Our draft
Water Resources
Management Plan

Appendix 1.1: Insight into the 2022 drought

Contents

Appendix 1.1: Review of the 2022 drought

Document Purpose:

At the same time as producing our draft WRMP, we have also been working closely with stakeholders to respond to the 2022 drought which has seen exceptionally low levels of rainfall combined with the highest ever temperatures, making 2022 one of the worst droughts on record. These factors have led to the implementation of drought measures including temporary use bans (TUBs) and application of drought permits which were not expected when we produced our WRMP19 or when we finalised our current approved Drought Plan.

The timing of the drought relative to publication of the dWRMP creates uncertainties: the investments we are planning to make in drought schemes have the potential to change our WAFU and/or change the economics of options being considered for future delivery. In response we have clearly documented our assumptions and conducted extensive sensitivity analysis to explore different scenarios.

Through our previous planning cycles including WRMP19, DEFRA had supported our position that water resources in the SW were resilient and had not required further work to prepare for a '1 in 500 years' low river flow event. While we have not seen a 1 in 500-year inflow event in 2022, we have observed a combination of pressures that resulted in a situation we believe to be beyond the currently applicable regulatory planning design requirement of 1:200.

This document reviews the supply and demand conditions observed in 2022 to provide context on what has changed since the publication of WRMP19 and our Drought Plan. In addition, we consider how weather factors have acted in combination to intensify 'drought'.

The insight from this section is designed to inform the discussion around attitudes to risk in managing the supply-demand balance.

Summary:

We have carried out a review of the supply and demand observed during the current drought (2022):

- Across the region we have seen rainfall, over an extended period, at the 2nd or 3rd lowest level since rainfall records began in the 1890s.
- We also saw extreme heat - the hottest year on record - which impacted evaporative loses from our reservoirs (a loss of an addition ~0.5% of capacity compared to recent years) and increased demand for water as customers strove to maintain their gardens, fill paddling pools and keep cool.
- If we examine the effective precipitation (rainfall figures adjusted for evaporative loses), the Roadford and Wimbleball Zones have seen conditions in 2022 drier than all the reference years in the 60 years since the Met Office effective precipitation records began.
- Demand, including driven by societies legacy response to the pandemic, has been materially higher than forecast in our WRMP19.

We have included additional scenarios and sensitivity testing in our dWRMP to ensure our plan is robust to demand levels at or 6% above those experienced this summer and to climate change uncertainty.

Other insights gained from the implementation of our drought plan is summarised below:

- **Tourism Demand**: we have included an uplift in consumption forecasts that reflects future tourism growth. Refer to Chapter 6.
- We have gained an insight from the impact of applying a **Temporary Use Ban** on demand-side savings. This supports our dWRMP planning assumption.
- We are committed to **environmental studies** to ensure our supply-side options are evidence based. These considerations have been included in our adaptive strategy set out in Chapter 11.
- We will undertake further study **to establish a most-likely post Covid19 demand baseline for our regions** - building on additional data collected during 2022.
- We have **considered how to represent our current drought options in our WRMP**. There is still uncertainty around whether some of these options will become permanent prior to 2025 – we have therefore included further scenarios and sensitivity tests to inform our adaptive strategy. Refer to Chapter 1 Section 9.3.2.

1 Introduction

Our Water Resource Management Plan seeks to understand and manage supply and demand changes over the long term. This includes changes to population, changes in the way our customers use water, changing needs of the environment and the challenges of climate change.

Until now, our approach to resource planning has delivered 26 years without temporary use bans and met the challenges of increased COVID demands and demand spikes in recent years produced by extreme heat and extreme cold (the 'Beast from the East' event).

The drought of 2022 has been significantly different to what we have previously experienced. While the drought is still ongoing, it is important to review what has happened so far and assess how this insight can inform our dWRMP.

2022 has been different both because of climatic factors (particularly the combination of heat and absence of rainfall) and because of the continued increased demand which has resulted from societal legacy impacts of the COVID19 pandemic (changes which have been particularly acute in Devon and Cornwall).

This chapter provides a review of the supply-demand balance during 2022 to contextualise this dWRMP submission. It assesses performance against the DEFRA approved WRMP19 (the planning document for 2022) and the Drought Plan approved by DEFRA in 2022. It also provides assessment of performance against the revised assumptions established for our dWRMP24 baseline.

Our 2019 Water Resource Management Plan, as well as our 2020-25 Business Plan, were developed and subsequently approved using historical information and forecasts based on assumptions and estimates informed from many different sources. Neither of these planning processes could possibly have foreseen the unprecedented impact that the pandemic has had on the UK, but more strikingly the unique impact seen in the South West in the first two years of this regulatory period. The societal changes produced by COVID19 continue to impact us today.

South West Water has invested significantly in ensuring that we can meet our supply-demand requirements, including a c.60% increase in leakage total expenditure over the first two years of the AMP, the acquisition of Hawk's Tor Pit in March 2022 (which is a new source of supply for Cornwall) as well as our base expenditure to maintain existing water resources. Our key supply-demand balance investments are underway, including the projects within the Green Recovery which are securing supplies for North Devon.

The 2022 drought has been unfolding during the production of our dWRMP. The drought is still a live issue, and the potential changes it will produce in our understanding and in our physical assets cannot be included into a single baseline position. Instead, we have undertaken a full range of scenarios to cover potential outcomes from the drought. This will include the development of new water resources on a permanent basis and refinements to our understanding of demand. Our final WRMP will sit within the scenarios presented for consultation in this draft WRMP.

For our WRMP24 we are working towards resilience to a 1 in 500-year low river flow drought event, with a target to achieve this performance by 2039. Our modelling at WRMP19 suggested that some parts of our network were already resilient to this standard based on or understanding of demand at that time.

The 2022 drought has been exceptional. For the first time in 26 years, it required the implementation of Temporary Use Bans (TUBs) in the Colliford Water Resource Zone and in a portion of the Roadford WRZ. SWW has also secured a number of drought permits to allow the abstraction of additional water. We have followed our DEFRA approved Drought Plan to mitigate the impacts of low rainfall and extreme heat.

1.1 Background to the SWW system

The following information has been provided to contextualise the analysis of the impacts of the 2022 drought on SWW region.

- Over 90% of the water we supply comes from surface sources – rivers and reservoirs. Our Devon and Cornwall Network is supported by a strategic reservoir in each of our three water resource zones (WRZs). Bournemouth does not have a strategic reservoir, with most of the abstraction coming from the Rivers Stour and Avon.
- Our Colliford and Roadford water resource zones are within the SW peninsula and, as such, are isolated from potential interconnections to surrounding WRZs – there are no WRZs to the South or North. Similarly, our Isles of Scilly WRZ consists of islands which are geographically separated from each other and from the mainland. These WRZs stand alone; they cannot be easily supported by intra company transfers and are dependent of the rainfall which they receive.
- Our reservoirs hold water both for public water supply and to maintain compensation water to supplement the flows downstream either through continuous discharge or through 'fish bank release' to create artificial spates in the rivers. We cannot 'drain' our reservoirs as we must maintain water to support compensation flows and ensure the health of aquatic life in the reservoirs themselves.
- 20% of overnight holiday stays in the UK are booked in the South West, compared to 15% in London and 13% in the South East (The Great Britain Tourism Survey (GBTS) 2021[1]). This is an increase in share from 18% in 2019[2]. The 9 months of (non-lockdown) data for 2021 estimate 65.8m nights stayed in the region compared to 66.9m nights for the whole of 2019. This is equivalent to a 12% increase in the non-resident population in the region each day. As such demand for water in our region is more variable than in other parts of the UK due to fluctuations in tourism numbers
- The SW has the greatest proportion of second homes in the UK, 27%[3], compared to 12% in London and 14% in the South East. English Housing Survey 2018-19. These properties create different demand patterns as people move temporarily into the region. The greater opportunities to work from home that have resulted from the COVID19 pandemic are changing the way people use second homes. The impacts of changing second home use on demand is more acutely felt within our region than elsewhere in the UK.

2 Overview of the 2022 drought to date: Supply

2.1 Summary: What has the data told us?

The UK has experienced a challenging water resource situation over the course of 2022, with a period of below average rainfall that began in November 2021.

As the following section sets out, supply has been materially impacted by the weather variables experienced during 2022. Exceptional Shortage of Rainfall (ESOR) has been compounded by extreme temperatures leading to marked reductions in effective precipitation across our region.

The following section sets out key statistics based on UK and local SWW data.

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[1] GB Domestic Overnight Tourism: Latest results | VisitBritain

[2] Great British Tourist Report 2019 (gov.wales)

[3] 2020_EHS_second_homes_factsheet.pdf (publishing.service.gov.uk)

From a review of UK wide statistics on rainfall and temperature we can conclude:

- The 8-month period from November 2021 to June 2022 was the driest in England since 1975/76, with an average of 421mm of rain falling in England, 74% of the 1991-2020 long-term average of 568 mm[4].
- July 2022 was the driest July for England since 1935[5].
- Two exceptional hot spells across July and August led to unprecedented water demand and wildfire risk, exacerbated by high evapotranspiration rates and soil moisture deficits. Overall, summer 2022 (June, July, August) was the joint hottest summer on record for England[6].
- Up to and including October 2022, England has seen 14 consecutive months with a mean temperature above the 1991-2020 average[7]. These temperatures have also helped to shape a unique water supply and demand situation.

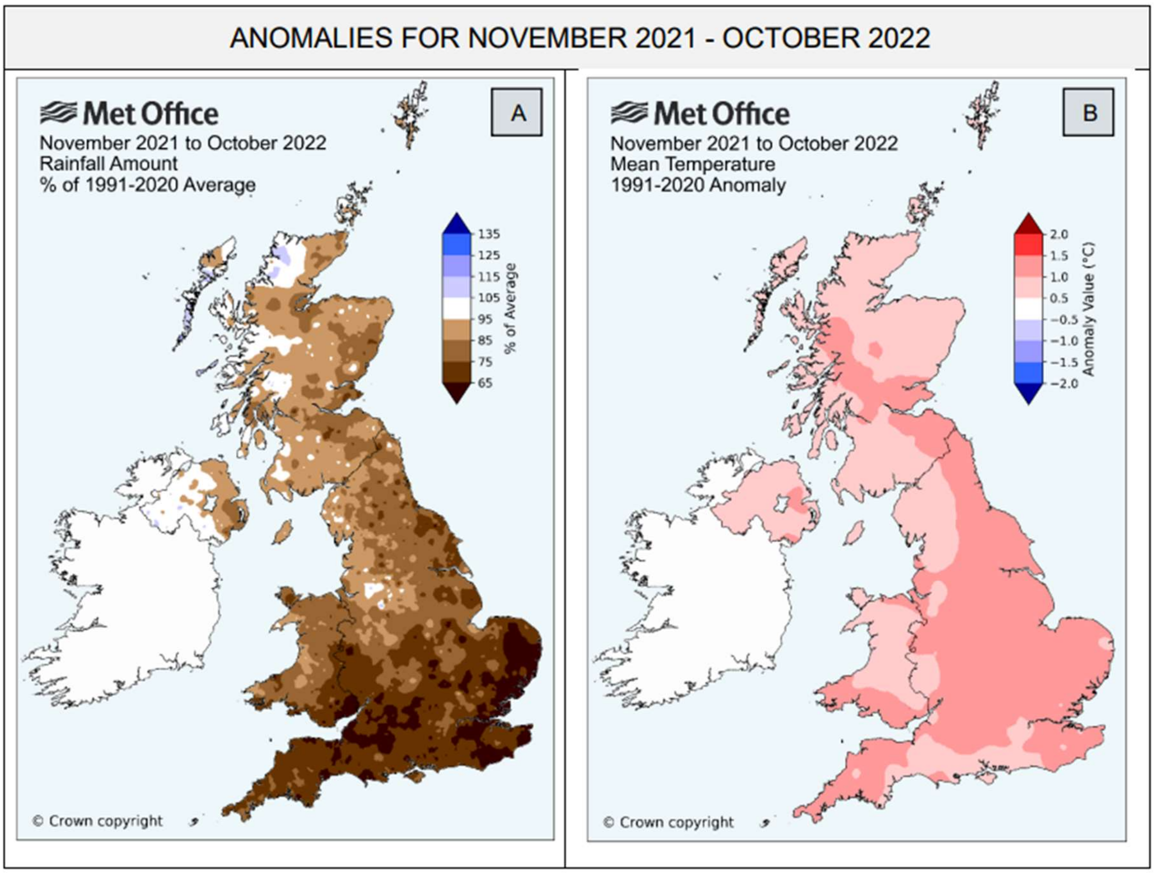

Figure 1: Graph showing anomalies in rainfall and mean temperature for Nov 21 to Oct 22

If we consider the experience in the SWW supply area in more detail, the Met office has set out that:

- we have seen an exceptional shortage of rainfall (ESOR) in 2022

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4 July 2022: a dry run for UK's future climate? | Official blog of the Met Office news team

5 Driest July in England since 1935 - Met Office

6 Joint hottest summer on record for England - Met Office

7 UK temperature, rainfall and sunshine anomaly graphs - Met Office

- across the region we have seen rainfall, over an extended period, at the 2nd or 3rd lowest level since the 1890s.
- we have also seen extreme heat, the warmest year on record, which impacts both on evaporative losses from our reservoirs (a loss of an addition ~0.5% of capacity compared to recent years) and increased demand for water as customers strive to maintain their gardens, fill paddling pools and keep cool.
- if we examine effective precipitation (rainfall figures adjusted for evaporative loses) the Roadford and Wimbleball Zones have seen drier conditions than all the reference years in the 60 year MORECs record.
- lower rainfall has also increased the requirement for supply releases from our reservoirs to maintain river flows, depleted by the drought, at a level which allows abstraction.

