Drought Plan 2022

Annex 4 – Appendix C:

River Test, Candover and River Itchen drought triggers technical note

Publication date: August 2025

This technical note sets out the proposed river flow triggers we would like to adopt in our final Drought Plan (fDP). Since our consultation in 2021, we have had to make a number of changes to the drought plan and annexes such as this in response to regulatory feedback. We have re-submitted our draft plan to regulators in May 2022, September 2022, February 2024 and January 2025. Following a letter received from Defra on 9 July 2025 we have made a small number of changes to our draft plan and the annexes that we were directed to make. None of the changes we have made affect compliance with legal agreements such as the section 20 agreement nor do they affect Portsmouth Water's level of service.

This appendix summarises the following:

- The development of our drought triggers for the River Test and Itchen
- The proposed triggers we are planning to adopt
- The implications of these triggers for our Levels of Service and drought interventions including a summary of the work we have undertaken since publication of our draft Drought Plan and Statement of Response
- A joint position statement with Portsmouth Water on the implications of the modelling for the level of service of each company.
- The proposed further work to further refine the triggers

This summary follows the additional modelling undertaken collaboratively with Portsmouth Water (PW) during early 2022 following our draft Drought Plan (dDP) consultation to review the relationship between the River Test and River Itchen drought triggers and our drought actions under our Section 20 Agreement with the Environment Agency,

dDP22 trigger development context

For our 2022 Drought Plan we undertook a revision and reassessment of most of our drought triggers to take account of new datasets and approaches. For our river flow triggers in particular we set out a series of goals which we believed would improve our flow triggers over our existing (DP19) trigger levels, some of which were originally derived for DP14. These goals included:

- Development of time-based triggers similar to the thresholds set out in the Section 20 Agreement with the Environment Agency that could be linked directly to preparation and application for of drought permit and orders to ensure sufficient time was in place for an application to be determined and implemented in advance of any Hands-off-Flow Thresholds being reached
- To better account for the baseflow response which drives flow recession in the groundwater dominated River Test and Itchen and to reduce risk of time-based crossings in observed data being delayed by short duration increases in flow due to "quickflow" rapid runoff following summer rainfall, as it does not materially influence the baseflow response due to high potential evapotranspiration preventing infiltration and groundwater recharge.

In 2020 we engaged Mott MacDonald to undertake a revision of all our flow triggers and through to submission of the draft drought plan in spring 2021, we held a number of meetings with the Environment Agency to update them with interim progress on development of the triggers. In our draft drought plan submission, we included updated river flow triggers for the River Test and Itchen based on the following:

- 90, 60 and 35-day triggers for the River Test Drought Permit ahead of a Hands-off-Flow (HoF) of 355Ml/d, with the 60 and 35-day triggers being directly linked to our required actions under the Section 20 agreement for pre-consultation and submission of the drought permit application
- 90, 60 and 35-day triggers for the River Test Drought Order ahead of an implementation threshold of 265Ml/d as set out in the Section 20 agreement, however the agreement does not specify any time-based thresholds only a flow at which the drought order could be implemented.
- Combined 90, 60 and 35-day triggers for the Candover and River Itchen Drought Order ahead of an implementation threshold of 205Ml/d and a HoF of 198Ml/d as set out in the Section 20 agreement. However, the agreement does not specify any time-based thresholds only the flows at which the drought orders could be implemented. Separate triggers for the River Itchen drought order (198 Ml/d HOF condition on the abstraction licence) were not developed, because it was felt that the preparatory actions for the Candover and the River Itchen drought orders would likely follow similar timings.

In spring 2021 at the time of our draft Drought Plan submission and during our discussion with the Environment Agency we jointly concluded that the combined Drought Order triggers for the River Itchen (A&H) may be triggering too frequently (almost 1 in 2 years for the 35-day application trigger) with potential consequences for our Level of Service commitments around drought order applications and use of demand restrictions. This “too frequent” triggering was primarily because the thresholds had been derived based on observed flow data which included some steep, but unexplained, drops in flow in late spring and early summer and hence to avoid the risk of similar future events the triggers had been set at higher flow in those months to ensure sufficient warning time was available. In discussion with the Environment Agency, we presented an alternative set of Itchen Flow Triggers which had been adjusted to try and reduce the frequency of crossing (but still maintain the specified time intervals where possible).

In May 2021 we held a joint drought workshop for the River Itchen with Portsmouth Water, the Environment Agency and Natural England. This highlighted further issues over the appropriateness of the combined River Itchen trigger set including:

- Concerns around potential impacts on levels of service for both drought permit and order applications and demand restrictions for both companies
- The potential impacts of demand restrictions at delaying the need for drought order interventions (by reducing abstraction and therefore the rate of flow recession) and how that was incorporated into the triggers
- The need to provide as much mitigation as possible before drought order intervention on the River Itchen.

Drought plan consultation response

Relevant issues identified in the Environment Agency representation following our consultation for dDP22 are summarised below:

- The Environment Agency were aware of the additional work we had undertaken to derive the “alternative” set of combined flow triggers for the River Itchen but these were not included in our draft drought plan and hence we were requested to provide further information on which trigger set we propose to adopt in our final plan, the basis for that decision and the implications for the sequencing and timing of our drought actions.
- There was concern that our flow recession curves, and associated River Test and Itchen flow triggers had not taken account of the effect of demand interventions in delaying flow recession in enough detail and that there might be a resultant risk to supply.

In response to these representations, we undertook two parallel work streams:

- We undertook some further refinement of the River Test and Itchen flow trigger sets with Mott MacDonald which included:
  - Providing the technical basis for the "Alternative" set of Combined Itchen Flow triggers developed after submission of dDP22 and originally presented, we have included this information in our revised draft
  - Developing a 35-day trigger level for the Itchen 198Ml/d threshold for the Candover Drought Order, using the same methodology as for the alternative 205Ml/d trigger set. However, as discussed later, we are not including a 35-day trigger for the River Itchen and Candover in this plan.

