual level of the resources and the prevailing and projected weather conditions.

Similar to implementation, the revocation of the restrictions will be published on our website and in two local papers as per the legislation. We will then carry out a post drought review to determine the effectiveness of the Drought Plan, document the lessons learnt and identify improvements for the future.

Contents

Separate reports associated with this plan

- Strategic Environmental Assessment (SEA) of the drought plan (available on request)
- Habitats Regulations Assessment (HRA) of the drought plan (available on request)
- Water Framework Directive (WFD) of the drought plan (available on request)

1. Introduction

1.1. Overview of process

Droughts are naturally occurring events and we plan to minimise the impacts that they might have. We produce a drought plan to explain how we will manage both supplies and demand for water during a drought in our region. Our plan aims to balance the interests of customers, the environment and the wider economy. The plan helps us and our stakeholders to make the right decisions at the right time and shows how we will provide a continuous supply of drinking water to our customers during a drought.

Under Sections 39B and 39C of the Water Industry Act 1991, as amended by the Water Act 2003, we are legally required to prepare and maintain a drought plan. This drought plan sets out how Hafren Dyfrdwy will *"continue, during a period of drought, to discharge its duties to supply adequate quantities of wholesome water, with as little recourse as reasonably possible to drought orders or drought permits".* This definition is consistent with the Water Industry Act 1991.

We are also required to consult with the public on the content of the plan, assess the representations we receive and prepare our statement of response[4] within 15 weeks of the draft plan publication date.

We have based the structure of this plan on the recommended structures provided in:

- Appendix C of the NRW Water Company Drought Plan Technical Guideline published in December 2017.

We have also consulted with our stakeholders to gain their views on how we plan to manage a drought. Figure 1 below shows an outline of the process that we follow to produce a Drought Plan.

[4] https://www.hdcymru.co.uk/content/dam/hdcymru/about-us/drought-plan/hd-drought-plan-statement-of-response-2019.pdf

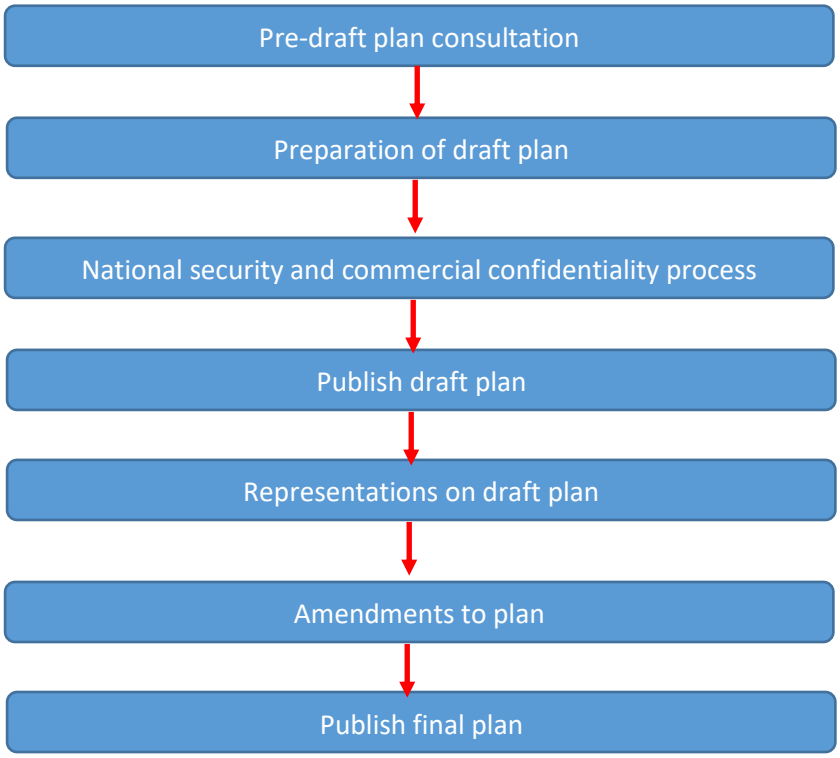


Figure 1 - Outline of drought plan process

Our Drought Plan does not include details of how we will cope with incidents of extreme drought that result in a civil emergency, these are covered in our emergency plans.

1.2. Drought plan development

According to the NRW 'Water Company Drought Plan Technical Guideline' published on December 2017, *"a drought plan should set out the short-term operational steps a company will take before, during and after a drought. These plans are not strategic and should focus on a company's actions if a drought was to occur under present circumstances. Drought plans should show how a company would operate in a range of droughts and present enough information to customers and partners to show what decision making processes a company will make in a drought event."* Figure 2 illustrates the process that we have followed in developing our drought plan, which shows the individual components of the drought plan and the links which exist between them. This report is set out in the recommended format that reflects this process.

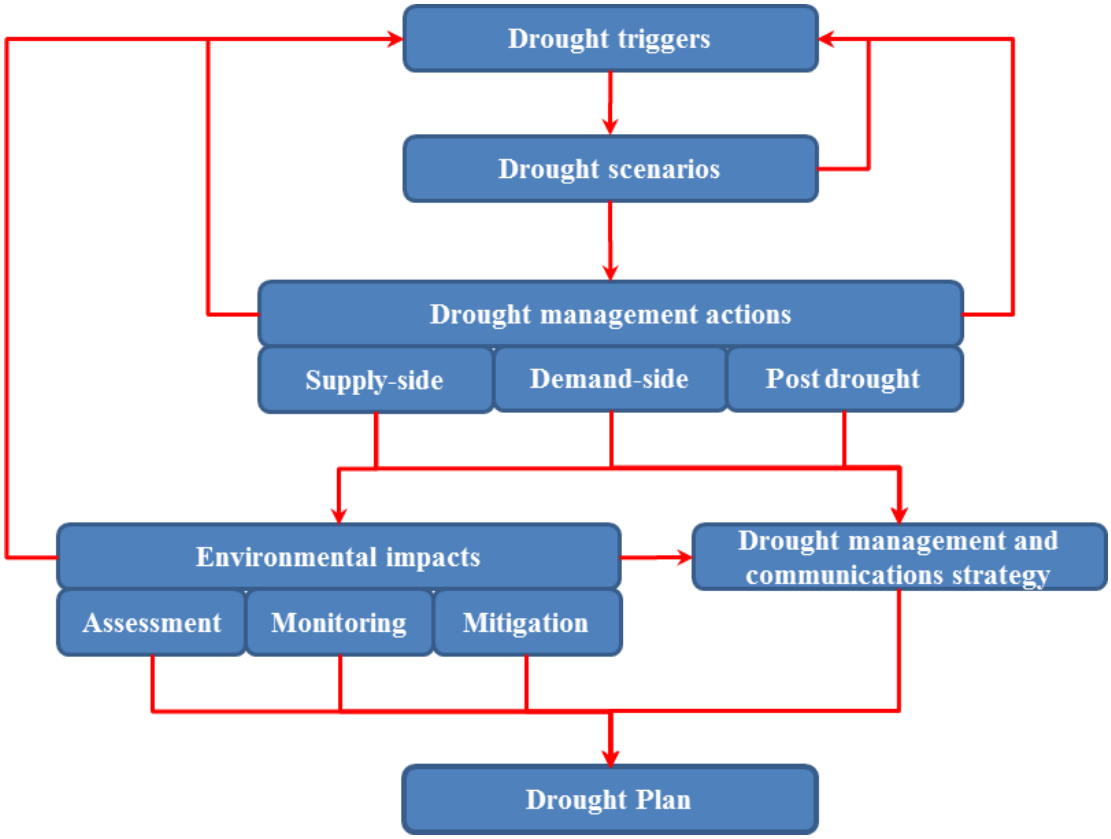


Figure 2: Drought plan development process

Drought triggers

A drought trigger is a specific event which prompts a drought management action, for example a drought trigger may be a recorded flow in a river that triggers water saving actions. Drought triggers are discussed in detail in section 2.

Drought scenarios

A drought scenario is a means by which the effectiveness of drought triggers are tested (see section 2). The scenario is also used to demonstrate how drought management actions would be implemented given a combination of increased demands and drought conditions.

Drought management actions

A drought management action is a reaction to a drought trigger and is an action which is taken to reduce demand (demand side) or to increase supply (supply side). The action must be consistent with our level of service, which is one in forty year for Temporary Use Ban (TUB), which we have set out in our Water Resources Management Plan. Our drought management actions are described in detail in section 3.

Environmental impacts

The likely environmental impacts of all drought management actions, in particular on European sites needs to be assessed and discussed in drought plans (see section 4). Monitoring and mitigation plans have been included to continuously assess and mitigate the

likely environmental impacts of implementing our supply side drought management action. Habitats Regulation Assessment, Strategic Environmental Assessment and Water Framework Directive assessment are carried out and separate reports have been produced for each.

Drought communications and management

Part of the Drought Plan is the communications plan, which details how we will communicate our drought actions effectively to implement demand side actions and minimise the impact on the environment (see section 5). The Communication Plan should align with the drought triggers and detail the stakeholders who will be targeted and how.

During a drought, all triggers, actions, communications and impacts need to be monitored carefully to ensure the actual drought sequence is unfolding as predicted by the scenario. However, there needs to be enough flexibility within the plan to deal with unexpected events, as all drought sequences are different.

Following a drought, monitoring will continue to assess the impact of the drought, which can then be fed back into the Drought Plan.

1.3. About Hafren Dyfrdwy

1.3.1. General

In February 2017, Dee Valley Water became part of the Severn Trent group. In May 2018, Ofwat approval was received to align the boundaries of Severn Trent and Dee Valley Water to the national boundaries of Wales and England. In line with this approval Hafren Dyfrdwy was launched on 1st July 2018. Both Severn Trent and Hafren Dyfrdwy customers should expect their respective drought plans to provide description of how water supplies and demand are managed during a drought in their region.

Hafren Dyfrdwy is a water and wastewater company which provides around 58 million litres of water per day, to a population of approximately 220,000 in the area of mid and north east Wales (Figure 3). Our customers comprise approximately 97,000 households and 8,000 business customers.

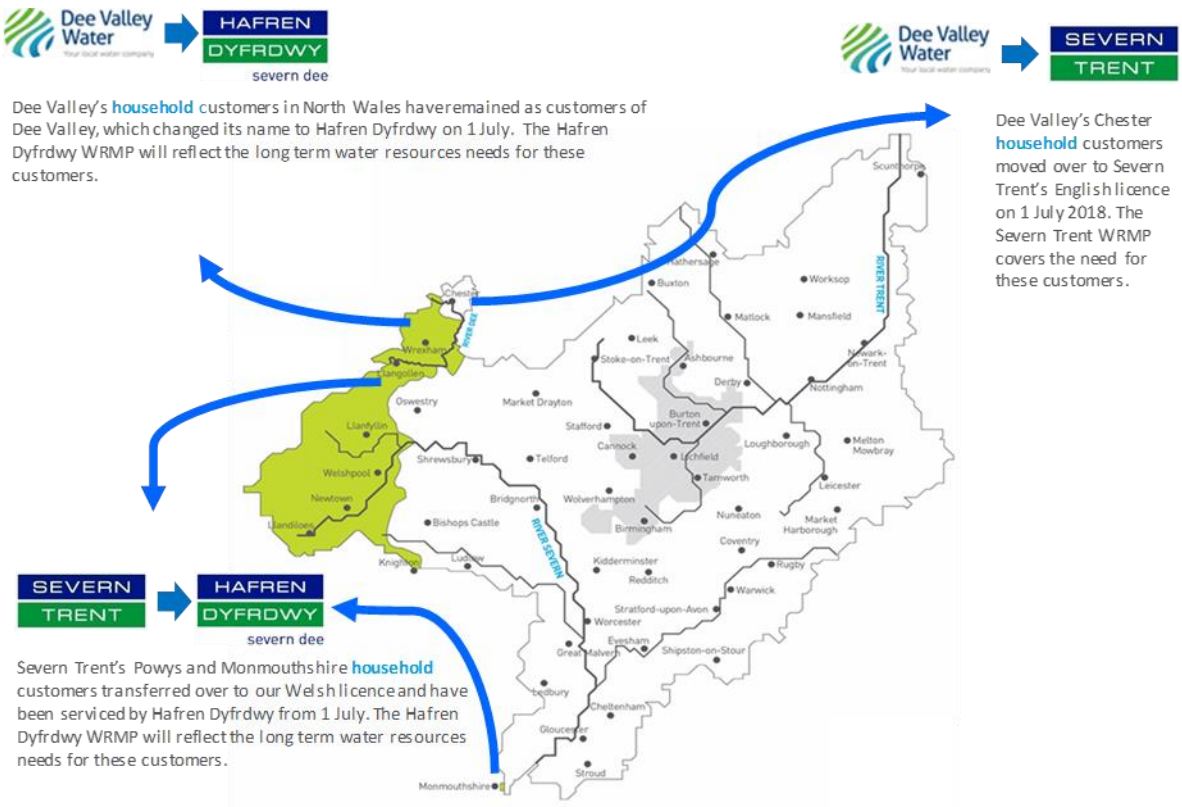


Figure 3 - Hafren Dyfrdwy region

61% of our raw water comes from the River Dee, 5% from a series of impounding reservoirs, 30% from boreholes in Powys and the remaining 4% from a spring source.

Water is treated at five treatment works and is then supplied to customers through a network of approximately 2600 km of water mains, 100 pumping stations and 85 clean water storage reservoirs.

1.3.2. Dee Consultative Committee

The River Dee is regulated by NRW according to the Dee General Directions: Normal General Directions and Drought General Directions (the 'Directions') under the Dee & Clwyd River Authority Act. The Directions are subject to the approval of the Dee Consultative Committee which comprises NRW, Environment Agency (EA), United Utilities, Dŵr Cymru Welsh Water, Hafren Dyfrdwy, Severn Trent Water and Canals and Rivers Trust.

In the event of a drought, the Dee Drought General Directions define the principles and detail of the conditions under which the prescribed flows and abstractions in the catchment must be reduced. The Directions were last updated in June 2016.

NRW are responsible for making sure that there is enough water available for everyone's needs, including the natural environment. To meet this responsibility they regulate the amount of water that can be abstracted from the available resources and for times of drought this is done through a Drought Plan.

Due to our dependence on the River Dee for 61% of our raw water, our Drought Plan is dictated mainly by the Dee Drought General Directions.

1.4. Baseline water resources situation and levels of service

1.4.1. Resource zones

Following the purchase of Dee Valley Water by Severn Trent Group and the creation of Hafren Dyfrdwy, our water resource zones have been amended to reflect the new company boundaries. Part of the Dee Valley historic Chester and Wrexham WRZs now lie in the Severn Trent WRMP and part of Severn Trent Water's Shelton zone and all of the Llandinam and Llanwrin zone now form part of Hafren Dyfrdwy region. These changes are to reflect the national boundaries and are not because of changes to connectivity in our supply system, hence customer's water supplies will remain the same and a legal agreement is in place between the two companies for the import and export of water. Figures 4 and 5 show the original Dee Valley and Severn Trent Water boundaries and new Hafren Dyfrdwy and Severn Trent company boundaries respectively.

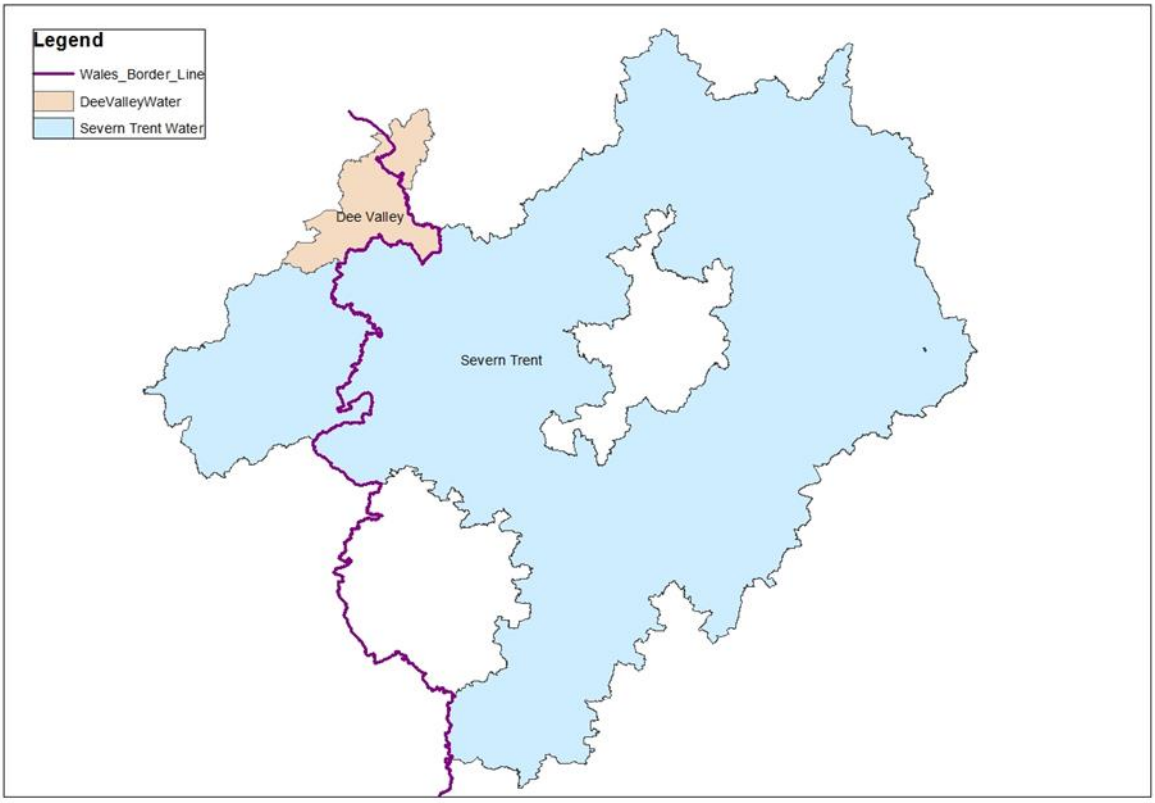


Figure 4 - Historic Dee Valley Water and Severn Trent Water boundaries

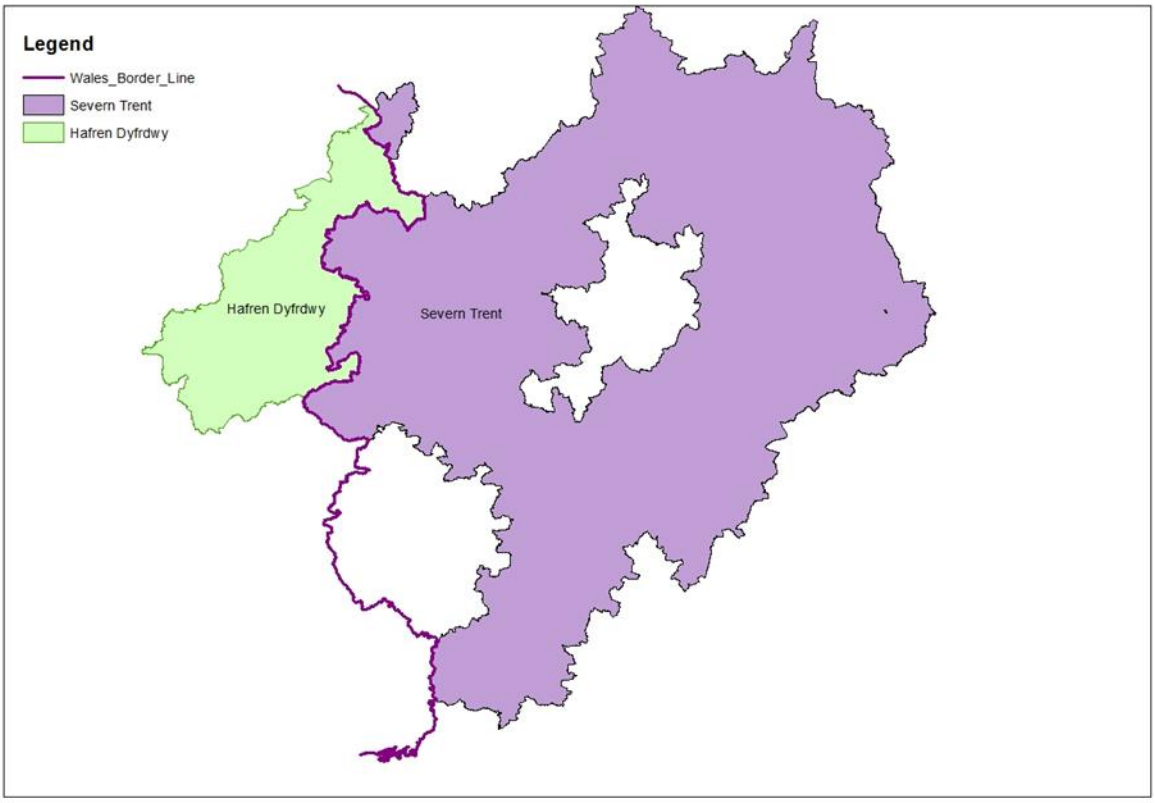


Figure 5 - New Hafren Dyfrdwy and Severn Trent Water company boundaries

Detailed analysis of the water resource zones affected by the company boundary changes has been undertaken. This included a review of the company boundaries, original resource zones, sources of supply and customer connections. In line with our WRMP19, this plan reflects the changes and reports on the new four WRZs – Wrexham, Saltney, Llanfyllin and Llandinam & Llanwrin (Figure 6).

We are required to 'define' our WRZs and agree these with NRW and the EA. For this definition process, there are a number of factors to consider, but the starting point is the definition provided by these regulators that a WRZ "describes an area within which, managing supply and demand for water is largely self-contained (apart from defined bulk transfers of water); where the resource units, supply infrastructure and demand centres are linked such that customers in the WRZ experience the same risk of supply failure". The main factor we have to consider is that significant numbers of customers should not experience different risk of supply failure in a zone. We met with EA and NRW in autumn 2018 to share our approach and agree the new WRZs.

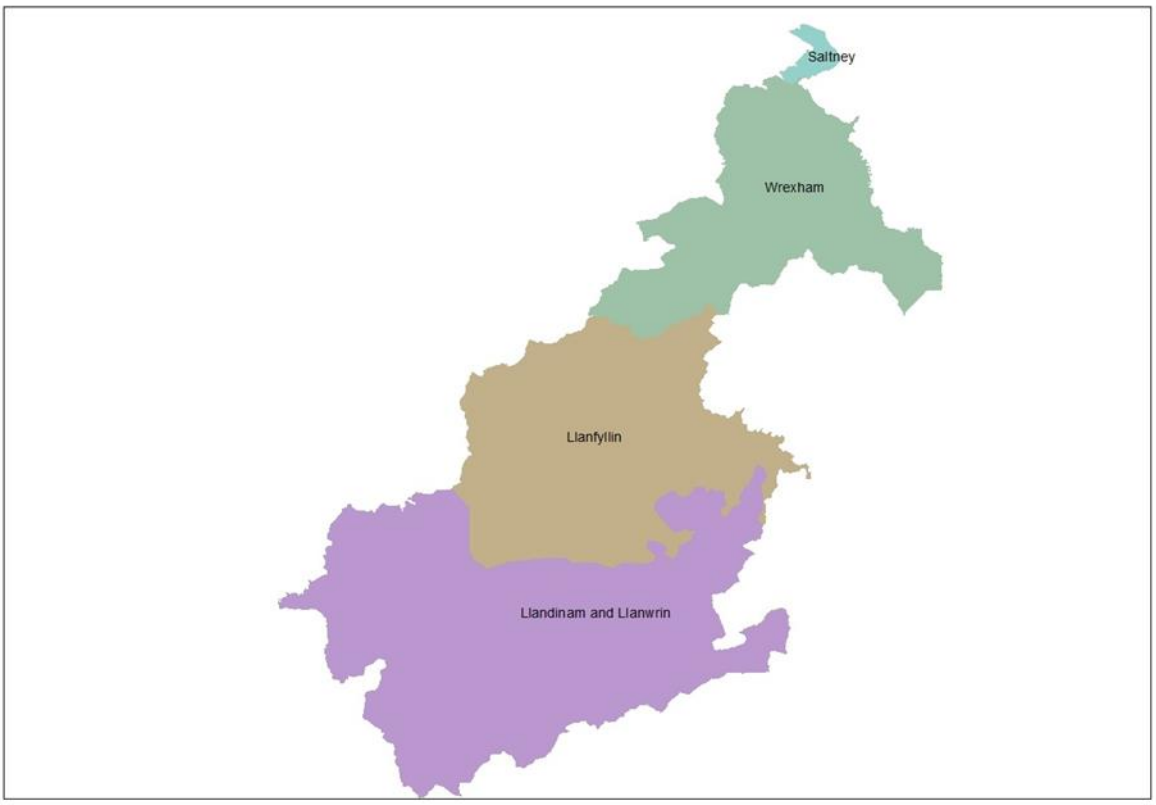


Figure 6 - Hafren Dyfrdwy water resource zones

1.4.2. Baseline water resources situation

Within our Water Resources Management Plan 2019 (WRMP19) we have described our baseline water resources situation, this is reviewed on an annual basis and reported to NRW. Over the twenty five years which WRMP19 covers, we are not projecting a deficit in the supply-demand balance. Therefore we do not have any options to develop new or existing resources.

NRW's River Dee Catchment Abstraction Management Strategy (CAMS) provides an overview of catchment water resource availability within the Supply Area and for some adjoining water supply areas not under our operation.

We also report a Security of Supply Index (SoSI) to regulators on an annual basis. This index is a measure that shows whether we are complying with our duty to safeguard the security of our water supplies. The SoSI does this by assessing the extent to which we can guarantee our planned level of service. Our current SoSI is 100 out of a maximum of 100.

1.4.3. Levels of service

Our planned level of service is to implement a TUB no more frequently than one in forty years. As part of the 2019 price review process we surveyed our customers to better understand their attitude towards the level of service which we provide. Although customers were willing to see a reprioritisation of investment and a lower level of service, such as a higher frequency of TUBs, the reduction in bills would be minimal and perhaps jeopardise future levels of service. Therefore, on balance we propose to maintain the current level of service that our customers receive as we do not believe it is acceptable to allow levels to reduce.

We consider that rota cuts, stand pipes and tankering of water to our customers are unacceptable as a response to a drought. Therefore, although these measures are listed in the Drought Plan, they are a response to an emergency situation rather than a drought.

1.5. Consultation

1.5.1. Pre-draft

Between the 19th November and 31st December 2018 we carried out a pre-draft Drought Plan consultation process with our major stakeholders who included Consumer Council for Water (CCWater), NRW, Environment Agency (EA), Ofwat, Welsh Government, Severn Trent Water, United Utilities and Dŵr Cymru Welsh Water. The aim of the pre-draft consultation process was to obtain our stakeholders views on the previous plan, so that we could use these to shape and improve this plan. During this consultation process, various areas of the drought plan have been discussed particularly with NRW, which were used in shaping and improving the plan. The issues discussed include:

- Drought vulnerability assessment for our water resource zones
- Drought resilience modelling
- Supply side drought management actions - augmentation of the River Dee with water from our Lower Pen-y-Cae Reservoir

- Geographical area supplied by HAFREN DYFRDWY and our new water resource zones
- Updates to control curves for our upland reservoirs in the Wrexham water resource zone

A number of improvements have been made to the Drought Plan to reflect these discussions, legislative and regulatory changes that have occurred since the previous plan, and to comply with the latest guidelines and codes of practice. These changes include:

- Drought vulnerability assessment has been carried out for our water resource zones in line with the latest NRW Water Company Drought Plan Technical Guideline issued in December 2017 and the associated guidance notes.
- Revisions to reflect the geographical area supplied by HAFREN DYFRDWY and our new water resource zones.
- Control curves for our upland reservoirs in the Wrexham water resource zone have been updated, which was carried out in line with our WRMP19.
- Our proposed drought management and communication plan has also been updated. This details how we will manage droughts and communicate with our customers and other stakeholders during a drought situation.
- A Water Framework Directive report has been produced and our Strategic Environmental Impact Assessment Screening Report and a Habitats Regulations Assessment Screening Report have been updated to identify any potential adverse effects that the drought options we have considered may have on the environment.

1.5.2. Draft

We published our draft Drought Plan 2019 and the accompanying Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and Water Framework Directive (WFD) Environmental Reports for consultation in July 2019. The consultation period has ended on 6th September 2019. We encouraged a wide range of stakeholders to respond to our draft Drought Plan. We received comments on our draft Drought Plan from two stakeholders.

We received representations from the following organisations:

Organisation	Abbreviation
Natural Resources Wales/Cyfoeth Naturiol Cymru	NRW
Cheshire West and Chester Council	-

Following on from the consultation process we amended our draft Drought Plan incorporating all the responses that we received. The points below are a summary of what we have done to address the above responses:

- Include an overview of what discussions were made during consultation stages and how these influenced the development of the drought plan (section 1.5).

- Provide details on the practical implementation of the method of water abstraction from the Lower Pen-Y-Cae Reservoir for flow augmentation (section 3.4).
- Update our drought plan to include detailed monitoring plan to assess the implementation of the supply-side drought management action (flow augmentation from the Lower Pen-Y-Cae Reservoir) (section 4.2 & 4.3).
- Included a method to monitor groundwater levels and provided trigger levels that will be used to trigger drought management actions for the Llandinam and Llanwrin WRZ (section 2.4).

We have now produced this final Drought Plan incorporating all the representations that we received from the consultation process. A detailed list of all the representations along with our proposed actions have been included in a document entitled 'DRAFT DROUGHT PLAN 2019 STATEMENT OF RESPONSE' and has been published on our website[5] in October, 2019.

The Welsh Government have now given their consent for us to publish our final Drought Plan along with supporting documents.

[5] https://www.hdcymru.co.uk/content/dam/hdcymru/about-us/drought-plan/hd-drought-plan-statement-of-response-2019.pdf

2. Drought triggers and scenarios

2.1. General

The River Dee is regulated through the Dee General Directions by the Dee Consultative Committee. Our biggest water resource zone, Wrexham WRZ, is heavily dependent on the River Dee which supplies 87.1% of the total requirements in the zone. This equates to 61% of our total company level raw water supply requirement and consequently our Drought Plan is mainly dictated by the Dee Drought General Directions. The Dee General Directions are explained further in sections 2.2 and 2.3.

Our upland reservoirs comprise approximately 5% of our supply and feed in to the Wrexham Resource Zone. We operate these in conjunction with the Dee Storage System on the principle of keeping them as full as possible for as long as possible. The purpose of this is to provide reserve storage in the event of a drought or other incident affecting the supply from the Dee. The remaining 4 % of supply into Wrexham zone is provided by a spring at Llangollen.

Llandinam and Llanwrin WRZ is supplied by boreholes. Neither Saltney nor Llanfyllin WRZs have their own water sources and are supplied solely via bulk supply transfers from Severn Trent Water.

2.2. Dee General Directions

The River Dee in north Wales is the most highly regulated river in Wales. Its regulation, using Llyn Tegid, Llyn Celyn and Llyn Brenig Reservoirs, is covered by Section 9 of the Dee and Clwyd River Authority Act 1973. Llyn Celyn and Llyn Brenig Reservoirs are owned and operated by Dŵr Cymru Welsh Water in accordance with a section 20 agreement. NRW manage the releases made on a day to day basis for the scheme, which supplies water to over 2.5 million people.