These weather variables (and their impact on demand) are considered in our long-term planning, particularly when we consider climate change and future resilience to 1 in 500-year droughts. While this year has not, on a rainfall measure alone, been a 1 in 500-year event, the combination of supply and demand pressures resulted in a situation in our Colliford WRZ beyond the current WRMP19 1 in 200 year design condition.

2.2 Detailed findings on supply factors

As per the summary above, the following section sets out more detail on each of the following factors:

1. An exceptional shortage of rainfall (ESOR)
2. The highest observed temperatures on record
3. Reductions in effective precipitation due to increase temperatures - increased evapotranspiration impacting on Soil Moisture Deficit (SMD) and hence reducing the benefits of rainfall.
4. The combination of ESOR and the highest ever temperatures.

There are also knock-on factors from the observed weather variables on demand for water – particularly the response to the intense heat.

2.2.1 An exceptional shortage of rainfall

We have worked with the Met Office to analyse rainfall patterns across our region. The 12-month deficit at the end of October 2022 ranked as the 6th driest for Colliford, 3rd driest for Roadford, 2nd driest for Wimbleball, 7th driest for Bournemouth, and 11th driest for St Mary's since 1891.

The associated rainfall return periods suggest the event was as extreme as a 1 in 20 year event in Colliford and Bournemouth, and as/more extreme than a 1 in 30 year event in Roadford and Wimbleball. Within the last year we have seen shorter periods with even lower return frequencies.

2.2.2 The highest observed temperatures on record

In terms of temperature anomalies, the event ranked first for both the 9- and 12-month averages, and 2nd or 3rd for the 6-month average, depending on the specific WRZ. This is based on a record from 1884, indicating that the heat return period is exceptional, especially when combined with the dry weather.

High temperatures increase direct evaporation from our reservoirs (up by ~0.5% this year), with increased evaporation leading to higher soil-moisture deficits and reducing effective precipitation.

2.2.3 Reduced Effective Precipitation

Effective Precipitation (EP) is the amount of precipitation that is added to the soil. During drier periods, low rainfall events would not be considered effective: low precipitation would likely evaporate from the surface before soaking into the ground. Effective precipitation enters the soil and can flow on to rivers and reservoirs.

Met Office analysis of water balance variables derived from the MORECS dataset confirmed the contribution of temperature to the drought conditions over the last 12 months. The excess evapotranspiration led to significant effective precipitation deficits (below 60% of the climatological baseline) and equally extreme soil moisture deficits.

The situations for Roadford and Wimbleball are highlighted as the most extreme, in terms of these water balance variables since the event ranked as the 1st driest both for effective precipitation and for soil moisture deficit.

Including the effect of (heat driven) evapotranspiration on rainfall analysis leads to some clear differences to the standard ESOR analysis used to support drought permits.

The evolution of the deficit in MORECS effective precipitation (EP) is presented below for Colliford. The evolution is similar to that of rainfall but with negligible contributions to the accumulations between March and August (when evapotranspiration largely exceeds rainfall). I.e., while some rainfall fell between March and August, this rainfall was not effective – it added nothing to water resources. Furthermore, unlike the droughts of ’76 and ’89, there was no strong recovery of effective precipitation in September and October.

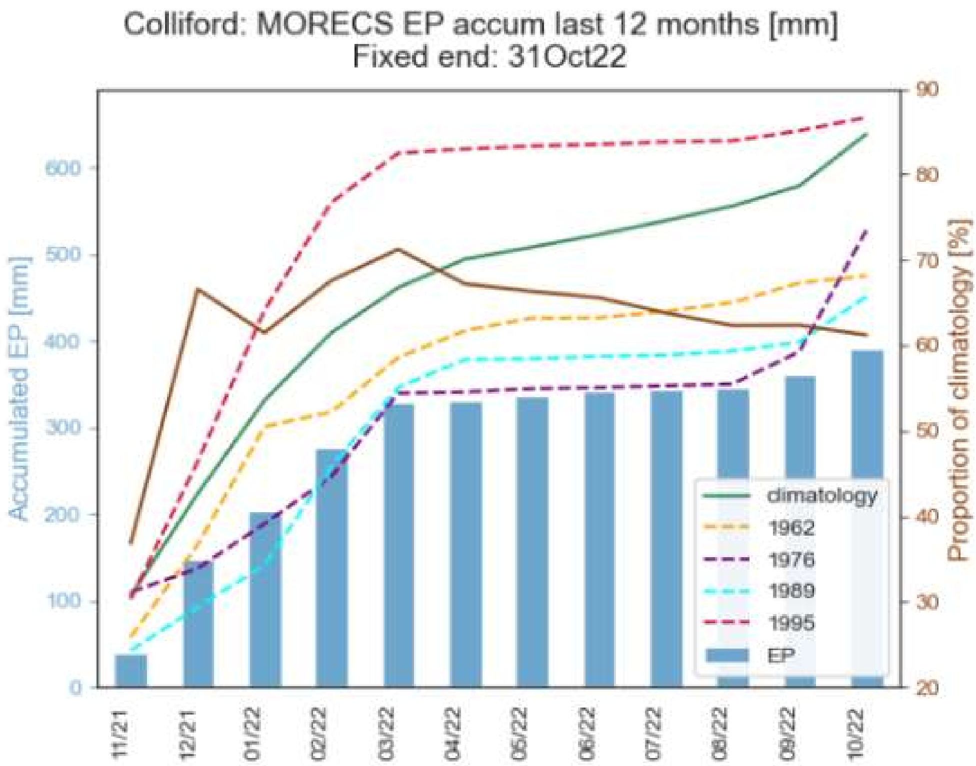


Figure 2 Evolution of the monthly EP accumulations over the previous 12 months (light blue bars) and the climatological baseline (green line) as reference. Dashed coloured lines indicate reference years. Brown line presents the accumulation as a percentage of the climatology.

The situation at the end of Oct22 was more severe than for rainfall, with EP accumulations still at around 60% of the climatology and likely explaining the slow recovery of the relevant reservoir. In terms of ranking, the 12 month evolution to October 22 ranked as the 3rd driest for the 1961-2022 period (62 years).

The evolution of the soil moisture deficit over Colliford is introduced below. This shows that by October 22, the cumulative SMD anomalies were exceeding the climatological baseline by 80%, and the situation was more extreme than all the reference years selected except for the 1988/1989 event.

The 12 months leading to October 22 also ranked 4th driest in 62 years for SMD (4th highest accumulated deficit).

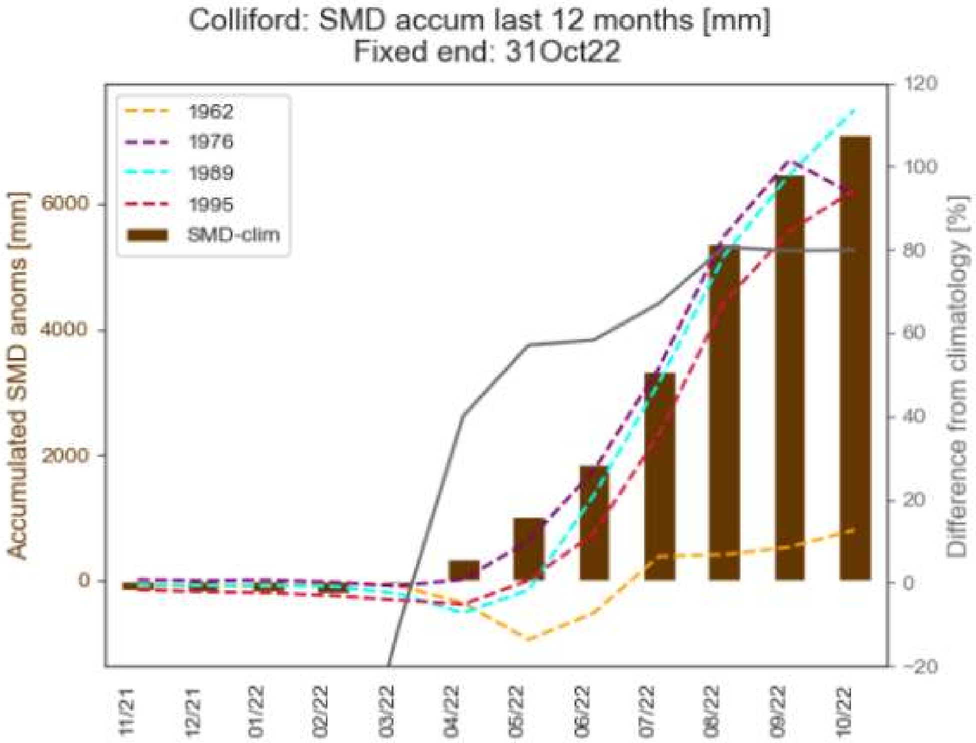


Figure 3: October 2022 soil moisture deficit cumulative anomalies for Colliford. Brown bars indicate the accumulation of the monthly SMD anomalies with respect to the climatology for the current event. Dashed coloured lines represent other reference dry events. Solid grey line (right y axis) indicates the difference from climatology as a percentage.

The evolution of EP for Roadford shows a slightly more severe situation than Colliford, with accumulation remaining below 55% of the climatological baseline. This 12-month EP accumulation ranked as the 1st driest in the 1961-2022 period. The SMD for Roadford shows drier conditions than all the reference years and ranks 1st in the MORECS record.

Wimbleball was like Colliford, with cumulative SMD anomalies exceeding the climatology by ~80%. The event generally showed less severe deficits than in 1975/76 but exceeded that event by Oct22. The SMD event ranked 1st for this WRZ.

The EP evolution for Bournemouth shows similar conditions than in the other WRZs, with the 12-month accumulation reaching ~52% of the climatology. For this WRZ, the event ranked 4th driest within the MORECS period.

2.2.4 Extreme combined effects

There are also some stark observations when considering the joint temperature and rainfall anomalies. For example, for the common 1884-2022 period, the event ranks in the top 2 of both variables for the Wimbleball WRZ. See Figure 4.

The graph below shows the covariance of reduced rainfall and increased temperature for the Colliford Zone. The October 2022 12-month average temperature conditions were the warmest on record, while the rainfall deficit matches or exceeds all the reference years (even 1975/76, which saw a notably wet September and October period in 1976).

The analysis is set out over a 12-month period, the duration of the current drought. Further graphs for the other zones can be found at the end of the document (Annex A).

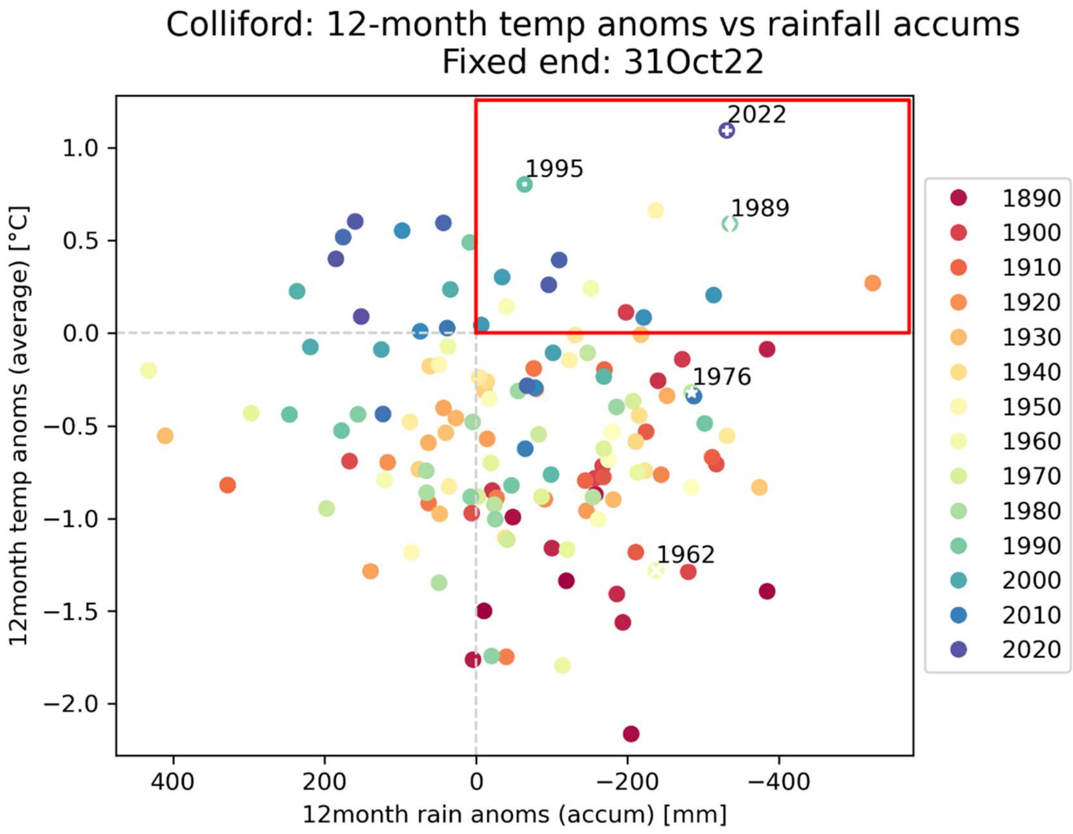


Figure 4: Graph showing temperature and rainfall anomalies by year.