Development of the "alternative" Itchen trigger set

In recognition of the representation and following initial pre-submission concerns we commissioned Mott MacDonald to undertake some further work in May 2021. We presented an alternative set of Itchen Flow Triggers which were adjusted to try and reduce the frequency of crossing the trigger but still maintained the specified time intervals where possible.

The high July trigger for the 205Ml/d trigger is calculated from an event in 1990 (a historical drought period between 1989 and 1992) which is captured using a 20Ml/d buffer on the minimum flow.

Figure 1: Comparison of the original dDP22 and "alternative" (May 2021) combined Candover and River Itchen Drought Order triggers (ahead of 205Ml/d)

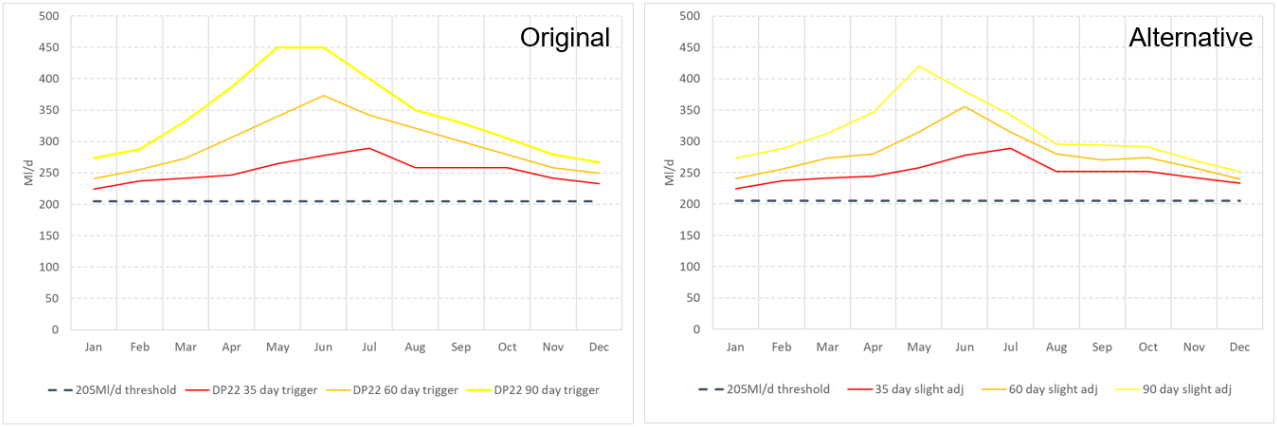


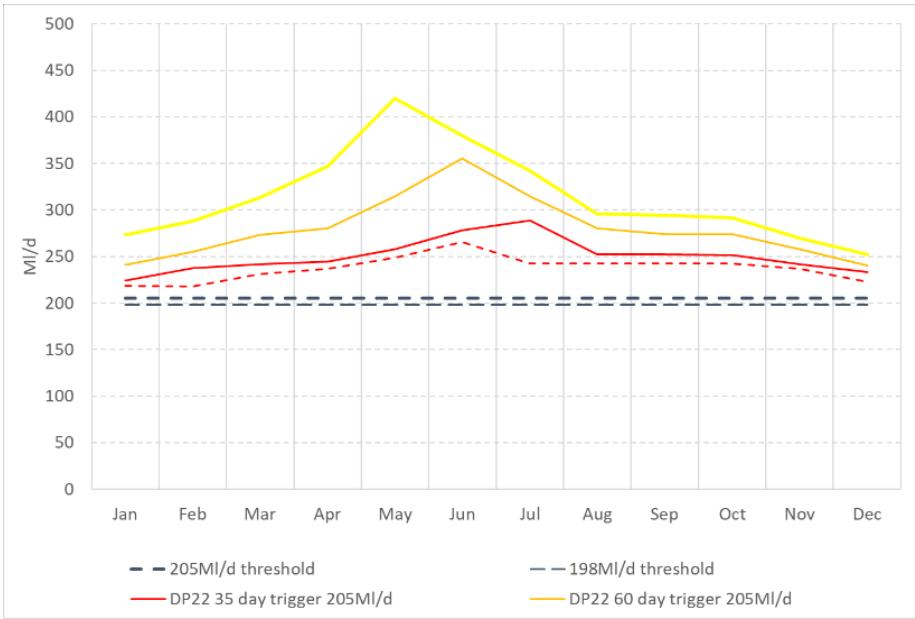
Table 1: Number of trigger crossings in historical flow record (62 years) for the original dDP22 and alternative (May 2021) combined Candover and River Itchen Drought Order triggers (ahead of 205Ml/d)

Yearly Crossings	Original (dDP22)	"Alternative" Set (May 2021)
90-day	59	43
60-day	46	40
35-day	27	24

River Itchen Drought Order trigger refinement

In addition to providing further information on the derivation of the alternative trigger set we also derived a new, separate ”35-day” Trigger for the River Itchen Drought Order (Figure 2) ahead of the 198Ml/d HoF at Allbrook and Highbridge. However, as we explain later in this document, we are not including a 35-day trigger in this drought plan. The assessment followed a similar process to the “alternative” trigger set.

Figure 2: 35 Separate day trigger derived (dashed red line) derived for the River Itchen (Allbrook and Highbridge) Drought Order



The 198Ml/d 35-day trigger[1] is crossed in 9 fewer years than the 205Ml/d 35-day trigger. For the 4 years that aren’t triggered between August and October the historic flow sits between the two trigger (205Ml/d “Alternative” and River Itchen 35-day) levels. The remaining 5 years fall in July due to the differences in the trigger level. The July trigger level is calculated using the stochastic data rather than historic (as there are no historical breaches) and is therefore lower.