In a drought, the Dee Drought General Directions define the principles and detail the conditions under which the prescribed flows and abstractions in the catchment must be reduced. These Directions were last updated in June 2016. They are subject to the approval of the Dee Consultative Committee, which is constituted under the 1973 Act. The Committee comprises representatives from NRW, EA, United Utilities, Hafren Dyfrdwy, Severn Trent Water, Dŵr Cymru Welsh Water, Canals and Rivers Trust.

2.3. Surface water triggers

2.3.1. River source drought triggers

As supply of water for our Wrexham resource zone is so heavily dependent on the River Dee, we regard the availability of water in the Dee as the fundamental operational measure of a drought situation in this zone. This means that the triggers and drought management actions for the Wrexham resource zone are those set out in the Dee Drought General Directions, in conjunction with monitoring the storage in the impounding reservoirs that we operate.

The Dee Drought General Directions specify the principles and detail under which the prescribed flows and abstractions must be reduced in a drought. During Normal General Direction the target is to achieve a minimum residual daily mean flow over Chester Weir of 4.2m3/s (362.88 Ml/d). Chester Weir residual flow is calculated using flows measured at Chester Suspension Bridge by an ultrasonic flow gauge less abstraction taken by United Utilities from the Chester Weir intake.

The abstraction point belonging to Hafren Dyfrdwy is at Bangor on Dee near Wrexham. Figure 9 shows a schematic view of the Bangor on Dee intake and how it feeds in to our Wrexham zone supply system.

From historic data, a system conservation curve and a series of drought management curves (see Figure 7) have been developed which indicate the level of storage within the Dee Storage System and thus how much can be safely abstracted.

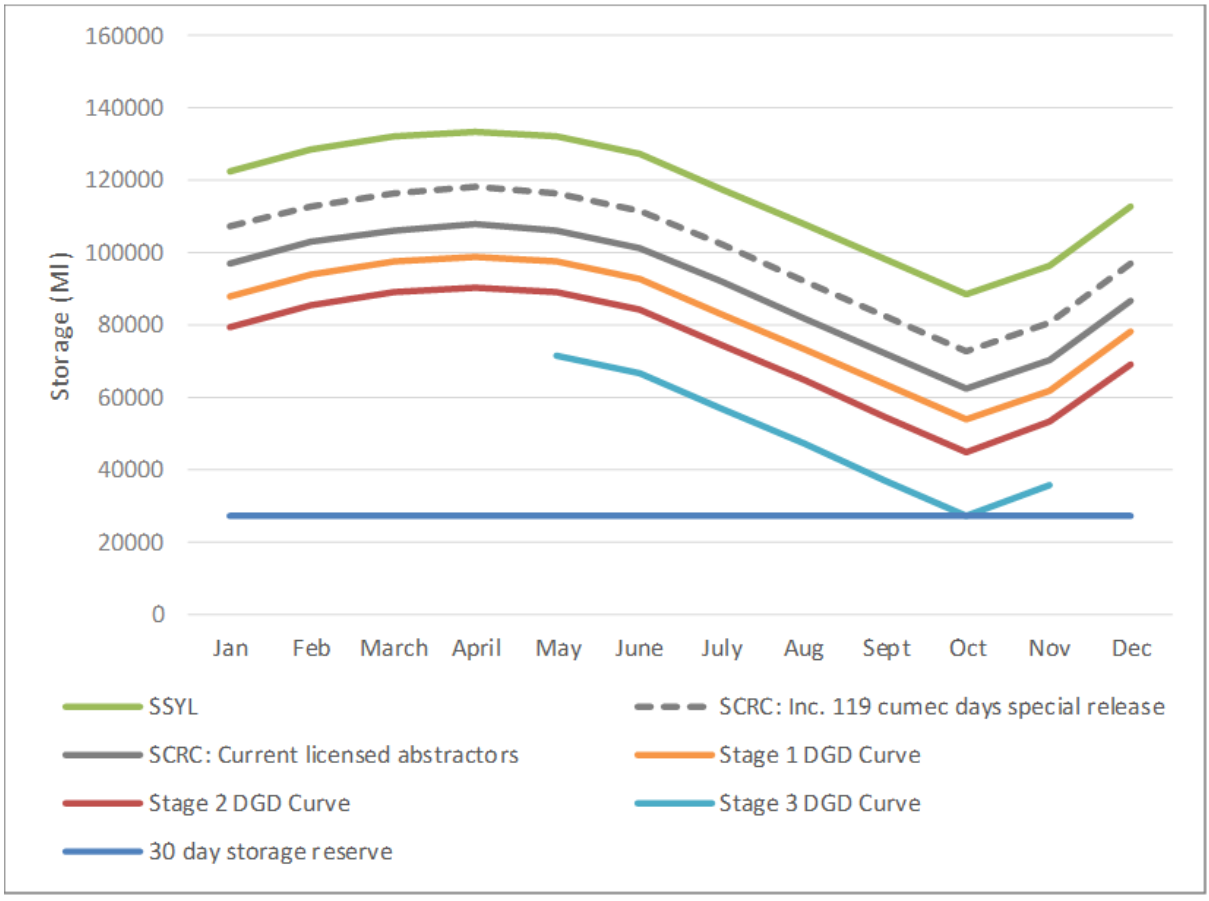


Figure 7 - Dee Storage System conservation rule curve and drought management curves

The DGD details both our gross and net abstraction associated with the River Dee. The gross abstraction relates to how much we can take out of the river at our abstraction points and does not consider how much water is returned downstream following the sewage treatment process. Net abstraction is equal to the gross abstraction less the water which is returned downstream following the sewage treatment process. For our Bangor on Dee abstraction, it is assumed that 90% of the water abstracted is returned to the river through the Five Fords

STW. Table 1 shows how the Wrexham WRZ allowable abstractions vary depending on the level of storage within the Dee Storage System.

Abstraction Regime	Bangor on Dee / Twll Abstraction Limit (Ml/d)
Above system safe yield line	45.5
Safe yield allocation	41.5
Stage 1 cutbacks	41.5[6]
Stage 2 cutbacks	41.5[7]

Table 1 - Wrexham WRZ abstraction agreements

Above System Safe Yield Line

At times of unsupported river flow, and times when the total storage in Llyn Celyn and Llyn Brenig are above the 'System Safe Yield Line' (SSYL), we are allowed to abstract within our authorised abstraction limits.

Trigger 1 – Crossing of System Safe Yield Line

At times when the river is supported and when the total storage in Llyn Celyn and Llyn Brenig has crossed the SSYL but is above the System Conservation Rule Curve' (SCRC) we are required to restrict our abstraction to the 'Safe yield allocations'.

Trigger 2 – Crossing of System Conservation Rule Curve

When the storage in Llyn Celyn and Llyn Brenig falls below the SCRC, Drought General Directions maybe introduced. When the system is expected to fall below this curve, the Dee Consultative Committee will meet to discuss the implementation of the Stage 1 Drought General Directions. This meeting must take place within seven days of the storage falling below the SCRC. The general principle of operation of Stage 1 Drought General Directions is that any reduction in residual flow over Chester Weir below 4.2m3/s should be matched by an equivalent reduction in net abstraction by designated abstractors.

Trigger 3 – Crossing of Stage 1 Implementation Curve

When the system reaches the Stage 1 implementation curve the amount of water we are able to abstract at Bangor on Dee is reduced by 0.2Ml/d. Table 1 shows the stage 1 maximum gross allocation. The gross allocations are dependent on how we choose to make the required abstraction reductions (either supply side, demand side or river augmentation). We must ensure the required reductions in abstraction are delivered within 7 days of crossing the SCRC, or such later date as the Dee Consultative Committee may determine.

Our chosen means of implementing the reduction in abstraction of 0.2Ml/d will be by augmenting the River Dee with the same volume from our Lower Pen-y-Cae Reservoir. Similarly, additional 0.2Ml/d will be augmented to the River Dee to account for the reduction

[6] Based on augmentation of 0.2 Ml/d from Lower Pen-y-Cae to implement the DGD abstraction cutbacks at Bangor on Dee

[7] Based on augmentation of 0.4 Ml/d from Lower Pen-y-Cae to implement the DGD abstraction cutbacks at Bangor on Dee

in the Severn Trent Water's abstraction at Barrelwell Hill abstraction in Chester WRZ. A raw water transfer has been agreed between Hafren Dyfrdwy and Severn Trent to enable the implementation of reduction in abstraction at Barrelwell Hill abstraction through augmentation from our Lower Pen-y-Cae Reservoir. Based on the scenario modelling we have done so far, we have considered the five worst historical droughts on record and we believe that we could provide the necessary augmentations under all these conditions. The only restrictions we have on this source are those of the abstraction licence which limit us to taking a maximum annual volume of 2.49Ml/d or a maximum daily volume of 3.41Ml/d. We still have further work to do in relation to the augmentation of the River Dee with water from Lower Pen-y-Cae Reservoir to finalise the exact details of how it will be carried out in practice, which are discussed in detail in sections 4 and 7.

When the storage falls below the Stage 1 implementation line the Dee Consultative Committee will again meet to discuss the implementation of Drought General Directions Stage 2. As with Stage 1 the meeting must be within seven days of the storage falling below the Stage 1 implementation line.

Trigger 4 – Crossing of Stage 2 Implementation Curve

When the system reaches the Stage 2 implementation curve we have to make further reductions in the amount of water we abstract. The reductions are equivalent to those made during Stage 1, 0.2Ml/d each at Bangor on Dee and Barrelwell Hill abstractions. We must ensure the required reductions in abstraction are delivered within 2 days of crossing the Stage 2 implementation curve, or such later date as the Dee Consultative Committee may determine. Stage 2 drought measures are only expected to occur with a frequency of around one in forty years.

The further reduction in abstraction of 0.2Ml/d each at Bangor on Dee and Barrelwell Hill abstractions will be through the same means as for Stage 1 measures, augmentation of the River Dee from Lower Pen-y-Cae Reservoir. As indicated above, we still have further work to do to finalise the exact details of how the augmentation will be carried out in practice. Under Stage 2 regulation the River Dee will be regulated to less than natural flows.

Trigger 5 – Crossing of Stage 3 Implementation Curve

If the storage approached the Stage 3 curve despite the implementation of all the measures under Stages 1 and 2, the Dee Consultative Committee would meet to discuss the available options. The trigger line for Stage 3 measures has never been crossed in any of the historic drought sequences modelled for the Dee Storage System. Stage 3 drought measures would include introducing TUBs and applications for Drought Orders and Permits.

Any drought management actions that have been implemented will only be revoked when the Dee Storage System has returned to a normal status. This is equivalent to crossing Trigger 2 and moving above the System Conservation Rule Curve.

Figure 8 summarises the triggers and actions of the River Dee Drought General Directions.

Status	Trigger	Operational Action
Normal	Dee Storage System in Zone 1	Abstraction is only constrained by licence conditions / Lift restrictions if entering zone as part of drought recovery.
	Trigger 1 – Dee Storage System crossing the System Safe Yield Line	Maximum abstraction must not exceed Safe Yield Allocation.
Developing Drought	Trigger 2 - Dee Storage System crossing the System Conservation Rule Curve	Dee Consultative Committee must convene within 7 days to discuss the implementation of Stage 1 Drought General Directions.
Drought	Trigger 3 - Dee Storage System crossing Stage 1 Implementation Curve	Net reduction in abstraction of 0.4Ml/d through the augmentation of the River Dee with water from Pen-y-Cae Reservoir. Dee Consultative Committee convenes within 7 days to discuss the implementation of Stage 2 Drought General Directions. Increased leakage management activities.
Severe Drought	Trigger 4 - Dee Storage System crossing Stage 2 Implementation Curve	Net reduction in abstraction of 0.8Ml/d through the augmentation of the River Dee with water from Pen-y-Cae Reservoir. Dee Consultative Committee convenes to discuss the implementation of Stage 3 Drought General Directions. Plan to implement Temporary Use Bans.
	Trigger 5 - Dee Storage System crossing Stage 3 Implementation Curve	Introduce and enforce Temporary Use Bans. Apply for Drought Orders. Implement Drought Orders

Figure 8 - Trigger and action diagram for the Dee Drought General Directions

2.3.2. Reservoir sources

There are two reservoir systems which supply the Wrexham Resource Zone: the Ty Mawr/Cae Llwyd/Pen-y-Cae Reservoir System and the Pendinas/Nant-y-Ffrith/Llyn Cyfynwy Reservoir System. Figure 9 shows the two reservoir systems and how they feed into the Wrexham Resource Zone.

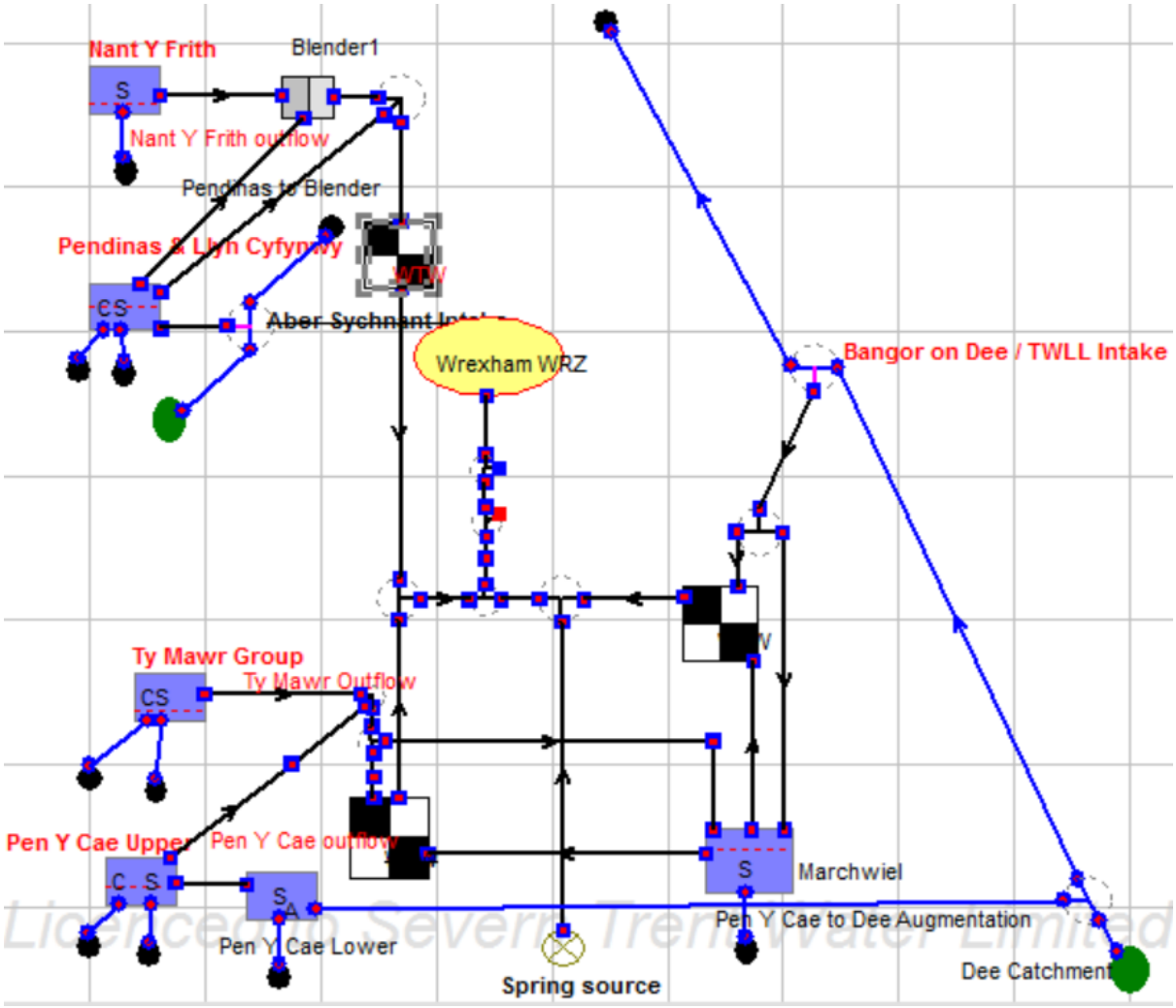


Figure 9 - Hafren Dyfrdwy upland reservoir schematic

We monitor the levels within our reservoirs by taking manual reading from depth gauges, which are then input into our data management systems.

The Ty Mawr/Cae Llwyd/Pen-y-Cae and the Pendinas/Nant-y-Ffrith/Llyn Cyfynwy Reservoir Systems within the Wrexham WRZ are operated in conjunction with the Dee Storage System on the principle of keeping the reservoirs as full for as long as possible. The reason for this is to provide reserve storage in the event of a drought or another incident affecting the supply from the River Dee.

The reservoir systems are managed using control curves, which help us to take appropriate drought management actions at the correct time. The control curves are used to constrain the output of a source depending on the storage relative to the specified curve. When storage falls below the relevant curve the maximum allowed abstraction from the reservoirs will be equal to the specified below curve take (BCT) (Table 2). Above the highest curve no restrictions are applied apart from the limits imposed by daily licences or hydraulic constraints. Where reservoirs had been aggregated (Pendinas and Ty Mawr systems) the curves were applied to the total storage in the group.

Reservoir yield modelling conducted as part of our WRMP19 modelling work has shown that the yield from the Nant-Y-Ffrith reservoir (0.59 Ml/d) was very close to the maximum abstraction capacity (0.60 Ml/d). Thus, no control curves are used at Nant-Y-Ffrith reservoir as no abstraction constraints were required.

In our WRMP19 Aquator modelling, Pendinas and Llyn Cyfynwy storages are aggregated as the water from both sources are equally accessible and are both equally vulnerable to drought conditions. Three control curves, which are named 3 Ml/d cc, 2.2 Ml/d cc and 2 Ml/d cc, will be used to operate the combined Pendinas and Llyn Cyfynwy storages with each control curve indicating levels below which maximum abstraction from the reservoirs is limited to 3 Ml/d, 2.2 Ml/d and 2 Ml/d respectively (Figure 10).

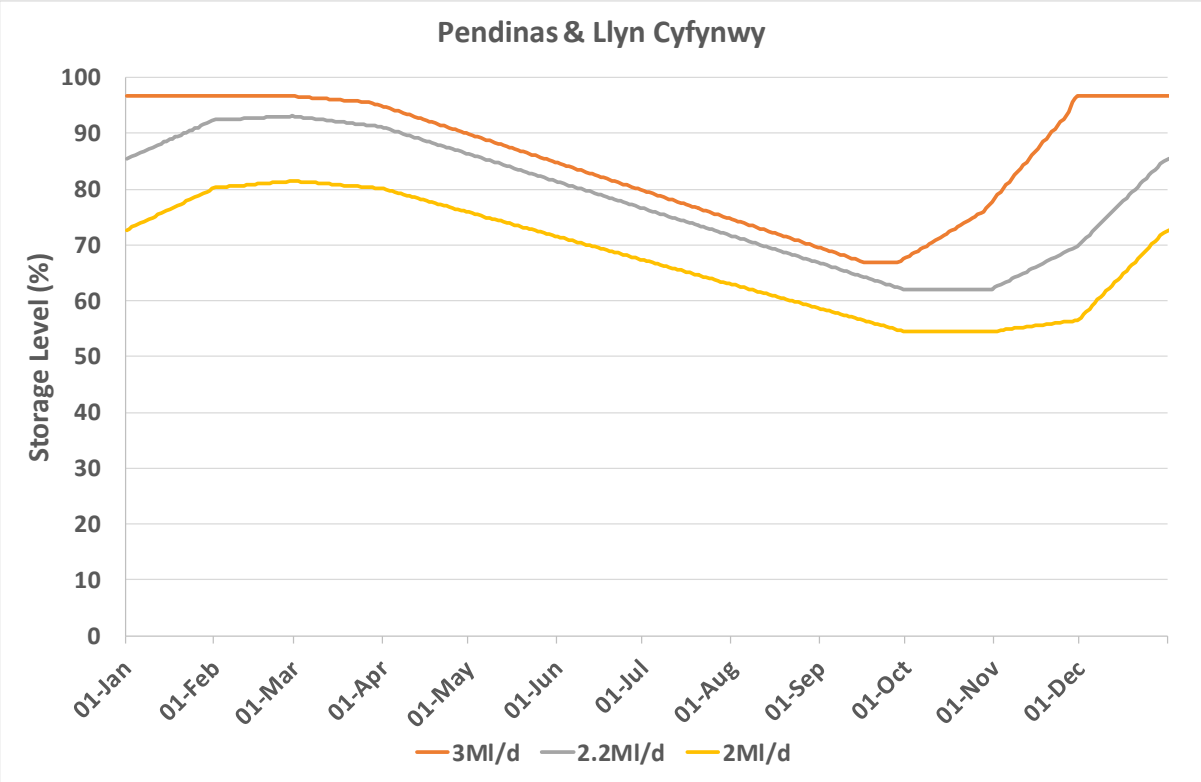


Figure 10 - Pendinas / Llyn Cyfynwy control curves in net storage

Similarly, storage in Ty Mawr and Cae Llwyd was aggregated as the water is equally accessible from both sources and are operated based on two control curves (9 Ml/d cc and 5.2 Ml/d cc), which specify storage levels below which maximum abstraction from the reservoirs is limited to 9 Ml/d and 5.2 Ml/d (Figure 11).

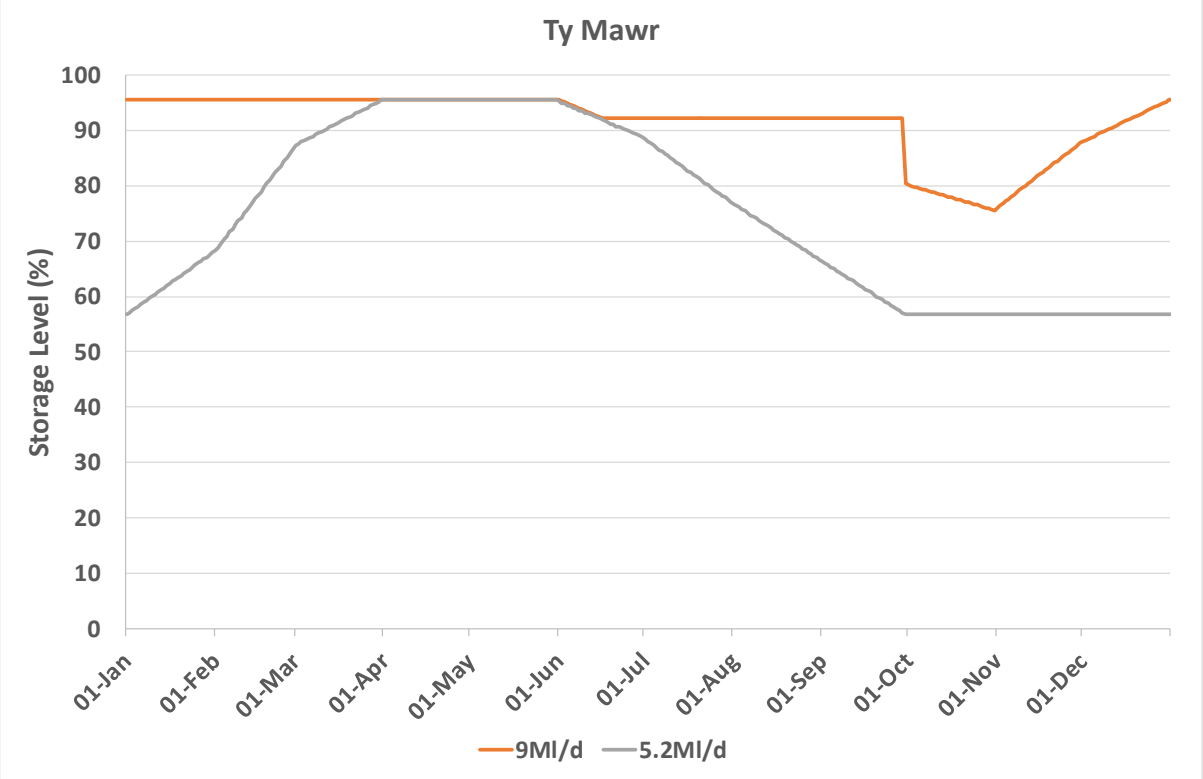


Figure 11 - Ty Mawr control curves in net storage

Pen-y-Cae upper reservoir will be operated using a single control curve below which abstraction from the reservoir is limited to 1.24 Ml/d (Figure 12). The Pen-y-Cae lower reservoir has a catchment area greater than that required to support its recharge and in addition does not have a compensation flow required as part of the abstraction licence. It is for this reason we propose using this reservoir to augment the River Dee during times of drought as per the Dee Drought Directions. See section 3.4 for more details of this supply side action.

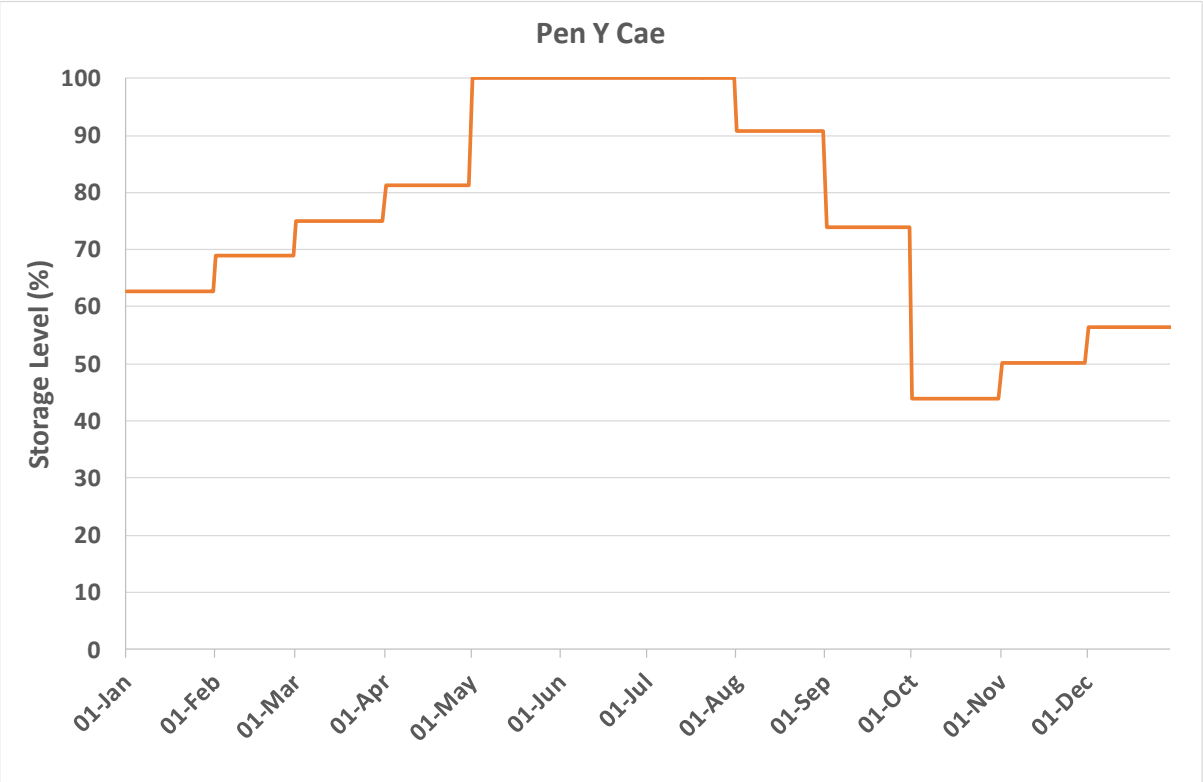


Figure 12 – Upper Pen-y-Cae control curve in gross storage

Computation of deployable output (DO) for our Wrexham WRZ was based on these control curves, which were implemented in our Aquator model and were used to constrain the output of the reservoir sources depending on the storage levels relative to the specified curves. Table 2 summarizes all the control curves used in the Ty Mawr/Cae Llwyd/Pen-y-Cae and the Pendinas/Nant-y-Ffrith/Llyn Cyfynwy Reservoir systems within the Wrexham Resource Zone and the amount of maximum abstraction allowed (below curve takes, Ml/d) when levels drop below the specified curves.

Reservoir	Curve name	Below curve take (Ml/d)
Nant-y-Ffrith	N/A - no curve used	
Pendinas/ Llyn Cyfynwy	3.0 Ml/d CC	3.0
	2.2 Ml/d CC	2.2
	2.0 Ml/d CC	2.0
Ty Mawr	9.0 Ml/d CC	9.0
	5.2 Ml/d CC	5.2
Upper Pen-y-Cae	Pen-y-Cae CC	1.24

Table 2 - Below curve takes

2.4. Ground water sources

Ground water sources constitute 34% of our total supply. These include a spring at Llangollen in Wrexham WRZ and boreholes in our Llandinam and Llanwrin WRZ.

The drought trigger levels for Llandinam and Llanwrin Water Resource Zone (WRZ) have been derived on a pro-rata abstraction licence basis of the combined annual licenced volume. The below table details the current Llandinam and proposed Llanwrin licences.

Licence number	Source	Annual Licence Limit (Ml/year)	Daily Licence Limit (Ml/day)	Annual Daily Licence Limit (Ml/day)
18/54/01/0175	Llandinam	6,588.00	24.00	18.00
Previously Exempt	Llanwrin	266.80	1.83	0.73
-	Total	6,854.80	25.83	18.73

Table 3 – Current Llandinam and proposed Llanwrin licences

It is of note that a licence application has been submitted for Llanwrin as the source was previously licence exempt, therefore, for the purpose of the derivation of drought trigger levels the proposed values in the licence application have been used.

The current Llandinam and proposed Llanwrin abstraction licences have been combined to create a combined total abstraction volume for which the drought trigger levels have been derived from. In total six drought trigger levels have been derived, creating six zones, A through F, with each zone relating to a number of drought management actions that are required to be implemented once crossed. Abstraction will be monitored and tracked against the drought trigger levels throughout the year and drought actions shown in Table 3 would be implemented as abstraction levels cross into different zones.

Derivation

Abstraction data from 1993 to 2015 has been analysed to understand abstraction licence usage across a wide dataset, including the high demand year of 2006. Following the analysis trigger levels shown in Figure 13 were derived based on a percentage of the pro-rata licence use and professional judgement. As the risk of implementing drought actions is low at the start of the year (beginning the 1st April), the starting volume for each drought trigger level was set to a percentage of their pro-rated licence use of the 3rd month (June). This was to clearly separate the drought trigger levels at the start of the year and prevent unnecessarily triggering drought actions. The drought trigger levels then followed a linear trajectory to the end of the year (ending the 31st March) until they reached their total pro-rated licence with the exception of drought trigger level E. For this drought trigger level once the annual licence limit was reached the trigger level was set to the annual licence limit. The trigger levels have taken into account demand factors, which were applied to reflect the seasonal variation in demand across the year i.e. higher demands in the summer months and lower demands in the winter months.

Figure 13 below presents the drought trigger levels derived for the Llandinam and Llanwrin WRZ and for reference the total combined licence. For the purpose of presentation the top of drought trigger level F has been set as a maximum of 130% of the pro rata licence use (8,911.2Ml), but zone F drought management actions will apply if pro rata licence use rises above this level.