3 Insights from Drought 2022: Demand

3.1 Summary: Demand

Demand for water in our region has significantly increased compared to our WRMP19 position. If demand in 2022 had reflected the dry year demand forecast in our approved WRMP19, our strategic reservoirs could be around 50% fuller than they currently are.

There are still significant uncertainties around what a post-Covid19 demand looks like for our region, but its impact in 2022 are clear.

Our analysis has shown that our demand during 2022 drought was on average circa 8% higher than expected.

3.2 Observed demand relative to forecast demand

Increased demand has made a significant contribution to the supply-demand balance in 2022. Demand increases combined with reduced effective precipitation are the main driver behind the requirement to implement the Drought Plan.

The graph below shows demand in our Colliford WRZ (similar graphs for the other zones are included as supporting information at the end of this document). The dry year profiles (shape of demand through the year) for WRMP19 and WRMP24 are calculated using observed demand in recent years:

- The blue line shows forecast demand for a dry year as set out in our approved WRMP19 – as standard in the industry the line shows higher consumption in 'summer months'.
- The orange line shows the increase in forecast demand produced for this dWRMP using the standard industry guidelines – projecting forward from a pre covid 2019 position to a 2025 starting point. The increase from Blue to Orange is 8,137 ML over the year (a figure equivalent to 29% of the capacity of the Colliford strategic reservoir or 22.3 MLD).
- The grey line shows actual observed demand in 2022 (with the final months of the year marked in yellow being the actual demand for those months in 2021). The increase from Blue to Grey is 13,848 ML (a figure equivalent to 49% of the capacity of the Colliford strategic reservoir or 37.9 MLD).

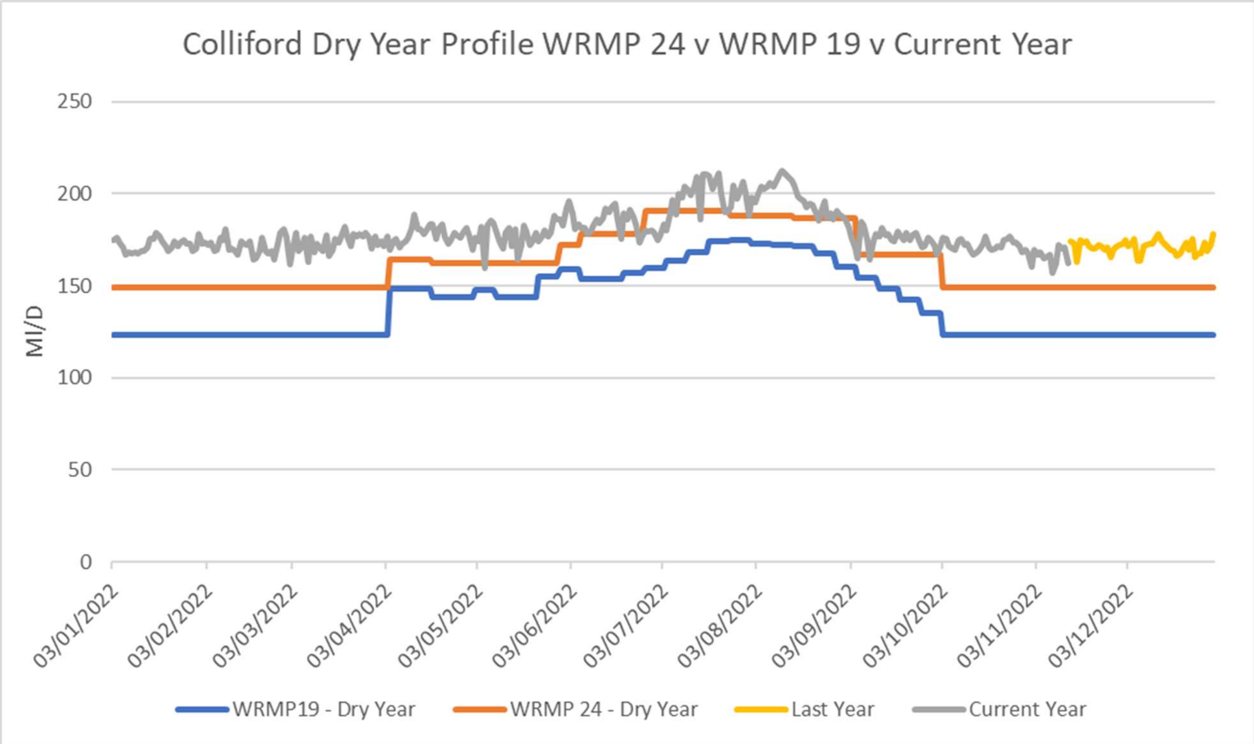


Figure 5: Colliford demand profile; current year, vs dry year forecasts in WRMP19 and 24

The orange and grey lines are broadly aligned during the summer peak, but have not picked up the highest spikes in demand, which can be correlated to the extreme heat peaks observed during 2022. However, there is a gap between the draft WRMP24 dry year (orange) and the observed demand during the non-summer months, a gap which is even larger when compared to our original WRMP19 forecast which was the basis for 2020-25 planning.

Our WRMP19 set out a confident resilience position based on a dry year demand in Colliford of 50,926 ML (140 MLD). If demand had matched this forecast in 2022 strategic storage would not have been drawn down during the early parts of the year and permit drought actions would not have been triggered in the autumn.

The resilience to ESOR in 2022 has been significantly diminished by the increased demand above that forecast in WRMP19 and our current drought plan. That is to say, the demand assumptions in our current drought plan show us to be resilient to a 1 in 500-year low river flow event in Colliford; the actual demand observed during the 2022 drought has been much higher. As such we have had to take additional actions (multiple drought permit applications) beyond those envisaged in our plan for a drought of this severity.

3.3 Changing demand 2017-2022

The graph below shows the evolution of demand in recent years. Numbers are presented using the current standardised reporting criteria – i.e., there is no change in reporting for the period of analysis.

The dashed lines show Total Distribution Input and can be read against the scale on the right-hand side. The data is not normalised for weather – 2018 and 2022 can be considered dry years.

Unbilled (including theft) and Distribution system operations (e.g., flushing) have remained constant through time.

Leakage in Colliford increased in 2020-21 and was brought back towards target in 2021-22. It is currently at a similar level to the start of the graph, with extensive work being delivered to bring it down.

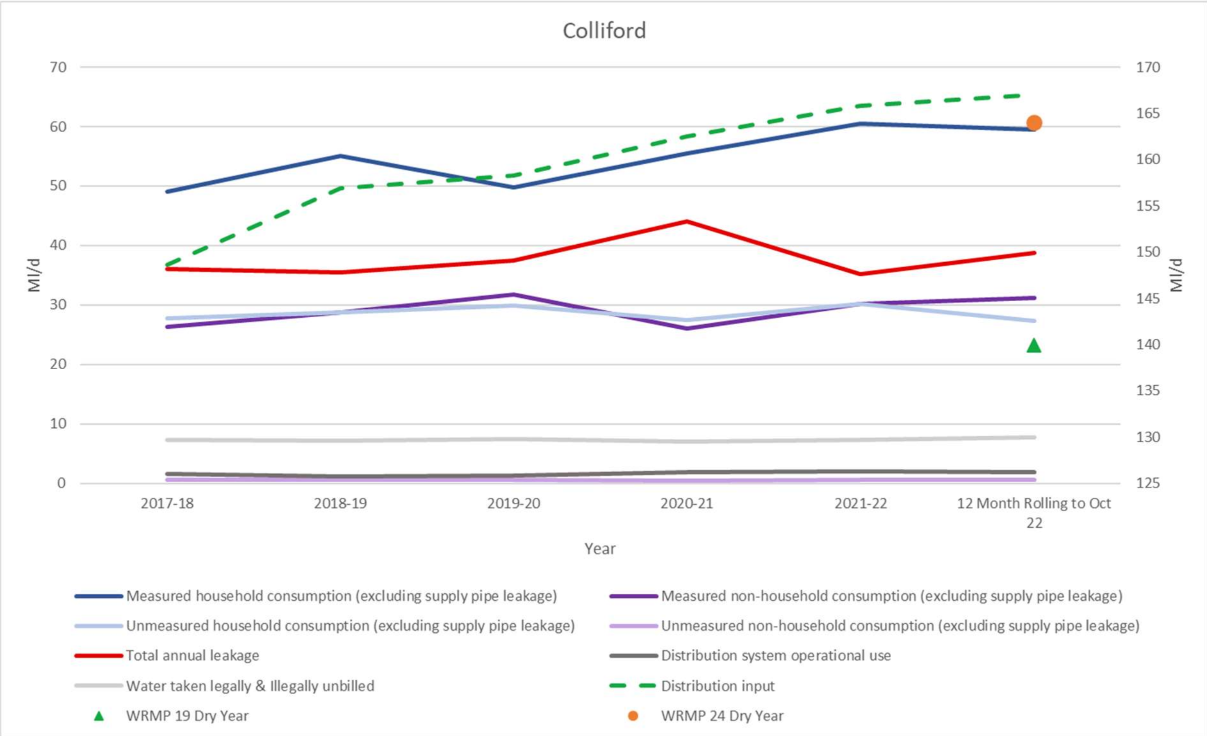


Figure 6: Graph showing change demand over time.

There has been an increase in the number of metered properties of around 3.8% over the period of the graph – this will reduce demand for non-metered properties and increase the demand from metered properties all other things being equal.

Measured household demand has increased by 10 MLD, measured non household has increased by 5MLD and Unmeasured (a shrinking category) has held steady.

Colliford	Units	2017-18	2018-19	2019-20	2020-21	2021-22	12 Month Rolling to Oct 22
Measured household	Ml/d	49.08	55.13	49.84	55.47	60.43	59.43
Measured non – household consumption	Ml/d	26.28	28.80	31.73	26.03	30.19	31.14
Unmeasured household consumption	Ml/d	27.74	28.71	29.93	27.53	30.12	27.32

Table 1: Changes in customer demand (excluding supply pipe leakage)

Household consumption increases reflect changes in the number of people in the region and in the way in which our water use behaviour has evolved through the pandemic:

- The sustained movement of people to the region as well as an increase in home-working: this reflects an increase in population travelling into the region through staycations, general tourism and extended use of second homes (which are prevalent in our area) as main homes. All these tourism-related activity increases have a proportion of their water use occurring at domestic properties.
- Changes in customers' water use behaviors as a result of the pandemic: this has ranged from increased hand washing to greater numbers of domestic toilet flushes (domestic toilets are less water efficient than urinals, and urinals at some businesses have continued to flush on their pre-set cycles without people being in the buildings) and increased garden watering. Data normalised for weather patterns for the first lockdown period (Jan-October 2020) shows a COVID driven demand increase in demand of ~8% (the national picture is presented at the end of this chapter).

We assume that demand will reduce between now and 2025 as we continue to implement leakage and water efficiency initiatives. The WRMP24 dry year assumes the benefits from these initiatives has been attained by the plan starting point in 2025.

3.4 Implications for WRMP

The demand scenarios used in this dWRMP24 close most of the gap between what we predicted in 2019 and what we observed in 2022. However, because of our baseline assumption of a return to pre covid demand levels, this dWRMP24 updates but does not fully resolve the supply/demand balance observed this year (the orange circle representing the WRMP24 dry year remains below the distribution input over the last 12 months, dashed green line, in the graph above).

This is in part due to weather variables such as days without rainfall and high temperatures, which are key triggers for increased garden watering. Gardens have become more highly valued since the pandemic, strengthening the existing link between low rainfall and increased demand[8].

We have, however, seen increased demand outside of the summer peaks.

In response to this, we are testing scenarios for this dWRMP which increase baseline demand in all our supply zones. We are also initiating further studies into the permanence of covid-driven demand changes which we can incorporate into our final WRMP.

Our baseline assumption for the dWRMP is that demand patterns will return towards pre-covid levels (people will begin to return to the office and activities such as increased hand, clothes and packaging washing will decline as people get used to living with the virus[9]). However, given ongoing high demand in 2022 we have undertaken a range of scenario tests to evaluate different demand profiles. These scenarios cover the full range of potential futures, allowing effective consultation on them to confirm the chosen pathway for our final WRMP.