[1] The analysis described here used 35-day Itchen triggers but as described later in this document, this drought plan no longer includes that trigger for the Itchen.

Our joint modelling study

In addition to the trigger refinements in autumn 2021 we commissioned Atkins to undertake a joint modelling study with Portsmouth Water to examine the implications of our proposed flow triggers for the River Test and River Itchen. The aims of the study were to:

- Investigate level of service implications for both companies of the proposed triggers
- Examine the coherence of drought events on the River Test and Itchen and to explore the relative timing of drought interventions on both rivers and associated water resource zones
- Carry out full system simulation modelling of our drought interventions to include the effect of demand restrictions and the sequencing of drought actions set out in the Section 20 in association with the trigger levels
- Where required propose or provide updated trigger suites that continue to protect supplies, but which reduce risks of unnecessary drought interventions and associated level of service impacts.

The study used a joint system simulation modelling (building on the regional water resources model developed in Pywr) utilising the stochastic time series developed for Water Resources South East (WRSE) to test assumptions around lead times, resultant levels of service (LoS), and coherence of Drought Permit requirements for both companies. For Southern Water the trigger sets adopted in the modelling are set out in Table 2.

Table 2: Summary of trigger sets included in our drought plans and the joint modelling study

Set	Trigger set	Included in DP19?	Included or updated in the dDP22?	Included in Joint Pywr modelling?	Comments
A	River Test Drought Permit (90/60/35-day triggers)	Yes	Updated	Yes	DP19 triggers were updated by Mott MacDonald for dDP22
B	River Test Drought Order (90/60/35-day triggers)	Partially	Yes	Yes	DP19 only had an implementation trigger at 265Ml/d
C	Original Combined River Itchen Trigger set	Partially	Yes	No	DP19 only had Level 1 Trigger in advance of 205Ml/d for the Rive Itchen
D	Combined “Alternative” River Itchen Trigger set	Partially	No	Yes	DP19 only had Level 1 Trigger in advance of 205Ml/d
E	New 35-day River Itchen Drought Order Trigger	No	No	No	Derived in Summer 2021 following dDP22 representations

The modelling included the full effect of demand restrictions and system simulation modelling so as to provide a realistic assessment of trigger performance.

The full modelling report is included as Appendix B[2] to Annex 4 and key findings of the study are summarised below:

- The River Test Drought Permit flow trigger curves (set A) which were updated for the dDP22 were found to provide an appropriate lead-in time for drought interventions on the River Test and are appropriate for the timings set out in the Section 20 Agreement
- For the River Test Drought Order flow trigger curves (set B) the results suggest that the 60-day and 35-day trigger levels included in the dDP would be more appropriate as the 90-day and 60-day trigger levels respectively. If this refinement is adopted, then a new, less conservative, 35-day trigger level could be developed and tested.
- The system modelling results demonstrate the value of the Candover Augmentation Scheme Drought Order in reducing the number of events that reach the 198Ml/d HoF.
- The results also suggest that the Combined "Alternative" trigger levels (set D) could be relaxed to less conservative levels as the shortest event duration exceeds the 90, 60 and 35-day drought curve levels. The current 35-day level could be used as the 90-day level. These results are dependent upon the full utilisation of the River Test licence (i.e. allowing unrestricted transfer from HSW to HSE). However, if drought permit conditions were implemented on the River Test (as occurred in 2019) which restrict use of that licence and transfer there is a risk that the drought order on the River Itchen would be triggered more frequently with more instances of flows reaching the 198Ml/d HoF.
- A review of the coherence of drought events identified that the majority of River Test Drought Permit 355Ml/d events preceded the River Itchen HoF events, aligning with the Section 20 Agreement.
- The coherence of drought restrictions between Southern Water and PW were analysed, and results suggest that demand restrictions on Southern Water customers are implemented more frequently in response to the River Itchen trigger at Allbrook & Highbridge (A&H) than on PW customers. TUBs only required to be implemented by PW 7% of the time that they are implemented by Southern Water and NEUBs are only implemented by PW 28% of the time that they are implemented by Southern Water. The modelling results show that for the majority of drought events both companies would have implemented their TUBs before the 198Ml/d HoF at A&H on the River Itchen was reached.

Our proposed set of triggers for the River Test and River Itchen

Following the further work we have undertaken and taking into account the conclusions of the modelling study, we proposed to adopt the following trigger sets in our revised draft Drought Plan as set out in Table 3.

[2] Appendix B to Annex 4 is not published on the Southern Water website as it contains information that may be shared due to grounds of national security. To view a paper copy in our head office please contact wrmp@southernwater.co.uk to make an appointment.

Table 3 Summary and status of trigger sets we propose to adopt in our final Drought Plan for the River Test and Itchen Flows

Set	Triggers	Included in DP19?	Included or updated in the dDP22?	Included in Joint Pywr modelling?	Adoption in Revised Draft/Final Drought Plan
A	River Test Drought Permit 355Ml/d Trigger Set (90/60/35-day triggers)	Yes	Updated	Yes	Yes – no change from dDP22
B	River Test Drought Order (265Ml/d) (90/60/35-day triggers)	Partially	Yes	Yes	Yes – but relabeled following modelling study Original 90-day trigger is to be dropped 60-day trigger becomes a 90-day trigger and 35-day trigger becomes a 60-day trigger
C	Original Combined River Itchen 205Ml/d Drought Order Trigger set (90/60/35-day triggers)	Partially	Yes	No	Not adopted
D	Combined "Alternative" River Itchen 205Ml/d Drought Order Trigger set (90/60/35-day triggers)	Partially	No	Yes	Yes but relabeled following modelling study Original 90-day trigger is to be dropped 60-day trigger becomes a 90-day trigger and 35-day trigger becomes a 60-day trigger
E	New 35-day River Itchen 198Ml/d Drought Order Trigger	No	No	No	Yes but relabeled as a 60-day trigger based on results of modelling study

All of these trigger sets, except for the revised Combined River Itchen Drought Order triggers (Set D) and the 35-day Trigger for the River Itchen Drought Order (Set E) were included in our draft Drought Plan (dDP) submission. These modifications do not affect the River Test Drought Permit 35-day trigger that is referred to in the Section 20 Agreement. But, because the River Itchen 35-day trigger is relabelled as the 60-day trigger, these modifications mean that this plan no longer contains an Itchen 35-day trigger.