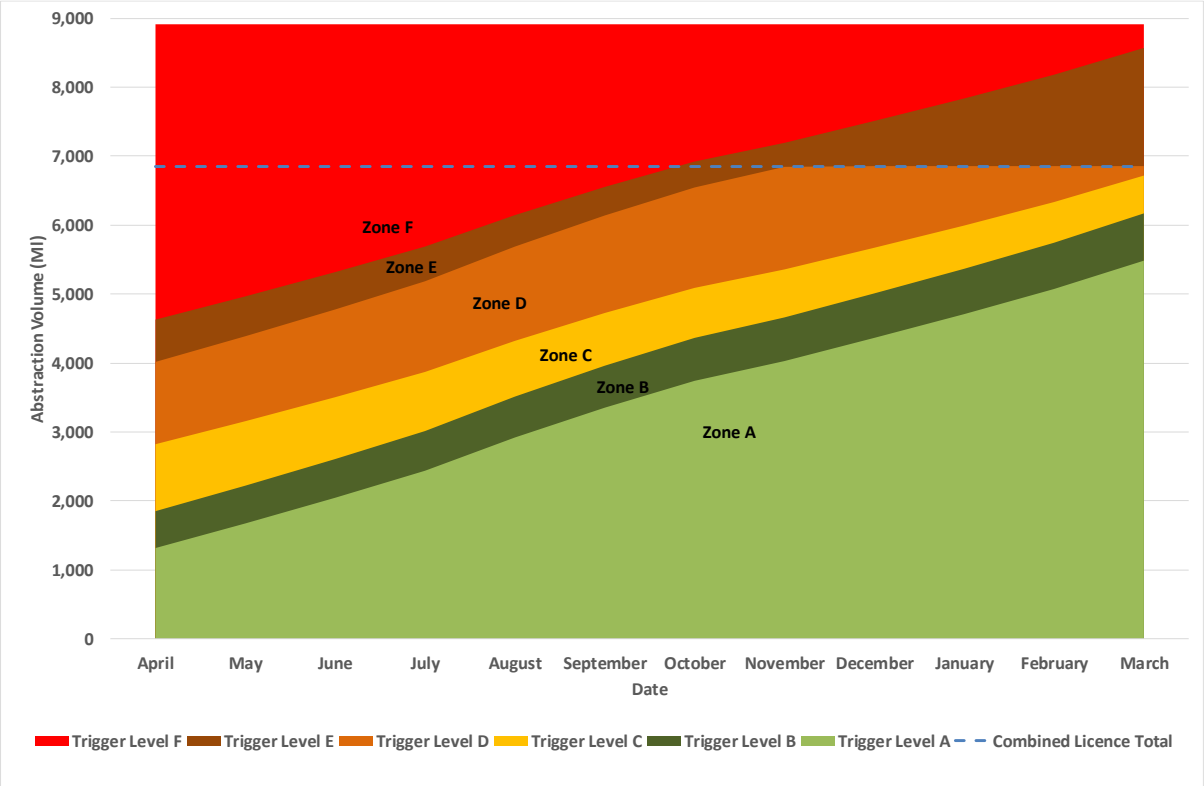


Figure 13 – Llandinam and Llanwrin WRZ groundwater trigger levels

The drought trigger levels have also been tested using a 'worse than a high demand year' scenario (scenario – 1 in Figure 14). The scenario applied an additional demand between June and October to the highest demand year in the dataset, 2006, and was based on 95th percentile rate daily rate of change recorded in 2006, which equated to an extra 2.83Ml/day. Additionally for reference the 2018/19 abstraction data was included to determine what level of drought management actions would have been triggered during the 2018/19 drought. The below chart illustrates the results of the scenarios against the drought trigger levels.

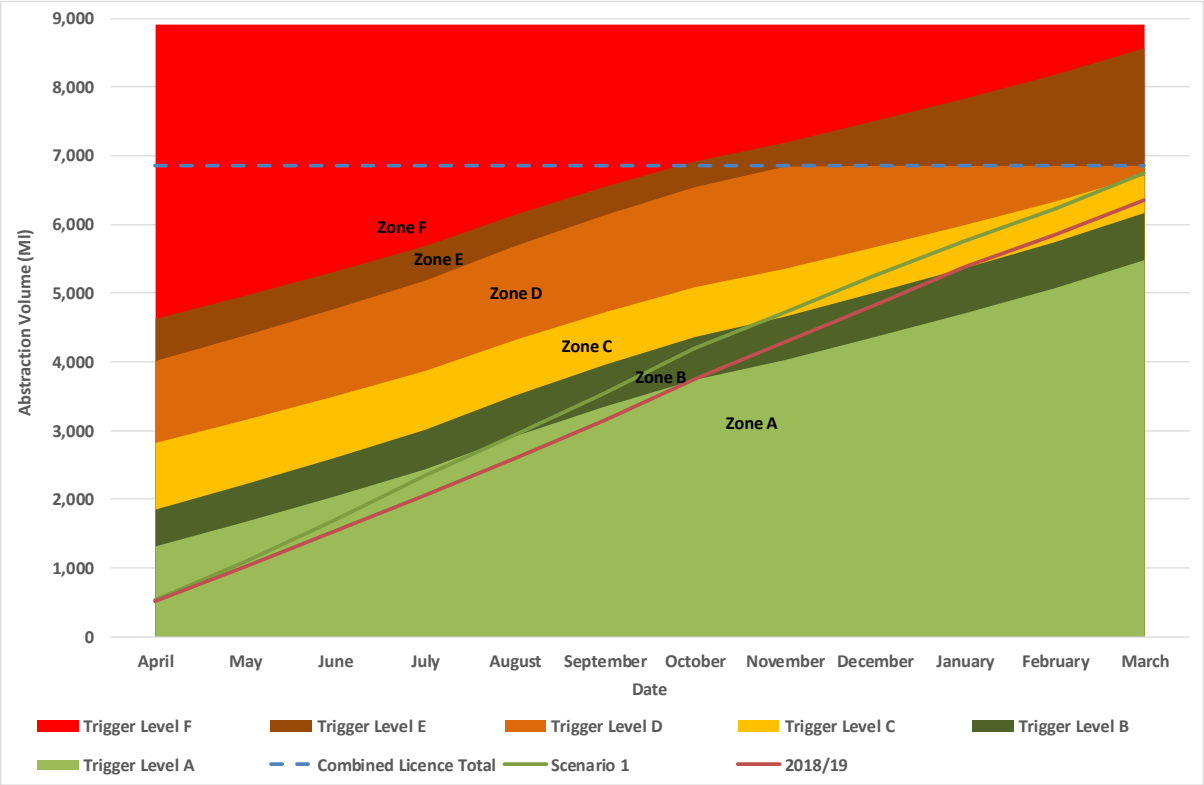


Figure 14 – Drought scenarios used to test Llandinam and Llanwrin WRZ groundwater trigger levels

As observed in the chart with the additional demand over the summer months the overall combined licence is not exceeded, however, drought trigger level D was briefly crossed in March. It is of note that the scenario does not take into account any drought actions that would be implemented to reduce demand. In the scenario the average daily abstraction rate was 18.48Ml/day, 1 Ml/day greater than the average abstraction rate recorded in 2006 (17.48Ml/day), and 0.25Ml/day less than the average daily combined licence rate. While this scenario is plausible it is considered to be unlikely to occur as abstraction rates have decreased since 2006/2007 by approx. 7%, with an overall decreasing trend. With regards to the 2019 data, while it was considered to be a high demand year, only drought trigger level C was crossed and when compared with the historic data set, 2006 still remains the highest demand year.

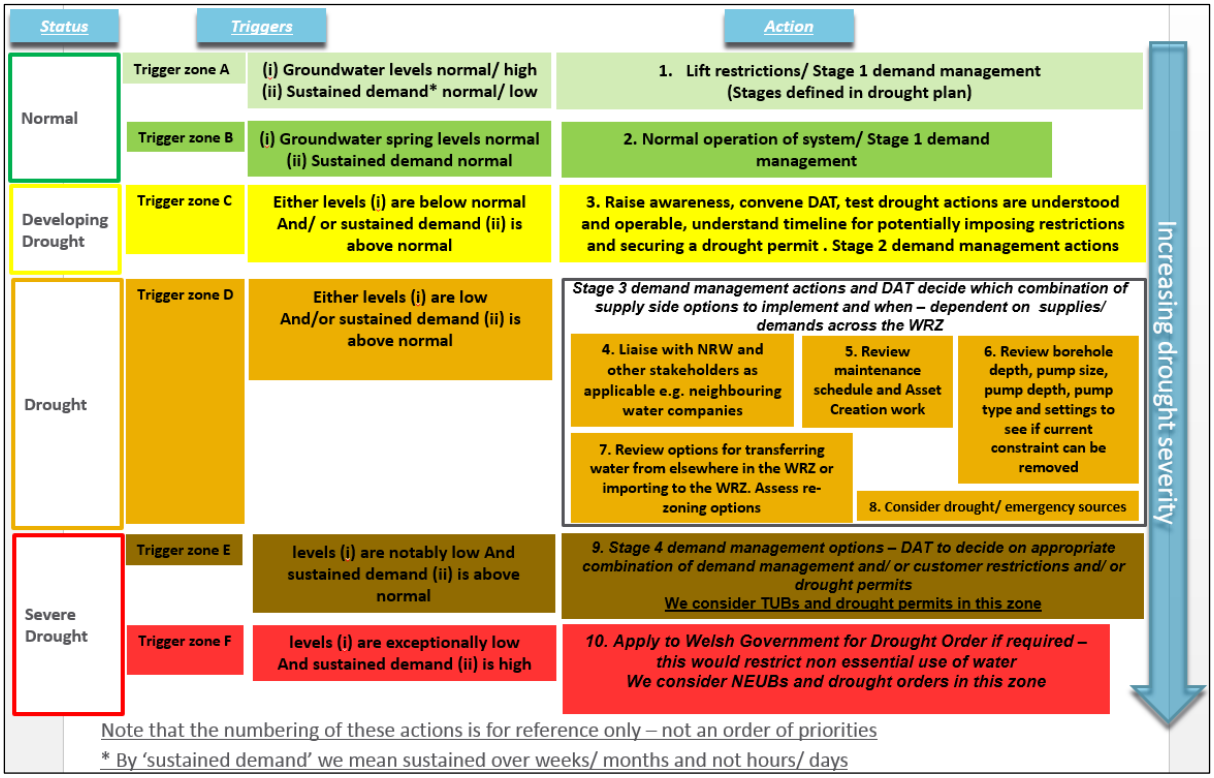


Figure 15 - Decision flow chart showing drought triggers and management actions for the Llandinam and Llanwrin WRZ

The mechanism that we use to manage groundwater drought risk involves a combination of monitoring, expert judgment and decision making. We consider the present and forecast conditions and how effective any action would be. The decision flow chart in Figure 15 illustrates this process. We would not expect a single low level to trigger significant drought management actions. Groundwater sources have a determined minimum reliable output and in most cases drought actions are dictated by an increase in local demand beyond this level or the deteriorating performance of other assets/storage. The process for monitoring groundwater and making decisions applies to all of our groundwater sources.

We use a combination of telemetry and manual dips to monitor our groundwater sources. We also use external sources of information on groundwater levels to monitor approaching drought conditions. For example, we use information from the Centre for Ecology and Hydrology (CEH) or NRW websites that show the groundwater picture for our region. We use data from regionally representative observation boreholes to support our drought indicator monitoring. When levels in observation boreholes start to cross into "below normal" conditions (as detailed in the Water Situation Report), we inform our Drought Action Team (DAT). We have some flexibility in how we operate groundwater sources. Most of our pumps are 'fixed speed' which means that the instantaneous flow is constant but we can vary the number of hours in a day that we operate them for. If demand increases in a dry year we would expect to run these pumps for longer to maintain levels in our service reservoirs. We

also switch between individual groundwater sources to meet demand and react to outages and other operational factors such as cost, which gives us some level of flexibility within the WRZ. When the drought risk is heightened we present groundwater level information to our DAT on a map to show where the risks to supply from our groundwater sources are greatest. When our groundwater team notices any drought problems relating to our groundwater they raise these concerns at our DAT.

As part of our PR19 work we have validated and updated groundwater DOs and source performance diagrams (SPDs) for our boreholes in the Llandinam and Llanwrin WRZ. These SPDs plot operational and drought water levels against site output. They help to provide a qualitative assessment of risk. We have included an example SPD below for one of the Llandinam Boreholes:

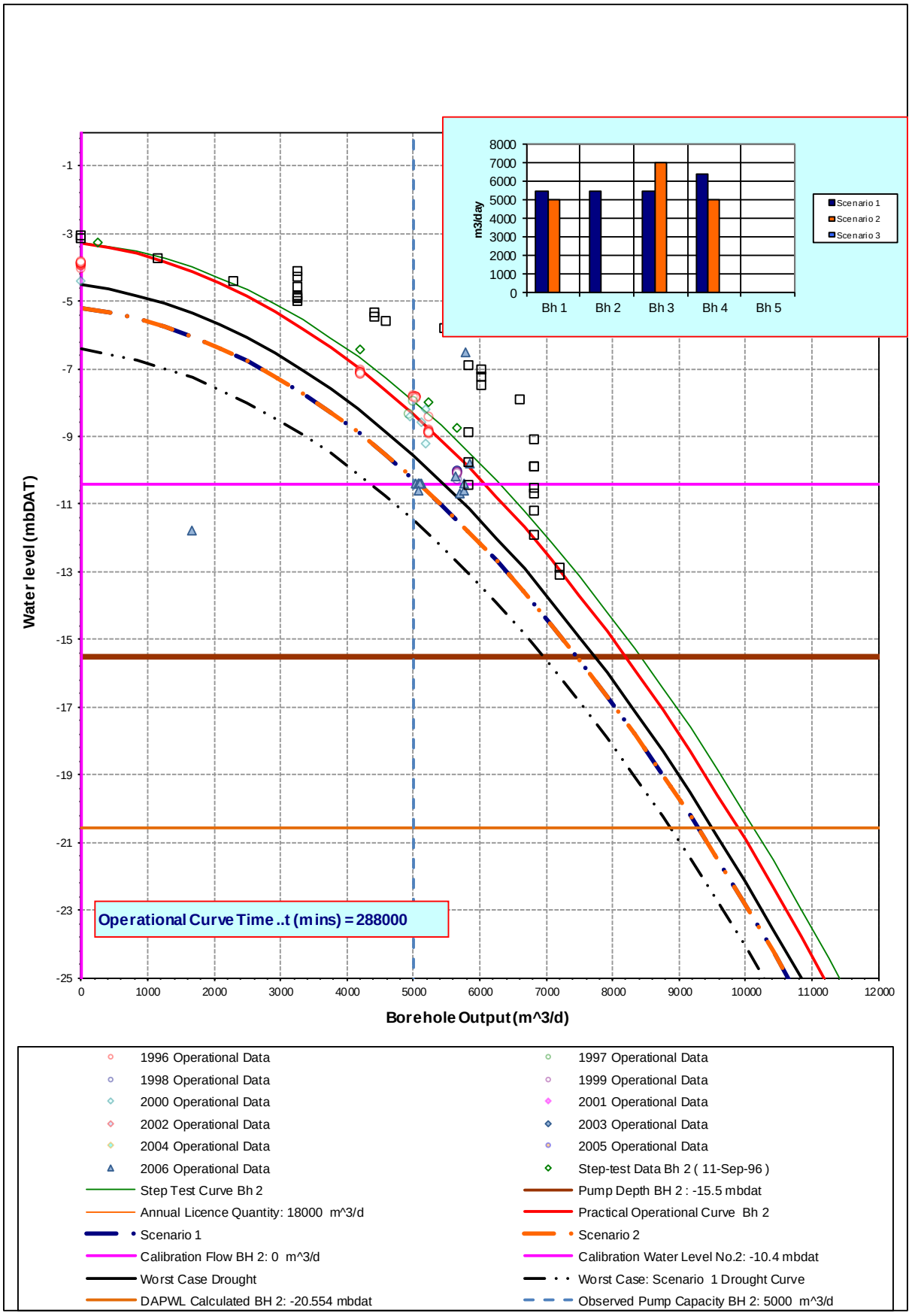


Figure 16 - Illustrative source performance diagram (SPD) – borehole in Llandinam and Llanwirn WRZ

This SPD is for a borehole in the Llandinam and Llanwrin WRZ. The transition from zone A to F on the SPD is not absolute as the performance of many groundwater sites is dependent on the operational use of the borehole. The predicted drought curve (and trigger levels) may be influenced by the number of boreholes in operation, the duration of pumping, the pumping rates at that specific time and also regional influences.

The difference in water levels observed at the assets in this WRZ is known to be approximately 0.7m between normal and drought conditions. As such even in the worst forecast drought scenarios the sources will still be limited by infrastructure capacities and not resource constraints.

In most cases, even if groundwater levels fall below the drought bounding curve, the output of the source will not decline. For example, where the source is licence constrained; groundwater levels may fall tens of metres below the drought bounding curve before the constraint changes from being the licence, to being a physical aquifer constraint (such as Deepest Advisable Pumped Water Level).

For our groundwater DO assessments we have followed current best practice. This is as outlined in both the 1995 UKWIR A Methodology for the Determination of Outputs of Groundwater Sources (95/WR/01/2) and 2000 UKWIR Unified Methodology for the Determination of DO (00/WR/18/1). We have assessed our groundwater sources' DO in the worst drought season and the worst case drought week. We have taken this approach for all of our groundwater sources in the Llandinam and Llanwrin WRZ. Assessment of the Llandinam and Llanwrin zone in our WRMP19 indicates that given the location of the Llandinam source adjacent to the River Severn, it could be sensitive to the impacts of climate change and therefore potentially also drought as the boreholes are in hydraulic continuity with the river.

Clywedog Reservoir, the key regulation reservoir used to help maintain statutory flow requirements at Bewdley on the River Severn is in close proximity of Llandinam, approximately 11 km upstream. Compensation releases are made from Clywedog throughout the year. Regulation releases up to 500Ml/d are made during April to October when flows at Bewdley begin to drop. If appropriate, flood drawdown releases are also made from the reservoir during the winter months. Given the scale of releases and the proximity to the reservoir it was assumed that the river gravels would be well supported under drought and extreme drought events.

2.5. Drought scenarios

We have considered a wide range of drought scenarios in this plan. In our WRMP19 modelling we've used drought scenarios in historical records that included flows across our region from 1927 to 2015. During this period, the North West of England and North Wales suffered a number of droughts differing in severity and geographical coverage. The following historic droughts were most severe in our supply area and Dee Drought Direction measures would be required if the same sequences were to be repeated:

- 1933/34 – Two season drought lasting from August 1933 to October 1934
- 1937/38 – Two season drought lasting from October 1937 to October 1938

- 1976/77 – Single season drought lasting from August 1976 to January 1977
- 1984 –Single season drought lasting from July to September 1984
- 1995/96 – Single season drought lasting from October 1995 to March 1996

NRW have modelled the Dee Storage System to predict how the system would respond to a historic drought using records going back to 1927. With current levels of abstraction, Stage 3 restrictions would never have been required whilst Stage 2 restrictions would only have been required for seven drought sequences over the historical record. Figure 17 shows when the measures would have been required.

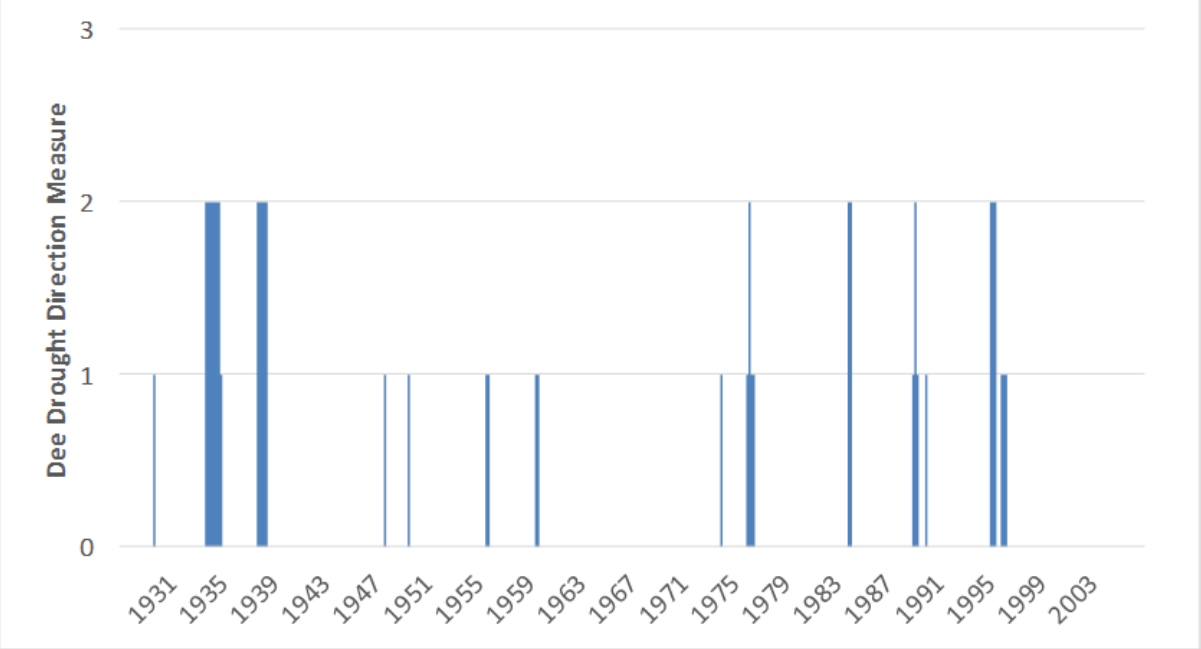


Figure 17 - Historic implementation of Dee Drought Direction measures

In this plan we have looked at what the impacts might be if we were to experience a more severe drought than these observed in the historical record. Occurrences of more extreme droughts in our region than the droughts we currently plan for could lead to emergency measures such as standpipes in the street or rota cuts for our customers. As discussed above, stage 3 restrictions would never have been required during the historical record period and we do not plan for rota cuts or standpipes. In an extremely severe drought we would consider using them but we do not have a planned frequency for this level of service.

We have used various techniques to investigate how our water resource system copes with a variety of droughts including a range of severities and durations. Section 3.4 of the current NRW's Water Resources Planning Guidelines (WRPGs) states that:

"As a minimum you should assess your plan against the worst drought on record."

In our case this includes droughts observed between 1927 and 2015. In this drought plan, our drought resilience assessment approach considers not only the worst droughts in the 1927 to 2015 record but also covers more challenging but plausible range of droughts using the following methodologies:

- Drought response surfaces (we describe what these are in section 2.5.1).
- Stochastically generated drought scenarios (we describe what these are in section 2.5.2)

2.5.1. Drought Response Surfaces

The UKWIR Report Ref No 17/WR/02/12 (Drought Vulnerability Framework), provides a summary of the approach and methods that can be used to generate Drought Response Surfaces (DRS). DRS are currently being promoted by the EA and NRW and the Drought Vulnerability Framework states that *"DRS are intended to provide visual representations of the interactions between:*

- *The rainfall deficit that occurs over a given drought duration (in 6 month increments from 6 to 60 months) at different levels of severity.*
- *The timing of the start and finish of the drought.*
- *The drought stress that occurs on the system as a result of the above, expressed in terms of the number of days where either abnormal restrictions on demand might be expected, or where Drought Orders and Permits might be implemented."*

More importantly, the use of DRS provides information on the most critical level of drought duration and timing for a given water resource zone. The impact of a given rainfall deficit on a particular water resource system increases as the duration of rainfall deficit increases. However, the probability of the occurrence of a certain rainfall deficit decreases as the duration of deficit period increases. The probabilities associated with the rainfall duration-deficit bands have been analysed and presented in the DRS as shown in Figure 18 below. The developed DRS therefore shows the level of water resources stress that occurs in each deficit/duration cell of the matrix associated with the probability that a given combination of deficit and duration would occur. This has also helped to identify droughts with statistically implausible duration/ deficit combinations. The stress on water resource systems caused due to the drought duration/ deficit combinations are represented in the DRS using 'number of days' failure metric, which describes either abnormal restrictions on demand might be expected, or where Drought Orders and Permits might be implemented.

We have used the approach outlined in the drought vulnerability framework report to develop DRS, which were used to illustrate how our water resource systems vulnerability varies according to drought duration and rainfall deficit. The use of DRS to present drought vulnerability analysis has enabled us to show the impact on customers of droughts with different durations and rainfall deficits (severities). A rainfall deficit is a way of expressing how much drier a drought is compared with average conditions. For example, if a certain six month period has half as much rainfall than long term average we would refer to this as a 50% of long term average (LTA) rainfall deficit. This is illustrated in Figure 18 below, where each box represents a different drought scenario. For example, the box in the bottom right represents the exceedingly unlikely scenario in which there is less than 5% of long term average rainfall for 48 months (4 years). In contrast the box in the top left is the much more likely scenario of having 95% of long term average rainfall for six months

In Figure 18 below colour coding is used to present the 'number of days' failure metric. Statistically implausible deficit/ duration combinations are greyed out on the response surface. The boxes shaded from yellow to dark red indicate the number of days that either abnormal restrictions on demand might be expected, or Drought Orders and Permits might be implemented under each drought scenario. As described in section 2.3, drought management actions in the Wrexham WRZ would be implemented based on storage levels in the Dee Storage System crossing triggers. Thus, we have developed DRS for the Wrexham WRZ based on the Dee Storage System dropping in to emergency storage, which is used to estimate number of days of failure as described in the drought vulnerability framework. NRW's River Dee Aquator model along with stochastically generated weather data for the River Dee catchments are used to produce the DRS for the Wrexham WRZ. Llandinam and Llanwrin WRZ has low vulnerability to drought, and is not typically constrained by water level but by other constraints, such as pump depth, due to the nature of the sandstone aquifers (see section 2.4 on groundwater sources) and we consider that producing DRS for this WRZ would be disproportionately complex. We also have not produced DRS for Llanfyllin and Saltney WRZs as both are bulk import zones.

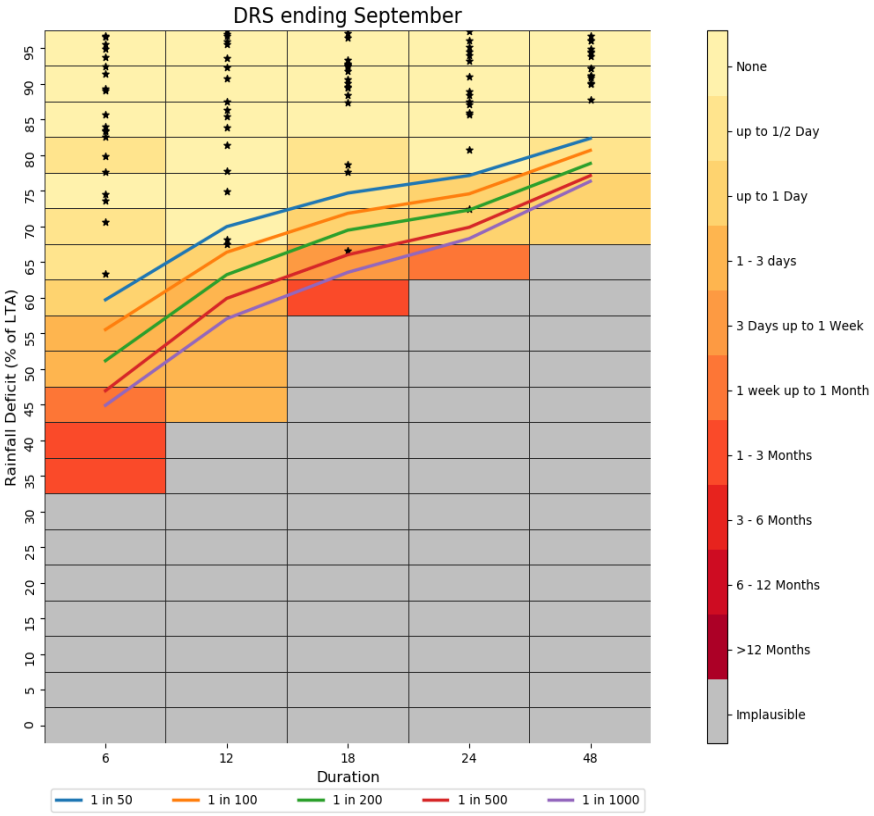
Demand levels on the River Dee system that represent all abstractions from the River Dee is set based on safe yield maximum abstraction; cutback levels are applied for various drought stages as specified in the DGD. Under normal conditions, abstractors are likely to take less than the maximum allowable abstraction capacity. Thus, setting the demand based on the maximum allowable abstraction limits would adequately account for the significance of drought risks on the River Dee system posed by the plausible drought ranges.

DRS are created for droughts ending in a pre-specified month, which is aligned to the most likely system failure point. For reservoir storage based system this is considered as the end of the draw-down period. Based on discussion with NRW, and analysis of the stochastic model results, DRS were created for droughts ending in September and October, as shown in Figure 18. The probability/deficit curves for each drought duration were generated by calculating the deficit for each duration in each year of the stochastic data set and then ranking in order. As there are a large number of data points to estimate the distribution of the rainfall data, no curve fitting was required and return periods are directly estimated. Rainfall deficits for selected return periods were then estimated for each duration, which is used to define the plausibility of drought scenarios specified by the various deficit/ duration combinations and inform the development of the DRS.

A rapid Catchmod model is used to generate daily flows using the stochastic potential evapotranspiration and rainfall records. The flow data from all the five River Dee catchments were then fed into the River Dee Aquator model. The Aquator model was run at the above specified level of demand, which represents all abstractors from the River Dee, and the durations the Dee Storage System stays below the emergency storage curve (the number of failure days) were reported for every year.

All the stochastic years are then allocated into rainfall deficit bands based on total rainfall over the specified drought durations. The sum of the number of failure days for all the years

that fall in the same deficit bands are then divided by the total number of years in the same deficit band to determine average number of days failure for each deficit/duration cell of the DRS. We plotted the results of this onto a grid using a range of colours to represent the impacts of the various drought scenarios. We added additional information to the DRS to show the characteristics of past significant droughts (Figure 18). This information provides useful context for how plausible the synthetic drought scenarios are compared to observed events.