[8] Understanding changes in domestic water consumption associated with COVID-19 in England and Wales Manchester University/Artesia (2021)

[9] Understanding changes in domestic water consumption associated with COVID-19 in England and Wales Manchester University/Artesia (2021)

4 Successful implementation of our Drought Plan

We submitted our final Drought Plan to DEFRA early in 2022 and it was subsequently approved for publication. The Drought Plan has provided a strong basis for formulating our response to the challenges which have arisen in 2022. Beginning with increased media campaigns and direct customer engagement events, through the deployment of temporary use bans and into the application of drought permits.

The following section explains further learning from the implementation on our drought plan covering:

- Evidence to demonstrate that our **supply model is robust.**
- The impact and learning from implementing Temporary Use Bans (TUBs) in the Colliford zone.
- Explanation behind **the need for TUBs in the Upper Tamar area**.
- Information on the **Drought Permit application within the Colliford Zone**.
- The **importance of Environmental Assessments**, to inform the feasibility of supply-side options.

4.1 Robust supply modelling

Our supply modelling software MISER has been used throughout the drought to understand the implications of different rainfall scenarios and help us to optimise across all our sources.

We have undertaken an exercise, back casting observed reservoir levels against those predicted in our supply modelling software using actual demand to check its accuracy. The results show that modelled figures are within a few percentage points of observed figures during the year – part of this difference will be explained by evaporation which is not included in our models.

We conclude that our models are valid for WRMP modelling.

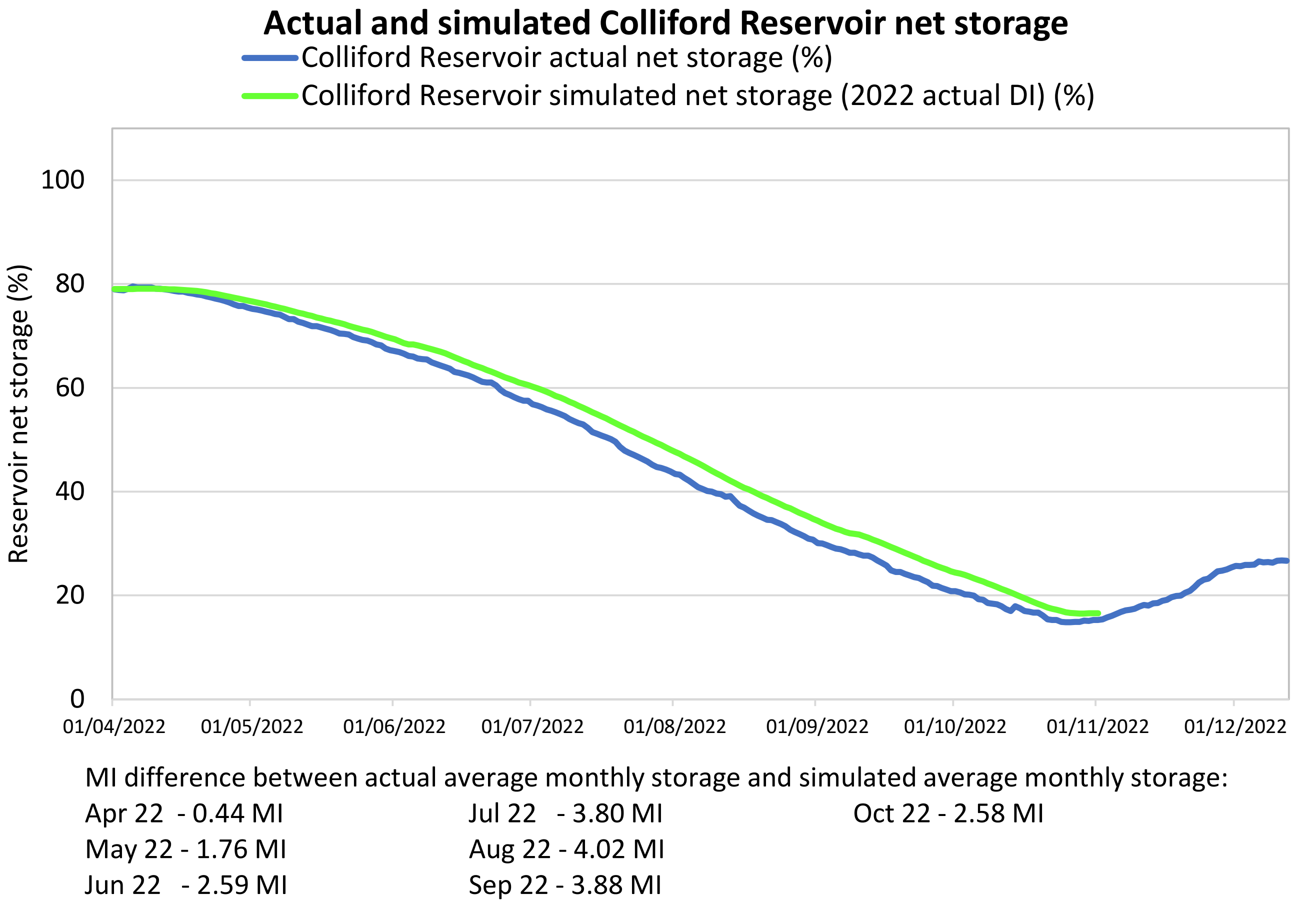


Figure 7: Plot showing actual and simulated colliford reservoir storage

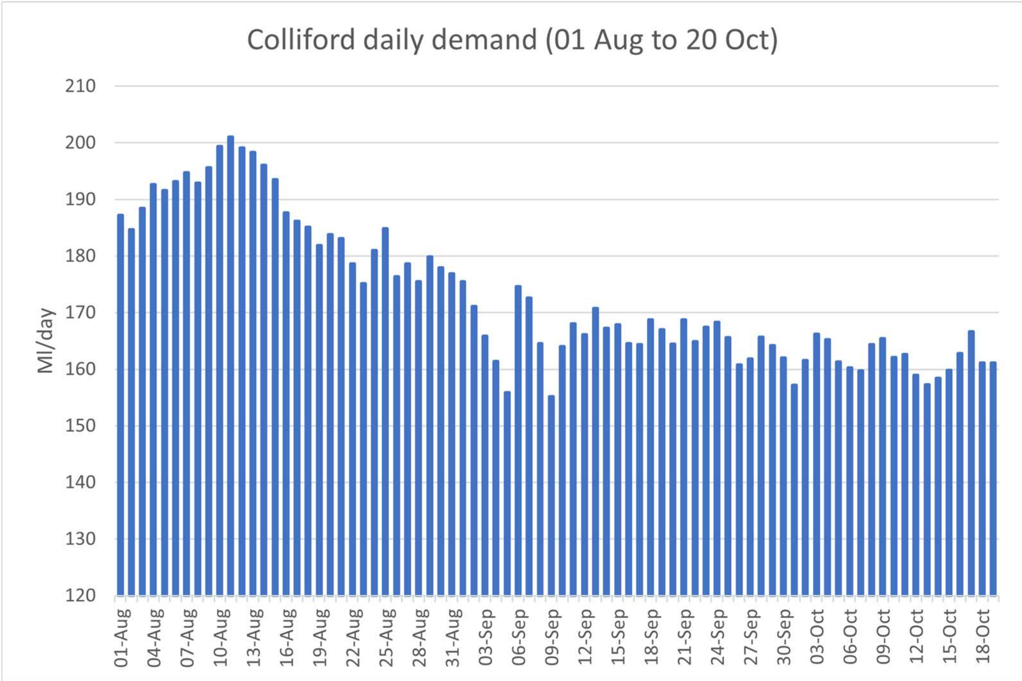
4.2 Implementation of TUBS

In line with our drought plan we introduced Temporary Use Bans (TUBs) in Colliford and part of Roadford WRZ in August 2022. We have examined the impact of the TUB on reducing demand to validate the assumptions we have made on TUB benefits for our dWRMP.

It can be difficult to precisely ascribe individual volumetric benefits to any individual demand-side activities. For example, the implementation of the TUBs in Colliford coincided with a change in the weather, lower temperatures, and more overcast days. The figure below sets out the daily demand from the DMAs supplied by Colliford and illustrates the c.10% reduction seen since the temporary use ban was announced on the 15 August 2022. The second figure compares distribution input over 2022 with 2021 and 2017. The announcement of a TUB on 15 August 2022 is shown by the line marked "B".

Daily demand for Colliford WRZ since announcing TUBS on 15 August 2022 is shown below.

Figure 8 – Daily demand for Colliford since TUBs introduced in August 2022.



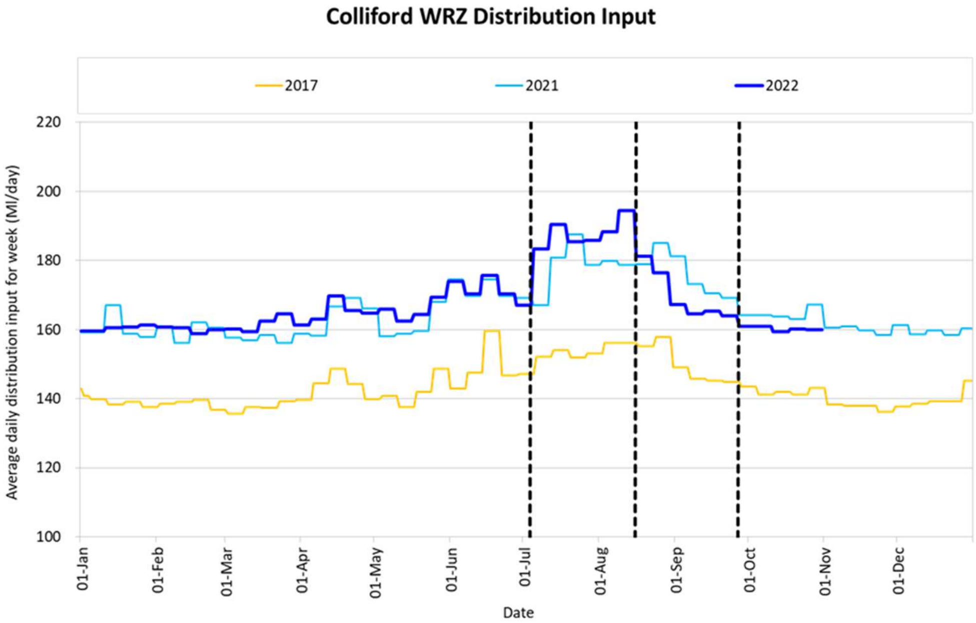


Figure 9: Distribution input for Colliford WRZ comparing 2022 with 2021 and 2017

Previous studies estimate that a c. 7% reduction in demand can be achieved from TUBS and the associated media campaign; the data available suggests that South West Water also experienced a reduction of this order of magnitude, underpinning this assumption in our dWRMP.

TUBs remain in place in Colliford and will do so until there is confidence storage levels are sufficient.

4.3 Upper Tamar

Summer 2022 required a TUB to be implemented in the north of the zone, usually supplied from Upper Tamar Lake, due to increased risk in comparison to the rest of the zone. As part of our response to this situation, we made improvements to the distribution system to allow additional water to be transferred into the area from Northcombe WTW, fed by Roadford Reservoir. This involved upgrading our pumping station at Brandis Corner, and new pumping at Beara Cross facilitating the import of an additional 2 Ml/d into the area. This has restored the current integrity of the zone – had these assets been available at the start of the summer drawdown, the TUB would not have been required.

4.4 Colliford Zone Drought Permits

The Colliford Zone has seen significant resource challenges this year as shown in the graph below (Figure 10). Following the dry Autumn and Winter 2021/2 the reservoir was around 80% full at the start of April. We have seen drawdown through the year, steepening through the summer as rainfall remained low and as demand was transferred from other reservoirs (which had been drawn down as per the drought plan) onto Colliford. We entered drought level 2 at the start of October (crossing the yellow/orange boundary on the graph). The drawdown profile is similar to that seen in 1995 (black solid line) until September, when for that drought year the reservior started to respond quickly to Autumn rains. This year Autumn rains commenced much later in the year.