Further detail and our rationale for adopting each set of triggers is set out in the following sections

Set A - River Test Drought Permit 355Ml/d trigger set (90/60/35-day triggers)

We consider that the River Test Drought Permit triggers in the dDP22 have been tested and validated by the modelling study.

The joint modelling study showed the River Test Drought Permit flow triggers, as included in our draft Drought Plan and updated compared to our 2019 Drought Plan, are appropriate in terms of timing and alignment with our required Section 20 Agreement actions at 60 and 35-days in advance of River Test 355Ml/d Hands-off-Flow for pre-consultation and application for the River Test Drought Permit.

We are therefore proposing that these triggers be adopted in our revised draft drought plan for the River Test Drought Permit and we also propose to use them in the ongoing Drought Permit application process in summer 2022.

Table 4 and Figure 3 show a comparison of the DP19 and proposed DP22 trigger sets for the River Test Drought Permit. In general, the DP22 triggers are slightly higher in flow and hence provide earlier warning than those for DP19. Our comparative assessment of trigger performance and flow forecasts over the past two years has shown this brings forward lead times to drought interventions by about a week.

Table 4 comparison of DP19 and proposed DP22 flow trigger sets for the River Test Drought Permit (355Ml/d)

	DP19 Trigger Set (Ml/d)			Proposed DP22 Trigger set (Ml/d)		
Month	**90-day**	**60-day**	**35-day**	**90-day**	**60-day**	**35-day**
Jan	660	535	435	660	589	509
Feb	660	535	440	728	589	497
Mar	660	535	440	728	589	486
Apr	660	535	440	728	589	486
May	660	535	465	738	589	486
Jun	660	535	465	738	589	486
Jul	660	535	455	738	589	481
Aug	660	535	455	738	589	476
Sep	660	535	455	738	589	472
Oct	660	535	420	738	589	467
Nov	660	535	420	715	589	467
Dec	660	535	435	677	589	485

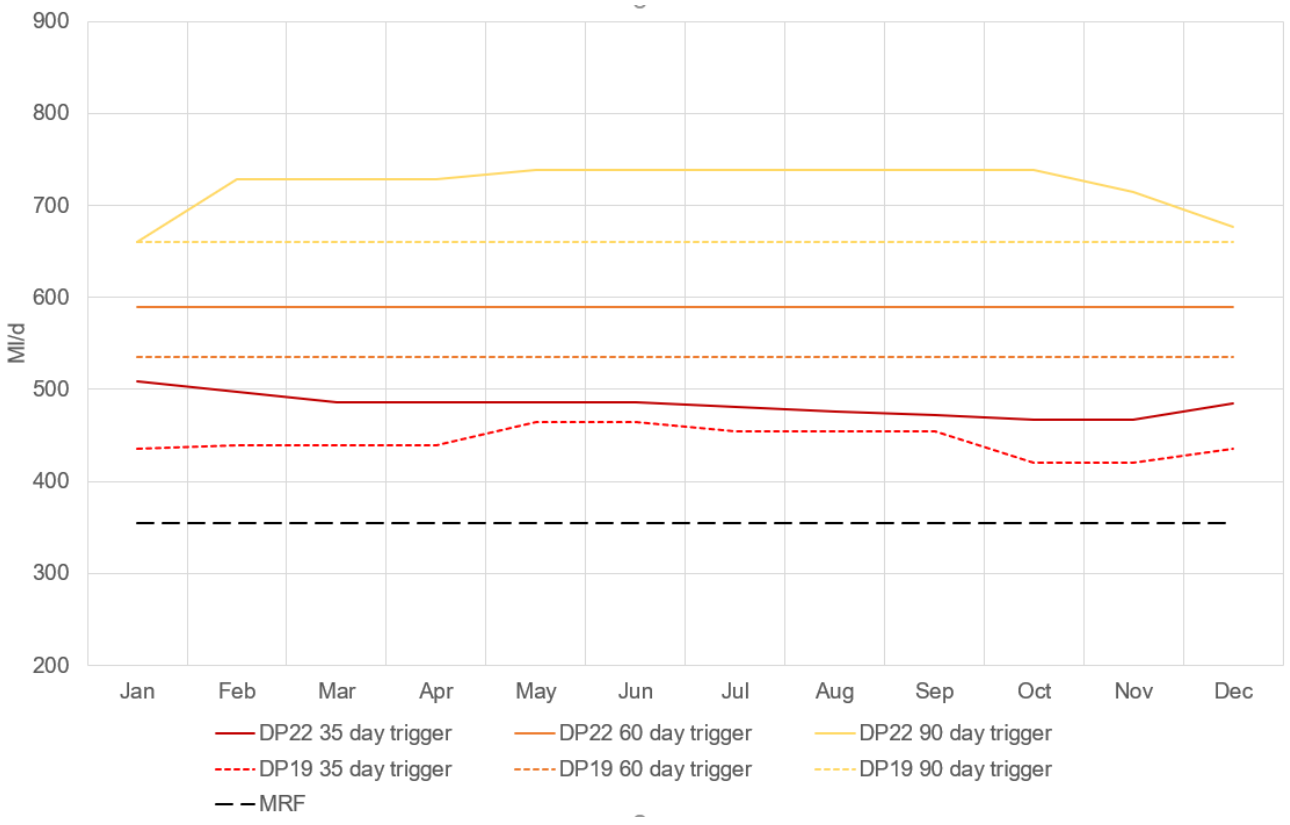


Figure 3 Comparison of DP19 and proposed DP22 flow trigger sets for the River Test Drought Permit (355Ml/d)

Set B - River Test Drought Order 265Ml/d trigger set (90/60-day triggers)

Under our existing DP19 there is only an implementation trigger for the River Test Drought order set at 265Ml/d. Unlike the Test Drought Permit there are no time-based triggers for this drought order set out in the Section 20 agreement.