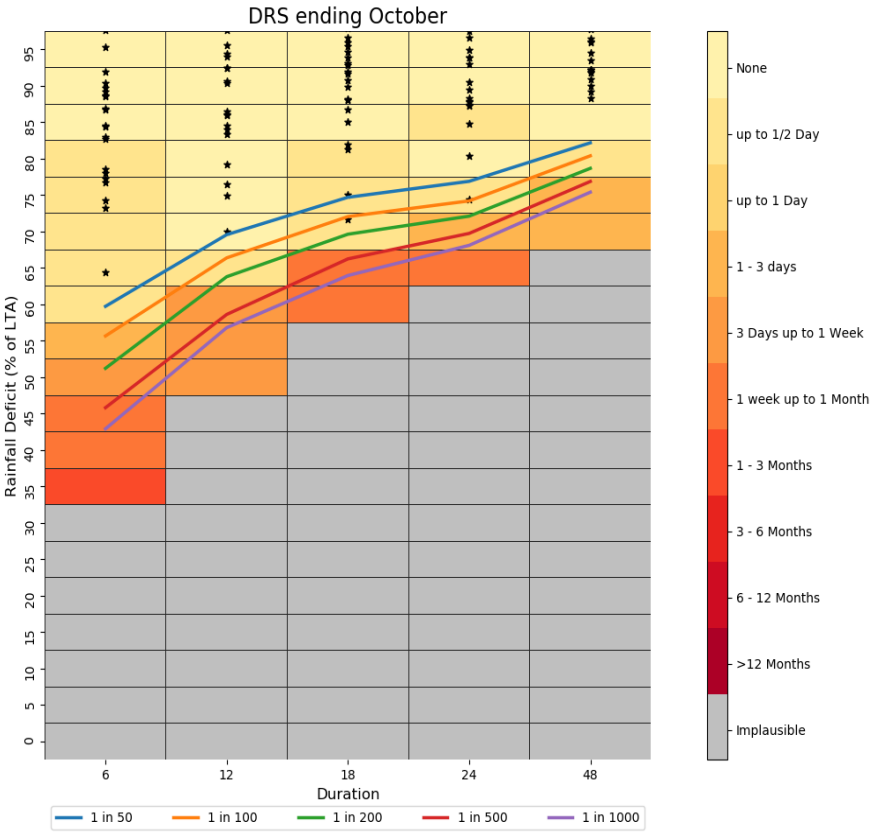


Figure 18 - Drought response surfaces for the Dee storage system

As can be seen in the DRS there are failures at more severe rainfall deficits / return periods in droughts of all durations. There are also some indicated failures at less severe deficits / return periods. However, in contrasting these results with the other outputs presented in this report, it is important to note two points:

1. The return period contours refer to a rainfall metric and not system response (i.e. frequency of reaching emergency storage). The characteristics of the catchment and physical supply system, as well as the timing of events, often means there is a degree of disconnect between the rainfall metric and system response metric.
2. The number of days of failure shown on the DRS is the average number of days of failure for all the stochastic drought scenarios that fall in the same rainfall deficit/duration grid. Hence, the variability in the occurrences of each drought scenario mean that different droughts with varying impacts (number of days of failure) on the system can be categorized in the same rainfall deficit/duration grid in the DRS. For example, an 18 months 70% LTA rainfall drought can have a very dry first 12 months and very wet last 6 months leading to a failure being recorded in the first 12 months, whereas a similar 18 months 70% LTA rainfall drought scenario can have a constant 70% LTA rainfall throughout the 18 months resulting in no failure being recorded. Consequently, some of the historical droughts are observed to fall in rainfall deficit/duration grids in the DRS that show some number of days of failure even if these historical droughts have not resulted in system failures.

2.5.2. Stochastic Drought Scenarios

In order to test how our water resources system responds to droughts that are worse than those observed in our baseline analysis we adopted an additional approach. The approach we selected was the creation of a number of stochastically generated drought 'what if' scenarios that haven't happened but plausibly could. The WRMP 2019 Methods – Risk Based Planning: Guidance (UKWIR, 2016) has informed the techniques we have used to develop these scenarios. We created 200 'what if' drought scenarios using a stochastic weather generator. This is 17,400 years of stochastic dataset, which can be considered as 200 alternative versions of the historic record. Stochastic weather generation is a modelling technique which uses the relationship between climate drivers and our observed rainfall data over the 20th Century. A rapid Catchmod model is then used to generate daily flows using these 17400 years of stochastic potential evapotranspiration and rainfall data. As a check, flow duration curves (FDCs) were generated for each of the River Dee catchments using both the stochastically generated flow and the historic flow sequences exported from the NRW Aquator model. As shown in Figure 19 below the fit between stochastically generated flow and historic flow data is very strong in all catchments.

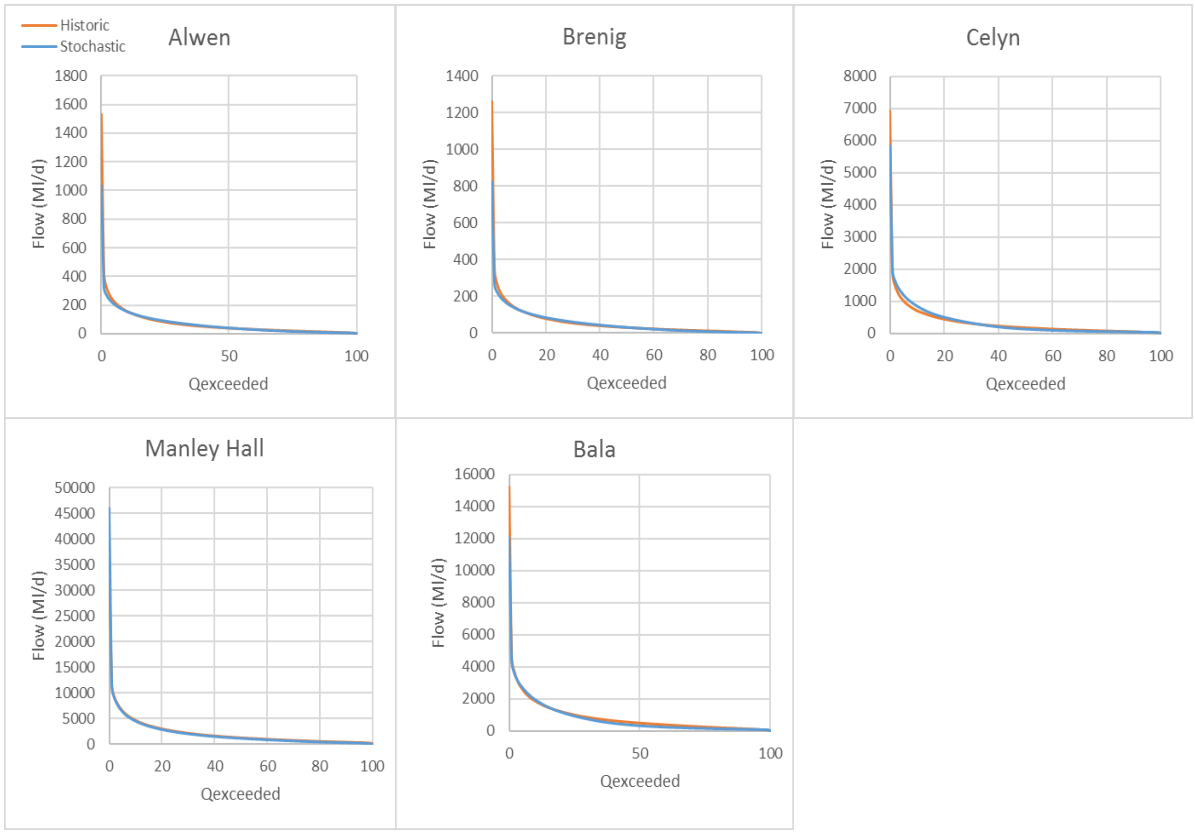


Figure 19 - Comparison of River Dee catchment stochastic and historic FDCs

The stochastically generated flows are then fed into the River Dee Aquator model, which was run to determine the corresponding daily Dee General Directions (DGD) permitted abstractions (safe yield or the stage 1 / 2/3 cut-backs). This time-series identifies periods of safe yield abstractions and stage 1/2/3 cutbacks across the stochastic years. Unlike previous climate change assessments undertaken by NRW, the DGD maximum yield, safe yield and cut-

back amounts were not adjusted. The stochastic dataset is generated based on the same climatic conditions as the historic dataset (Figure 19), therefore there is no rationale to change any of the current DGD rules in the model.

We retained the NRW model assumption that all Dee abstractors always take their maximum DGD entitlement. In reality this is not the case as abstractors also take into account operational rules and costs. However, drought resilience modelling based on all Dee abstractors always taking their maximum DGD entitlement would help to account for the risk that might be caused by other abstractors altering their operating practices in the future.

Time-series of maximum / safe yield abstractions and cutback periods over the stochastic years were then loaded into the HD Aquator model as a boundary condition (i.e. available River Dee flow). The results from the River Dee Aquator model stochastic run have showed that, Wrexham WRZ abstractions from River Dee won't be affected by availability of water in the River Dee even under extreme drought conditions. However, whilst Wrexham WRZ is dominated by supply from the River Dee, its drought resilience can be affected by other sources and the ability of Lower Pen-Y-Cae reservoir to augment the River Dee during drought events. In order to assess severe droughts, revised inflow sequences were also required for each of the reservoirs in the Wrexham WRZ. For our WRMP19 DO modelling, these flow time series for the Wrexham reservoir catchments were generated by sampling flow duration curves (FDC) from Low Flow Enterprise and a local gauge (67005 Ceiriog at Brynkinalt Weir). A similar approach was used to sample stochastic flows for the catchments of Wrexham upland reservoirs using the Dee stochastic record, the Dee stochastic flow duration curve and the Wrexham extended flow duration curve. Sampled stochastic flows for the Wrexham upland reservoir sources have showed that these sources have a high level of drought resilience, but not quite matching that of the River Dee. As such, low flow conditions during plausible drought events are likely to constrain the Wrexham DO rather than asset capability/ licences.

Half of the stochastic dataset (8700 years of data) was run through the Wrexham WRZ Aquator model using the Scottish Method DO analyser in Aquator to derive the relationship between demand and frequency of failures (DO vs return period), as shown in Figure 20. The modelling results indicate that for a range of drought scenarios between 1 in 44 years return period (our current DO of 51.2) and 1 in 500 years return period (DO = 49.04) there is a small reduction in DO of 2.2 Ml/d. The 1 in 200 years return DO is 50.11 Ml/d, which is higher than the total of the highest dry year demand, target headroom and outage over the planning period for the Wrexham WRZ (46.44 Ml/d). The results do not include TUB and/or NIUB demand savings described in the DGD Stage 3 demand management actions. Thus, implementation of demand restrictions when the Dee Storage System drops into stage 3 is expected to provide higher DOs for each return periods and hence increase the resilience of the resource zone to droughts.

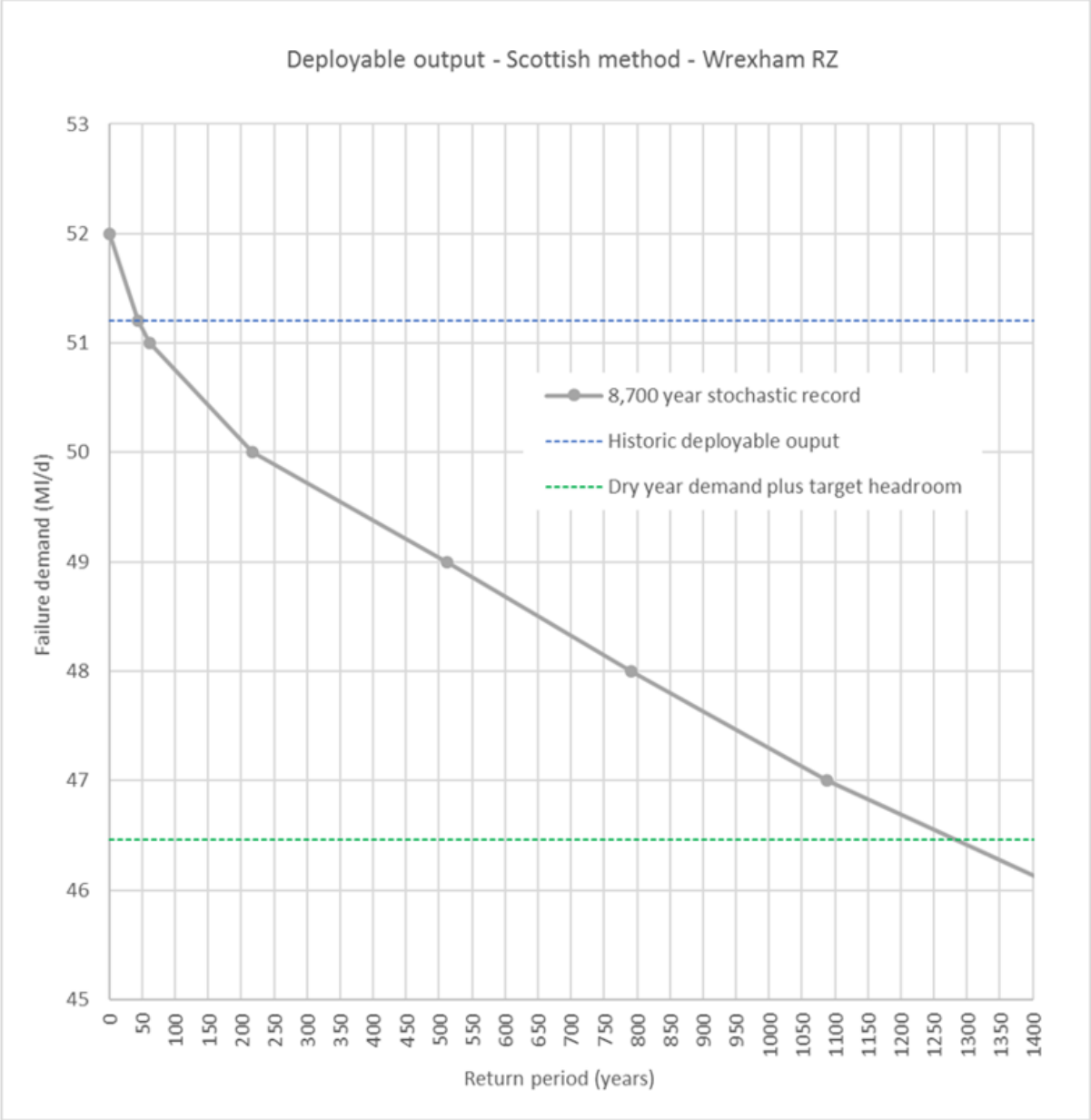


Figure 20 - Return periods of deployable outputs estimated using stochastic modelling

2.6. Testing our drought triggers

Modelling various drought events including those on the observed record and synthetic droughts provides us with a number of scenarios to test our drought triggers and proposed actions. The following two sub-sections present plots of modelled reservoir storage data with our drought trigger zones for the Ty Mawr/Cae Llwyd/Pen-y-Cae Reservoir System and the Pendinas/Nant-y-Ffrith/Llyn Cyfynwy Reservoir System, using various drought scenarios. Each drought event has unique characteristics which allow us to evaluate how our drought triggers and proposed actions perform under different scenarios. For this analysis we have selected an event from our baseline modelling period (1995/96) and a stochastically generated 1 in 200-year 24 month drought.

2.6.1. Baseline Data

Figure 21 below presents the modelled storage of the Ty Mawr/Cae Llwyd, Upper Pen-y-Cae, Pendinas/ Llyn Cyfynwy and Nant-y-Ffrith reservoir systems during the 1995/96 drought. These plots highlight the variation of drought impacts on our reservoirs with notable impacts on storage on the Ty Mawr/Cae Llwyd and Upper Pen-y-Cae Reservoirs. Even though no control curves are used at Nant-Y-Ffrith reservoir, storage levels have remained above 65% through the 1995/96 drought period with a minimum storage level of 65.6% reached on November 11, 1995. The relatively higher resilience at Nant-Y-Ffrith reservoir is mainly due to out flow from the reservoir being limited by the maximum abstraction capacity of 0.60 Ml/d, which is close to the yield from the reservoir (0.59 Ml/d). The combined Pendinas and Llyn Cyfynwy storage has dropped down to 60% in November 1995 and October 1996 during which it is observed to recover relatively quickly. The combined Ty Mawr/Cae Llwyd modelled storage dropped below 50% during periods from September, 1995 to January, 1996 and August to November, 1996 with a modelled minimum storage of 38.5% observed on November, 1995. Upper Pen-y-Cae modelled storage levels dropped below 50% in October 1995 for 11 days with a simulated minimum storage of 44.5% observed on October 30, 1995. Upper Pen-y-Cae storage levels are also observed to recover more quickly than Ty Mawr/Cae Llwyd storage levels following drought events, which indicates the relatively higher rate of inflows to the Pen-y-Cae reservoirs. DO calculation in our WRMP19 for the Wrexham WRZ was based on these control curves and the supply/demand balance is always positive over the period which this drought plan covers. In summary, this means that the amount of water that customers require, including a headroom allowance (to allow for uncertainties in estimates and climate change reductions), is always less than the amount of water available from our resources.

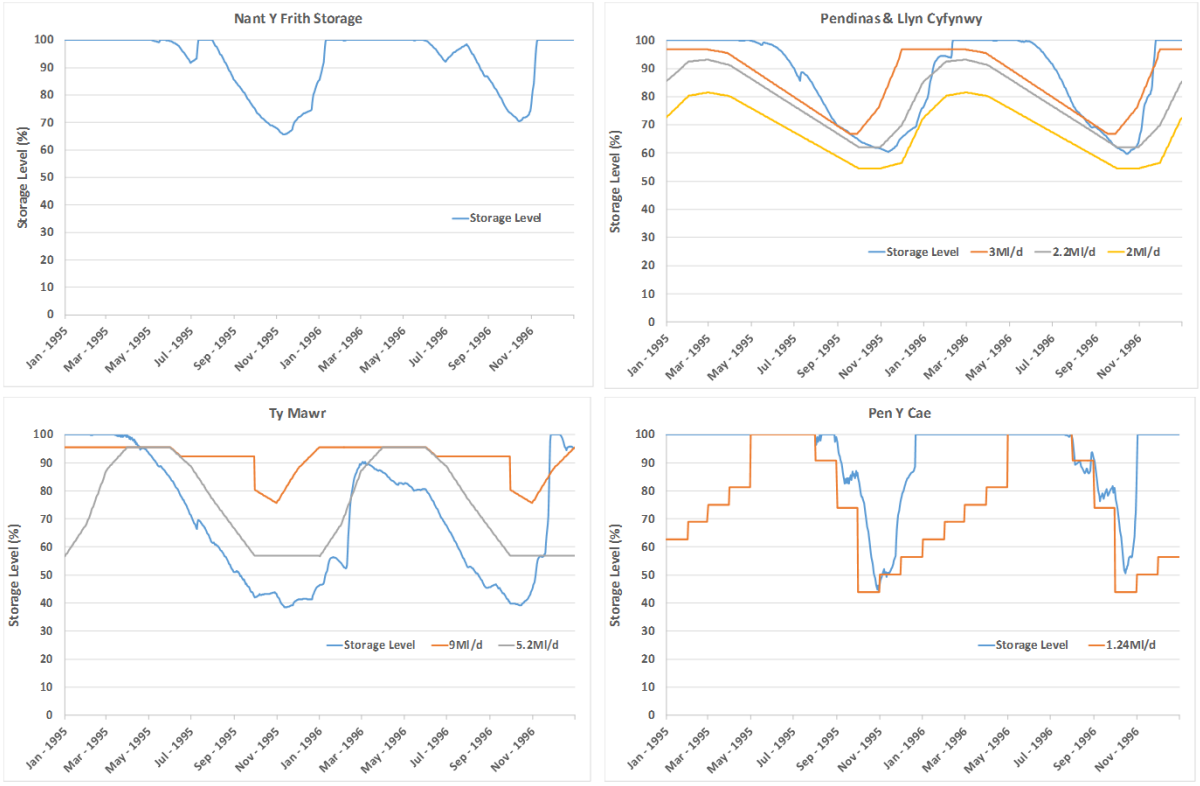


Figure 21 - Modelled reservoir storage and drought triggers for the 1995/96 drought

2.6.2. Stochastic Drought Scenarios

Figure 22 shows the modelled reservoir storage during a stochastically generated 1 in 200 - year return period 24-month drought (see section 2.5.2). A 24 month drought period with a 1 in 200 year return period for the River Dee catchment is identified from the stochastic rainfall data. Reservoir levels for our upland reservoirs in the Wrexham WRZ are exported for these 24 months (Figure 22) to assess how these reservoirs would have performed under a 1in 200 year return period drought. Drawdown in Nant-Y-Ffrith reservoir storage level has occurred between June to September in both drought years with a minimum storage level of 58.8% reached at end of September in the first year. The combined Pendinas and Llyn Cyfynwy storage has dropped below 70% in September of both years. The 3 Ml/d cutback would have been implemented only during the September in the first year of the drought. The combined Ty Mawr/Cae Llwyd modelled storage dropped below 50% during September in both years of the drought with a modelled minimum storage of 46%. Both the 9Ml/d and 5.2Ml/d cutbacks would have been implemented in drawdown periods that occurred in both years, which would help to recover storage levels. For Upper Pen-y-Cae reservoir, a sharp drop of modelled storage level is observed in the first year of the drought from August to early October and levels are observed to recover back to 100% very quickly. The relatively quick recovery of modelled storage levels observed at Upper Pen-y-Cae in both the 1995/96 drought and the 1 in 200 years 24 month drought is believed to be due to the large catchment that recharges Upper Pen-y-Cae and the relatively small capacity of the reservoir. In general, storage levels in all four reservoirs during the identified 1 in 200 year 24 month drought period is observed to be better than the 1995/96 drought, which is likely due to variations in the occurrence of

meteorological droughts that are known to define impacts of droughts on water resources/ storage levels. This highlights the need to directly assess impacts of droughts on level of service as addressed in section 2.5.2 of this drought plan.

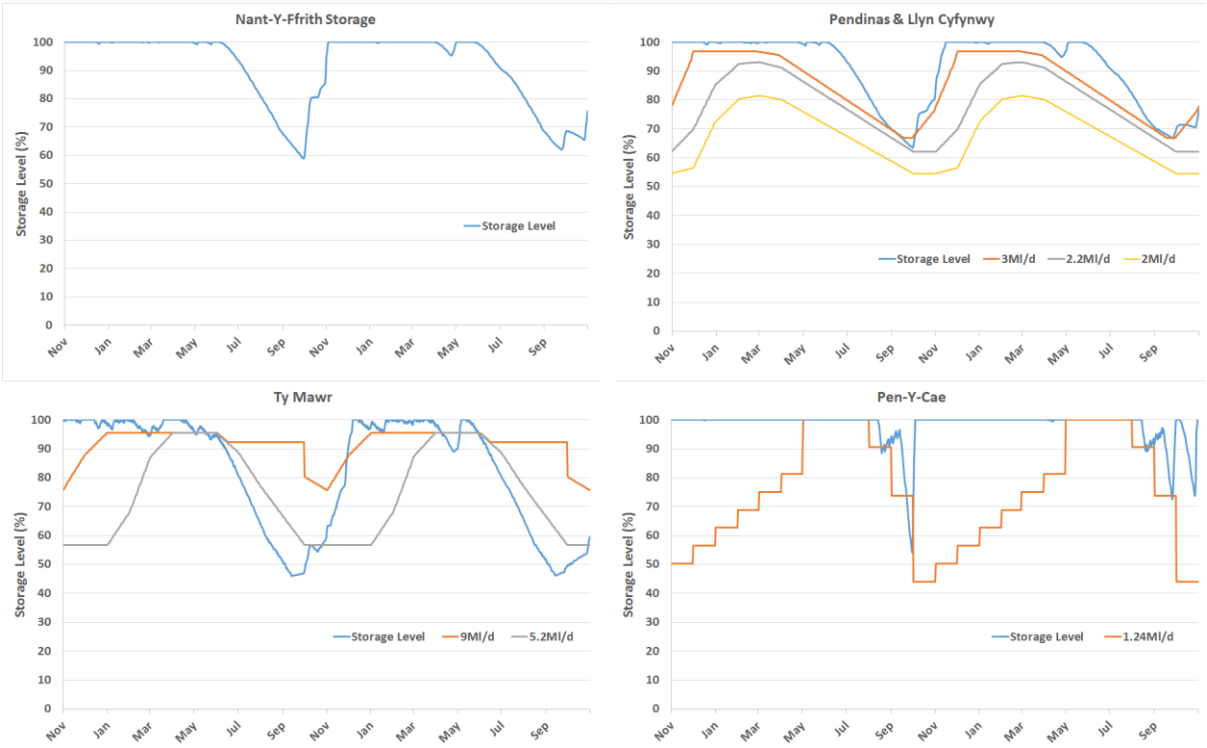


Figure 22 - Modelled reservoir storage and drought triggers for a stochastic 1 in 200 year drought

2.7. Data sources

Data monitoring with respect to the Dee Storage System is carried out by NRW and includes a number of gauges within the catchment area. The principle gauging station at the Chester Suspension Bridge uses an ultrasonic flow gauge, less the United Utilities abstraction taken at Chester Weir, to calculate the Chester Weir residual flow.

On a weekly basis NRW produce a summary of the Dee Storage System stocks which is emailed to all members of the Dee Consultative Committee. The summary states the present level of regulation on the system and includes the current stock within the Llyn Celyn and Llyn Brenig Reservoirs along with a chart displaying the reservoir storage with respect to the control curves.

An example of the weekly summary report is given in Appendix B – Dee Storage System Stock Summaries.

Data associated with our own resources and operations such as rainfall, reservoir levels, ground water levels, abstraction rates, compensation flow releases, leakage and water demand are retrieved daily from our data management systems. This information is used to

produce a range of routine reports on either a weekly or monthly basis which help us monitor and manage our resources.

The main report we produce is a Water Resources Report which is reviewed by senior management at their monthly meetings. Our internal report includes the current storage within our Ty Mawr/Cae Llwyd, Pen-y-Cae and Pendinas/Nant-y-Ffrith/Llyn Cyfynwy Reservoir Systems as well as duplicating the information from the Dee Storage System summary. For both our own sources and the Dee Storage System we also indicate the storage for the same period last year and the current position with respect to the specific control curves. Monthly and 12 monthly rolling rainfall data is also included in the Water Resources Report, this provides an additional means of monitoring the current situation as well as increasing awareness throughout the business.

The levels of storage within our own sources along with our river abstraction data is also provided to NRW on a weekly basis.

2.8. Supply arrangements

Our main arrangements are those detailed in the Dee General Directions which are administered through the Dee Consultative Committee. This has been detailed in sections 1.3.2 and 2.2.

We also have a number of small supply agreements with United Utilities, Severn Trent and Dŵr Cymru Welsh Water. These are a mixture of emergency feeds and feeds to small areas. In addition, two of our water resource zones are bulk import zones supplied from Severn Trent. In the event of a drought, customers in all these areas would be subject to restrictions imposed by ourselves rather than the companies that physically supply their water. This is because these customers pay their bills to Hafren Dyfrdwy and therefore only expect to receive communications from Hafren Dyfrdwy. There are no inset appointments in either of our water resources zones and we are not aware of the potential for any in the future. In the event that an inset appointment was to be granted, we would expect the appointee to mirror any drought restrictions which we implement.

3. Drought management actions

3.1. Introduction

Drought management actions comprise of demand side actions and supply side actions, the implementation of which are determined by triggers (discussed in Section 2) that relate to how much water is available in the Dee Storage System and groundwater sources in the Llandinam and Llanwrin WRZ. The chart below illustrates the various triggers that show the status of the Dee Storage System as it changes from normal through to severe drought, which are used to inform implementations of drought management actions.

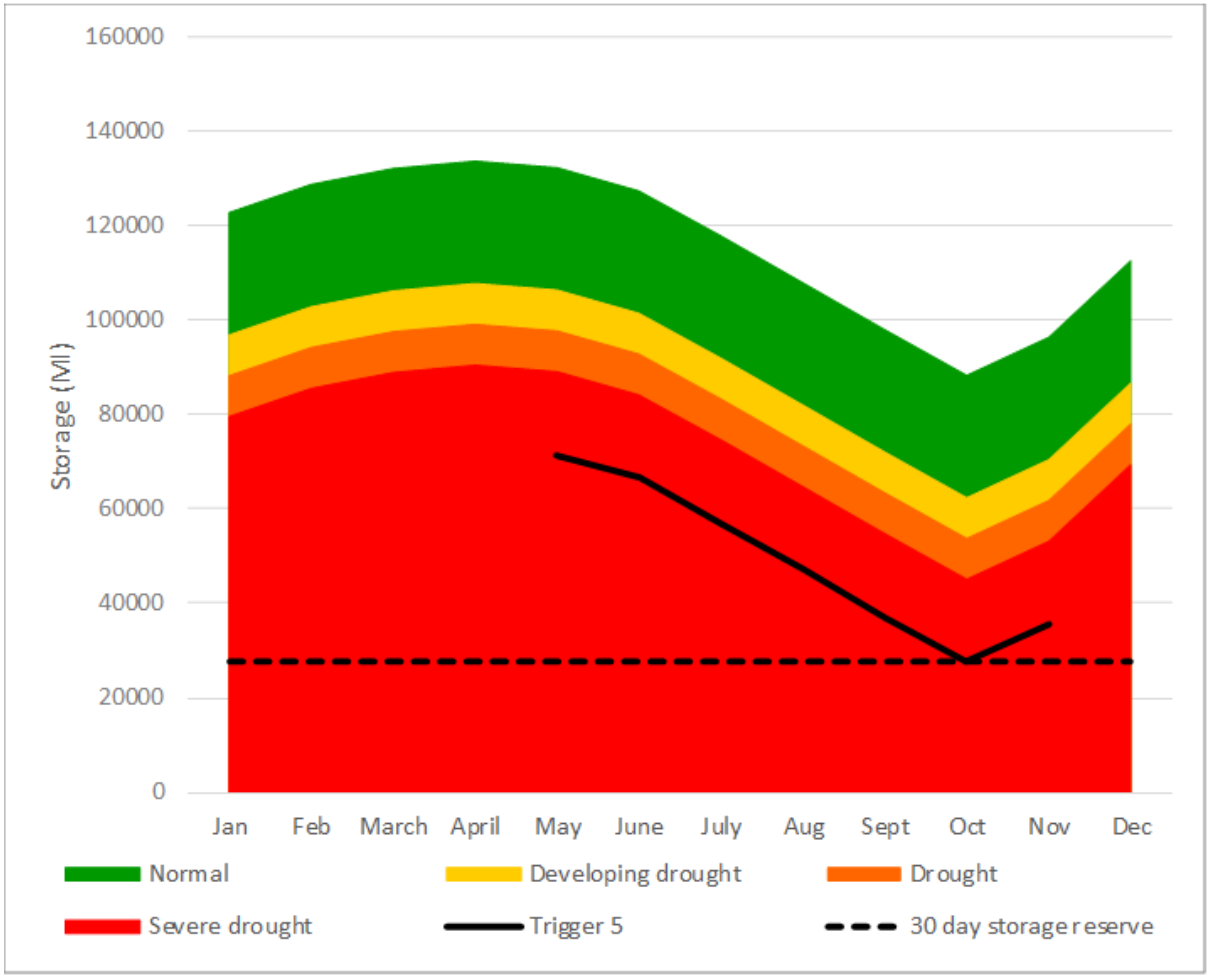


Figure 23- Drought management actions and their associated triggers

There are several actions we can take to manage the effects of a drought. We broadly split these into two groups: demand-side and supply-side. The demand-side actions are ones that reduce the demand from our customers and network for water during a drought. Supply side actions are those that increase the availability of water within the system. We only have one supply side option available to us, the augmentation of the River Dee with water from Lower Pen-y-Cae Reservoir. As the status of the Dee Storage System moves from developing drought to drought we would start augmenting the river with 0.4Ml/d of water (instead of the 0.2 Ml/d net reduction in abstraction each from Wrexham and Severn Trent Water's Chester

zone), this is trigger 3. On trigger 4, as the status of the system moves from drought to severe drought we would increase the augmentation from 0.4 Ml/d to 0.8Ml/d.