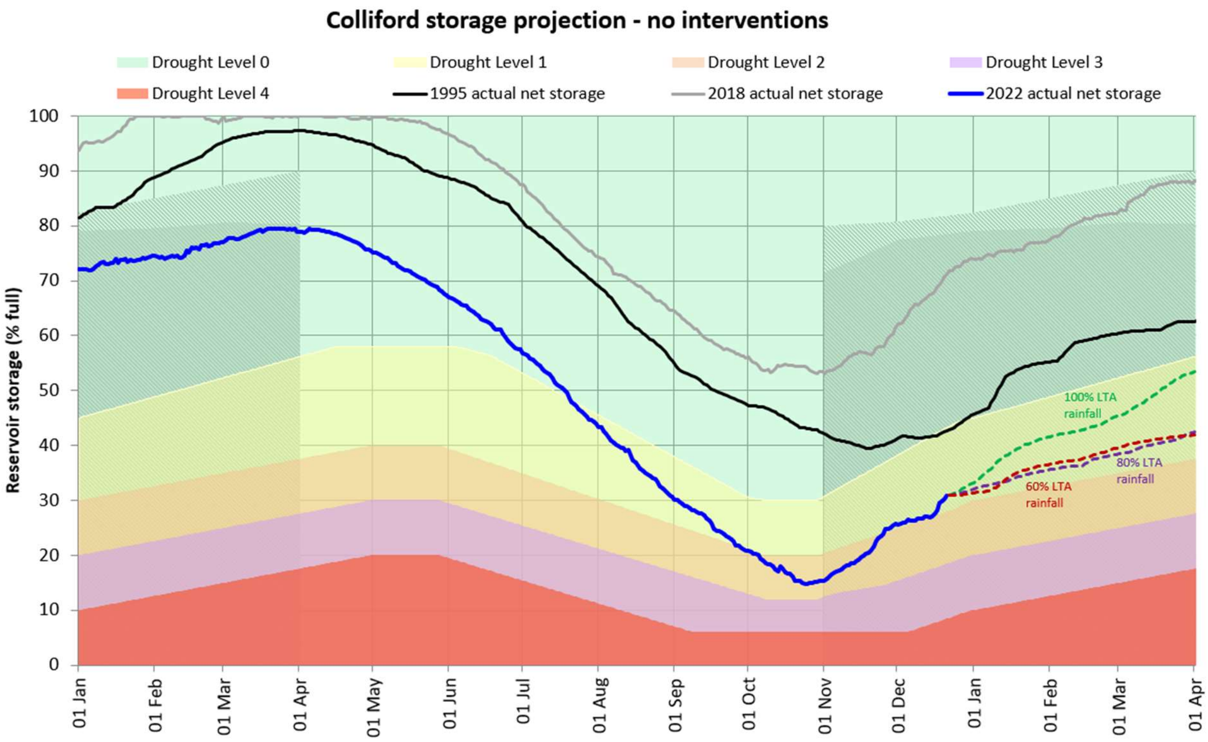


Figure 10: Graph showing drought projections for Colliford Zone.

In addition to TUBs in 2022, we also had an extensive water efficiency campaign that has allowed us to understand how customers respond to messages during a drougth. We heaviliy targeted our drought communication campaign into the Colliford Zone, including roadshow events, emails to domestic and business customers, advertised on buses, at transport hubs (railway sations and motorway services to target visitors), via social media (including TikTok) and on the radio, and our Stop the Drought financial incentive, which saw customers receive money off their bills for reducing demand.

We submitted 5 drought permits, designed to recover storage levels through the winter for this multi-year system. Our permits have been a mix of further abstraction from existing active reservoir sources (Park, Stannon), bringing previously used (drought) sources into supply (Hawks Tor Pit & Porth Reservoir) and increasing the annual abstraction at Restormel to allow further winter storage pumping back into Colliford Reservoir[10]. Investment in engineering and environmental studies alongside insight gained from implementation of the permits strengthens our ability to respond to future droughts. The investments made at Porth Reservoir (construction of pipelines and treatment facilities) and to a lesser degree at Hawks Tor Pit has implications for the assumptions made in our dWRMP (see section 10.3.2 of Chapter 1).

4.5 Environmental Assessments

To progress drought pemits, we have undertaken additional Environmental Assesment Reports (EARs). These investigations, covering a full range analysis from fisheries impacts to impacts on tourism and recreation, have further developed our understanding of the effects arising from our abstractions.

4.6 Refresh of Drought Plan

Considering the extremely dry weather that we experienced in 2022, we will review our Drought Plan and prepare and publish a revised plan following engagement with the Environment Agency and re-consultation if material changes are identified. This will reflect the completion of our environmental assessment (HRA) work and response on the Lower Avon for the Bournemouth region and will include appropriate updates to reflect other material changes that are the result of taking actions to address the drought affecting Devon and Cornwall this summer. Given the multi-year impacts of the current drought it is envisaged that we will begin consultation on a review of our drought plan in Autumn 2023 (after submission of our final WRMP).

5 Conclusions

The insights that we have formed from the 2022 drought has been used to inform our plan as summarised below:

Theme	What we have learnt	The impacts on WRMP
Extreme heat / impacts on effective precipitation	We have seen the impacts of extreme heat both in terms of demand spikes and significant impacts on effective precipitation.	We have produced scenarios and undertaken sensitivity tests as part of our adaptive planning, to look at the impacts of climate change on our recommended plan. Refer to Chapter 10 for further details.
Approach to WRMP should be evidence-led	Environmental assessments have been fundamental in supporting the development of drought permits. Our approach to WRMP is that we should be evidence led – this applies to understanding options development and existing environmental challenges.	Our plan includes significant investment for further environmental studies so that we can be more confident in the relationship between our abstractions and the environment. These studies will in turn inform our enhanced response to future droughts and in the development of WRMP29.
Tourism Demand	The impacts of COVID introduce more uncertainty than we saw at WRMP19 due to the increased demand from tourism. The impacts of these	Our demand forecast (Chapter 6) has included an uplift in consumption forecasts due to future tourism growth: insight from Appendix 6.2: Experian

[10] The benefits of these interventions are not shown on the reservoir graph below.

Theme	What we have learnt	The impacts on WRMP
	demands affect both metered and unmetered demand.	Population and properties forecasts (Feb 22)
Demand scenarios	Our insights from drought have shown the additional demand post-covid and during the hot-summer months. We saw demand during the 2022 drought 9% higher than expected. Figure 11 shows a graph of forecast demand based on WRMP19 & 24, vs actual observed demand.	We have included a "high-high" and "high-high-high" demand scenario of c 9% and 15% above DYAA dry year annual average (6% higher demand than experienced during 2022 drought) to ensure that our adaptive strategy set out in Chapter 11 is robust.
Demand baseline		For our final plan, we will undertake further study to establish a most-likely post covid demand baseline for our regions building on additional data collected during 2022.
New Resource Options	The drought has also seen us develop several new water resources through permitting arrangements (schemes identified in our Drought Plan and this dWRMP). It is likely that some of these schemes, with further engineering and licensing, will become part of our baseline supply position in the first half of CAL23.	As this change is uncertain we have not included these potential drought options in our baseline. Instead, we have created scenarios to assess the impact of them being made permanent on our adaptive plan. These scenarios are defined in chapter 10. Section 9.3.2 in Chapter 1, sets out how we have considered our drought options within our dWRMP.

Figure 11 shows the 'High High High' scenario used for the Colliford zone. This demand is 15% above the WRMP24 dry year forecast. We have also modelled 'High' and "High High' scenarios which are broadly aligned to a half way position between WRMP24 dry year and observed 2022 and the observed 2022 demand respectively.

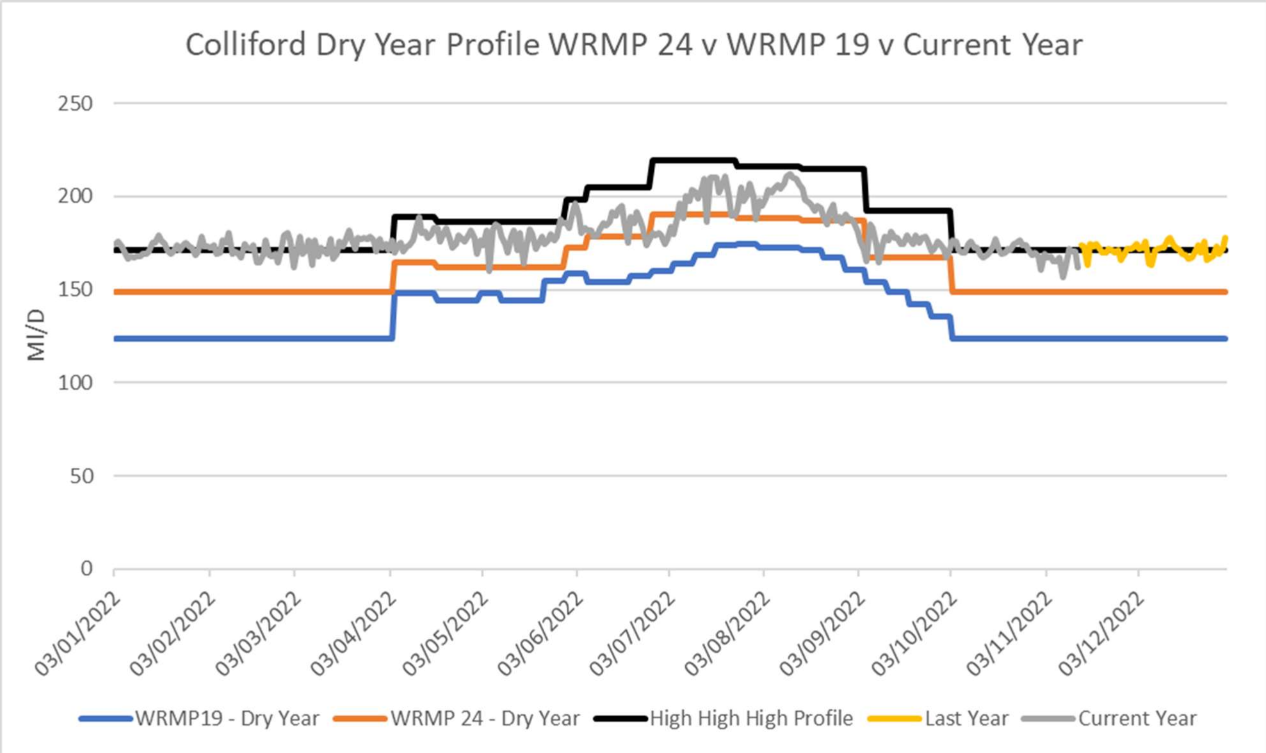


Figure 11: Demand scenarios used to inform our adaptive strategy, compared to actual demand levels and previous WRMP demand forecasts.

Demand has been significantly higher than forecast when the WRMP19 was approved. In Colliford, average demand throughout 2022 has been 38 ML/D higher than our WRMP19 'dry year' forecast – driven by Covid effects and to a lesser degree extreme heat. This volume of water is equivalent to 49% of the storage in Colliford reservoir over 12 months.

The resilience to Exceptional Shortage of Rainfall (ESOR) in 2022 has been diminished by the increased demand above that forecast in WRMP19. That is to say, the demand assumptions in our WRMP19 show us to be resilient to a 1 in 500-year low river flow event in Colliford, the actual demand observed during this year's drought has increased our reliance on drought measures beyond what would have been expected in WRMP19.

While we have not definitively quantified the rarity of the 2022 event, what we can say from our analysis of 2022 is that:

- the combination of pressures resulted in a situation beyond the currently applicable regulatory planning design requirement of 1:200
- the demand assumptions in our WRMP19 show us to be resilient to a 1 in 500-year low river flow event in Colliford. The actual demand observed during this year's drought has increased our reliance on drought measures beyond what would have been expected in WRMP19. Importantly we note that we continued supply to our customers through greater than a 1 in 200 year design condition without resorting to "Drought Level 3" (eg, Non-Essential Use Bans) or "Drought Level 4" (e.g., standpipes and rota cuts) actions, consistent with our existing levels of service.

6 Next Steps

Whilst winter recharge has filled several of our smaller reservoirs, strategic reservoirs in Roadford and particularly in Colliford remain low.

We will continue to operate the approved drought permits through the winter and spring and will be prepared for further permitting in the summer if required.

Water demand management around leakage, metering and water efficiency will continue and hosepipe bans will remain in place as per our Drought Plan.

Also, under our Drought and Resilience Programme, we have developed a 'Plan A' and "Plan B" of drought supply and water resilience interventions including licence changes and the commissioning of new water resources. These interventions will be implemented in 2023. Our Plans have been shared with the Environment Agency and Defra. Through these drought interventions we aim to recover our strategic reservoirs.

Both of our "Plan A" and "Plan B" include new desalination options that were not identified in our WRMP19. We have included these drought interventions as options in our data tables to provide quantification of potential costs and benefits. This will provide input to support short term decision-making, building on changes since our WRMP19 to provide an in-period adaptation based on best value principles.

These changes are driven by the increased demand within the Colliford WRZ and the subsequent reduction in our SDBI there.

These drought interventions are not yet built or licensed and, as such, we have not yet included them within our baseline supply figures. We have, however, run scenarios to evaluate the impact on our plan of the new drought interventions being included in our baseline. The process is set out in Chapter 1 of the dWRMP24 and has been discussed with the Environment Agency through our consultation process.

The selection of drought interventions for delivery in 2023, to move away from our previous SDBI deficit and recover from drought, is primarily driven by the need to secure public water supply in the short term. In evaluating drought interventions, the volume of water available, the speed of delivery of drought supplies and the potential environmental impacts are the three primary factors for decision making. We must build now to meet current needs.

There are six drought interventions that we are looking to deliver in 2023 (we also have drought interventions in reserve, including further desalination, additional permits and potential recovery of mines water):

1. **Licence increase at Stannon**. This is a dWRMP24 option and was also presented as a feasible option in WRMP19. This option is picked by our best value modelling process for delivery in AMP8, but the benefits are not claimed in our dWRMP24 as we have excluded licence increases the benefits of which are not yet agreed with the EA. Groundwater tests delivered in August 2022 and current drought permit operations are providing a strong evidence base for a permanent licence change. This option is low cost and quick to implement. We recommend bringing it forward.