The joint modelling study showed that the preparation, pre-consultation and application triggers for River Test Drought Order flow triggers, as included in dDP22, were triggered moderately frequently (every 5 to 9.1 years on average) but the Drought Order itself was very rarely implemented, the 265Ml/d flow threshold only being reached in extreme droughts (more than 1 in 400 year return period). The study concluded that the time-based triggers could be relabelled, and our interventions adjusted accordingly to better match the modelled recession characteristics.

We therefore propose to make the following modifications to this trigger set:

- The 90-day trigger included in dDP22 will be dropped
- The 60-day trigger included in dDP22 will be relabelled as a 90-day trigger, better matching modelled recession rates and will be linked to actions to begin internal drought order preparation (~1 in 9 year frequency)
- The 35-day trigger included in dDP22 will be relabelled as a 60-day trigger, better matching modelled recession rates and will be linked to actions to begin formal drought order pre-consultation (~1 in 9 year frequency).

The proposed triggers we intend to adopt for the River Test Drought Order are set out in Table 5 and Figure 4. Because of the adjustment to the triggers this means that we will no longer have a dedicated “35 day” application threshold. 35-day. Instead, we will use our flow forecasting approach (set out in our drought plan) to forecast the timing and likelihood of flow recession and would intend to submit the application at a threshold agreed with regulators 35-day before we forecast there to be a significant risk with the 265Ml/d flow threshold for implementation of the River Test Drought Order being reached.

Table 5 comparison of DP19 and proposed DP22 flow trigger sets for the River Test Drought Order (355Ml/d)

	DP19 Trigger Set (Ml/d)	Proposed DP22 Trigger set (Ml/d)		
Month	Implementation only	90-day	60-day	35-day
Jan	265	443	367	N/A
Feb	265	443	367	N/A
Mar	265	443	367	N/A
Apr	265	445	369	N/A
May	265	416	360	N/A
Jun	265	415	350	N/A
Jul	265	409	341	N/A
Aug	265	407	341	N/A
Sep	265	400	340	N/A
Oct	265	400	340	N/A

Nov	265	430	340	N/A
Dec	265	445	326	N/A

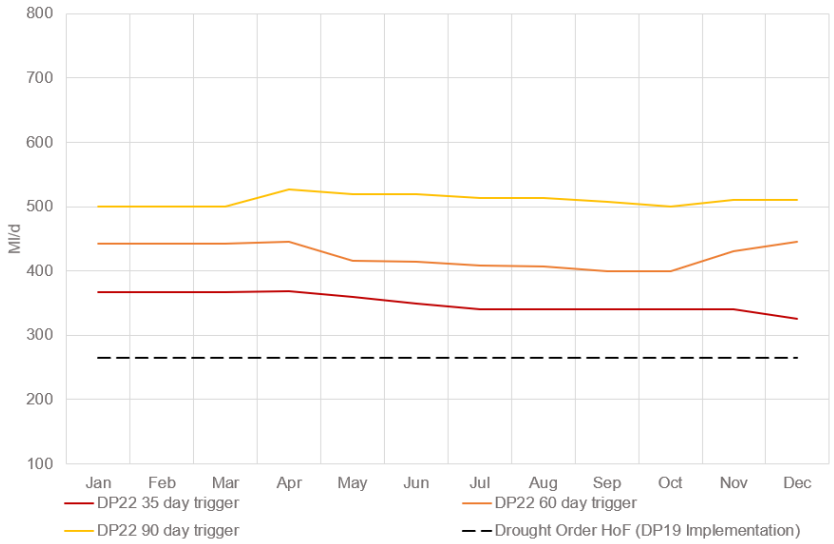


Figure 4 Summary of proposed triggers for the River Test Drought Order

A further outcome of the modelling study to note, irrespective of the trigger levels is that examination of the coherence of drought flow recession for the River Test and Itchen showed that, in severe to extreme drought events, the 265Ml/d River Test Drought Order threshold was only reached ahead of the River Itchen 198Ml/d Drought Order threshold 2% of the time and so in a severe drought event it is likely that the Candover and/or River Itchen Drought Order implementation would likely be required before the River Test Drought Order. This feature of the flow recession therefore imposes some limitations on sequencing of interventions under the Section 20 Agreement.

Set C - Original dDP22 combined River Itchen 205Ml/d Drought Order trigger set (90/60/35-day triggers)

This set of triggers, which were originally included in dDP22 were considered to be too conservative and trigger too frequently and have been superseded by the “alternative” trigger set developed after submission of dDP22. This trigger set will not be adopted.

Set D Combined “alternative” River Itchen 205Ml/d Drought Order trigger set (90/60/35-day triggers) and Set E new 35-day River Itchen 198Ml/d Drought Order trigger

Following the refinements undertaken post submission of dDP22 and the outcomes of the joint modelling study we propose to adopt the “Alternative” combined trigger set for the Candover Drought Order ahead of 205Ml/d (Set D) and the new 35-day trigger for the River Itchen Drought Order ahead of 198Ml/d) with the following modifications:

- Set D - 90-day combined River Itchen trigger is to be dropped
- Set D - 60-day combined River Itchen trigger is to be relabelled as a combined 90-day trigger linked to internal preparation of the Candover and/or River Itchen (Allbrook and Highbridge) Drought Order

- Set D – 35-day combined River Itchen trigger (for 205Ml/d) is to be relabelled as a combined 60-day trigger linked to formal pre-consultation of the Candover Augmentation Scheme
- Set E – 35-day trigger for the River Itchen Drought order is to be relabelled as a combined 60-day trigger linked to formal pre-consultation of the River Itchen (Allbrook and Highbridge) Drought Order and Portsmouth Water's Lower Itchen abstraction licence Drought Order.