3.2. Demand-side actions

Our trigger and action diagrams presented in section 2 for the Dee Drought General Directions and resource levels in the Llandinam and Llanwrin WRZ show how we would expect to phase in the different demand management options available to us. Section 5 also provides detail on how we would increase our focus on demand management progressively in line with our communications strategy.

We consider that demand-side actions can be applied anywhere in our supply region. However, we will select the appropriate combination of options and target them depending on the extent to which different parts of our region are affected by drought. The following list shows some of the options available to us:

- Water efficiency measures – During normal operational conditions we ask our customers to try and reduce the amount of water they use through various efficiency measures, these include: fitting a cistern displacement device, reducing the time spent in the shower, turning off the tap whilst cleaning their teeth etc. We also carry out water efficiency property surveys and education within schools. We would intensify our water efficiency promotion as the Dee Storage System moves from a developing drought to a drought (this is trigger 3) and/or groundwater sources in the Llandinam and Llanwrin WRZ move from Trigger zone C to zone D.
- Increased leakage management – An additional action that we can take to reduce the demand for water during a drought, is to increase our leakage management activities. We would increase the number of resources that we allocate to finding and fixing leaks as the Dee Storage System moves from a developing drought to a drought (this is trigger 3) and/or groundwater sources in the Llandinam and Llanwrin WRZ move from Trigger zone C to zone D.
- Voluntary use restriction – As a drought becomes more severe we would ask our customers to make voluntary use restrictions, these primarily include not using a hosepipe or sprinkler. A voluntary use restriction is not compulsory. We would implement voluntary use restrictions as the Dee Storage System moves from a drought to a severe drought (this is trigger 4) and/or groundwater sources in the Llandinam and Llanwrin WRZ are in Trigger zone E or below.

And, in the most severe drought conditions:

- Temporary water use restrictions, which are discussed in section 3.3 and, ultimately
- Restrictions on non-essential use through a drought order.

We consider that pressure optimisation and working with our customers to encourage the efficient use of water are routine activities that we carry out as part of our normal operation.

The water conservation campaign mentioned above is over and above our 'normal' water efficiency work. We have provided details of our water efficiency and leakage activities in the following sections.

3.2.1. Water efficiency

As part of our normal operations we promote the efficient use of water to both household and non-household customers. Our household water efficiency strategy is principally based on:

- Providing free water saving products to our customers. We have increased the range of products compared to previous years. We have made available to customers pipe lagging and tap guards to prevent leaks during freezing weather
- Providing subsidised higher value products to our customers (e.g. water butts and shower heads).
- Working with social housing providers to reduce water consumption in social housing properties by providing free water saving products to these organisations. .
- Providing information to our customers on how to use less water.
    - Information on customer bills and billing leaflets
    - General water efficiency messages
    - Garden water efficiency messages
    - Household water efficiency messages
    - Winter water efficiency messages – e.g. lag pipes to prevent bursts
    - Free issue of water saving devices for use in toilet cisterns
    - Promotion of water efficiency and provision of water efficiency devices at local events, such as flower shows
    - A comprehensive self-audit calculator which offers tips on how to reduce consumption and recommends free water saving products to our customers.
- Joint initiatives with other organisations to promote water efficiency (e.g. housing associations, large employers, local groups)
- Providing an educational programme to schools and adult groups which aims to deliver long-term behaviour change and a change in water using habits.
- We also continue to contribute to improving the evidence base by measuring the savings delivered by our home install programme which we carry out with high consumption visits.

We are also developing a programme to help non household customer reduce their consumption.

An example of an advert that we may use on our website or in a local newspaper is given in Appendix D.

3.2.2. Leakage control

Whilst leakage control is a long term activity, during a drought, if we expect our customers to make an effort in reducing demand then it is only appropriate for us to make a similar effort in relation to leakage detection and repair activities.

In a drought event, additional leakage detection and repair activities will be implemented, these will take effect when the Dee Storage System reaches trigger 3 and/or groundwater sources in the Llandinam and Llanwrin WRZ move from Trigger zone C to zone D.

Through working overtime and redeploying personnel, additional members of staff could be made available to leakage detection activities in the short term. A similar reorganisation would be required to fix the expected increase in repairs.

For Dee Valley Water's WRMP14 an assessment was carried out to evaluate our Social and Economic Level of Leakage (SELL). As the name suggests, SELL is the most sustainable level at which we will manage our leakage that provides best value for money to our customers whilst not adversely affecting society and the environment. Based on the outcome of the SELL assessment, Dee Valley Water set a leakage target of 10.17 Ml/d. An additional downward trend was expected in the total leakage during the WRMP19 planning period as a result of an increase in meter penetration and a reduction in supply pipe leakage.

While our leakage forecast for WRMP19 has been calculated in line with the 15% leakage reduction challenge from Ofwat, our baseline figure of 14.08 Ml/d has been taken from the Dee Valley Water and Severn Trent Water Welsh WRZ WRMP14 forecasts for 2019/20. Our out-performance of SELL meant no further leakage reduction was required in WRMP14 via an AMP6 investment – so in the WRMP tables, distribution losses are flat through the forecast. However total leakage does reduce due to a fall in household USPL from metering. This takes us to the 14.08Ml/d at the end of AMP6, and is our current best estimate for an AMP6 leakage exit level.

Whether we could reallocate enough resources to achieve higher leakage reduction during a drought event would depend on the necessity of other business needs at the time. Figure 24 shows a graphical representation of our reduction in SELL as part of increased leakage management activities.

In the event that a drought extended into the longer term we would consider contracting outside resources to prevent other areas of the business suffering due to the redeployment of staff. The ability to do this would be dependent on whether the drought is localised or nationwide.

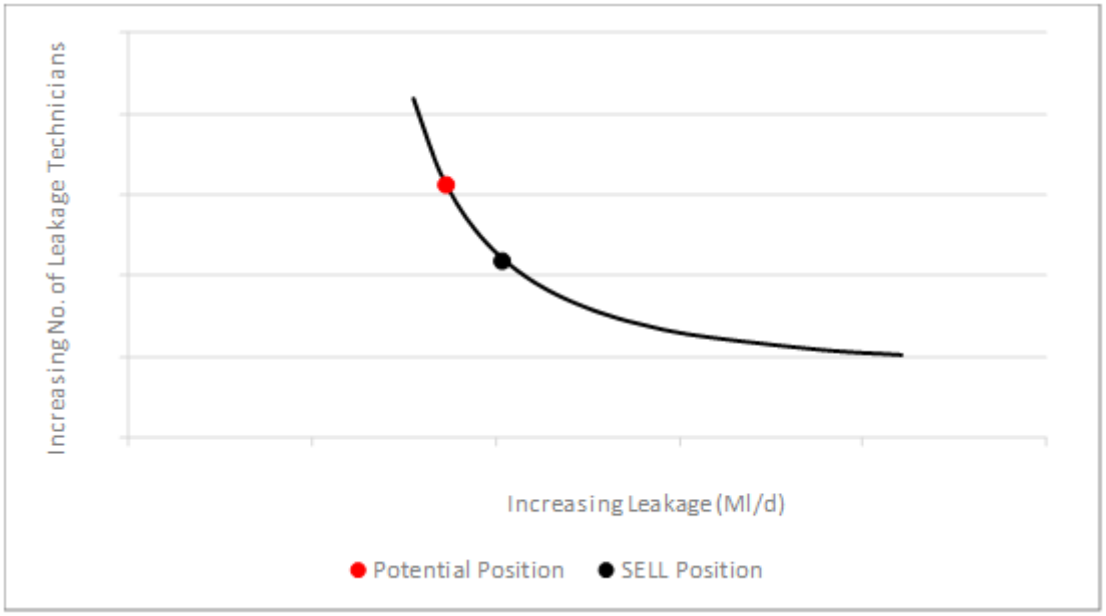


Figure 24 - Active leakage control curve

Drought conditions have been shown to increase leakage due to increased movement in the soil as the soil moisture deficit increases. In this case, it may mean that the additional leakage detection resources that we propose will be required to simply maintain current levels rather than reduce them.

- In order to achieve the projected savings a number of measures would be required outside normal operational activities, these are:
- Increased leakage management meetings
- Increased data analysis to improve targeting of areas
- Increased leakage detection activities such as sounding and step tests
- Increased reservoir and trunk mains surveys
- Contact councils to request that notice periods are reduced for carrying out work on a highway
- Accelerate pressure management schemes that have already been identified
- Optimise existing pressure management schemes
- Further promote our free leak repair line

The exact means by which we would target leakage reduction during a drought would be dependent on the geographical context of the drought, the time of year (winter or summer) and the expected savings.

We would increase our leakage detection activities when the Dee Storage System moves from a developing drought to a drought, (this is trigger 3). For Llandinam and Llanwrin WRZ we will place an extra emphasis on leakage when our drought indicators are in trigger zone D as discussed in section 3.2. The preparation and implementation time for increasing leakage detection activities is in the order of a month; however, there are caveats as the levels of savings that could be achieved would not be instantly apparent, rather only becoming apparent over a period of weeks or months.

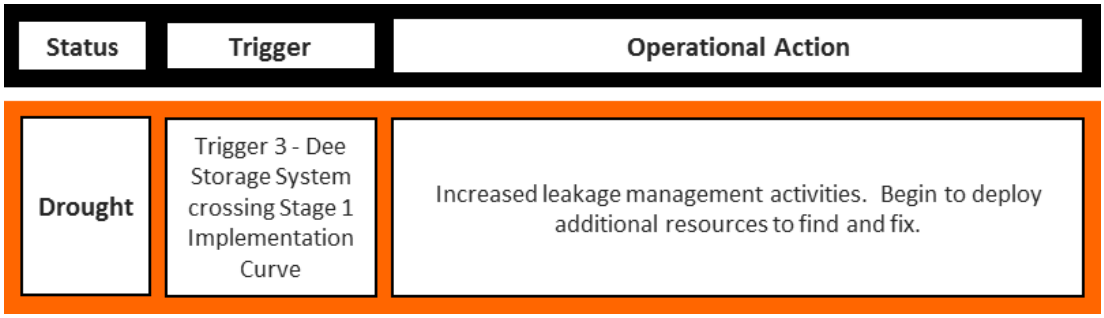


Figure 25 - Implementation of increased leakage management activities

3.2.3. Effects on Fire service

There are a small number of actions we take that could affect fire hydrants. The most obvious of these is that when we lower pressure during a drought to reduce leakage. In this reduced pressure scenario we will mitigate the potential problems for the fire service in the following ways:

- As happens during non-drought periods we will communicate with the fire service during incidents - this is usually via our 24hr call centre.
- If appropriate, we advise them of alternative locations to take a supply from that have higher pressure/ flow. For example, we may suggest that they connect to a larger main or bypass anything (e.g. a PRV) that is creating a head loss.
- In addition, if needed, we will send a Hafren Dyfrdwy technician to the area to assist.
- In the future we intend to be more proactive so we will inform the fire service which areas we will lower pressure in before we do it.

3.2.4. Bulk imports and exports

We have existing bulk supply agreements with United Utilities, Severn Trent and Dŵr Cymru Welsh Water, which are summarised in Table 4. Most of these are for emergency use only and therefore not included in the supply-demand balance calculations. The remaining supplies that are used regularly to supply single customers or very small supply areas account for less than 0.5 Ml/d. Table 4 also includes our new bulk supply agreements with Severn Trent for a bulk export from Wrexham WRZ to Severn Trent and bulk imports to our Saltney and Llanfyllin WRZs. These bulk transfers are not usually variable in a drought. However, in a drought we would communicate with all other water companies to help with message consistency and to see if we can assist each other.

Location	Company	Transfer type	Use	WRZ
Bowens Hall Farm	United Utilities	Import	Feeds single customer	WRX
Pontyblew / Glyn Morlas	Severn Trent	Import	Emergency use only	WRX
Glyndyfrdwy	Welsh Water	Import	Emergency use only	WRX
Dimmock Arms	United Utilities	Import	Emergency use only	WRX

Bowens Hall	United Utilities	Import	Emergency use only	WRX
Farndon	United Utilities	Export	Feeds small area	WRX
Saltney WRZ	Severn Trent	Import	We import up to 3.51 Ml/d of treated water, which feeds the whole WRZ	Salt
Llanfyllin WRZ	Severn Trent	Import	We import up to 6.75 Ml/d of treated water, which feeds the whole WRZ	Llanf
WRX WRZ	Severn Trent	Export	We export up to 3.07 Ml/d of treated water	WRX

Table 4 - Bulk supply agreements

3.3. Temporary water use restrictions

3.3.1. Code of practice and guidance on water use restrictions

In spring 2013 an update to the UKWIR Code of Practice and Guidance on Water Use Restrictions was published which incorporated the lessons learnt during the 2011/12 drought. The code of practice relates to existing legislation covering water use restriction:

- TUBs on water as provided for in Section 76 of the Water Industry Act 1991, as amended by Section 36 of the Flood and Water Management Act 2010 and detailed in The Water Use (Temporary Bans) Order 2010.
- Ordinary Drought Orders, as provided for in Sections 73 to 81 and Schedules 8 and 9 of the Water Resources Act 1991 and detailed in the Drought Direction 2011.
- Emergency Drought Orders as defined in the Water Resources Act 1991.

The code of practice sets out a framework for evaluating whether and how water use restrictions should be implemented during a drought event. Its aim is to ensure that all water companies are consistent in their management of water use restrictions so that their customers can be reassured that their interests have been considered and to minimise the risk of confusion in relation to policies of neighbouring water companies.

The processes outlined in sections 3.3.3 and 3.5 below are based on the above code of practice to ensure that we meet our statutory obligations in the event that we have to impose water use restrictions on our customers.

Within this document we refer to temporary water use restrictions or Temporary Use Bans (TUBs) rather than to hosepipe bans which may have been used in previous documents. This change in terminology is to reflect the relatively recent legislative changes that the government has introduced.

3.3.2. Voluntary use restrictions

Prior to introducing a TUB, we would encourage a reduction in demand through voluntary use restrictions. We would publish an advert on our website, social media and possibly in local newspapers asking customers to follow voluntary use restrictions. The focus of the restrictions will be to avoid the use of hosepipes and sprinklers. These activities are similar to those covered by a TUB but the message for voluntary use restrictions will be simple and concise: avoid using hosepipes and sprinklers to reduce the risk it being confused with a TUB. An example of the advert is given in Appendix D.

We would implement voluntary use restrictions when the Dee Storage System moves from a drought to severe drought, this is trigger 4 and/or groundwater sources in the Llandinam and Llanwrin WRZ are in Trigger zone E or below. It is hoped that by implementing a voluntary use ban at the same time as advertising the intention to implement a TUB, we will avoid spikes in demand before the restrictions take place.

The preparation and implementation time for promoting voluntary use restrictions would be as per water efficiency promotion, dependent on the chosen form of media.

3.3.3. Temporary Use Bans (TUBs)

Since the introduction of Section 36 of the Flood and Water Management Act 2010, water companies have wider and more far reaching powers to restrict water use. When required, the following activities may be prohibited through a TUB:

- Watering a garden using a hosepipe
- Cleaning a private motor-vehicle using a hosepipe
- Watering plants on domestic or other non-commercial premises using a hosepipe
- Cleaning a private leisure boat using a hosepipe
- Filling or maintaining a domestic swimming or paddling pool
- Drawing water, using a hosepipe, for domestic recreational use
- Filling or maintaining a domestic pond using a hosepipe
- Filling or maintaining an ornamental fountain
- Cleaning walls, or windows, of domestic premises using a hosepipe
- Cleaning paths or patios using a hosepipe
- Cleaning other artificial outdoor surfaces using a hosepipe

We would start the process of implementing a TUB as the Dee Storage System moves from a drought to a severe drought (trigger 4), subject to the outcome of a meeting of the Dee Consultative Committee and approval of our DAT, and/or groundwater sources in the Llandinam and Llanwrin WRZ are in Trigger zone E. The preparation and implementation time for imposing a TUB is between one and three weeks. Figure 26 shows the process of implementing a TUB along with the anticipated timescales.

We do have the option of phasing in the above restrictions, however we think this would be difficult to communicate to our customers and lead to unnecessary confusion. In addition, we do not think it is fair to imply that some activities are ‘more important’ than others by

prohibiting them later on in the process. Therefore we would impose all eleven of the above restrictions at the same time. This policy is in line with our neighbouring companies: United Utilities, Severn Trent and Dŵr Cymru Welsh Water.

The savings resulting from imposing TUBs are generally restricted to the summer period due to the limited use of hosepipes for garden watering and cleaning of motorised vehicles during the winter. Therefore we do not plan to impose any restrictions during the winter months (October-March) regardless of our water resources situation. However, we may extend restrictions which are already in place into the winter months if we believe them to be beneficial.

3.3.4. Geographical coverage

In most drought scenarios the clearest way to impose restrictions on customers is on a company wide basis. However, we do not believe that our customers, or the environment, would benefit if restrictions on use were imposed in WRZs unaffected by drought conditions. Thus, if circumstances mean that companywide restrictions are not in our customers' best interests, we want to keep open the option of imposing restrictions on a WRZ basis. We would choose these WRZs by considering how a specific drought was affecting water resources across our region. If we did this and later needed to widen the spatial extent of the restrictions, we expect that the TUB would then apply to the whole company. Supplies to our bulk import WRZs (Llanfyllin and Saltney) will not be impacted by drought management actions imposed by Severn Trent upon its customers or any section of its customers. This includes severe drought events when Severn Trent imposes a restriction on the use of water drawn through a temporary use ban. In the event of a drought, customers in these WRZs would be subject to restrictions imposed by ourselves, which will be based on our communication with all other water companies to help with message consistency and assist each other.

3.3.5. Exceptions

As set out in the legislation and the UKWIR Code of Practice, we will allow exceptions to the TUB for certain customers. The exceptions fall under three categories. These are:

- Statutory Exceptions – Specified through legislation and are on the grounds of health and safety, the environment or where businesses may be effected.
- Discretionary Universal Exceptions – Common to all water companies and primarily relate to Blue Badge holders.
- Discretionary Concessional Exceptions – Granted by individual water companies following the receipt of a representation. All exceptions are subject to our discretion and will only be granted if it is in the best interest of the community. We will consider granting an exception to customers on the company's Vulnerable/Water Sure Customer Lists and to those whom have mobility issues but are not in possession of a Blue Badge. These exceptions will require customers to write or make representation to Hafren Dyfrdwy to obtain permission. A form to make a representation has been provided in Appendix H – Temporary Water Use Exception Form. Review of the

representations will be the responsibility of our Drought Action Team (DAT), specifically the Technical/Data and Stakeholder Leads.

A more detailed list for each TUB category can be found in Appendix G.

Clarification of what is and is not included in the above exceptions will be provided in the notice published to inform customers of our intention to impose restrictions. Any exceptions listed under discretionary may be rescinded if the perceived savings are determined necessary and beneficial.

Customers may also apply for an exception even if they do not consider themselves to be included within any of the exception categories. A copy of the proposed form that will require completing and returning to ourselves is given in Appendix H – Temporary Water Use Exception Form. Details of how to make a representation will also be given in the notice that we will publish prior to imposing restrictions.

There is no formal process for objecting to restrictions under a TUB, we will only introduce these measures in very extreme circumstances when it is in the best interest of both customers and the environment. Objection can be lodged as a judicial review under the Human Rights Act.

3.3.6. Implementation of restrictions

In the event that we would need to impose restrictions we would publish our intention to do so through a notice on our website and in two local newspapers. The format of the notice would follow that recommended in the UKWIR Code of Practice, a copy of this has been included in Appendix E – Temporary use ban notice example. Included in the notice will be details of activities which are exempt from the restriction. In addition to the formal notification a short leaflet would also be made available summarising the notice.

The approximate timescales and process that we expect to follow to implement a TUB are shown in Figure 26.

Status	Trigger	Operational Action
Severe Drought	Trigger 4 - Dee Storage System crossing Stage 2 Implementation Curve Week1	Advertise voluntary restrictions. Publish intent to impose restrictions through a Temporary Use Ban via a notice on our website and in two local papers.
	Trigger 4 Week 1-3	Consider and respond to representations.
	Trigger 5	Implement and enforce Temporary Use Bans.

Figure 26 - Process for implementing a voluntary restriction and Temporary Use Ban

Based on historical data there is no instance when a TUB would have been required. As such, the above timescales are only indicative in that we estimate we would need three weeks to implement a TUB. Publishing our intention to implement a TUB in the Wrexham WRZ will be based on the gradient of the fall in storage of the Dee Storage System and the projected date of crossing trigger 5.

3.3.7. Revocation of restrictions

TUBs will be lifted when the water resources have returned to their normal level of risk. To determine this point, consideration will be taken of the actual level of the resources and the prevailing and projected weather conditions.

Similar to implementation, the revocation of the restrictions will be published on our website and in two local papers. An illustration of the wording for the revocation of restrictions is given in Appendix F – Revocation of restrictions example.

3.4. Supply-side actions

As detailed in section 2.3.1, in a drought, the Dee Drought General Directions define the principles and detail the conditions under which the prescribed flows and abstractions within the River Dee catchment must be reduced. Under normal operation we always assume 'Safe yield allocations' as the Dee Storage System regularly crosses Trigger 1 the Safe Yield Line.

During a drought, we are required to further reduce our abstractions (below 'Safe yield allocations') by specified volumes depending on the storage in the Dee Storage System. How we make these reductions is our own choice, they can be through reducing abstraction i.e. using less water ourselves and asking our customers to use less water, or by augmenting the River Dee with water from a different source.

Our preferred choice is to augment the River Dee using water from our Lower Pen-y-Cae Reservoir via the Trefechan Brook. This is primarily because augmenting the River Dee is within our own controls so we can guarantee the overall reductions in abstractions. Asking customers to make reductions and reducing the amount of water we use through activities such as leakage management, has numerous dependencies and therefore a less certain outcome.

Under our abstraction licence agreements for Lower Pen-y-Cae Reservoir, we do not provide a compensation flow into the Trefechan Brook. This means that in the event of a drought, the stream bed may initially be dry leading to some losses prior to the augmentation water reaching the River Dee. To try and further understand the possible magnitude of these losses, we have put in place a plan to monitor the discharge from Lower Pen-y-Cae Reservoir and the corresponding inflow into the River Dee. Before doing this careful consideration must be made as to the prevailing conditions at the time of the test. Carrying out the test in winter, when the ground is water logged, would not provide accurate results, however carrying out the test during dry conditions may pose an unnecessary risk.

When flow augmentation is required during a drought event, we plan to install a suitable temporary pumping station at the Lower Pen-Y-Cae Reservoir that enables us to abstract

water from the top level of the reservoir. We plan to measure the daily volume of flow augmentation using the pumping rate/pump capacity. We will also carry out flow measurements downstream of the reservoir during the flow augmentation and collected data will be used to validate the use of pumping rate for measuring the flow augmentation. Pumped water will be conveyed to downstream of the Lower Pen-Y-Cae Reservoir through a pipe that will be placed over the spillway. As drought conditions develop, decisions made by the Dee Consultative Committee (DCC) at different stages of the drought will be used to inform early planning of temporary pump installation process, which will be managed by our Drought Action Team (DAT). We plan to install the temporary pumping station and implement the flow augmentation with in a period of 7 days from the day of notification. The duration for augmentation is dependent on the storage in the Dee Storage System but assumed to be less than six months. Prior to using this supply option, we'll put in place monitoring and mitigation plan, which are discussed in detail in sections 4.2 and 4.3.

3.5. Drought Orders and Permits

3.5.1. Drought Orders and Permits

Drought Orders and Permits are a means by which further action can be taken to mitigate the impact of a drought by either increasing water supply or further restricting water use.

To implement a Drought Order or Permit, we must first apply to the Welsh Government or NRW for approval. The application and approval process can be lengthy and may take a number of weeks/months, it is therefore essential that the requirement of an order or permit is established as soon as possible.

Before a Drought Order or Permit would be granted by the Welsh Government or NRW, we would be expected to demonstrate that we have already exercised all means available to restrict domestic demand as far as possible.

The preparation and implementation time for imposing a Drought Order is up to six weeks. Figure 27 shows the process of implementing a Drought Order along with the anticipated timescales.

Ordinary Drought Orders

The Water Resources Act 1991 (WRA 1991) empowers the Welsh Government to make provision for ordinary and emergency Drought Orders. Under these provisions, as a Water company, we can apply for ordinary Drought Orders that:

- Authorise us to take water from any specified source
- Authorise us to prohibit or limit the use of water for any purpose set out in the direction
- Authorise us to discharge water to any place specified
- Authorise NRW to prohibit or limit any person taking water from a specified source
- Prohibit or limit NRW from taking water from a specified source
- Suspend or modify existing supply and discharge permits and obligations
- Authorise NRW to suspend or vary effluent discharge

Within this plan we have only considered the option of applying for a Drought Order to prohibit or limit the use of water. The Drought Direction 2016 sets out those purposes that companies can prohibit or limit under the WRA 1991. These are as follows:

- Watering outdoor plants on commercial premises;
- Filling or maintaining a non-domestic swimming or paddling pool
- Filling or maintaining a pond
- Operating a mechanical vehicle-washer
- Cleaning any vehicle, boat, aircraft or railway rolling stock
- Cleaning non-domestic premises
- Cleaning a window of a non-domestic building
- Cleaning industrial plant
- Suppressing dust
- Operating a cistern in any building that is unoccupied and closed

The main aim of this type of Drought Order is to extend existing restrictions that have been imposed on domestic customers, through the implementation of TUBs, to non-domestic customers. We would start the process of implementing a Drought Order on trigger 5.

In addition to the above we can also apply for emergency Drought Orders which allow us to restrict supplies to customers through the imposition of rota cuts and the introduction of standpipes. However, as stated in section 1.4.3, we deem the imposition of these measures as part of a drought to be unacceptable and as such we would only implement them in an emergency not as part of a drought plan.

Drought permits

A drought permit allows us to take water from specified sources by suspending conditions of our abstraction licences or by reducing compensation flows from our upland reservoirs. None of the measures included within a Drought Permit are part of our drought plan and as such no allowance has been made for their application.

3.5.2. Geographical coverage

As per TUBs, the imposition of a Drought Order would be at company level or WRZ level.

3.5.3. Exceptions

As set out in the legislation and the UKWIR Code of Practice, we will allow exceptions to a Drought Order for certain customers. The exceptions that we will grant fall into the same three categories detailed in section 3.3.5: Statutory Exceptions, Discretionary Universal Exceptions and Discretionary Concessional Exceptions. A more detailed list for each Drought Order Purpose of Use category can be found in Appendix G – Restricted activities for TUBs and Drought Orders and their expected exceptions.

Persons requesting an exemption should do so by making a representation to the Welsh Government. Details of how to do so will be given in the notice published on our website.

3.5.4. Implementation of a Drought Order

Any requirement to implement a Drought Order would be determined though the Dee Consultative Committee (for Wrexham WRZ) and/or DAT. In the event that a Drought Order was required we would first have to serve notice on the persons or bodies to whom the notice applied. We would then publish the notice, for a period of at least seven days in one or more local newspapers, in the London Gazette, on our website and at a number of other places within the community. It is during this seven day period that persons or bodies which the Drought Order would impact can make representations to the Welsh Government.

The format of the notice would follow that recommended in the UKWIR Code of Practice, a copy of this has been included in Appendix I – Drought Order notice example. Included in the notice will be details of activities which are exempt from the order. In addition to the formal notification a short leaflet would also be made available summarising the notice.

Following on from serving and publishing the notice we would then apply to the Welsh Ministers for the Drought Order.

The details of how to apply for a Drought Order are given on the NRW website[8].

Figure 27 outlines the process and approximate timescales of applying for and implementing a Drought Order. An allowance of 28 days has been made from the point of submission of the application to the implementation of the Drought Order. It should be noted that these timescales are only approximate and the commencement date of serving the notice would be estimated based on the projected rate of decline in the Dee Storage System storage and the need to allow 28 days for approval of the submission.

[8] https://naturalresourceswales.gov.uk/guidance-and-advice/environmental-topics/water-management-and-quality/drought/?lang=en

Status	Trigger	Operational Action
Severe Drought	Trigger 4 - Dee Storage System crossing Stage 2 Implementation Curve	Dee Consultative Committee convenes to discuss proposals and establish justification of need for a Drought Order. Discusses the need with the Secretary of State or the Welsh Government and other key stakeholders. Begin to collate information for drought order application.
	Trigger 5 - Dee Storage System crossing Stage 3 Implementation Curve Week1	Serve notice on the persons/bodies to whom the Drought Order will apply.
	Trigger 5 Week2	Publish notice for public inspection in at least one local newspaper, the London Gazette and on our website for a period of at least 7 days.
	Trigger 5 Week3	Submission of application to Secretary of State or Welsh Government.
	Trigger 5 Week3-6	Secretary of State or Welsh Government consider and respond to representations.
	Trigger 5 Week 7	Application granted by Secretary of State or Welsh Ministers. Implement and enforce ordinary Drought Order.

Figure 27 - Process for implementing a drought order

Based on historical data there is no instance when a Drought Order would have been required. As such, the above timescales are only indicative in that we estimate we would need six weeks to apply for and implement a Drought Order. Serving notice on those whom the order applies will be based on the gradient of the fall in storage of the Dee Storage System and the prevailing conditions.

3.5.5. Revocation of a Drought Order

Under normal circumstances a Drought Order is issued for a period of six months and can then be extended for a further six months if required.

We may revoke restrictions imposed as part of the Drought Order prior to the end of the six month period if our water resources have returned to their normal level of risk. To determine this point, consideration will be taken of the actual level of the resources and the prevailing and projected weather conditions.

Similar to implementation, the revocation of the Drought Order will be published on our website and in two local papers. An illustration of the wording for the revocation of restrictions is given in Appendix F – Revocation of restrictions example.

3.5.6. Emergency Drought Orders

Our drought plan does not include the use of Emergency Drought Order for reasons outlined in section 1.4.3. Planning for Emergency Drought Orders as part of a normal drought is not an acceptable level of service for our customers.

Emergency Drought Orders allow us to restrict the supply of water to our customers through the imposition of rota cuts and/or the introduction of standpipes to deal with the very remote possibility of an extreme drought.

Implementing Emergency Drought Orders are part of our emergency contingency plans. We stress that the probability of having to carry these out as part of a drought event is extremely low.

3.6. Potential drought permit and order sites

Not applicable.

3.7. Enforcement of a Temporary Use Ban or Drought Order

If we impose restrictions and we become aware that some customers are not complying we will try to work with them to understand why this is. If this does not work then we will explore the enforcement options open to us. However, we expect that by demonstrating that we are reducing leakage and doing everything that we can, that the overwhelming majority of our customers will also 'do their bit'.