2. **Licence change at Porth**. This is a dWRMP24 option and was also presented as a feasible option in WRMP19. This option is not picked by our modelling process for the preferred plan due to its relatively high cost to build against volume of water produced. However, it can be rapidly

implemented and the new licence would provide environmental benefits compared to the current licensing arrangements. The investment made to enable the current drought permit significantly reduces the cost (£/ML) of the scheme. For dWRMP24 we have assumed that the Porth Option would include cost of delivery.

3. **Licence increases at Restormel**. This is a dWRMP24 option and was also presented as a feasible option in WRMP19. It has not been taken forward into the preferred planning process as further environmental assessment work is required. An environmental study is underway as part of the response to the current drought. This is a low-cost option and, subject to satisfying environmental screen criteria, can be quickly implemented. If environmental criteria are met it would be picked by our best value approach.

4. **New abstraction at Blackpool Pit**. This is a dWRMP24 option but was not taken forward into the preferred planning process as further engagement is required with the asset owners to finalise agreement on access to the resource. Environmental and engineering study work is ongoing, but the option is financially viable to support our drought needs. We have completed cost and carbon forecasts within our data tables based on the work completed to date. We are continuing to build cost confidence as engagement and design progresses.

5. **Desalination (Par) and Desalination (Polkerris)**. These schemes are not in our dWRMP24 options. They have been developed in recent months as a specific response to the current drought. The schemes provide significant volumes of water to support the recharge of Colliford Reservoir. Whilst these options have potentially higher financial and (depending upon energy source) carbon costs than some of the other options being considered, there is a strong confidence that they can deliver the required volume of water within the required timeframe. These options also have relatively low ecosystem impacts as they do not reduce river/ reservoir levels. We have completed cost and carbon forecasts within our dWRMP data tables based on the work completed to date. We are continuing to build cost confidence as engagement and design progresses.

The evolving situation through 2023 will determine how these drought interventions are presented in our final WRMP24. These drought interventions may appear in our final WRMP submission as either:

- an inclusion in an updated baseline (reflecting scenarios presented in the dWRMP);
- options that can be chosen as part of best value and adaptive planning; and/or
- as drought options.

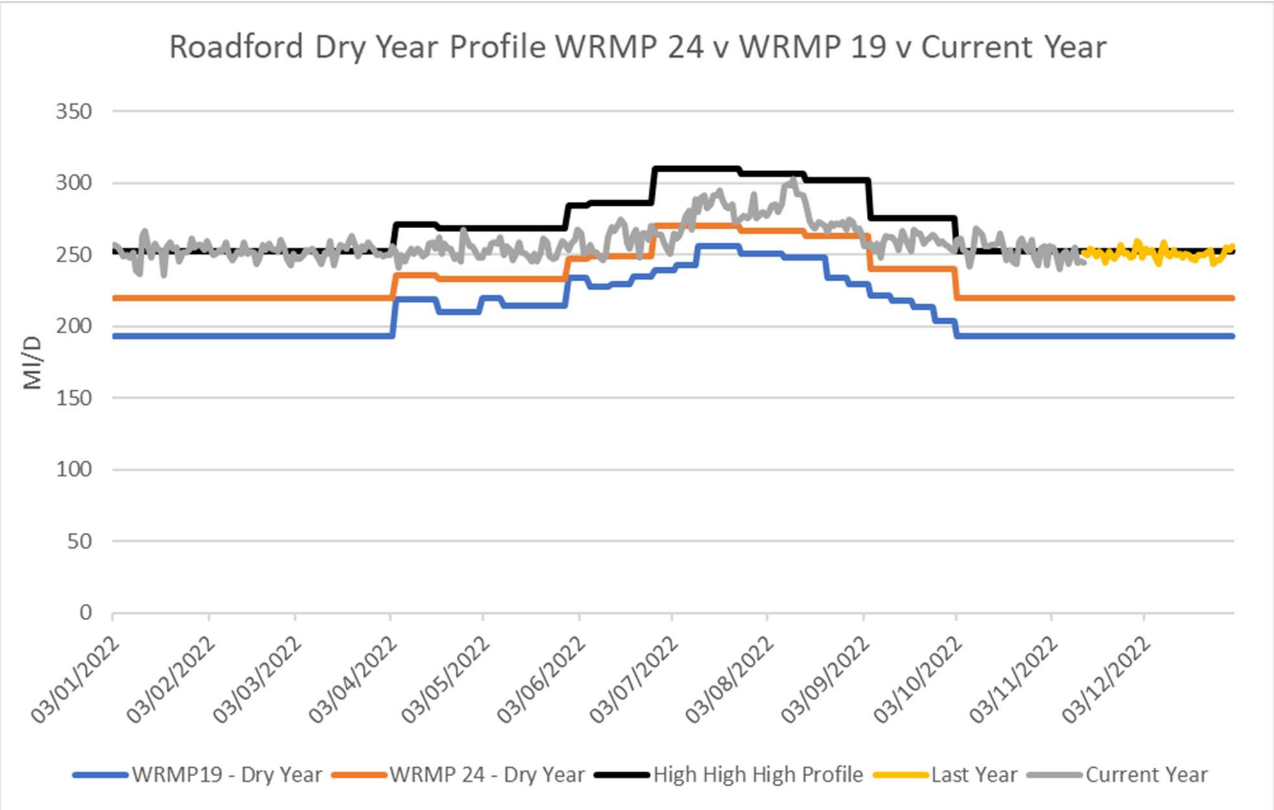
We would expect these items to be in our baseline. For items not added to our baseline, we will apply our best value and adaptive planning framework as set out in Chapter 10 to determine whether they are selected for future implementation.

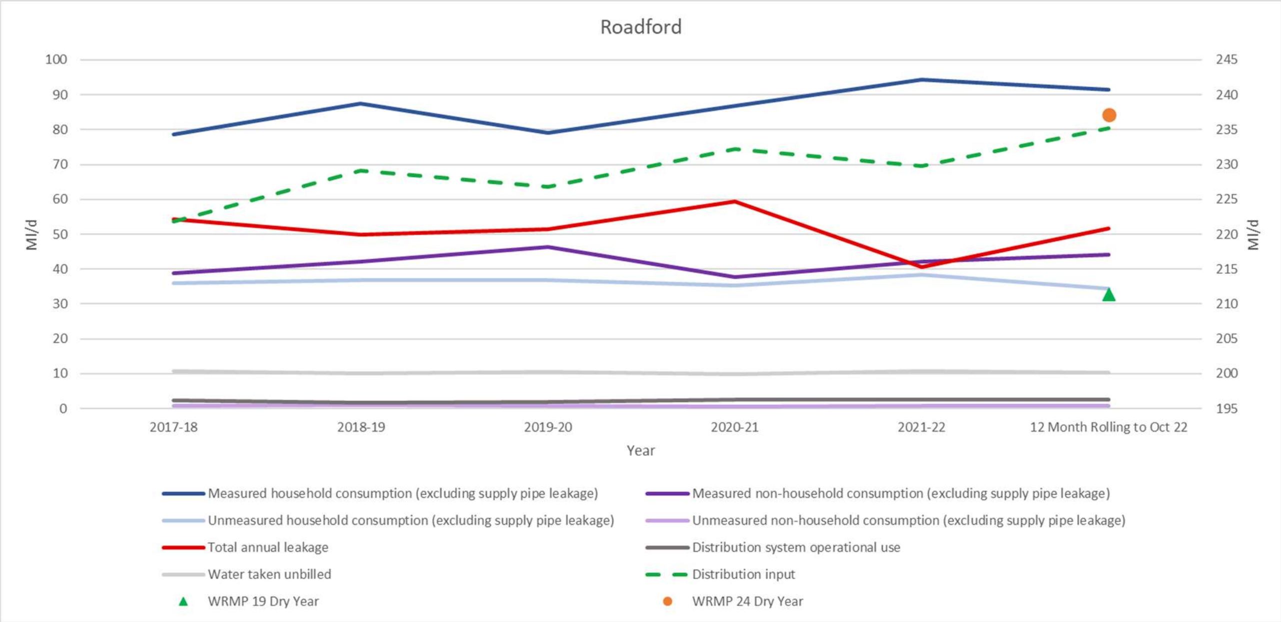
Annex A: Analysis for other Water Resource Zones

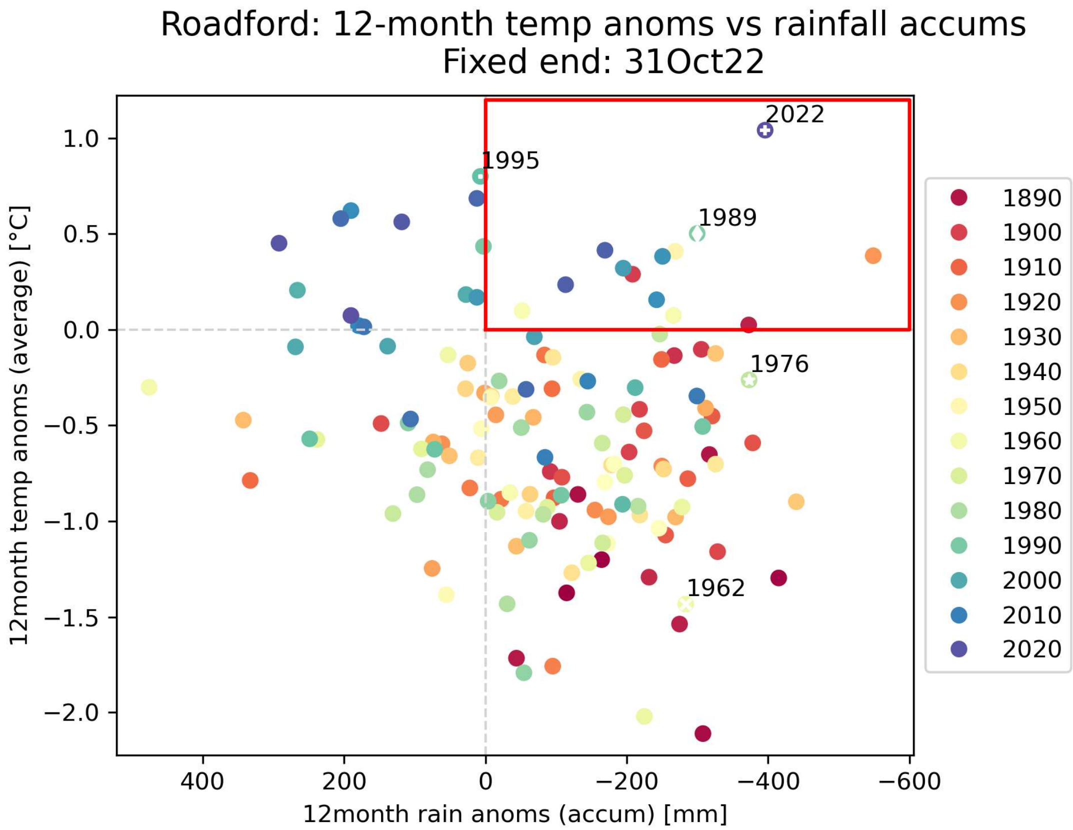
The narrative set out above focuses on our Colliford Supply Zone. The graphs included in this section complete the analysis for our other WRZs which show broadly similar patterns to Colliford.

Roadford WRZ

- The blue line shows forecast demand for a dry year as set out in our approved WRMP19 – as standard in the industry the line shows higher consumption in 'summer months'.
- The orange line shows the increase in forecast demand produced for our draft WRMP using the standard industry guidelines – projecting forward from a pre covid 2019 position. The increase from blue to orange is 8,448 ML over the year (a figure equivalent to 24% of the capacity of the Roadford strategic reservoir or 23.2 MLD).
- The grey line shows actual observed demand in 2022 (with the final months of the year marked in yellow being the actual demand for those months in 2021). The increase from blue to grey is 17,065 ML (a figure equivalent to 49% of the capacity of the Roadford strategic reservoir or 46.8 MLD).