As requested in the representation we received on our dDP consultation (in particular recommendation 2) we have updated our Drought Plan and its Annexes to provide further details on how these new triggers were derived. This follows on from discussions and presentations made to the Environment Agency in May 2021 and November 2021 and during the joint modelling study.

DP19 included an early warning Level 1 trigger (set at 1 in 5 year flows) and a Level 2 trigger set at 206Ml/d just in advance of the Candover Augmentation. Comparisons of the two trigger sets are presented in Table 6 and Figure 5.

The DP19 and DP22 share different shapes because they differ in how they were derived, the DP19 triggers being based on monthly flow return periods whilst the DP22 triggers based on potential time before flow recession to the Hands off Flow or Candover Drought Order threshold. The proposed DP22 triggers are therefore more directly linked to interventions than those for DP19 and their shape varies according to the gradient of the expected flow recession.

Table 6 comparison of DP19 triggers and proposed "Alternative" DP22 Triggers for the Candover (Set D) and River Itchen (Set E) Drought Orders

	DP19 Trigger Set (Ml/d)		Proposed DP22 Trigger sets E and D (Ml/d)		
Month	Level 1 Trigger	Level 2 Trigger	90-day (Set D)	60-day to 205Ml/d (Set D Candover)	60-day to 198Ml/d (Set E River Itchen)
Jan	280	206	241	224	218
Feb	355	206	255	237	218
Mar	370	206	273	241	231
Apr	345	206	280	244	237
May	305	206	315	258	249
Jun	270	206	355	278	265
Jul	245	206	315	289	242
Aug	225	206	280	252	242
Sep	220	206	274	252	242
Oct	220	206	274	252	242
Nov	220	206	258	242	237
Dec	220	206	240	233	223

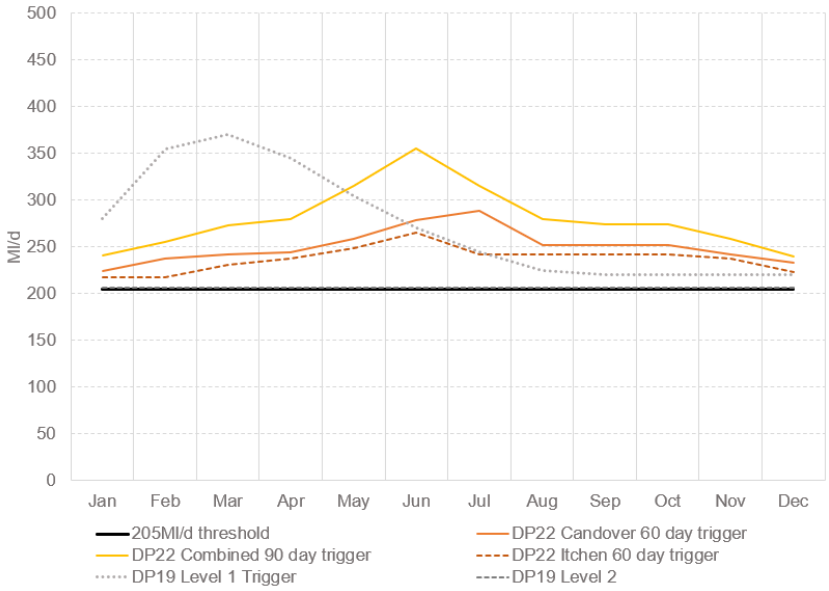


Figure 5 – Comparison of DP19 and proposed DP22 triggers for the Candover and River Itchen Drought Orders

River Itchen trigger performance

Figure 6 shows that both the DP19 and proposed DP22 triggers provide early warning of potential crossing of the HoF however the DP19 Level 2 trigger is set just in advance of the Candover Augmentation Scheme trigger level and hence would not provide any time or warning of the need to prepare that drought order. The only early warning would be provided by the Level 1 trigger in February ahead of HoF breaches in the summer. The proposed new trigger set therefore provide a greater degree of granularity than the existing DP19 triggers and are more directly linked to drought order implementation thresholds.