The Water Industry Act 1991 and Water Resources Act 1991 states that anyone found guilty of breaching a TUB can be fined up to Level 3 (an amount of £1000 under the standard scale of fines for summary offences in the Criminal Justice Act 1982 section 32). Offenders breaching a Drought Order restrictions are liable to a fine not exceeding the statutory maximum (which is an amount of up to £5000). Conviction on indictment renders an offender liable to a fine with no specified upper limit.

3.8. Demand management savings

We have estimated demand management savings for the Wrexham WRZ using the UKWIR 2007 methodology entitled 'Modelling the impact of restrictions on demand during drought' which was based on the drought experienced in the South East of England during 2005/06. However it should be noted that there were some caveats to the methodology such as care should be taken when drawing inference from the analysis with application to other areas and future media campaigns may be significantly different to those carried out in 2005/06.

As it is many years since we employed drought measures for a sustained period of time in our supply area, we have little experience to base our assumptions on and to quantify the results of the analysis. Table 5 shows the estimated savings that would be achieved through implementing the proposed demand side saving options, the percentage values are the savings represented as a percentage of the resource zone distribution input.

Resource zone	Demand side saving options (Ml/d)			
	Drought		Severe drought	
	Increased water efficiency promotion	Increased leakage management activities	Temporary Use Ban implementation	Drought Order implementation
Wrexham	0 - 0.24 (0.57%)	0 - 1.0 (2.35%)	0 - 0.92 (2.16%)	0 - 0.64 (1.51%)

Table 5 - Estimated savings from demand side drought management actions

The estimated savings are slightly different to those stated in our previous plan as we have reviewed the assumptions behind the estimates, this included the volume of non-household use that is sensitive to drought restrictions and the expected reduction in household consumption in relation to increased water efficiency promotion and TUBs.

4. Environmental impacts

4.1. Environmental assessment

To ensure that, during a drought event, we can provide an adequate supply of wholesome water to our customers with as little recourse as reasonably possible to Drought Orders or Drought Permits, we have developed the following options:

- Drought publicity
- Increased leakage detection and repair activity
- Water use restrictions
- Implementation of ordinary Drought Orders
- Augmentation of the River Dee with water from Pen-y-Cae Reservoir

The only one of these options that requires construction work is the increased repair activity as a result of additional leakage detection. For this option it can be argued that the leaks identified would require fixing at some point in the future and carrying out increased leakage detection is just bringing the fix activity forward, and not creating additional minor construction work.

There are 15 designated sites (either SAC[9], SPA[10], Ramsar[11] or a combination) within or partially within our Supply Area. The only sites where the identified drought options pose a risk of adverse impacts are the River Dee and Bala Lake SAC, the Dee Estuary SAC/SPA/Ramsar and the Berwyn and South Clwyd Mountains SAC/SPA. The only drought option which poses a risk is our intention to augment the River Dee with water abstracted from Pen-y-Cae Reservoir which is located within the Berwyn and South Clwyd Mountains.

It was identified that the River Dee and in turn the Dee estuary may be impacted through non-toxic contamination (changes in sedimentation, thermal regime, turbidity etc) as water will be transferred from lower Pen-y-Cae Reservoir into the river. It is noted that the potential increased flows are considered negligible, equating to increase in flow equates to 0.1% of the Q_{95} of the River Dee at Ironbridge (Q_{95}= 789.7 Ml/d). Furthermore, water quality impacts were deemed unlikely as under normal conditions additional water in lower Pen-y-Cae Reservoir (which is not abstracted for use) feeds the River Dee via Trefechan Brook. The risk of non-toxic contamination impacting abstractors downstream of the augmentation site was also considered to be unlikely.

Impacts on the Berwyn and South Clwyd Mountains through the augmentation of the River Dee with water from lower Pen-y-Cae Reservoir which is located within the SAC/SPA was also considered unlikely. The Pen-y-Cae reservoir is located downstream of the SAC /SPA and the Annex 1 habitat for which the site is designated are not hydrologically connected to the reservoir or the watercourses downstream of the reservoir. As we do not plan to abstract below the minimum operating volume or outside our abstraction licence impacts on the supporting habitats for the bird population of the SPA are unlikely.

WFD screening concluded that the demand management options included in this drought plan are not likely to pose any WFD deterioration risks, either alone or in combination with

[9] Special Area of Conservation
[10] Special Protection Area
[11] Wetlands of international importance

other plans and projects. However, augmentation of flow from Lower Pen-y-Cae may lead to temporary and reversible WFD deterioration risks for Lower Pen-y-Cae Reservoir and River Eitha.

From the HRA screening appraisal we have concluded that No Likely Significant Effects (NLSE) are expected on the River Dee and Bala Lake SAC, the Berwyn and South Clwyd Mountains SAC/SPA or the Dee Estuary SAC/SPA/Ramsar as a result of the implementation of the augmentation of the River Dee with water abstracted from the Lower Pen-y-Cae Reservoir.

The SEA screening appraisal identifies that drought options included in the plan mainly relate to measures to control water demand and would have limited potential for adverse effects to the environment, society or economy. The water efficiency measures and increased leakage management related drought options will have sustained beneficial environmental effects due to reduced demands on water resources, reduced energy requirements for pumping and water treatment, and improved public awareness of the importance of water efficiency. The demand side drought actions applicable in the most severe drought conditions could have greater significance with respect to businesses and the local economy. However, the probability of these actions being implemented is extremely low.

The one supply side option which involves augmentation of the River Dee using water from Pen-y-Cae Reservoir will help conserve water resources within the Dee catchment which is essential to help maintain public water supplies during a period of drought. The SEA screening appraisal identifies the potential for minor to moderate adverse effects mainly relating to water quality in Pen-y-Cae Reservoir, the Trefechan Brook and Afon Eitha. However, the effects identified would be short term, temporary and reversible.

The SEA screening appraisal has concluded that the drought options identified within the Drought Plan will not lead to any significant adverse environmental effects and no new developments are required which will necessitate an environmental impact assessment. The SEA screening appraisal also identifies that the potential for cumulative effects are limited to the likely cumulative beneficial effects on water resources and energy usage associated with the demand management options. From the SEA screening appraisal we have concluded that none of our drought options are likely to cause any significant adverse environmental impacts.

4.2. Environmental data provision and monitoring

The single supply-side option in the Drought Plan relates to the augmentation of the River Dee using releases of water from the Lower Pen-y-Cae Reservoir via the Trefechan Brook, which would be required in severe drought conditions. Under normal conditions, additional water in Lower Pen-y-Cae Reservoir feeds the River Dee via Trefechan Brook, which is a tributary of the River Eitha. We will work with NRW to update the conditions included in the DGD regarding the implementation of the flow augmentation scheme with a view to ensure any concerns about the effects of water released from the Lower Pen-y-Cae Reservoir are addressed. We will carry out water quality monitoring programme at different stages and locations to mitigate any potential effects of water released from the Lower Pen-y-Cae Reservoir on the downstream rivers during various drought conditions. The conditions in the DGD will be set out in line with the proposed monitoring and mitigation measures that have

been agreed with NRW and included in this drought plan. Section 4.3 below describes details of the agreed monitoring program and mitigation measures that we plan to carry out to meet the DGD conditions to implement the augmentation option.

4.3. Proposed monitoring plan and mitigation measures

During low flow conditions, Trefechan Brook is understood to be dry or has low flow, as there are no requirements for compensation flows from Lower Pen-y-Cae Reservoir. Thus, there would be higher stream bed losses during dry periods when augmentation would be required. We plan to do hydrological monitoring to quantify the volume of water that needs to be released from the Lower Pen-y-Cae Reservoir in order to ensure augmentation of flows in the River Dee by 0.4Ml/d in stage 1 and 0.8Ml/d in stage 2.

Hydrological monitoring will be conducted during dry and low flow period, which is a period during which the conditions will be representative of these occurring when the augmentation option is most likely to be implemented.

In addition, we also plan to carry out water quality monitoring programme in order to inform further assessment of environmental risks associated with the flow augmentation option. The water quality monitoring program will be conducted at different periods as described in detail in Tables 6 and 7 below.

Feature	**Site (see map below)**	**Monitoring**
Hydrology	Trefechan Brook River Eitha	Hydrological monitoring will be conducted during dry and low flow period. Spot flows should be undertaken at selected locations to determine the contribution of flows from the Pen-y-Cae Reservoir to the downstream waterbodies. The flows should be measured using standard flow monitoring techniques: • The water width and bank full width should be measured. • The water width should be divided into 20 sections of equal width. • Water depth should be measured at the midpoint of each section. • Velocity should be measured at the midpoint of each section using, at 60% depth if depth was less than 0.76m and at 20% and 80% depth if depth was greater than 0.76m. • The discharge of each section should be determined by multiplying velocity, section width and section midpoint depth. The total flow in the channel should be then calculated by adding together each of the 20 section discharges.

		Daily measurements will be made during the hydrological monitoring period that will be conducted during dry and low flow conditions. Spot flows will be collected from different sites (Figure 28 shows location of the different sites): • Trefechan Brook - upstream of confluence with the River Eitha (site 2) • River Eitha – upstream and downstream of the confluence with the Trefechan Brook and upstream of the confluence with the River Dee (sites 3, 4 and 5)
Water Quality	Lower Pen-y-Cae Reservoir	In situ weekly measurements will be undertaken of the following variables: • Dissolved oxygen (concentration in mg/l and % saturation) • Conductivity (µS/cm) • Temperature (℃) • Turbidity (NTU units) • pH levels • Depth (m) The in situ measurements will be carried out at every meter of the Lower Pen-y-Cae Reservoir to cover the full profile of the reservoir depth. Water quality samples will also be collected on a monthly basis and, in addition to the above listed variables, detailed analyses of water samples will be undertaken. Appendix K shows a list of determinants that have been agreed with NRW to be measured at the Lower Pen-y-Cae Reservoir. The monthly samples will be collected from the Lower Pen-y-Cae Reservoir for a 6-month period during April-September, which is a period representative of when the augmentation scheme is most likely to be implemented. To provide a baseline understanding of the reservoir water quality profile, these samples will be collected from the Lower Pen-y-Cae Reservoir even if Lower Pen-y-Cae Reservoir is spilling. All samples from the Pen-y-Cae Reservoir will be collected at three different depths (surface, middle and bottom) of the reservoir (i.e. 3 samples to be collected at a time from the reservoir).

Table 6 - Proposed monitoring plan to inform assessment and operation of the flow augmentation option

We also plan to carry out monitoring and mitigation measures during the implementation of the flow augmentation option. Details of the proposed monitoring and mitigation programme and associated triggers and indicators for the implementation of the flow augmentation stage are identified in Table 7 below.

Feature	Site (see map below)	Monitoring	Trigger	Proposed mitigation action(s)
Walkovers	Lower Pen-y-Cae Reservoir Trefechan Brook River Eitha River Dee	Walkover survey during low flow conditions - Mapping of sensitive habitats, communities, species and any monitoring sites that are required in order to improve understanding of the baseline communities.	N/A	N/A
Water Quality	Lower Pen-y-Cae Reservoir Trefechan Brook River Eitha River Dee	In situ weekly measurements will be undertaken of the following variables: • Dissolved oxygen (concentration in mg/l and % saturation) • Conductivity (µS/cm) • Temperature (℃) • Turbidity (NTU units) • pH levels • Depth (m) The in situ measurements will be carried out at every meter of the Lower Pen-y-Cae Reservoir to cover the full profile of the reservoir depth. Water quality samples will also be collected on a monthly basis and, in addition to the above listed variables, detailed analyses of water samples will be undertaken. Appendix K shows a list of determinants that have been agreed with NRW to be measured at the sites described below. Samples will be collected at the following sites (location of all sites are marked in Figure 28):	N/A	N/A

		• Pen-y-Cae Reservoir – samples will be collected at three different depths (surface, middle and bottom) of the reservoir (i.e. 3 samples to be collected at the reservoir – site 1). • Trefechan Brook - upstream of confluence with river Eitha (site 2) • River Eitha – upstream and downstream of the confluence with the Trefechan Brook and upstream of the confluence with the River Dee (sites 3, 4 and 5) • River Dee - upstream and downstream of the confluence with the River Eitha (sites 6 and 7)		
Algae	Lower Pen-y-Cae Reservoir	Regular visual checks will be made for the presence of scumming using Centre of Ecology and Hydrology's CEH 'Blooming Algae' app on phone[12]. If the visual check suspects an algal bloom to be potentially harmful, undertake numerous spot samples to determine levels of chlorophyll *a,* key nutrients, and cyanobacteria cell counts.	Sample reveals algal species to be dominated by non-harmful species.	Report any algal blooms to NRW. For smaller reservoirs such as Lower Pen-y-Cae, the installation of barley straw bales around margins can prevent further algal growth (reliant on the breakdown of the bales which can take time to occur). This will be undertaken alongside aeration as bales may reduce dissolved oxygen levels during breakdown. Initial dosage rate is ~500 kg/ha.

[12] https://www.ceh.ac.uk/news-and-media/news/bloomin-algae-new-app-help-reduce-public-health-risks-harmful-algal-blooms

				Dead aquatic and non-aquatic vegetative will also be removed, which may be contributing towards elevated nutrient levels.
			Sample reveals algal bloom to contain harmful species.	In addition to the mitigation measures for non-harmful algal blooms; Temporary suspend any recreational activities undertaken in/near the reservoir (e.g. angling and water sports). Make local stakeholders, public and farmers aware of the threats of harmful algal blooms to animals and livestock.
Fish	Lower Pen-y-Cae Reservoir	Fish are stranded or deemed at risk of being cut off from more suitable habitats within the reservoir as water levels recede and the reservoir bed becomes increasingly exposed, leading to the formation of separate 'pool' features. Targeting monitoring of mean dissolved oxygen levels in-reservoir[13] using a calibrated	Fish grouped up in noticeably high densities within areas of the reservoir that are reduced in size/shallow in depth, and/or disconnected from the main remaining body of water.	Rescue and relocate fish to more suitable habitats within the reservoir, or a pre-arranged holding facility/waterbody. Suitable sites for relocation will be agreed with NRW prior to implementation of the flow augmentation option. Temporarily suspend any angling.

[13] Mean dissolved oxygen to be measured according to lake type as follows: Mixed lakes (no stratification) - 0.5m depth intervals throughout the water column. Stratified lakes - below the thermocline (sample to be taken from the hypolimnion)

		in-situ probe (weekly) or through installation of a continuous probe[14]. Where an algal bloom is assessed as present in the reservoir during periods of hot weather, pay particular attention to dissolved oxygen concentrations in the morning[15].	Reservoir contains only coarse fish *(no salmonids present)*: Mean dissolved oxygen level drops below 4mg/l.	Deploy oxygenation units within these areas of the reservoir. This would increase oxygen levels and minimise fish distress. Temporarily suspend any angling.
			Fish seen to be gasping at the water's surface or showing signs of lethargy/turning on their side on the surface.	As a last resort, rescue and relocate fish to more suitable habitats within the reservoir, or a pre-arranged holding facility/waterbody. Any netting and transfer of fish would be arranged during the drought as soon as environmental conditions were below an acceptable standard. Prior to the implementation of the flow augmentation option, any requirements regarding the translocation of fish (including the selection of suitable receptor sites) will be agreed with NRW. Temporarily suspend any angling.

[14] Oxygen conditions in lakes are strongly influenced by depth and thermal stratification. It is necessary to take this into account when measuring oxygen conditions in lakes

[15] Photosynthesis is more vigorous during strong sunlight, during hot weather, super-saturation (dissolved oxygen) of the water can occur in the late afternoon, but after nightfall the Concentration of dissolved oxygen falls rapidly, to the extent that by dawn fish survival is at risk

		Targeting monitoring of water temperature in-reservoir using a calibrated in-situ probe or through installation of a continuous probe.	Average temperature of water column exceeds 26ºC for a period of 3 days or more[16].	Rescue and relocate fish to any available areas within the reservoir that possess temperatures below the trigger level.
		Notable increase in the presence and feeding activity of piscivorous/scavenging birds, mammals and/or fish carcasses on the shore being fed upon.	Presence of predators around areas which are known or likely to contain high densities of fish as a result of 'crowding'. Predators to note include: • Piscivorous/scavenging birds, such as cormorant, goosander, gulls and heron. • Mammals, such as mink and otter. Presence of fish carcasses with signs of predation.	Installation of artificial floating islands with anti-predation fish mesh/cage below surface. Bird scarers, general human activity around lake (e.g. regular presence of monitoring teams/rangers).
		Marginal plants (e.g. reed beds) and/or marginal macrophyte located in the reservoir margin left exposed and unavailable to fish as levels recede. Access to marginal plants and macrophytes typically required between March and July (by mixed species of coarse fish).	Marginal plants and macrophytes exposed between March and July.	Introduce artificial floating island features 1 month prior to spawning period – floating islands should possess suitable spawning medium attachments (e.g. artificial spawning brushes). Temporarily suspend any angling during spawning season/s.

Table 7 - Proposed monitoring and mitigation during the implementation of the flow augmentation option

[16] Based on the information provided by Turnpenny A.W.H. & Liney K.E. (2007) Review and development of temperature standards for marine and freshwater environments. Jacobs, on behalf of SNIFFER

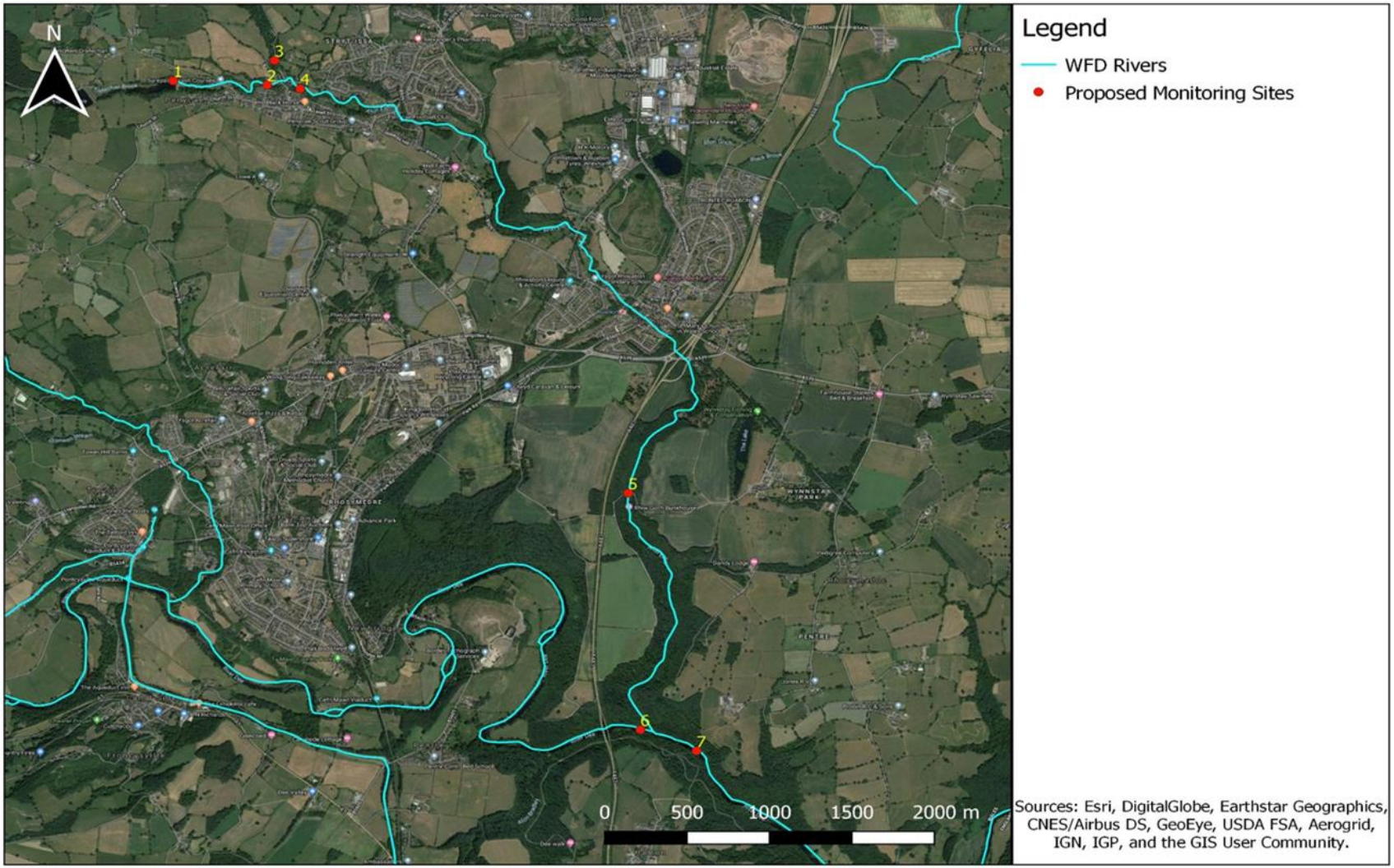


Figure 28 - Proposed location of monitoring sites

5. Management and Communications strategy

5.1. Introduction

An essential part of the Drought Plan is the communications strategy that we intend to follow in the event of a drought. Effective communications can help to reduce customer demand, increase the available water for supply, reduce the impact on the environment and avoid confusion especially with respect to water use restrictions.

This section explains the management structure that will be put in place prior to the start of a drought, the actions that will be taken in relation to the triggers identified in section 2 and lessons learned from previous droughts.

5.2. Management structure

It is essential that we have a clear management chain and line of communication. This is necessary so we can make informed decisions quickly and effectively, and can agree and implement these actions. Overall control of our response to a drought is managed by our Drought Action Teams (DATs). We have four different levels of DAT:

- Operational bronze
- Operational silver
- Tactical DAT
- Strategic DAT

We judge which level of DAT we need to convene by monitoring levels of raw water against our drought triggers (described in section 2). The DAT levels that we use to manage different stages of droughts are shown below:

I. If Dee Storage System is in zone 1 and/or resources in Llandinam and Llanwrin WRZ are in Trigger zones A or B and tracking normally, we manage through our normal operating rhythm
II. If Dee Storage System is crossing the system safe yield line (Trigger 1) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zones A or B but trending towards zone C, we will manage our system via operational bronze DAT
III. If Dee Storage System is in developing drought status (Trigger 2) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone C, we will manage our system via operational silver DAT
IV. If Dee Storage System is in drought status (Trigger 3) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone D, we will manage our system via tactical DAT
V. If Dee Storage System is in severe drought status (Trigger 4 and 5) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone E or below, we will manage our system via strategic DAT

5.2.1. Operational bronze DAT

This team meets fortnightly if condition (ii) above applies. We have set out the composition of this DAT in the following table:

DAT member	Role
Strategic Asset Management - Water Resources Lead (Chair)	Overall responsibility for managing the response to a drought whilst conditions (i) and (ii) above apply
Principal Hydrologist	Provides technical advice on hydrology and licensing
Water Resources and Production Manager	Controls interventions and daily production requirements
Strategic Network Optimisation Advisors	Support water resources and production manager
Hydrologist	Provides technical advice on hydrology and modelling
(Principal/ Senior) Hydrogeologist(s)	Provides technical advice on hydrogeology and groundwater assets

Table 8 - Operational Bronze DAT

5.2.2. Operational silver DAT

We have set out the composition of this DAT in the following table:

DAT Member	Role
Head of Network Control (Chair)	Overall responsibility for managing the response to a drought and network management
Head of Strategic Asset Management (Chair)	Responsibility for strategic asset planning and water resource management planning
Head of Asset Creation Non-Infra	Responsible for engineering projects on our non-infrastructure assets
Strategic Asset Management - Water Resources Lead	Leads on implementation of drought plan measures
Strategic Grid and Resilience Manager	Advice on grid resilience and capacity head of asset management
Area Production Operations Lead (for the areas affected)	Responsible for managing water production operations
Principal Hydrologist	Provides technical advice on hydrology and licensing
Hydrologist	Provides technical advice on hydrology and modelling
(Principal/ Senior) Hydrogeologist(s)	Provides technical advice on hydrogeology and groundwater assets
Process Design Engineering Lead	Advice and sign off on water treatment processes
Network control – water resources lead	Supports Head of Network Control
Water Resources and Production Manager	Controls interventions and daily production requirements

Operation Control Centre – Response Lead	Supports Head of Network Control
Head of Regulatory Performance and Assurance – if needed	Responsible for contact with NRW and environmental permitting
Customer Strategy and Experience – if needed	Responsible for customer experience
External Communications – if needed	Responsible for all external customer communications

Table 9 - Operational Silver DAT

5.2.3. Tactical DAT

The operational silver DAT expands to become the tactical DAT if any sites enter the conditions specified in (iv) above. We have set out the composition of this DAT in the following table:

DAT Member	Role
Head of Network Control (Chair)	Overall responsibility for managing the response to a drought and network management
Head of Strategic Asset Management (Chair)	Responsibility for strategic asset planning and water resource management planning
Head of Asset Creation Non-Infra	Responsible for engineering projects on our non-infrastructure assets
Strategic Asset Management - Water Resources Lead	Leads on implementation of drought plan measures
Strategic Grid and Resilience Manager	Advice on grid resilience and capacity head of asset management
Operation Control Centre – Response Lead	Supports Head of Network Control
Network control – water resources lead	Supports Head of Network Control
Water Resources and Production Manager	Controls interventions and daily production requirements
Area Production Operations Lead (for the areas affected)	Responsible for managing water production operations
Principal Hydrologist	Provides technical advice on hydrology and licensing
Hydrologist	Provide technical advice on hydrology and modelling

(Principal/ Senior) Hydrogeologist(s)	Provides technical advice on hydrogeology and groundwater assets
Security and Resilience Lead	Responsible for security, emergency plans, incident management, engaging with mutual aid and Local Resilience Forums
Legal Counsel (Legal) – if needed	Responsible for legal issues
Customer Strategy and Experience – if needed	Responsible for customer experience
External Communications – if needed	Responsible for all external customer communications
Head of Regulatory Performance and Assurance – if needed	Responsible for contact with EA and environmental permitting
Water Regulations and Public Health Lead – if needed	Responsible for water quality considerations

Table 10 - Tactical Drought Action Team (DAT)

5.2.4. Strategic DAT

This is the highest level of DAT and it is chaired by the Production Director or an appropriate deputy. The silver, tactical and strategic DATs include senior managers who have expertise in water resources, water treatment, water quality and communications. These managers are supported by extensive technical expertise from within their departments. Strategic DAT includes all of the members of tactical DAT as well as the people listed in the following table:

DAT Member	Role
Production Director (Chair of Strategic DAT)	Overall responsibility for managing the response to a drought
Head of Customer Network Operations	Responsible for managing the distribution network in our region
Chief Engineer	Responsible for engineering and providing a 2nd line assurance of DAT decisions
Deputy General Counsel (Legal)	Responsible for legal issues
Head of Finance and Performance Production	Responsible for financial and performance issues
Head of Customer Strategy and Experience	Responsible for customer experience
Head of Asset Creation Infrastructure	Responsible for engineering projects on our Infrastructure asset
Head of Communications	Responsible for all communications

Table 11 - Strategic Drought Action Team (DAT)

Our DATs allow us to monitor and evaluate the effectiveness of our drought management actions. It also provides the benefit that it is a forum for technical discussions as well as for

understanding the implications to our communication activities. By ensuring consistent internal and external drought messages we are in a stronger position to join-up our communications with those of our relevant stakeholders.

5.2.5. Annual Review

This drought plan does not only apply during drought years. We have a regular 'raw water availability' agenda item at our water availability steering group meeting. This helps to remind staff of the processes described in this plan, to assess the need for any further proactive mitigating actions and to ensure that our drought plan remains both current and achievable.

5.3. Communications plan

It is vital that we have a clear communications route to our customers and other stakeholders so that we communicate the correct messages at the correct time. This section of our plan sets out the communications plan that we would follow at different stages before, during and after a drought.

Effective communications can help to reduce demand in a drought, for example, by raising customer awareness of the limited availability of water resources. Conversely, poorly prepared messages can have a detrimental effect on the public response to appeals for restraint.

We use the DAT to prevent this from happening. For instance, the communications team attend DAT meetings and work with the DAT to provide clear briefings for internal communication, ensuring our employees communicate appropriate messages and advice to customers. External methods of communication available to us include leafleting, mailed letters, radio and/or television, local and national press, social media and by updating our website.

5.3.1. Stakeholders

Under normal conditions water resources are monitored using a Water Resources Report. This report is discussed on a monthly basis at our water availability steering group meeting. The report contains current and historic data in relation to levels of storage in our own reservoirs and in the Dee Storage System, rainfall, demand and leakage. As the storage in our own resources and the Dee Storage System move from normal to developing drought, we would increase the frequency of which the Water Resources Report will be discussed in our DATs.

Customers

It is our responsibility to communicate effectively and efficiently with our customers. The messages and the timings of these communications are detailed in Table 13. We will work closely with Consumer Council for Water (CCWater), NRW, EA, other water companies and other bodies such as Waterwise and local representative groups to ensure clarity and consistency. Prior to any communications with customers we will review our plans with CCWater as they are the independent customer representative.

In the event we have to introduce a TUB we will use a number of channels of communication such as newspapers, television and radio to inform our customers. Special consideration will be taken with regard to vulnerable customers and Water sure.

In the unlikely event that a Drought Order has to be implemented, we will endeavour to contact customers that are likely to be directly affected by these measures to minimise any adverse impacts.

We recognise that we may receive elevated levels of customer contacts with requests for more information, water saving devices or meter requests. We have additional facilities which we can use to deal with higher volumes of customer contacts and we will employ them if necessary.

Dee Consultative Committee

One of our principal means of coordinating our operational and communications actions will be through the Dee Consultative Committee which comprises NRW, EA, United Utilities, Dŵr Cymru Welsh Water, Hafren Dyfrdwy, Severn Trent Water and Canals and Rivers Trust. The liaison process through this group will ensure consistency of messaging for customers and provide the opportunity for joint working with the potential for joint campaigns, advertising, newsletters, press releases and press conferences.

Wales Drought Liaison Group

In the event that the water situation in Wales appears to be moving towards a developing drought, Welsh Government will convene their Wales Drought Liaison Group. This is chaired by Welsh Government and comprises NRW, Hafren Dyfrdwy, and Dŵr Cymru Welsh Water with Public Health Wales and representatives from local authorities also being invited to participate as required. The aim of this group is to:

- Steer direction and ensure consistency of thinking and communication across the different organisations;
- Support the delivery of the Welsh Government's agenda for water as set out in the Welsh Government's Water Strategy;
- Engage key organisations in planning the strategic direction for water management in Wales; and
- Facilitate open and frank discussions on the water situation all aspects relating to the strategic management of water in Wales.

Other Stakeholders

We will liaise with other stakeholders during a drought by disseminating information using letters, telephone calls and emails. The stakeholders whom we will contact will be dependent on how the drought evolves. As demonstrated by our list of consultees, we have a comprehensive list of organisations and individuals whom we will consider contacting.