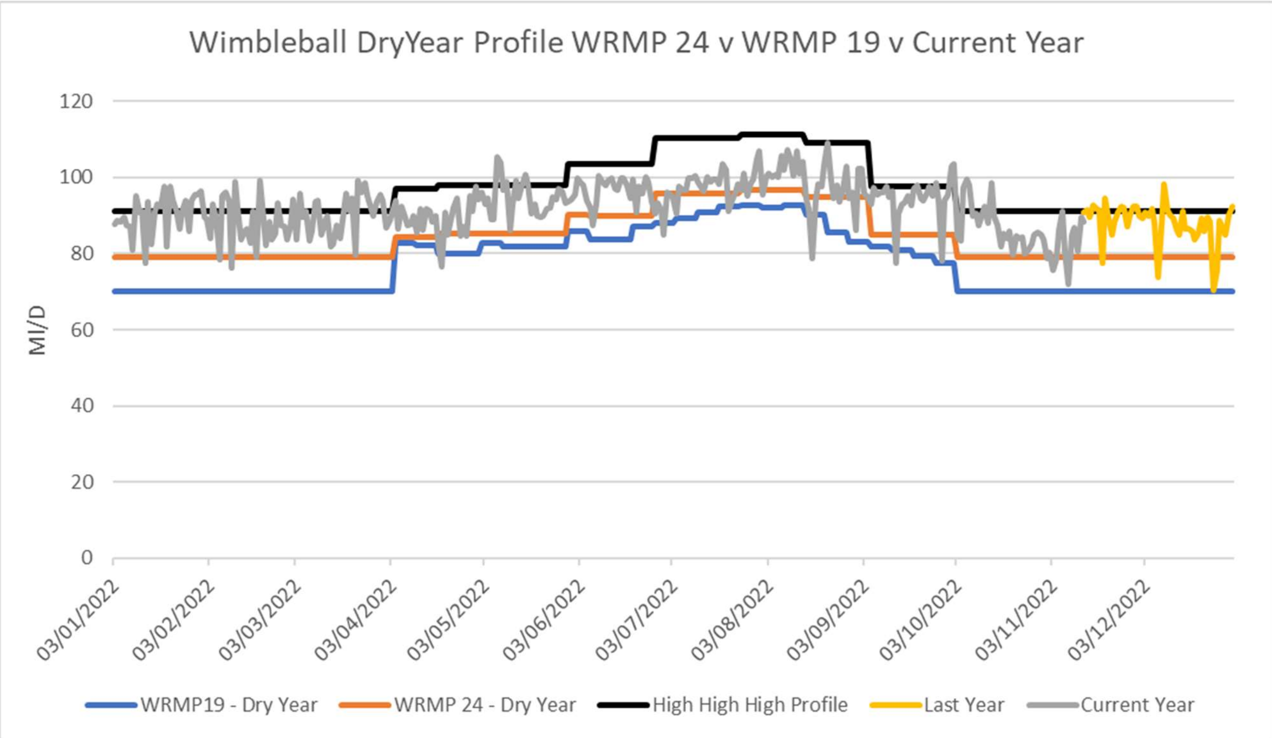


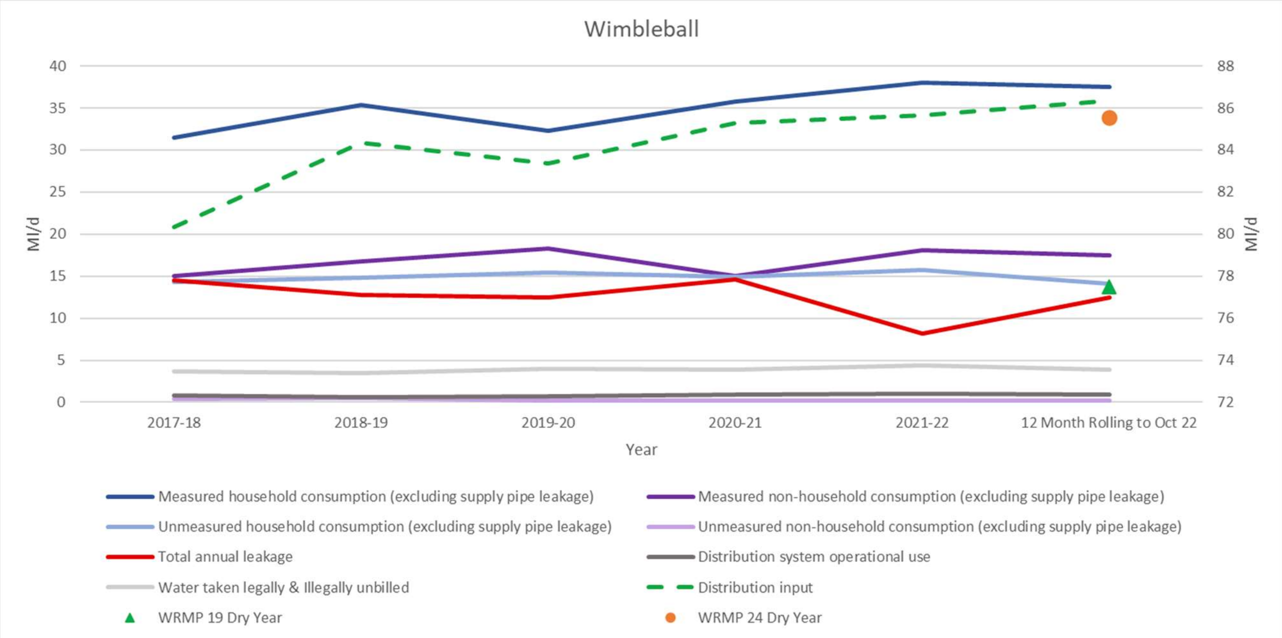

Roadford
100
90
80
70
60
50
40
30
20
10
0
245
240
235
230
225
220
215
210
205
200
195
Ml/d
Ml/d
2017-18
2018-19
2019-20
2020-21
2021-22
12 Month Rolling to Oct 22
Year
Measured household consumption (excluding supply pipe leakage)
Measured non-household consumption (excluding supply pipe leakage)
Unmeasured household consumption (excluding supply pipe leakage)
Unmeasured non-household consumption (excluding supply pipe leakage)
Total annual leakage
Distribution system operational use
Water taken unbilled
Distribution input
WRMP 19 Dry Year
WRMP 24 Dry Year

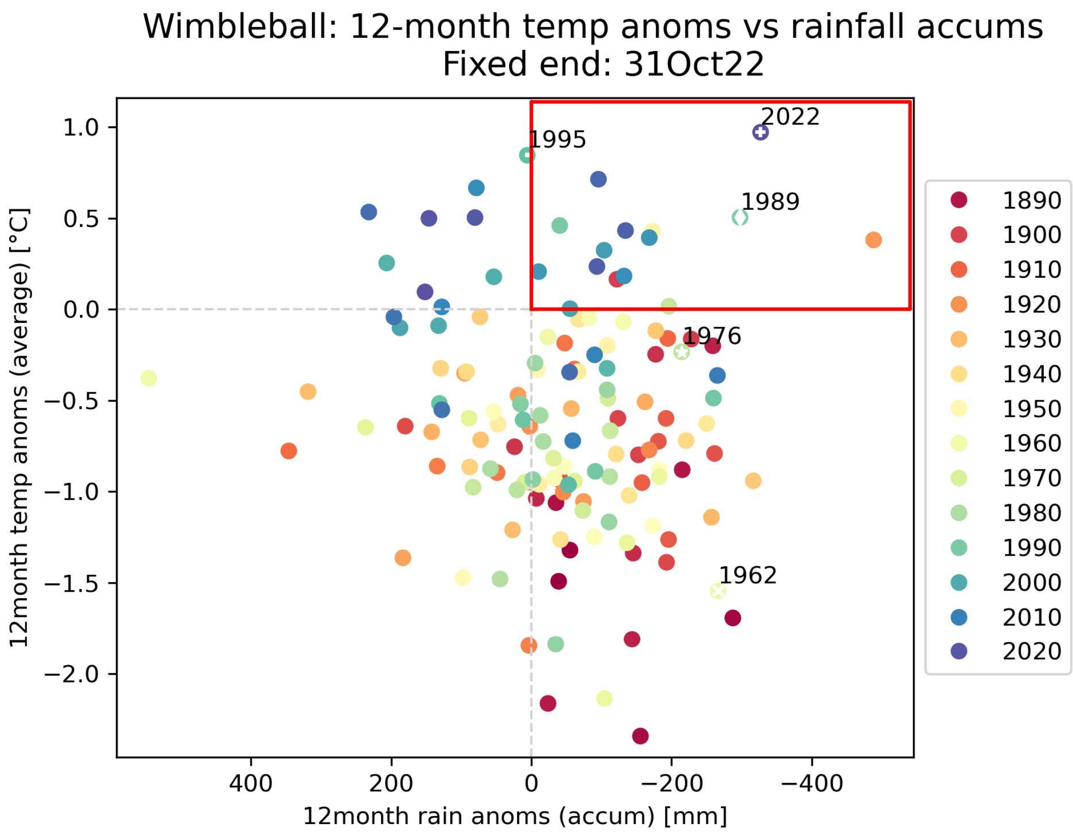

Roadford: 12-month temp anoms vs rainfall accums
Fixed end: 31Oct22
12month temp anoms (average) [°C]
12month rain anoms (accum) [mm]
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
400
200
0
−200
−400
−600
2022
1995
1989
1976
1962
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

Wimbleball

- The blue line shows forecast demand for a dry year as set out in our approved WRMP19 – as standard in the industry the line shows higher consumption in 'summer months'.
- The orange line shows the increase in forecast demand produced for our draft WRMP using the standard industry guidelines – projecting forward from a pre covid 2019 position. The increase from Blue to Orange is 2,557 ML over the year (a figure equivalent to 12% of the capacity of the Roadford strategic reservoir or 7.0 MLD).
- The grey line shows actual observed demand in 2022 (with the final months of the year marked in yellow being the actual demand for those months in 2021). The increase from blue to grey is 5,216 ML (a figure equivalent to 24% of the capacity of the Roadford strategic reservoir or 14.3 MLD).