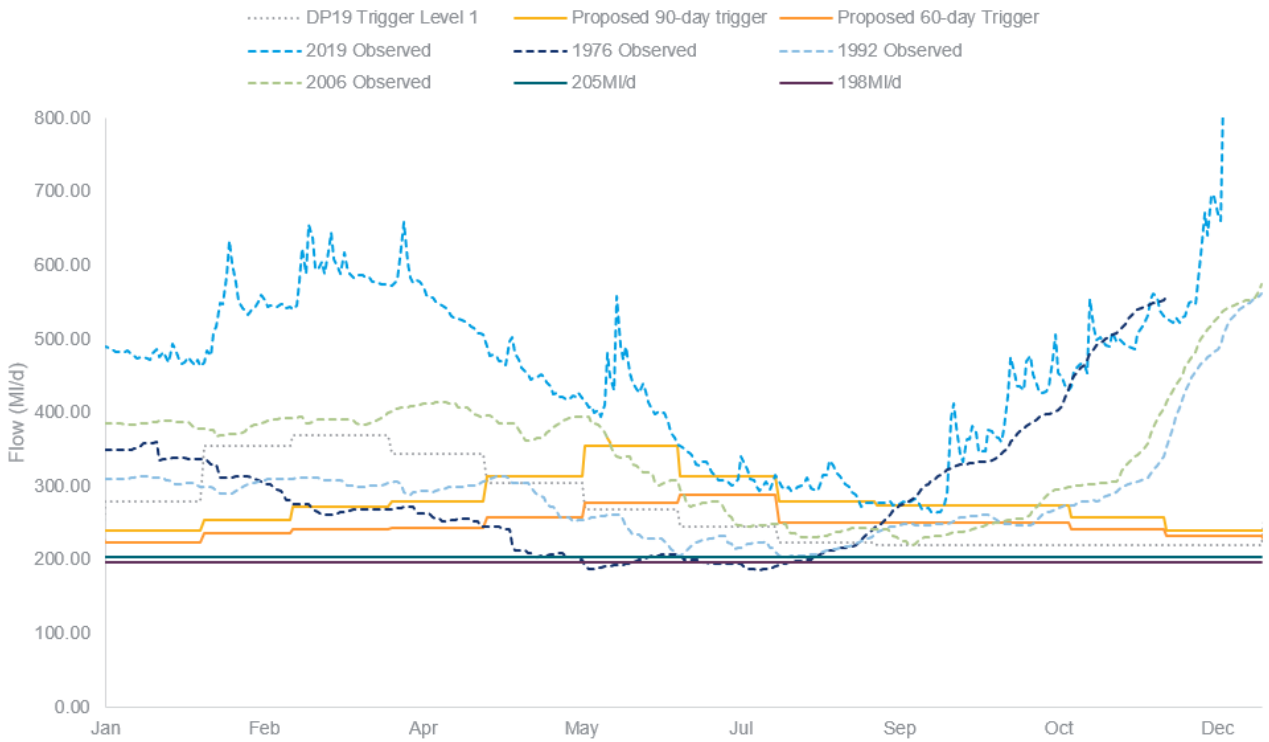


Figure 6 Comparison of the DP19 and the proposed River Itchen drought triggers (Set D) against selected historical dry years

Table 7 summarises and compares the trigger performance for the DP19 set, the original dDP22 trigger set (Set C) and the proposed triggers (Set D and E) for selected historical droughts and the years since the River Itchen Licence change in 2018. Comparative plots are provided in Appendix 1 at the end of this document.

The data show the increased utility of the proposed revised trigger set (Sets D and E) compared to that for both DP19 and dDP22 (Set C). Compared to DP19 the triggers still offer early warning, with the 90-day trigger being reached in most years but the timing of that trigger crossing provides greater utility and relevance to the minimum flow than the 1 in 5 year Level 1 trigger from DP19.

Compared to the dDP22 triggers (Set C), the revised triggers (Sets D and E) trigger less frequently resulting in less abortive work although in recent years neither trigger set would have resulted in a drought order application and hence imposition of TUBs, both of which have impacts on our level of service. Only 2006 and 1976 would have resulted in us implementing our River Itchen Drought Orders.

However, comparison of the Set C with Sets D and E in historical droughts do indicate that with the less conservative approach the timing between trigger crossings is not always satisfied. However, it is worth noting that the triggers have been defined based on typical average abstraction rate and can be disrupted by periods of high abstraction, as is suspected for the 1976 event where the HoF is first breached in early July (still ~60-days from the proposed 60-day River Itchen trigger)

Table 7 Comparison of River Itchen trigger performance against historical drought events and recent years since the River Itchen Licence Changes

Event	DP19 Trigger Set (Ml/d)	Original dDP22 Triggers (Set C)			Proposed dDP22 Triggers (Sets D and E)				
	Level 1	90-day (Set C)	60-day to 205Ml/d (Set C)	35-day to 205Ml/d (Set C)	90-day (Set D)	60-day to 205Ml/d (Set D Candover)	60-day to 198Ml/d (Set E River Itchen)	Date of Minimum Flow	Minimum Flow (Ml/d)
1976	01/02/76	27/02/76	07/03/76	29/04/76	07/03/76	01/05/76	01/05/76	25/07/76	187.2
1992	01/02/92	01/03/92	01/04/92	23/05/92	01/05/92	24/05/92	01/06/92	02/08/92	204.6
2006	Not Crossed	01/05/06	08/06/06	03/07/06	10/06/06	03/07/06	04/08/06	11/09/06	221.2
2018	Not Crossed	24/06/18	10/07/18	Not Crossed	23/07/18	Not Crossed	Not Crossed	04/10/18	293.2
2019	Not Crossed	15/05/19	29/06/19	Not Crossed	29/06/19	Not Crossed	Not Crossed	19/09/19	263.6
2020	Not Crossed	23/06/20	04/08/20	Not Crossed	11/08/20	Not Crossed	Not Crossed	12/08/20	310.6
2021	Not Crossed	13/06/21	Not Crossed	Not Crossed	Not Crossed	Not Crossed	Not Crossed	26/09/21	418.4
2022 (to date))	Not Crossed	27/05/22	Not Crossed	Not Crossed	14/07/22 (and recrossed 09/08/22)	Worst Case Forecast for 18/08/22	Worst Case Forecast for 18/08/22	Worst Case Forecast for HoF at 08/10/22	N/A

As a further validation the proposed trigger performance (Sets D and E) for the 2022 flow recession suggest timings, under a worst case extremely dry scenario that are generally in line with forecast recession to the HoF with 35-days expected between the 90-day and 60-day trigger and 51 days from the Set D 60-day trigger to the HoF.

Trigger frequency

Both the Mott MacDonald assessment and the joint modelling study also reviewed the likely frequency of trigger crossings (Table 8) in the historical record (62 years) and the full stochastic sequence (19600 years). This shows expected crossings of the 90 and 60-day triggers are relatively frequent even after adopting the more conservative thresholds.