The following table provides a list of stakeholders that we expect to communicate with during a drought. In this list, we have included all of the groups mentioned in Appendix K of the NRW drought plan technical guideline regardless of whether these are statutory or non-statutory

consultees. Although we expect to contact most of the non-statutory groups in a drought there may be circumstances when we do not need to specifically contact every one of these groups. This list is not exhaustive and we may contact other bodies not included in this table:

Group	Stakeholder
Domestic and commercial customers	Private customers
	Consumer Council for Water
	Citizens Advice Bureau
Regulators	Drinking Water Inspectorate (DWI)
	Welsh Government
	Ofwat
	Defra
	Natural Resources Wales / Cyfoeth Naturiol Cymru
	Environment Agency
	Natural England
Environmental and other relevant interest organisations and groups	Local wildlife groups and campaign groups
	Waterwise
	Local fisheries bodies and groups
	Angling Trust
	Campaign to Protect Rural England
	RSPB
	WWF
	Resource Efficient Wales
	Cadw
	Friends of the Earth
	National Trust
	National Parks
Local authorities and political representatives	Councils
	MPs, AMs
	MEPs
Representative bodies	Primarily Water UK but also others such as: Confederation of British Industry, NFU, Chambers of Trade and Commerce, Countryside Landowners and Business Association, Horticultural Trade Association
Community based institutions and organisations	Parish Councils
	Town Councils
Water companies	For example, neighbouring water companies like DCWW, United Utilities and Severn Trent Water.
Public services	Fire Service
	Health Authorities
	Police services
	Local Resilience Forums (LRFs)
Press and media	Newspapers
	TV
	Radio

	Internet based
Sports and interest groups	Angling clubs
	Canoe/ boating clubs
Waterways and navigation	Canal and Rivers Trust
	Canal authorities
	Welsh Dee Trust
Other relevant water undertakers	

Table 12 - Stakeholders that we expect to contact in a drought

In addition to the public consultation, we invited the following statutory stakeholders to comment on the draft drought plan:

- NRW
- Ofwat
- Welsh Ministers
- Any licensed or appointed water supplier which supplies water in the Hafren Dyfrdwy region via our supply system.

Once Strategic DAT has recommended that we impose restrictions on our customers' water use, we will send regular briefing statements to Welsh Government, CCWater and Ofwat. If drinking water quality could be affected, we will contact the DWI. All such communications will be approved by Strategic DAT.

We will report on the situation regularly to Water UK particularly if other UK water utilities are suffering similar drought problems. It is important that Water UK co-ordinate any reporting of the national situation and present it in a consistent manner in the national news media. Regular conference calls will ensure this is handled consistently.

Similarly, we will involve other external bodies if supplies are under extreme risk. For example, if tankering to outlying areas becomes necessary, we may ask the police and county highways departments for advice. We will make contact with the Local Resilience Forums (LRFs) to ensure full public awareness of the situation.

5.3.2. Escalation of messages

Communications will:

- Show customers that their contribution to water efficiency is worthwhile
- Explain to customers in simple terms how they can save water
- Demonstrate to customers that we are doing our bit to manage water resources wisely

Stages of Communication	Trigger
Stage 1- first fall in resources • Ongoing water efficiency communications continue as per normal water efficiency campaign plan Includes standard marketing of • Save-a-flushes • Water butts and other products (e.g. shower heads, timers) • Guide to saving water (print and web) • Education activity • Opportunistic media and PR	Dee Storage System in developing drought status (Trigger 2) and/or resources in Llandinam and Llanwrin WRZ are moving towards zone C
Stage 2 – projections show likelihood of continued fall in resources • Specific and targeted focus on promoting water efficiency through regional media, exploiting existing relationships • Social media campaigns, e.g. ask customers for their best water saving tips • Extra emphasis on leakage. We provided some illustrative information on the quantities of leakage reduction we could achieve in section 3.2.2. We will start this extra emphasis on leakage in stage 2 but will continue with this work in stage 3 and 4. • We will showcase our work in finding and fixing leaks, promotion of leakline, reporting leaks online and report a leak app. • Show good examples of our customers taking action to reduce consumption • Working with the gardening industry to promote saving water in the garden • Frost awareness PR • Work with WaterWise, Water UK and other water companies to ensure joined up and consistent messaging • Working closely with non-household retailers to understand their predicted water use profiles over the coming weeks	DAT convened/ Dee Storage System in drought status (Trigger 3) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone C
Stage 3 – one to two weeks leading to proposed restrictions on use • Specific focus in the regional media on water usage and efficiency • Possible radio campaign showing what we do and what customers can do • This would include paid for elements of advertising, including features and promotions	DAT decision/ Dee Storage System in severe drought status (Trigger 4 or 5) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone D or E

• Possible increased activities such as water efficiency product giveaways via radio and TV • Higher profile of water saving on the website, including front page banner • Increased use of social media including Facebook and Twitter campaign • Press features on water resources activity, summarising how we plan for dry spells and how customers can help • Water efficiency adverts in newspapers • Formal media appeals to conserve water • Possible sponsorship of weather section in print, tv and radio media • Participate in any joint national media campaigns on water efficiency • One to one media briefings • Setting out what actions are likely to happen over the coming days/weeks so that nothing comes as a surprise to people • Close liaison with stakeholders and regulators to maintain "no surprises" • Close working with other water companies – consider joint statements and adverts • Asking large commercial customers if there is scope for them to reduce demand	
Stage 4 – restrictions imminent or in place • We plan to give a notice period (14 days) to customers before we put any restrictions in place • We will use at least two local newspapers as well as social media and our website to advertise restrictions. • We will give details of how customers can make representations • Daily updates on water resources levels to manage high volumes of reactive interest • Intense local broadcast activity – All traditional media (TV / radio / newspapers) as well as social media. This activity will reach far more people than those who see the adverts in the local newspapers and on our website • Advertising in the media in areas where there is a known supply/demand imbalance • Close contact with stakeholders on a regular basis • Withdrawal of softer messaging to avoid any confusion as hard messaging introduced.	DAT decision/ Dee Storage System is in severe drought status (Trigger 5) and/or resources in Llandinam and Llanwrin WRZ are in Trigger zone E or below
Stage 5 – removal of restrictions	DAT decision/ Dee Storage System is in zone 1 and/or

• Strong message in the media - thank you to our customers for their help at this time • Close liaison with stakeholders to ensure messaging is consistent	resources in Llandinam and Llanwrin WRZ are in Trigger zone A

Table 13 - Escalation of messages

When we communicate with customers during a drought or a period of extremely hot weather we are able to measure the number of people accessing information on our website, the number of tweets that people click to request further information and the number of water efficiency packs that we distribute. We also know how many people different newspapers or radio programmes reach and we record what communications activities we do and when. In addition to this we measure how demand changes across the company and over time.

However, there is not always an obvious correlation between the extent and type of communications work and the demand for water. This makes monitoring the effectiveness of our communications a challenging exercise. For example, in response to periods of hot weather we increase the amount of proactive media work that we do. In addition, we also devote additional resources to our leakage reduction work. We describe this in more detail in section 3.2.2.

Waterwise published a report in July 2013 on the 2010-12 drought and one conclusion of this report was that "The impacts on the public of communications and promotion are difficult to measure but by most measures, there seems to have been a positive reaction both in terms of action and understanding". This supports our point that it is not easy to measure the effectiveness of this type of communications.

5.3.3. Private supplies

We have prepared this drought plan to show how we intend to provide our customers with water during drought. However, we are aware that some people in our region depend on 'private supplies'. For example, householders or businesses may have their own borehole. If a drought adversely affects these people then we encourage them to contact us. If this scenario arises we will consider how we can help without putting our own customers' supplies at risk.

5.4. Lessons learned from previous droughts

The drought of 2011/12 affected much of the UK but particularly the east, south-east and south of England. During this drought a number of water companies introduced TUBs for the first time following the enactment of the Flood and Water Management Act of 2010. Implementing TUBs for the first time highlighted some of the difficulties that were likely to be encountered. Differences in the interpretation and use of TUBs, combined with the varying geographical coverage and intensity of the drought made it difficult to provide clear and consistent messaging/communications.

As part of the experience gained from the 2011/12 drought, the UKWIR code of Practice and Guidance on Water Use Restrictions was revised and a series of actions developed to incorporate the lessons learnt:

- Companies, regulators and government to work together
- Coordinate communications
- Adopt a common phased approach, considering socio-economic factors
- Adopt a common approach to exceptions

Prior to producing this Plan we reviewed the above actions and have included them in our management actions. We recognise that a joined up strategy for managing a drought will provide the best response for our customers, ourselves and the environment and we have endeavoured to incorporate this throughout the plan.

6. Post drought actions

We define the end of a drought as being when the water resources have returned to their normal level of risk. Indicators we would use to signify that a drought was ending are:

- A period of rainfall at or above the average for the time of the year
- Flows within the River Dee at acceptable levels for the time of year and above the required trigger point
- Storage levels in the Dee storage system and within our reservoirs above the reservoir control curves

The above indicators will be reviewed in combination by the DAT and through the Dee Consultative Committee to ensure that all our water resources are no longer at risk.

A post-drought review will be carried out by the DAT shortly after the drought has ended. A preliminary meeting will be held to determine the initial understanding of the effectiveness of the options that were implemented. This will provide early feedback to highlight where there is a risk that drought conditions could be re-entered within the near future. It will also provide a better understanding of exactly how we are going to measure the effectiveness of the plan and assist with the preparation of a 'lessons learnt' report that will be used to modify and improve a future Drought Plan. Examples of how the effectiveness of implemented drought management actions may be measured both quantitatively and qualitatively include:

- A comparison of the actual environmental impacts of the drought and those anticipated
- Effectiveness of the environmental monitoring
- Effectiveness of any mitigation measures that were implemented to minimise any environmental impact
- The effectiveness of the different methods of communication employed to inform customers and other stakeholders such as:
    - Change in the number of website hits that were received as the severity of the drought increased
    - The number of adverts (TV, radio or newspaper) that were issued and where they were issued
    - Number of requests for more information that were received
    - The additional number of water saving devices that were requested
    - The additional number of water saving devices that were actively distributed
    - The number of text messages that were sent out
    - Discussions with CCWater and other stakeholders to gain an understanding of how they perceived the our communication strategy worked
- Identification of additional infrastructure investment required
- Success of the supply side measures in particular the augmentation of the River Dee with water from Lower Pen-y-Cae Reservoir, this may include:
    - Measurements of any losses that were incurred between Lower Pen-y-Cae Reservoir and the River Dee via Trefechan Brook
    - Ease with which any supply side measures were implemented

    - Discussions with the NRW to understand how the implementation of any supply side measure was from their perspective
- Success of demand side measures in particular the implementation of TUBs and Drought Orders, this may include:
    - Reduction in leakage
    - Addition resources used to achieve any reduction in leakage
    - Reduction in distribution input
    - Reduction in demand from households and non-households further subdivided into measured and unmeasured customers
    - Reductions in demand for our domestic consumption monitor
- Identification of any aspects of the Water Resources Management Plan that may require updating
- Review of neighbouring water companies' experiences and what lessons they may have learnt

Following an initial draft of the 'lessons learnt' report we then plan to discuss our findings with our main stakeholders which will include: NRW, United Utilities, Dŵr Cymru Welsh Water (possibly through the Dee Consultative Committee) and CCwater. We may also consider expanding our discussions to other stakeholders depending on the drought management actions that were taken.

7. Future Work

7.1. Trefechan Brook stream bed losses

As mentioned in section 3.4, we are anticipating that there may be some losses to the stream bed of Trefechan Brook if we were to use it to augment the River Dee with water from our Lower Pen-y-Cae Reservoir. To try and further understand the possible magnitude of these losses, we have set out a plan to monitor the discharge from Lower Pen-y-Cae Reservoir and the corresponding inflow into the River Dee (Table 6). Before doing this, careful consideration must be given to the prevailing conditions at the time of the test. For example, carrying out the test in winter, when the ground is water logged, would not provide accurate results, however carrying out the test during dry conditions may pose an unnecessary risk.

We will also work with NRW to update the conditions included in the DGD regarding the implementation of the flow augmentation scheme with a view to ensure any concerns about the effects of water released from the Lower Pen-y-Cae Reservoir are addressed. Section 4.3 describes details of the monitoring program and mitigation measures that have been agreed with NRW and we plan to carry out to mitigate any potential effects of water released from the Lower Pen-y-Cae Reservoir on the downstream rivers. The DGD conditions will require this monitoring program to be undertaken in order to be able to implement the flow augmentation scheme when required.

Glossary of terms

Term	Definition
Abstraction	Removal of water from a source of supply (surface or groundwater).
Abstraction licence	The authorisation granted by the Environment Agency or Natural Resources Wales to allow the removal of water.
AONB	Area of outstanding natural beauty.
Augmentations	The support of a river by an additional supply.
Catchment	The area from which precipitation and ground water will collect and contribute to the flow of a specific river.
Catchment Abstraction Management Strategy	A strategy produced by the Environment Agency/Natural Resources Wales for managing water resources at a local level.
Compensation flow	Water released from reservoirs in order to maintain a certain flow or level further downstream of the river.
Consumer Council for Water	Organisation representing the interests of water customers
Dee Consultative Committee	A committee which comprises NRW, EA, United Utilities, Dŵr Cymru Welsh Water, Hafren Dyfrdwy, Severn Trent Water and Canals and Rivers Trust. The committee supports Natural Resources Wales in the establishment and the implementation operational control rules known as the Dee General Directions.
Dee Drought Directions	Specifies the principles and detail under which the prescribed flows, and abstractions must be reduced in a drought more severe than the design drought.
Dee General Directions	A set of principles which detail the regulation of the River Dee, using Llyn Tegid, Llyn Celyn and Llyn Brenig Reservoirs.
Dee Normal Directions	Specifies the principles and detail under which the prescribed flows are maintained in the River Dee under normal operations.
DEFRA	Department of the Environment, Food and Rural Affairs
Demand	The amount of water required for use, includes customer demand and leakage.
Deployable output	The output of a commissioned source or group of sources or of a bulk supply as constrained by: the environment, abstraction licences, water quality, existing water treatment and supply system capabilities.
Dissolved Oxygen Levels	A relative measure of the amount of oxygen that is dissolved within water.
Drought	A general term covering prolonged periods of below average rainfall resulting in low river flows and/or low recharge to groundwater, imposing significant strain on water resources and potentially the environment.
Drought Order	A means where Water Companies and/or Environment Agency /Natural Resources Wales apply to Welsh Ministers or the Secretary of State for the Environment for the imposition of restriction in the uses of water or to take water from a source.
Drought Permit	Issued by the Environment Agency/Natural Resources Wales in order to allow a Water Company to abstract water outside of the normal terms of an Abstraction Licence during a drought period.
Drought Trigger	A specific event/incident which triggers a drought action to occur.
DWI	The Drinking Water Inspectorate - Organisation that regulates drinking water quality in England and Wales.
EA	Environment Agency
Emergency Drought Order	A means by which a Water Company can restrict the supply of water to its customers through the imposition of rota cuts and/or the introduction of standpipes to deal with the very remote possibility of an extreme drought.
Gauging station	A site where the flow of a river is measured.
Groundwater	Water that is contained in underground rocks.
Habitat	Place in which a species or community of species lives, with characteristic plants and animals.

Term	Definition
HRA	Habitats Regulations Assessment - Process for identifying the implications of the drought plan options for European designated sites (SAC, SPA and RAMSAR).
Hydrology	The study of the Earth's water, in particular of water under and on the ground before it reaches the ocean and before it evaporates.
Leakage	Water lost from a supply network between the point of supply and the point of demand.
Level of Service	Reliability of water supply to a Water Company's customers expressed as s frequency of the imposition of water use restrictions.
Ml/d	Mega litres per day (Mega - million)
NRW	Natural Resources Wales
Ofwat	Office of Water Services (the economic regulator of the water industry in England and Wales).
pH	pH is a measure of the acidity of an aqueous solution . Pure water is neutral, with a pH close to 7 whilst solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline.
Ramsar	Ramsar sites are wetlands of international importance designated under the Ramsar Convention. More formally known as "The Convention of Wetlands of International Importance especially as Waterfowl Habitat" it is an intergovernmental treaty signed in Ramsar, Iran in 1971.
Regulated river	A river where the flow is augmented through the addition of water from another source.
Reservoir control curves	A graph showing managed reservoir levels which are expected to occur during normal weather conditions and levels which act as triggers when levels fall during dry weather, to warn of possible drought.
Resource zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall.
Review of Consents	The Environment Agency/Natural Resources Wales process by which abstraction licences (and other consents such as discharge consents) that have the potential to adversely affect SAC and SPA sites are being reviewed by the Environment Agency/Natural Resources Wales to determine if they need to be altered. The process will result in changes such as increases to compensation or prescribed flow requirements and reductions to the volume of water that can be abstracted.
SAC	Special Area of Conservation - Designated under the EU Habitats Directive. Together with SPAs these for the Natura 2000 network of protected sites.
SoS	The Secretary of State for Defra (Department for Environment, Food and Rural Affairs).
SPA	Special Protection Area - Designated under the EU Directive on the conservation of wild birds. Together with SACs these for the Natura 2000 network of protected sites.
SSSI	Site of Special Scientific Interest - Designated under the Countryside and Rights of Way (CRoW) Act 2000.
STW	Severn Trent Water PLC
Telemetry	A means of collecting information by unmanned monitoring stations using a computer that is connected to the public telephone system.
Temporary Use Ban (TUB)	A means by which a water company can restrict water use as provided by Section 36 of the Flood and Water Management Act 2010.
Turbidity	A measure of the cloudiness/haziness of water.
UKWIR	United Kingdom Water Industry Research Limited - Organisation jointly funded by all UK water and waste water service suppliers.
UU	United Utilities Water PLC
Voluntary Water Use Restrictions	Prior to the introduction of Temporary Use Bans, voluntary water use restrictions would be implemented. As the name suggests customers are asked to voluntarily reduce their water consumptions.

Appendix A – Other plans that we produce

Table showing the purpose of the other plans we produce that could affect our ability to manage drought

The table below shows the different types of other plans that we produce that relate in some way to drought planning. It also summarises the purpose of each of these reports:

Plan	Purpose of plan	Comment
Business plan	This plan sets out what we expect to invest across the business over the next 5 years and beyond. It covers clean water, waste water, customer service and it shows what the impact of our proposed investment programme would have on customers' bills and company returns. We submit these plans to Ofwat for them to make a determination on what to allow within price limits. This means that they decide on how much we can charge our customers in the next 5 years. Supply demand and resilience to events like droughts are components within our company wide business plan.	We update these every 5 years.
Emergency plans	These plans describe what we will do in an emergency situation. This may be caused by a more extreme drought than we have ever experienced but could also become applicable after a major flood, asset failure and potential loss of services to customers. This plan includes arrangements to use emergency measures such as tankers and bottled water.	These plans are not published in the public domain due to their sensitivity.
Water resources management plan (WRMP)	The plan explains our proposals for making sure we have enough water available, in the right place and at the right time to supply our customers in an affordable and sustainable way over the next 25 years. Although there is an overlap between a WRMP and a drought plan, the WRMP is a more strategic longer term plan.	We update these every 5 years.

Appendix B – Dee storage system stock summaries

From:
FWDO-Dee@cyfoethnaturiolcymru.gov.uk

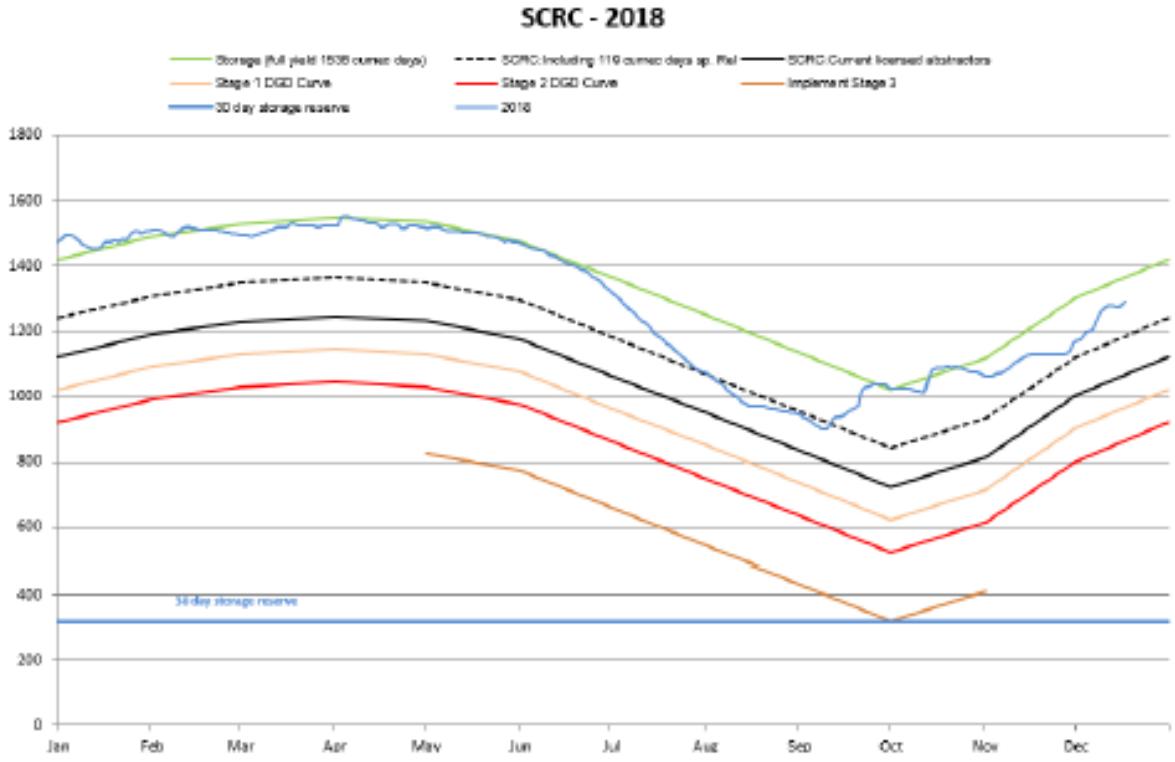
Cyfoeth Naturiol Cymru Natural Resources Wales

Report Date: Monday 17th December 2018 **Note: - River Dee is UNSUPPORTED**

The river remains unsupported. Abstractions are not constrained by the Dee General Directions and abstractors may abstract up to their full licensed entitlement at this time. The combined storage for both Celyn and Brenig reservoirs remains below the safe yield line.

Looking at Celyn reservoir alone we are currently above the storage level which should ensure it recovers to Normal Retention Level by 1st May next year. Brenig will be held below NRL for the pre-planned reservoir safety work.

Date	Celyn Storage (cumec days)	Brenig storage (cumec days)	Combined storage	% full	Weekly change
Mon 10-Dec	664.28	607.56	1271.84	82.80	5.67
Thu 13-Dec	671.96	604.45	1276.41	83.10	
Mon 17-Dec	686.05	602.91	1288.96	83.92	1.11



Please note: It is important and the responsibility of all Water Companies to notify Natural Resources Wales staff, of daily forecasted abstractions using the email address at the top of this report.

During dry weather conditions, there is a minimum 48 hours notice required for any increase or decrease of forecasted abstraction. It is assumed that all abstraction is at a continuous rate.
N.B. All figures in cumec days - Llyn Tegid stock not included.

Appendix C – Drought scenario modelling

Historic drought scenarios

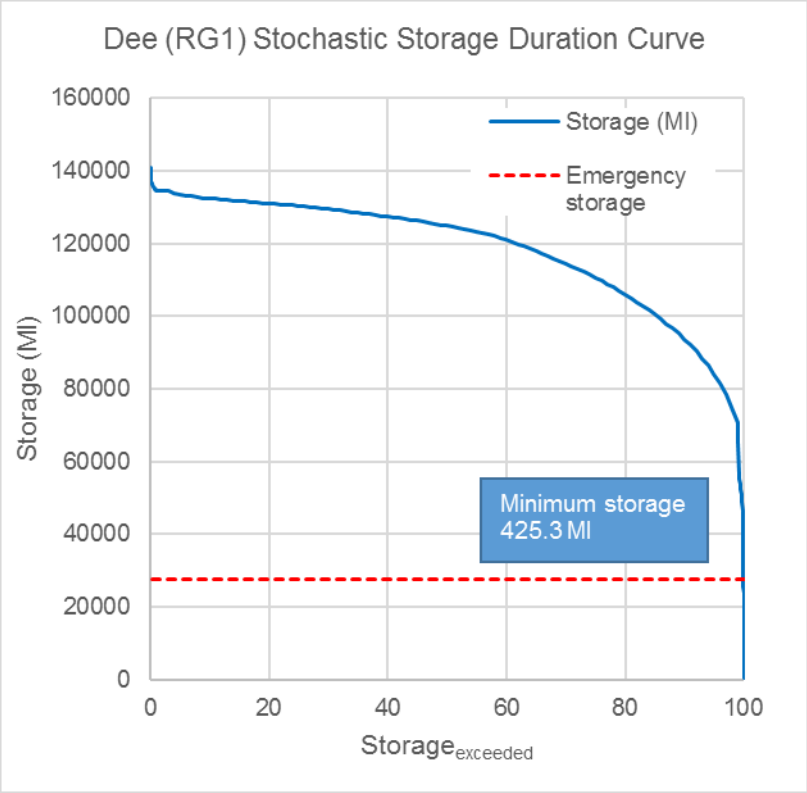
The data in the table below is a summary of the data provided by NRW from their Aquator model of the Dee Storage System. The coloured bands in the table below indicate the periods that have been used for the drought scenarios modelling.

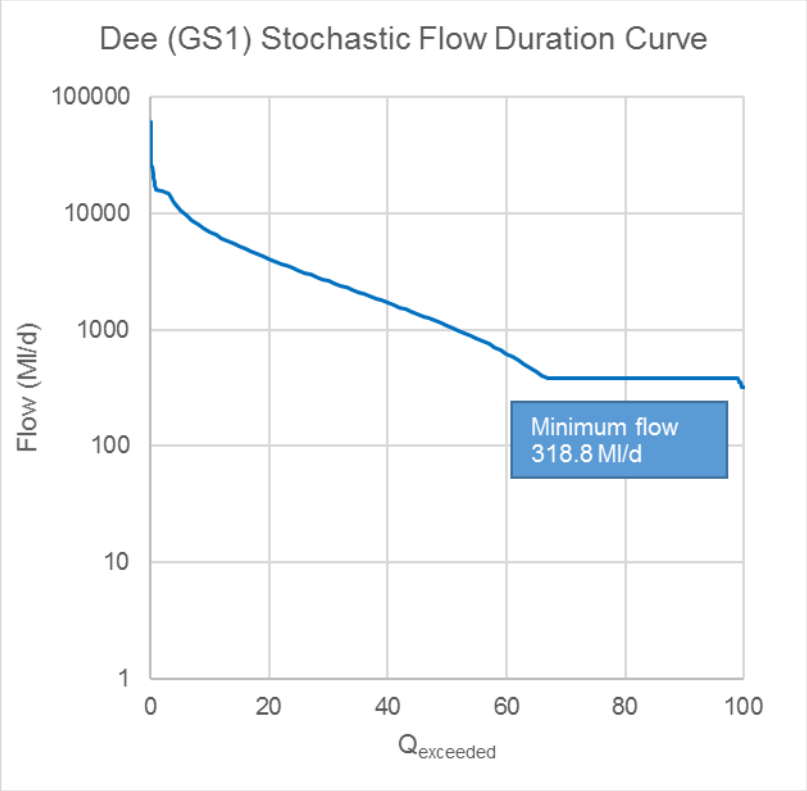
Date	Restriction type	Stage 1 Restrictions No. Days	Stage 2 Restrictions No. Days
09/07/1929	Start of Stage 1 restrictions	33	
11/08/1929	End of restrictions		
20/08/1933	Start of Stage 1 restrictions	20	
09/09/1933	Start of Stage 2 restrictions		272
08/06/1934	End of Stage 2 start of Stage 1 restrictions	8	
16/06/1934	Start of Stage 2 restrictions		99
23/09/1934	End of Stage 2 start of Stage 1 restrictions	31	
24/10/1934	End of restrictions		
19/11/1934	Start of Stage 1 restrictions	31	
20/12/1934	End of restrictions		
10/10/1937	Start of Stage 1 restrictions	9	
19/10/1937	Start of Stage 2 restrictions		99
26/01/1938	End of Stage 2 start of Stage 1 restrictions	37	
04/03/1938	End of restrictions		
20/04/1938	Start of Stage 1 restrictions	23	
13/05/1938	Start of Stage 2 restrictions		21
03/06/1938	End of Stage 2 start of Stage 1 restrictions	7	
10/06/1938	End of restrictions		
03/11/1947	Start of Stage 1 restrictions	21	
24/11/1947	End of restrictions		
11/10/1949	Start of Stage 1 restrictions	14	
25/10/1949	End of restrictions		
20/11/1955	Start of Stage 1 restrictions	40	
30/12/1955	End of restrictions		
14/10/1959	Start of Stage 1 restrictions	16	
30/10/1959	End of restrictions		
06/11/1959	Start of Stage 1 restrictions	31	
07/12/1959	End of restrictions		
01/07/1974	Start of Stage 1 restrictions	4	
05/07/1974	End of restrictions		
06/08/1976	Start of Stage 1 restrictions	17	
23/08/1976	Start of Stage 2 restrictions		34

Date	Restriction type	Stage 1 Restrictions No. Days	Stage 2 Restrictions No. Days
26/09/1976	End of Stage 2 start of Stage 1 restrictions	19	
15/10/1976	End of restrictions		
21/11/1976	Start of Stage 1 restrictions	67	
27/01/1977	End of restrictions		
07/07/1984	Start of Stage 1 restrictions	21	
28/07/1984	Start of Stage 2 restrictions		54
20/09/1984	End of Stage 2 start of Stage 1 restrictions	10	
30/09/1984	End of restrictions		
15/09/1989	Start of Stage 1 restrictions	3	
18/09/1989	End of restrictions		
03/10/1989	Start of Stage 1 restrictions	15	
18/10/1989	Start of Stage 2 restrictions		4
22/10/1989	End of Stage 2 start of Stage 1 restrictions	45	
06/12/1989	Start of Stage 2 restrictions		13
19/12/1989	End of Stage 2 start of Stage 1 restrictions	22	
10/01/1990	End of restrictions		
12/09/1990	Start of Stage 1 restrictions	19	
01/10/1990	End of restrictions		
03/10/1990	Start of Stage 1 restrictions	1	
04/10/1990	End of restrictions		
20/10/1995	Start of Stage 1 restrictions	18	
07/11/1995	Start of Stage 2 restrictions		104
19/02/1996	End of Stage 2 start of Stage 1 restrictions	41	
31/03/1996	End of restrictions		
19/09/1996	Start of Stage 1 restrictions	40	
29/10/1996	End of restrictions		
26/01/1997	Start of Stage 1 restrictions	18	
13/02/1997	End of restrictions		

Storage duration curves and flow duration curves - generated using the stochastic data to help demonstrate the resilience of the Dee catchment

RG1 corresponds to the Celyn and Brenig storage combined





Model DGD parameters applied

Updated DGD cut-back rates were provided by NRW along with the River Dee maintained flow condition values applied.

DGD status	Lower Dee Demand (Ml/d)	River Dee maintained flow (Ml/d)
Maximum abstraction	763	381.98
Safe yield	717.12	381.98
Stage 1	687.12	350.4
Stage 2	657.12	318.82
Stage 3	627.12	318.82

Appendix D – Example adverts for water efficiency and voluntary restrictions

Example advert for increased water efficiency promotion

Don’t waste water this summer

HAFREN DYFRDWY

severn dee

Drought Status
Drought

Please only use the water you need and don’t waste it
Protect our water supplies this summer

We are approaching drought conditions, please help us to protect our water supplies and the environment

Shower time - Simply flip this four minute shower timer when you get into your shower and when it runs out you'll be in your cosy towel.