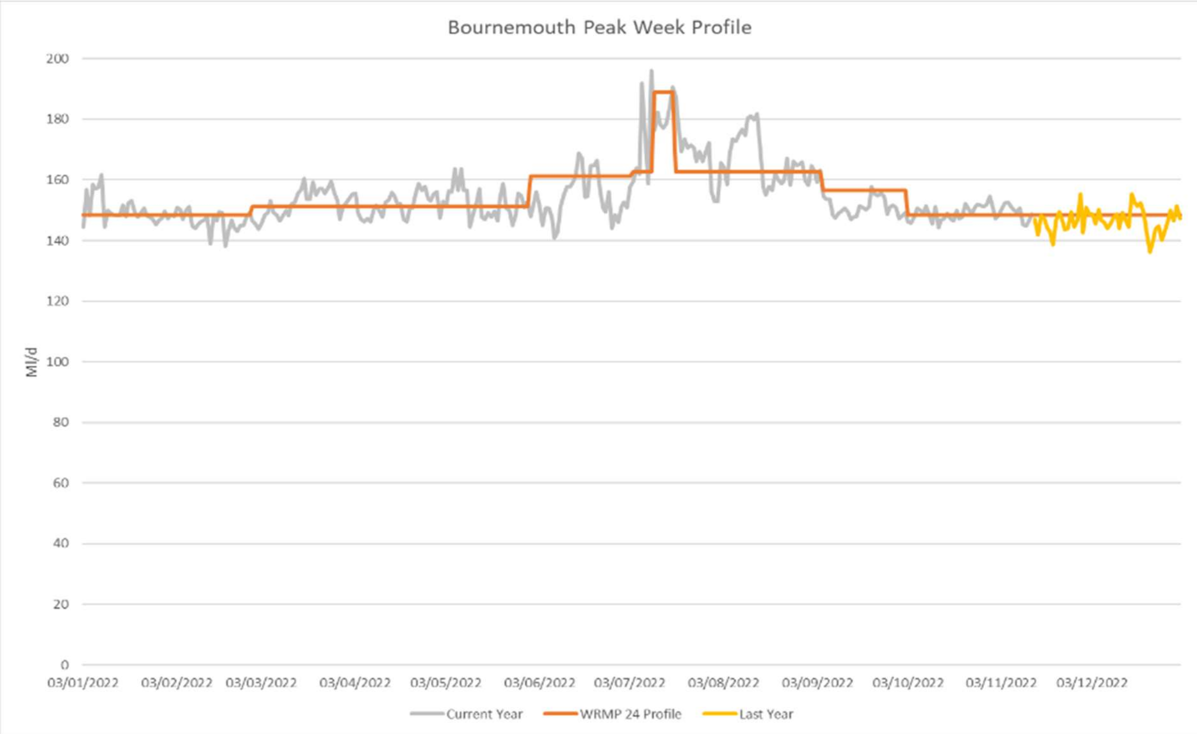


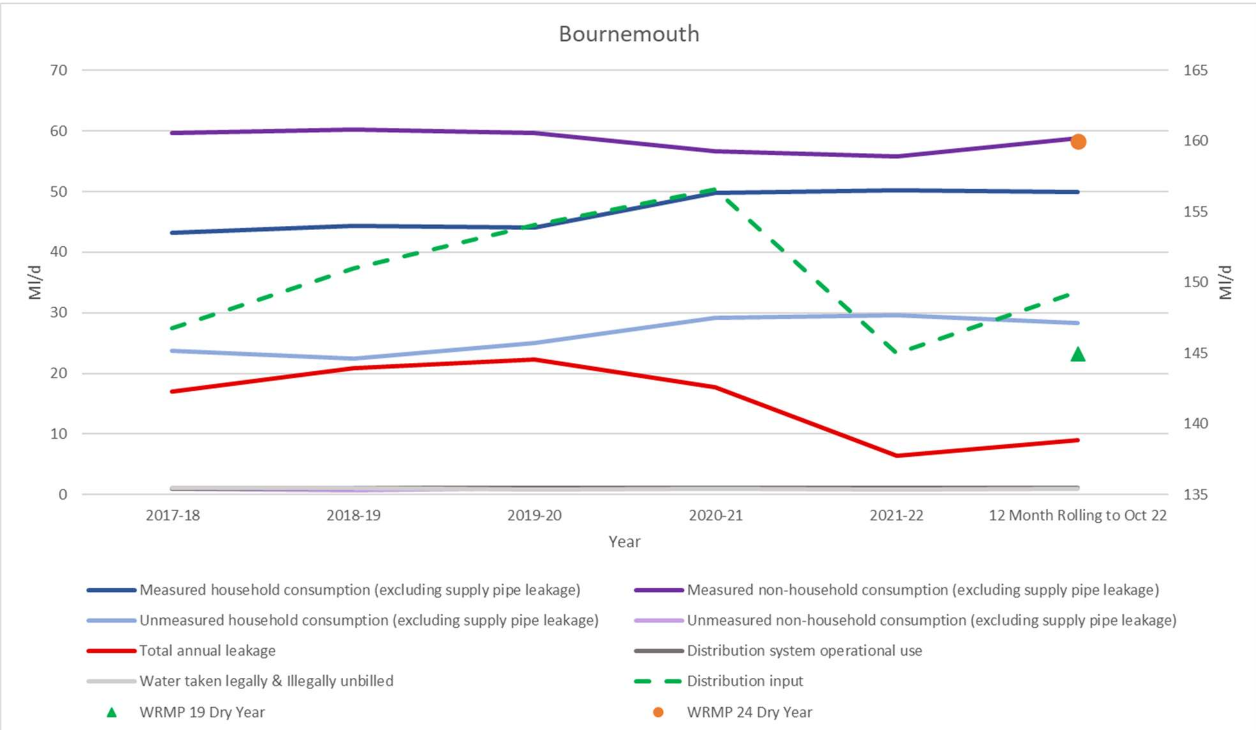

Wimbleball
Ml/d
40
35
30
25
20
15
10
5
0
88
86
84
82
80
78
76
74
72
2017-18
2018-19
2019-20
2020-21
2021-22
12 Month Rolling to Oct 22
Year
Measured household consumption (excluding supply pipe leakage)
Measured non-household consumption (excluding supply pipe leakage)
Unmeasured household consumption (excluding supply pipe leakage)
Unmeasured non-household consumption (excluding supply pipe leakage)
Total annual leakage
Distribution system operational use
Water taken legally & Illegally unbilled
Distribution input
WRMP 19 Dry Year
WRMP 24 Dry Year

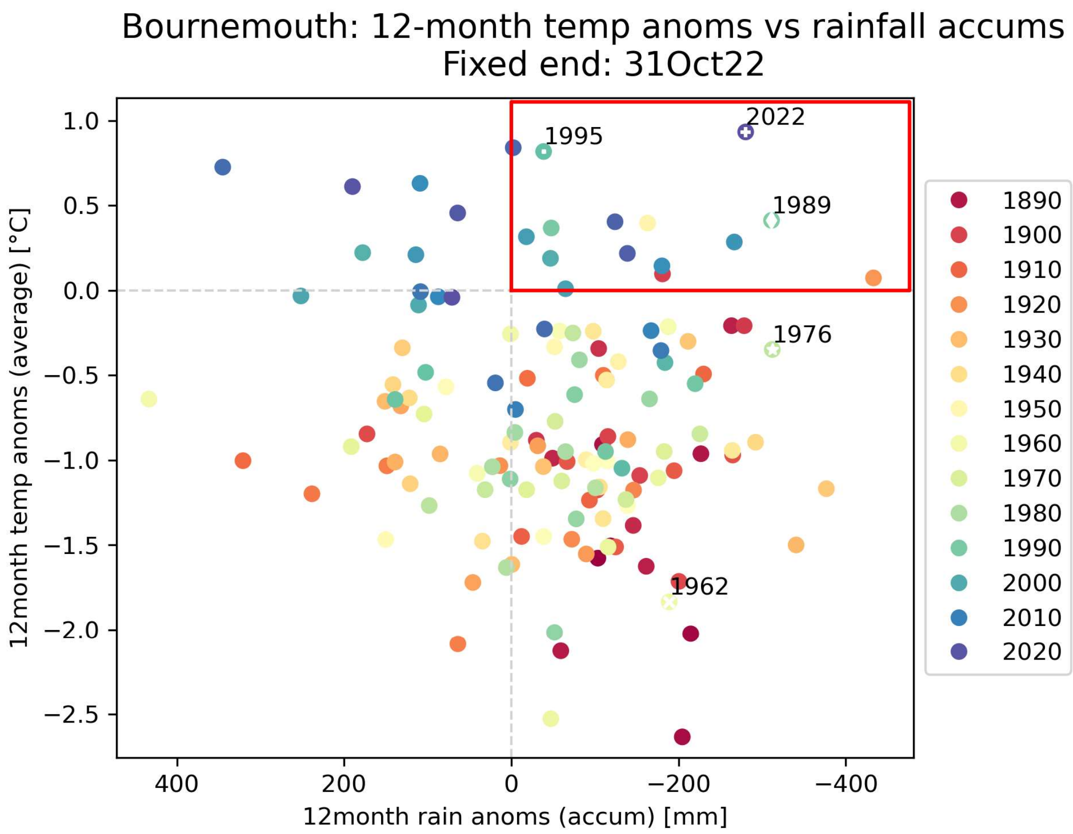

Wimbleball: 12-month temp anoms vs rainfall accums
Fixed end: 31Oct22
12month temp anoms (average) [°C]
12month rain anoms (accum) [mm]
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
400
200
0
−200
−400
2022
1995
1989
1976
1962
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

Bournemouth

- The orange line shows the increase in forecast demand produced for our draft WRMP using the standard industry guidelines – projecting forward from a pre covid 2019 position.
- The grey line shows actual observed demand in 2022 (with the final months of the year marked in yellow being the actual demand for those months in 2021). The increase from orange to grey is 163Ml over the year (a figure equivalent to 0.45 Ml/d).
- The demand graph shows a significant reduction in leakage which is driving down DI.






Bournemouth: 12-month temp anoms vs rainfall accums
Fixed end: 31Oct22
12month temp anoms (average) [°C]
12month rain anoms (accum) [mm]
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
400
200
0
−200
−400
2022
1995
1989
1976
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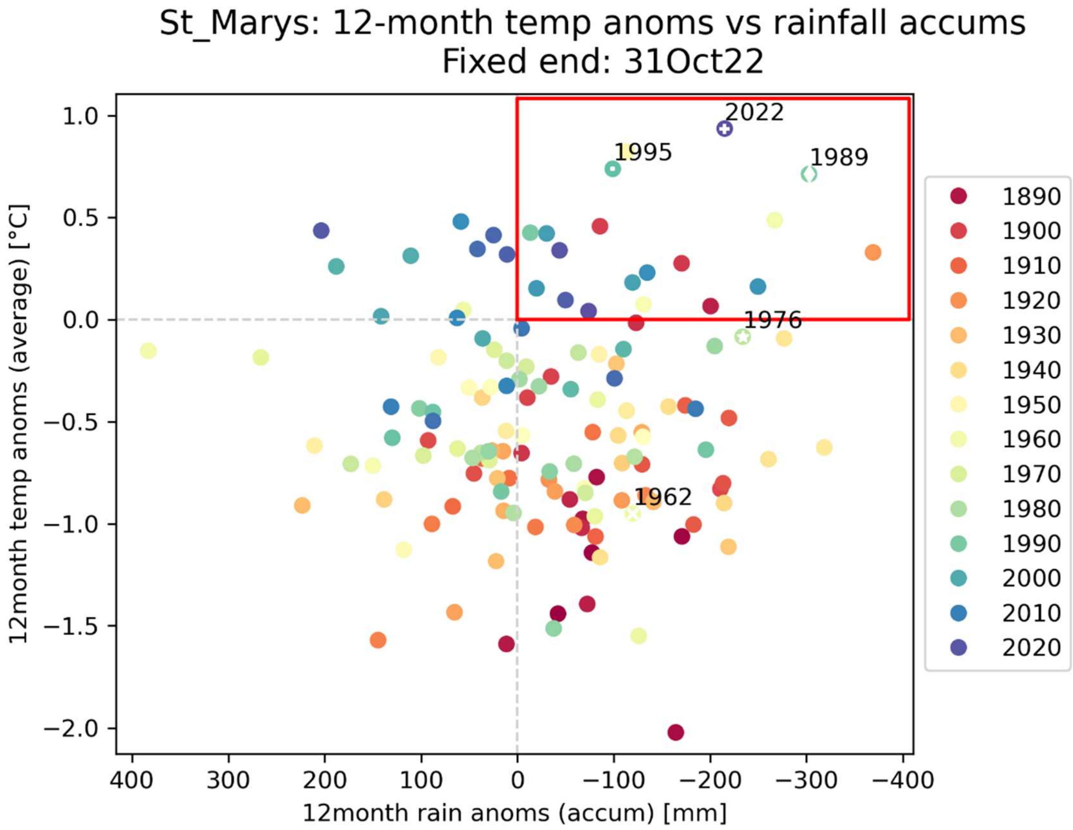
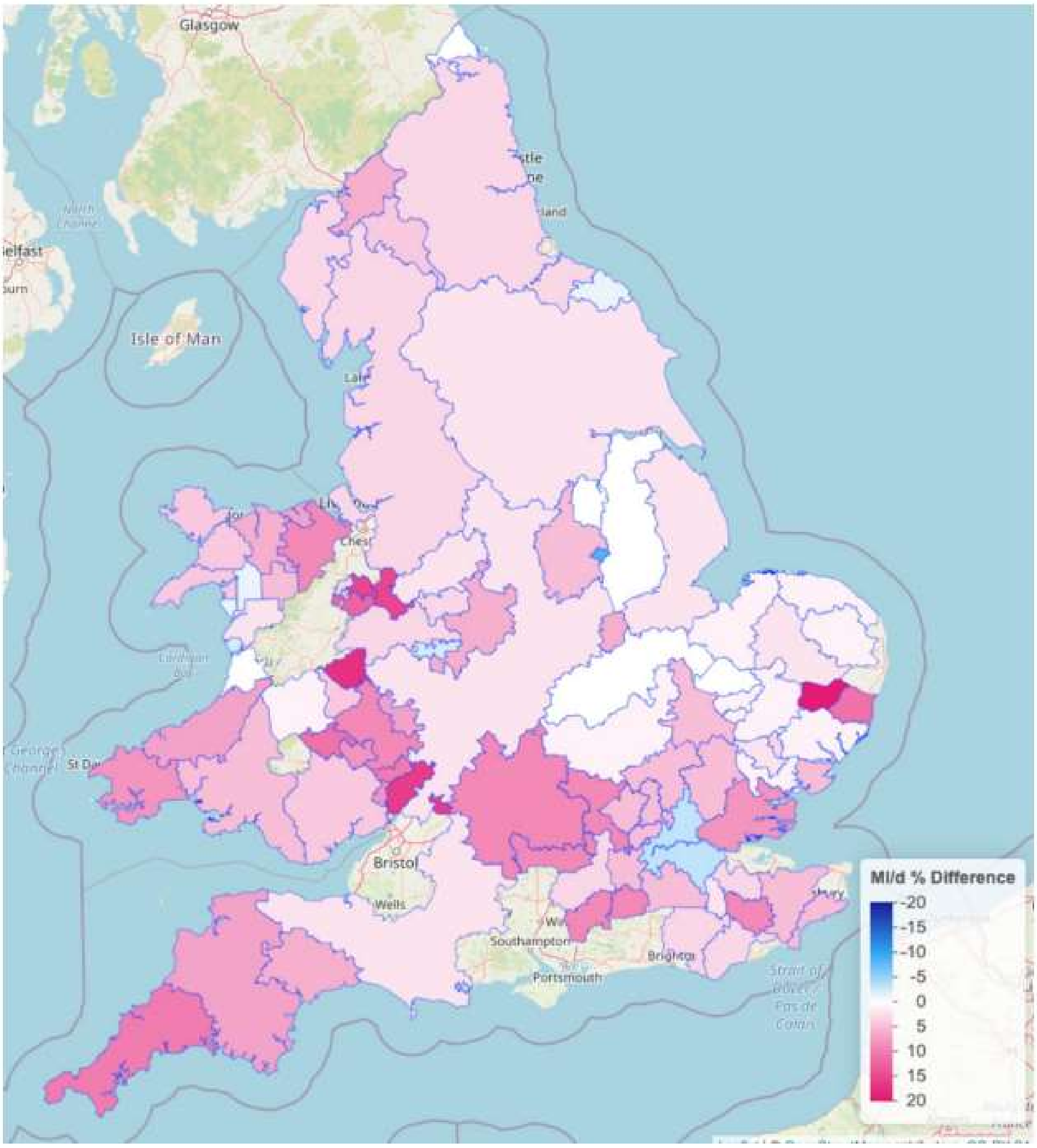
2010
2020

Isles of Scilly



National COVID 19 lockdown impacts on demand (weather adjusted):[11]



[11] Understanding changes in domestic water consumption associated with COVID-19 in England and Wales Manchester University/Artesia (2021)

South West Water

Bournemouth Water

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