Hippo - This simple device can be popped into your toilet cistern saving up to 1.2 litres of water every time you flush.

Plant water saving gel - Reducing the need for frequent watering, the 'gel', stores water that your plan: roots can extract from, when needed.

ShowerSave - This easy to fit gadget controls the flow of your shower to eight litres per minute without reducing pressure.

Tap aerators - Make your taps water efficien: by slowing down the rate of which the water comes out and limiting splashing.

Leak detection tablets - Simply drop a tablet in the toilet cistern and in a few moments you'll know if your cistern is leaking into the toilet.

Example advert for Voluntary Restrictions

Voluntary Water Use Restrictions

HAFREN DYFRDWY

severn dee

Drought Status
Severe Drought

Please follow our voluntary water use restrictions and protect our water supplies this summer

We are approaching severe drought conditions, please help us to protect our water supplies and the environment by avoiding the use of **hosepipes** and **sprinklers**.

Use a water can for your garden

Please don't use hosepipes and sprinklers to clean your car or water your garden.

Use a bucket and sponge to clean your car

Although these restrictions are voluntary, your efforts really can make a difference

Appendix E – Temporary use ban notice example

TEMPORARY BAN ON WATER USED
IN THE HAFREN DYFRDWY AREA

Hafren Dyfrdwy gives notice that, pursuant to sections 76 and 76A–C of the Water Industry Act 1991, the following uses of water supplied by Hafren Dyfrdwy are restricted.

This notice, and further details concerning the prohibitions, current drought and water efficiency advice may be found on our website: www.hdcymru.co.uk

Water use restrictions will start on [DATE] at [TIME] and continue until further notice. The restriction applies to the following [LOCATIONS]. Thank you for your support at this important time.

Prohibited Uses
The use of a hosepipe, including using sprinklers, dripper hoses, automatic irrigation systems and similar devices, is prohibited for the following:

1. Watering a garden using a hosepipe
2. Cleaning a private motor-vehicle using a hosepipe
3. Watering plants on domestic or other non-commercial premises using a hosepipe
4. Cleaning a private leisure boat using a hosepipe
5. Filling or maintaining a domestic swimming or paddling pool
6. Drawing water, using a hosepipe, for domestic recreational use
7. Filling or maintaining a domestic pond using a hosepipe
8. Filling or maintaining an ornamental fountain
9. Cleaning walls, or windows, of domestic premises using a hosepipe
10. Cleaning paths or patios using a hosepipe
11. Cleaning other artificial outdoor surfaces using a hosepipe

Note that customers can still undertake the above activities if they use mains water from a bucket or watering can; or use water that is not sourced from the mains such as grey water, rainwater from a water butt through a hosepipe, or private borehole.

The following definitions apply:

- "Using a hosepipe" includes the drawing of water supplied by the Company from a container through a hosepipe; and filling a container by means of a hosepipe with water supplied by the Company;
- “Garden” includes a park, gardens open to the public, a domestic garden, a lawn, a grass verge, an allotment used for non-commercial purposes and any other green space;
- “Hosepipe” includes anything designed, adapted or used to serve the same purpose as a hosepipe. The prohibitions apply whether or not any device is attached to the hosepipe, such as a sprinkler for example; and

- "Using a hosepipe for domestic recreational use" includes operating water slides and other recreational equipment.

These prohibited water uses are covered by the Water Industry Act 1991 section 76 as amended by the Flood and Water Management Act 2010. Further definitions may be found in the Water Use (Temporary Bans) Order 2010, which is available at www.legislation.gov.uk/uksi/2010/2231/contents/made

Statutory Exceptions

Customers who meet the requirements below can continue to use water without having to make representation to Hafren Dyfrdwy to receive permission. In using water, it is requested that customers use water wisely and adopt water efficient practices:

- Using a hosepipe for health or safety reasons, where this includes (a) removing or minimising any risk to human or animal health or safety; and (b) preventing or controlling the spread of causative agents of disease;
- Watering plants that are (1) grown or kept for sale or commercial use, or (2) that are part of a National Plant Collection or temporary garden or flower display;
- Cleaning any area of a private leisure boat which, except for doors or windows, is enclosed by a roof and walls;
- Filling or maintaining a pool where necessary in the course of its construction;
- Filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment;
- Filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease;
- Filling or maintaining a pool used in the course of a programme of veterinary treatment;
- Filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity;
- Filling or maintaining a domestic pond in which fish or other aquatic animals are being reared or kept in captivity; and
- Filling or maintaining an ornamental fountain which is in or near a fish-pond and whose purpose is to supply sufficient oxygen to the water in the pond in order to keep the fish healthy.

NB Watering areas of grass, which are used for sport or recreation, is covered by a Statuary Exception for health & safety only in relation to the active strip/playing area, not the entire ground.

Discretionary Universal Exceptions

Customers who meet the criteria below for a Discretionary Universal Exception can continue to use water without having to make representation to Hafren Dyfrdwy to receive permission to use water for the following restricted uses. It is requested that customers that meet the requirements for a Discretionary Universal Exception use water wisely and adopt water efficient practices.

The criteria for a Discretionary Universal Exception include:

Specific details of exceptions will be decided at the time of publication and will depend on the nature severity of the drought.

Discretionary Concessional Exceptions

Customers can make representation to Hafren Dyfrdwy to receive a Discretionary Concessional Exception to use water for the following restricted uses. If permission for a Discretionary Concessional Exception is given, it is requested that customers use water wisely and adopt water efficient practices.

The water uses for which a Discretionary Concessional Exception can be applied for by writing Hafren Dyfrdwy include:

> *Specific details of exceptions will be decided at the time of publication and will depend on the nature severity of the incident.*

Representations

Representations concerning any of these prohibitions may be made in writing by [DATE] to Managing Director at Packsaddle, Wrexham Road, Rhostyllen, Wrexham, LL14 4EH.

If, as a result of any representation Hafren Dyfrdwy decides to vary any terms of the prohibition, a further notice will be published. Subject to this, the prohibitions will have effect from the stated date and will remain in force until further notice.

Any person who contravenes any of these prohibitions may be guilty of an offence, and liable, on summary conviction, to a fine not exceeding £1,000.

Information to be included with the Temporary Ban Notice

- A quote from company spokesman to thank customers in advance for their support;
- Description of the sources of water supplied by the water company and how the prevailing conditions are affecting supply;
- Description of the state of water resource/severity of the situation with reference to long term averages;
- A graphic showing key data of relevance;
- Expanded definition of certain terms
- Detailed explanation of restrictions exceptions
- Tips on how to save water
- Description of the Company's efforts for tacking leakage
- Other relevant information

Appendix F – Revocation of restrictions example

REMOVAL OF WATER USE RESTRICTIONS
IN THE HAFREN DYFRDWY AREA

[INSERT RELEVANT REFERENCE TO LEGISLATION ACCORDING TO THE WATER USE RESTRICTIONS THAT HAVE BEEN IN PLACE (TUBs/Ordinary Drought Orders)]

Since [DATE] a number of temporary restrictions on the use of water (with some exceptions) have been in force in the Hafren Dyfrdwy area.

We are pleased to announce that that from [time and date] all of these restrictions are lifted.

We are very grateful to our customers for their cooperation in conserving supplies during the water shortage. We ask customers to continue to show restraint and to use water responsibly to help secure future supplies.

[Detailed explanation here if desired]

Any queries in connection with this announcement should be addressed to:

Chief Executive Officer
Hafren Dyfrdwy
Packsaddle
Wrexham Road
Rhostyllen
Wrexham
Ll14 4EH

Or by email to: [EMAIL ADDRESS]

[DATE]

Information on the following should be included with the Revocation Notice

- A quote from company spokesman to thank customers for their support and to praise them for being water efficient;
- A short history of the water resource situation (historically low rainfall and river levels for example)
- The make-up of the company's supplies: groundwater, river etc and how the unprecedented conditions affected resources;
- Explanation of how the conditions triggered the water restrictions as stipulated in the company's Drought Plan; a statutory process;
- Statement whether or not other companies also implemented and are lifting restrictions if appropriate;
- Description of the change in circumstances which led to the restrictions to be lifted, perhaps using a local example known to the customers (e.g. reservoir, borehole, groundwater, river level);
- Description of the water company's current and future actions to improve supplies (leakage removal, mains replacement, metering, promotion of water efficiency);
- A statement to raise awareness of free water efficiency devices that customers can obtain, and to ask customers to report any leaks they may discover; and
- Name and contact details for further information.

Appendix G – Restricted activities for TUBs and Drought Orders and their expected exceptions

Temporary Use Bans

TUB Category	Statutory Exception	Discretionary Universal Exception (granted by all water companies)	Suggested Discretionary Concessional Exception (granted by individual water companies)
Watering a garden using a hosepipe	Using a hosepipe to water a garden for health or safety reasons. NB In this category, the definition of "a garden" includes "an area of grass used for sport or recreation". Therefore it should be noted that watering areas of grass, which are used for sport or recreation, is covered by a Statutory Exception for health & safety only in relation to the active strip/playing area, not the entire ground.	To Blue Badge holders on the grounds of disability Use of an approved drip or trickle irrigation system fitted with a pressure reducing valve (PRV) and timer	To customers on the company's Vulnerable Customer and Water Sure Lists and who have mobility issues but are not in possession of a Blue Badge
Cleaning a private motor-vehicle using a hosepipe	A "private motor-vehicle" does not include (1) a public service vehicle, as defined in section 1 of the Public Passenger Vehicles Act 1981(c), and (2) a goods vehicle, as defined in section 192 of the Road Traffic Act 1988(d)	To Blue Badge holders on the grounds of disability Use of a hosepipe in the course of a business to clean private motor vehicles where this is done as a service to customers	To customers on the company's Vulnerable Customer and Water Sure Lists who have mobility issues but are not in possession of a Blue Badge
Watering plants on domestic or other non-commercial premises using a hosepipe	Does not include watering plants that are (1) grown or kept for sale or commercial use, or (2) that are part of a National Plant Collection or temporary garden or flower display.	To Blue Badge holders on the grounds of disability Use of an approved drip or trickle irrigation system fitted with a PRV and timer	To customers on the company's Vulnerable Customer and Water Sure Lists who have mobility issues but are not in possession of a Blue Badge
Cleaning a private leisure boat using a hosepipe	(1) cleaning any area of a private leisure boat which, except for doors or windows, is enclosed by a roof and walls. (2) Using a hosepipe to clean a private leisure boat for health or safety reasons	Commercial cleaning Vessels of primary residence Cases where fouling is causing increased fuel consumption Engines designed to be cleaned with a hosepipe.	To prevent or control the spread of non-native and/or invasive species

TUB Category	Statutory Exception	Discretionary Universal Exception (granted by all water companies)	Suggested Discretionary Concessional Exception (granted by individual water companies)
Filling or maintaining a domestic swimming or paddling pool	(1) filling or maintaining a pool where necessary in the course of its construction (2) filling or maintaining a pool using a hand-held container which is filled with water drawn directly from a tap (3) filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment (4) filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease (5) filling or maintaining a pool used in the course of a programme of veterinary treatment (6) filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity	None	None
Drawing water, using a hosepipe, for domestic recreational use	None	None	None
Filling or maintaining a domestic pond using a hosepipe	Filling or maintaining a domestic pond in which fish or other aquatic animals are being reared or kept in captivity	Blue Badge holders on the grounds of disability	None
Filling or maintaining an ornamental fountain	Filling or maintaining an ornamental fountain which is in or near a fish-pond and whose purpose is to supply sufficient oxygen to the water in the pond in order to keep the fish healthy	None	To operate water features with religious significance
Cleaning walls, or windows, of domestic premises using a hosepipe	Using a hosepipe to clean the walls or windows of domestic premises for health or safety reasons	To Blue Badge holders on the grounds of disability Commercial cleaning	None
Cleaning paths or patios using a hosepipe	Using a hosepipe to clean paths or patios for health or safety reasons	To Blue Badge holders on the grounds of disability Commercial cleaning	To customers on the company's Vulnerable Customer and Water Sure Lists who have mobility issues but are not in possession of a Blue Badge
Cleaning other artificial outdoor surfaces using a hosepipe	Using a hosepipe to clean an artificial outdoor surface for health or safety reasons	To Blue Badge holders on the grounds of disability Commercial cleaning	To customers on the company's Vulnerable Customer and Water Sure Lists who have mobility issues but are not in possession of a Blue Badge

Drought Orders

Drought Order Purpose of Use	Statutory Exception	Discretionary Universal Exception (granted by all water companies)	Suggested Discretionary Concessional Exception (granted by individual water companies)
Purpose 1: watering outdoor plants on commercial premises	The purpose specified does not include watering plants that are: (a) grown or kept for sale or commercial use; or (b) part of a National Plant Collection or temporary garden or flower display	None	None
Purpose 2: filling or maintaining a non-domestic swimming or paddling pool	The purpose does not include: (a) filling or maintaining a pool that is open to the public; (b) filling or maintaining a pool where necessary in the course of its construction; (c) filling or maintaining a pool using a hand-held container which is filled with water drawn directly from a tap; (d) filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment; (e) filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease; (f) filling or maintaining a pool that is used in the course of a programme of veterinary treatment; (g) filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity; (h) filling or maintaining a pool that is for use by pupils of a school for school swimming lessons. Note that a pool is not open to the public if it may only be used by paying members of an affiliated club or organisation.	None	Swimming pools serving industrial training if considered justified Pools with religious significance;
Purpose 3: filling or maintaining a pond	The purpose does not include: (a) filling or maintaining a pond in which fish or other aquatic animals are being reared or kept in captivity (b) filling or maintaining a pond using a hand-held container which is filled with water drawn directly from a tap	To Blue Badge holders on the grounds of disability	None
Purpose 4: operating a mechanical vehicle-washer	Operating a mechanical vehicle-washer for health or safety reasons	None	None
Purpose 5: cleaning any vehicle, boat, aircraft or railway rolling stock	Cleaning any vehicle, boat, aircraft or railway rolling stock for health or safety reasons	None	Small businesses whose sole operations are cleaning of vehicles using hosepipes To prevent or control the spread of non-native and/or invasive species
Purpose 6: cleaning non-domestic premises	Cleaning of any exterior part of a non-domestic building or a non-domestic wall for health or safety reasons	None	Small businesses whose sole operations are cleaning of non-domestic buildings using hosepipes;

Drought Order Purpose of Use	Statutory Exception	Discretionary Universal Exception (granted by all water companies)	Suggested Discretionary Concessional Exception (granted by individual water companies)
Purpose 7: cleaning a window of a non-domestic building	Cleaning a window of a non-domestic building using a hosepipe for health or safety reasons	None	Small businesses whose sole operations are cleaning of non-domestic buildings using hosepipes
Purpose 8: cleaning industrial plant	Cleaning industrial plant using a hosepipe for health or safety reasons	None	None
Purpose 9: suppressing dust	Suppressing dust using a hosepipe other for health or safety reasons	None	None
Purpose 10: operating cisterns (in unoccupied buildings)	None	None	None

Appendix H – Temporary Water Use Exception Form

Temporary Water Use Exception Form

Contact details
Name:
Address:
Postcode:
Telephone Number:
Email Address:
Account Number:

Exception details		
Is the exemption on the grounds of health and safety? (please tick the appropriate box)	**Yes**	**No**
Details:		
Is the exemption on the grounds of mobility issues? (please tick the appropriate box)	**Yes**	**No**
Details:		
If not health and safety or mobility issues, what is the exception on the grounds of?		
Details:		

For company use only		
Representation approved	**Yes**	**No**
Comments:		
Approved by:		

Please complete this form and return to:

Hafren Dyfrdwy
Packsaddle
Wrexham Road
Rhostyllen
Wrexham
LL14 4EH

Or email to:

[email address]

Appendix I – Drought Order notice example

NOTICE OF APPLICATION FOR DROUGHT ORDER
PROHIBITION OR LIMITATION ON THE USE OF WATER
IN THE HAFREN DYFRDWY AREA

Take notice that due to the threat of a serious deficiency in supplies of water within the affected area, caused by an exceptional shortage of rainfall, Hafren Dyfrdwy of Packsaddle, Wrexham Road, Rhostyllen, Wrexham. LL14 4EH, is applying to the Secretary of State for Environment, Food and Rural Affairs or Welsh Government for a Drought Order under sections 73 and 74(2)(b) of the Water Resources Act 1991.

The affected area includes all of the following areas insofar as they receive a supply of water from the Company: [LIST PLACES OR MAP HERE].

The Drought Order is necessary to manage the demand for water in order to meet the deficiency of supplies of water in the area. The uses of water that can be prohibited or limited under the Drought Order are those prescribed by the Secretary of State in the Drought Direction 2011. These activities are in addition to the activities covered by Temporary Use Ban that are currently in place for domestic customers.

The proposed Drought Order will allow Hafren Dyfrdwy to prohibit or limit the use of water within the area referred to for any of the following purposes:

Purpose 1: Watering outdoor plants on commercial premises;
Purpose 2: Filling or maintaining a non-domestic swimming or paddling pool;
Purpose 3: Filling or maintaining a pond;
Purpose 4: Operating a mechanical vehicle-washer;
Purpose 5: Cleaning any vehicle, boat, aircraft or railway rolling stock;
Purpose 6: Cleaning non-domestic premises;
Purpose 7: Cleaning a window of a non-domestic building;
Purpose 8: Cleaning industrial plant;
Purpose 9: Suppressing dust; and
Purpose 10: Operating a cistern in any building that is unoccupied and closed.

Statutory Exceptions
Customers who wish to use water for the actions below can continue to use water without having to make representation to Hafren Dyfrdwy to receive permission. In using water, it is requested that customers use water wisely and adopt water efficient practices.

- Purpose 1 does not include watering plants that are: grown or kept for sale or commercial use; or part of a National Plant Collection or temporary garden or flower display
- Purpose 2 does not include:
    - filling or maintaining a pool that is open to the public;
    - filling or maintaining a pool where necessary in the course of its construction;
    - filling or maintaining a pool using a hand-held container which is filled with water drawn directly from a tap;
    - filling or maintaining a pool that is designed, constructed or adapted for use in the course of a programme of medical treatment;
    - filling or maintaining a pool that is used for the purpose of decontaminating animals from infections or disease;
    - filling or maintaining a pool that is used in the course of a programme of veterinary treatment;
    - filling or maintaining a pool in which fish or other aquatic animals are being reared or kept in captivity;
    - filling or maintaining a pool that is for use by pupils of a school for school swimming lessons.
- Purpose 2 a pool is not open to the public if it may only be used by paying members of an affiliated club or organisation.
- Purpose 3 does not include: filling or maintaining a pond in which fish or other aquatic animals are being reared or kept in captivity; or filling or maintaining a pond using a hand-held container which is filled with water drawn directly from a tap.
- Purpose 3 does not include filling or maintaining a domestic pond using a hosepipe.
- Purpose 5 permits the cleaning any vehicle, boat, aircraft or railway rolling stock for health or safety reasons
- Purpose 6 permits the cleaning of any exterior part of a non-domestic building or a non-domestic wall for health or safety reasons
- Purpose 7 permits the cleaning a window of a non-domestic building using a hosepipe for health or safety reasons
- Purpose 8 permits the cleaning industrial plant using a hosepipe for health or safety reasons
- Purpose 10 permits the suppression of dust using a hosepipe for health or safety reasons

Discretionary Universal Exceptions

Customers who meet the criteria below for a Discretionary Universal Exception can continue to use water without having to make representation to Hafren Dyfrdwy to receive permission to use water for the following restricted uses. It is requested that customers that meet the requirements for a Discretionary Universal Exception use water wisely and adopt water efficient practices.

The criteria for a Discretionary Universal Exception include:

Specific details of exceptions will be decided at the time of publication and will depend on the nature severity of the incident.

Discretionary Concessional Exceptions
Customers can make representation to Hafren Dyfrdwy to receive a Discretionary Concessional Exception to use water for the following restricted uses. If permission for a Discretionary Concessional Exception is given, it is requested that customers use water wisely and adopt water efficient practices.

The water uses for which a Discretionary Concessional Exception can be applied for by writing to Hafren Dyfrdwy include:

Specific details of exceptions will be decided at the time of publication and will depend on the nature severity of the incident.

View the applications
Anyone may inspect a copy of the application, including a copy of the draft Drought Order and plan showing the affected area, free of charge, at the offices of Hafren Dyfrdwy, Packsaddle, Wrexham Road, Rhostyllen, Wrexham, Ll14 4EH between the hours of 9.0am to 5.00pm, Monday to Friday, within 7 days of the date of publication of this notice. A copy of the draft Drought Order and plan showing the affected area is also available for inspection at the offices of the undermentioned solicitors between the hours of [HOURS], Monday to Friday, within 7 days of the date of publication of this notice.

Objections may be made in writing to the Secretary of State for Environment, Food and Rural Affairs, c/o [NAME OF CONTACT], [DEPARTMENT AND ADDRESS (or by e-mail to [EMAIL ADDRESS]), giving an address to which correspondence relating to the objection may be sent. Objections should be made within 7 days of the date of publication of this notice.

[NAME AND ADDRESS OF SOLICITORS]
Solicitors acting for Hafren Dyfrdwy

Appendix J – Demand side drought option forms

Option Name: Increased water efficiency promotion	
Trigger(s) (or preceding actions)	On reaching trigger 3 we would increase our water efficiency promotion to our customers. Concurrent actions would be additional leakage control through a variety of activities including increased leakage detection and repair.
Demand Saving Ml/d unless stated otherwise	Demand savings associated with increased water efficiency promotion are difficult to quantify on their own. However combined with voluntary use restriction we estimate savings of 0.57% and 0.67% of the dry year annual average household demand for the Wrexham and Chester Resource Zones respectively. This equates to approximately 0.24 and 0.16 Ml/d. The above savings will subject on the time of year which they are implemented. Winter savings are likely to be lower than those achieved in summer.
Demand Saving Percentage reduction on peak week demand	See above.
Location Area affected or whole supply zone	Increased water efficiency promotion would be targeted at specific geographical areas depending on the nature of the drought and the localities where we project we can achieve the best savings.
Implementation timetable Preparation time, time of year effective, duration	Preparation time: The preparation time is entirely dependent on the form of media that is being used to promote water efficiency. Updating our website can be carried out within days, local radio and newspaper adverts may take two weeks whilst messages on bills will be reliant on the issuing cycle. Time of year: The type of publicity will be dependent on the time of year. In winter focus will be placed upon lagging pipes and water saving in the home whilst in summer publicity would concentrate on outdoor water use such as garden watering. Duration: The duration of increased water efficiency promotion will be dependent on the rate of decline in the Dee Storage System and the potential need for the promotion of more severe measures such as voluntary restriction, Temporary Use Bans and drought orders. If the need arises to promote the more severe measures they will take priority over water efficiency promotion to avoid confusion through mixed messages.
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	None
Risks associated with option	Estimated savings cannot be relied upon as they will depend on the circumstances of the drought.

Option Name: Additional leakage control	
Trigger(s) (or preceding actions)	On reaching trigger 3 we would carry out additional leakage control through a variety of activities including increased leakage detection and repair. Concurrent actions would be increased water efficiency promotion to our customers.
Demand Saving Ml/d unless stated otherwise	Redeployment of resources to provide increased leakage detection and repair activities could reduce leakage by 1.5Ml/d below the economic level of 10.17Ml/d set out in our WRMP13. However there are caveats to this estimate as it would require redeployment of resources, working overtime and this level of savings could not be achieved instantly rather over a period of weeks/months. In addition drought conditions have been shown to increase leakage due to increased movement in the soil as the soil moisture deficit increases. There may be difficulties in sustaining this level of reduction if the drought became long term as resources are not available for redeployment on a permanent basis.
Demand Saving Percentage reduction on peak week demand	See above.
Location Area affected or whole supply zone	Those areas where greatest savings could be achieved.
Implementation timetable Preparation time, time of year effective, duration	Preparation time: Days. Time of year: All. Duration: 1-2months.
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	None
Risks associated with option	Estimated savings cannot be relied upon due to the potential for a drought to increase the break out of leaks. Redeployment of resources could not be sustained for more than a few weeks without detrimental effects on other aspects of the business.

Option Name: Voluntary water use restriction	
Trigger(s) (or preceding actions)	We would consider implementing voluntary water use restrictions at trigger 4 if the drought was to occur during the summer months (April-September). Outside the summer months a decision to implement voluntary use bans would be based dependent on whether any worthwhile savings could be achieved. The proposed three week consultation period for the implementation of Temporary Use Bans will be used for the implementation of the voluntary use bans. Preceding actions are increased water efficiency promotion and additional leakage control
Demand Saving Ml/d unless stated otherwise	As per increased water efficiency promotion.
Demand Saving Percentage reduction on peak week demand	As per increased water efficiency promotion.
Location Area affected or whole supply zone	As per increased water efficiency promotion.
Implementation timetable Preparation time, time of year effective, duration	As per increased water efficiency promotion.
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	As per increased water efficiency promotion.
Risks associated with option	As per increased water efficiency promotion.

Option Name: Temporary use bans	
Trigger(s) (or preceding actions)	We would implement Temporary Use Bans at trigger 5 (as per the Dee Drought Directives) if the drought was to occur during the summer months (April-September). Outside the summer months a decision to implement Temporary Use Bans would be dependent on whether any worthwhile savings could be achieved and would be discussed at a meeting with the Dee Consultative Committee.
Demand Saving Ml/d unless stated otherwise	Demand savings associated with Temporary Use Bans are estimated to be 2.16% and 2.61% of the dry year annual average household demand for the Wrexham and Chester Resource Zones respectively. This equates to approximately 0.92 and 0.63 Ml/d. The above savings will subject on the time of year which they are implemented. Winter savings are likely to be lower than those achieved in summer.
Demand Saving Percentage reduction on peak week demand	See above.
Location Area affected or whole supply zone	Whole company or water resource zone.
Implementation timetable Preparation time, time of year effective, duration	Preparation time: 3 weeks approximately Time of year: Subject to discussions with the Dee Consultative Committee; unlikely to implement a Temporary Use Bans outside the summer months (April-September). Duration: The duration of a Temporary Use Bans will be decided by the Dee Consultative Committee.
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	The decision to introduce a Temporary Use Bans rests with ourselves subject to satisfying the criteria in Section 76 of the Water Industry Act 1991 (serious deficiency of water available for distribution).
Risks associated with option	Estimated savings cannot be relied upon as they will depend on the circumstances of the drought.

Option Name: Ordinary Drought Order to prohibit or limit the use of water	
Trigger(s) (or preceding actions)	We would implement an ordinary drought within six weeks of crossing trigger 5. The decision to apply for and implement a Drought Order would be dependent on the time of year whether any worthwhile savings could be achieved and would be agreed at a meeting with the Dee Consultative Committee. An ordinary drought order would only be implemented after a Temporary Use Bans had been implemented.
Demand Saving Ml/d unless stated otherwise	Demand savings associated with ordinary drought orders are estimated to be 1.51% and 1.14% of the non-household demand for the Wrexham and Chester Resource Zones respectively. This equates to approximately 0.64 and 0.28 Ml/d. The above savings will subject on the time of year which they are implemented. Winter savings are likely to be lower than those achieved in summer.
Demand Saving Percentage reduction on peak week demand	See above.
Location Area affected or whole supply zone	Whole company or water resource zone.
Implementation timetable Preparation time, time of year effective, duration	Preparation time: 6 weeks approximately Time of year: Subject to discussions with the Dee Consultative Committee Duration: The duration of an ordinary drought order will be decided by the Dee Consultative Committee.
Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	The decision to apply for an ordinary drought order to prohibit or limit the use of water rests with ourselves. To decision to grant the order rests with either the Welsh Government or the Secretary of State/
Risks associated with option	Estimated savings cannot be relied upon as they will depend on the circumstances of the drought.

Option Name: Augmentation of the River Dee with water from Lower Pen-y-Cae Reservoir		
Option Implementation Assessment	**Trigger(s)** (or preceding actions)	On trigger 3 we would augment the River Dee with water from Lower Pen-y-Cae Reservoir via Trefechan Brook with 0.4Ml/d. On trigger 4 we would augment the River Dee with a further 0.4Ml.d (0.8Ml/d total) from Lower Pen-y-Cae Reservoir.
	Deployable output of action Ml/d unless stated otherwise	See above.
	Location Area affected or whole supply zone	N/A
	Implementation timetable Preparation time, time of year effective, duration	Preparation time: Days Time of year: Any Duration: The duration of the augmentation will be dependent on the storage in the Dee Storage System.
	Permissions required and constraints Including details of liaison carried out with bodies responsible for giving any permits or approvals	A decision to augment the River Dee will be taken by the Dee Consultative Committee
	Risks associated with option	No risks are associated with this option
Environmental Assessment	**Risk to the Environment** (High/medium/low or unknown)	Low
	Summary of likely environmental impacts Include details for features of moderate and major sensitivity and minor sensitivity features from designated sites	The SEA and HRA screening appraisals did not identify any environmental impacts as a result of this option.
	Baseline information used	Historic rainfall and runoff data to confirm that abstraction below the minimum operating volume or outside our abstraction licence would not occur if a historic drought was to be repeated.
	Summary of additional baseline monitoring requirements	If the need arose to abstract water below the minimum operating volume of Lower Pen-y-Cae Reservoir additional monitoring would be undertaken; this would include, but not be limited to: • Dissolved oxygen levels • Alkalinity • Turbidity • pH levels
	Mitigation measures	If necessary, aeration systems would be installed in the reservoirs to increase oxygen levels and minimise fish distress. Any netting and transfer of fish would be arranged during the drought as soon as environmental conditions were below an acceptable standard.
	Impact on other activities e.g. fisheries, industry etc	A local fishing club is based at Lower Pen-y-Cae Reservoir, they are unlikely to be impacted by this option as we do not plan to abstract below the minimum operating volume or outside our abstraction licence

Appendix K – List of water quality parameters to be measured during monitoring programme

List of water quality parameters to be measured during water quality monitoring
Iron dissolved µg/l
Manganese dissolved µg/l
Aluminium dissolved µg/l
Calcium total mg/l – in watercourses only
Magnesium total mg/l – in watercourses only
Dissolved lead µg/l
Nickel dissolved µg/l
Zinc dissolved µg/l
Cadmium dissolved µg/l
Turbidity NTU units
D.O. (% and mg/l)
Conductivity uS/cm
pH pH units
Copper dissolved µg/l
Total Phosphate – in reservoir only
Ortho phosphate mg/l – in reservoir and watercourses
Ammonia mg/l
Temperature ℃
Suspended solids mg/l
Dissolved Organic Carbon mg/l – in watercourses only
Total Oxidised Nitrogen mg/l
Chlorophyll µg/l - in reservoir only
Sulphide – in reservoir only
Sulphate – in reservoir only
Chlorophyta
Cyanobacteria
Cyanobacteria
Other algae area
Other algae cell
Total algal count
Bacillariophyta