Table 8 Frequency of River Itchen and Candover Trigger Crossings

Yearly Crossing	Mott MacDonald Assessment Historical Record	Atkins Joint Modelling study
Set D 90-day	1 in 1.6 years	1 in 1.4 years
Set D 60-day	1 in 2.6 years	1 in 2.1 years
Set E 60-day	1 in 4.2 years	N/A
205Ml/d	1 in 31.5 years	1 in 40.2 years
198Ml/d	1 in 62 years	1 in 59.3 years

The results in the table above assume no Candover Augmentation

The triggers protect against a worst-case scenario

Our key design criteria for the flow triggers were that they should provide sufficient time intervals for us to prepare applications, engage effectively in drought permit/order pre-consultation with stakeholders and to provide sufficient time for a drought permit/order application to be submitted, reviewed and granted before Hands-off-flow (HoF) conditions are met, thereby protecting water supplies.

The triggers are based on worst case scenario recession timing and assume that flows will fall to the HoF condition within at least 90 or 60 days of the trigger being breached under conditions of relatively high abstraction. However, there will always be a risk that in the majority of cases rainfall will cause flows to recover above drought thresholds before any interventions are required. This is common of all drought triggers. By adopting the revised triggers, we have reduced the conservatism, but we believe that the triggers we propose present an improvement over those in DP19.

For the River Itchen our review and use of both historical flow data, and synthetic stochastic flow data for more severe droughts has shown that there is no obvious “one size fits all” set of triggers that works efficiently in all drought events. The triggers contained in this plan and the use of flow forecasting give improved flexibility when compared to those in DP19. Both historical and synthetic droughts, for example 1976 (May) and 1990 (July) have shown examples where flows can drop rapidly through trigger levels (10s of Ml/d over several days) for reasons which are, as yet not fully understood. This could relate to changes in abstraction patterns, antecedent rainfall or correlation with groundwater behaviour which are not well characterised by available data.

Our key design criteria for the flow triggers were that they should provide sufficient time intervals for us to prepare applications, engage effectively in drought permit/order pre-consultation with stakeholders and to provide sufficient time for a drought permit/order application to be submitted, reviewed and granted before Hands -off-flow (HoF) conditions are met, thereby protecting water supplies.

The proposed triggers will be part of our multi factor approach

We use a multi factor approach to drought monitoring which relies upon multiple indications of drought status including rainfall, groundwater levels, river flows and potential evapotranspiration.

Aside from where actions are specified as part of the Section 20 (e.g. the 60 and 35-day thresholds for the Test Drought Permit) our decision-making during drought is therefore based on no single trigger but the

ensemble of primary and supporting triggers. The interventions we take are dependent on consideration of the full range of drought indicators and will be supported by drought forecasting (e.g. flow or groundwater level recessions) where appropriate.

We believe this approach significantly reduces the risk of unnecessary or abortive work even if flow triggers are breached frequently since our choice to intervene will be based on full consideration of the data and state of the environment and our water resources at that time. As we move towards full application readiness status for our River Itchen drought orders this will further reduce the burden of work required should any drought triggers be crossed.

The proposed triggers are consistent with the Section 20 Agreement

We believe that our proposed, updated, suite of triggers for the River Test are consistent with the actions and timing required under the Section 20 Agreement. Our joint modelling exercise has shown that in the vast majority of cases the River Test Drought Permit flow triggers which meet the required timings under the Section 20 Agreement will be reached before those on the River Itchen.

Once pre-consultation for a River Test Drought Permit is underway this feasibly brings into consideration further drought interventions for Hampshire Southampton West and East water resource zones (WRZs) including the River Itchen and Candover drought orders should flows continue to recede.

During any pre-consultation and under our multi factor approach we would continue to review the coherence of flow recession on both the River Itchen and River Test. This means that although our River Itchen flow triggers are conservative in terms of timing, they would never be considered in isolation and any further likely drought interventions required would be agreed through our pre-consultation process on the River Test Drought Permit and ongoing drought management discussions with the Environment Agency and other stakeholders.

Drought coherence between River Test and Itchen

An important consideration to note is that the findings of the joint modelling study are based on the assumption that the River Test Drought Permit is implemented first and is fully utilised (i.e. up to the licence limit of 80Ml/d). It can thereby provide protection to the Itchen by allowing water to transfer to Hampshire Southampton East (HSE) from Hampshire Southampton West (HSW) allowing Itchen abstractions to reduce to manage the approach to the HoF.

In the joint modelling study this transfer from HSW to HSE is triggered as a ‘last resort’ when the River Itchen flows at A&H fall below 215Ml/d and when the Portsmouth Water bulk supply has been fully utilised. It transfers water from the River Test at Test Water Supply Works (WSW) into the Southern Water system at Itchen WSW and can provide a maximum capacity of 24Ml/d. Using the transfer becomes more favourable (via modelled costs) when the flows on the River Itchen at A&H fall below 215Ml/d ensuring that the HSW to HSE transfer is only utilised when required.

The utilisation of the HSW to HSE Transfer was explored to understand the dependence of the River Itchen on this intervention. The baseline behaviour in September was removed to isolate the reliance on the transfer for drought intervention. The transfer is utilised approximately once every 9 years. When the transfer is activated, it is almost fully utilised (ranging from 17Ml/d to 24Ml/d). Therefore, there is a risk that any future drought permit constraints on the Test WSW and the HSW transfer could increase the frequency of drought interventions on the River Itchen.

If conditions are applied to the Test Drought Permit, similar to those imposed in 2019, which limited abstraction at Test WSW and the amount of water we could transfer from HSW to HSE, it is likely that the

frequency of drought order interventions on the River Itchen would increase to compensate for that loss of transfer. In such a situation we consider it to be prudent to have higher flow triggers for the River Itchen to ensure earlier actions are taken to protect supplies.

Portsmouth Water's Lower Itchen abstraction licence and implications for Portsmouth Water

The joint modelling study identified that the Portsmouth Water's Lower Itchen abstraction licence Drought Order may be required more frequently than the River Test Drought Permit, the Candover Augmentation Scheme and River Itchen Drought Order (at Allbrook and Highbridge) with an estimated return period of approximately 1 in 16 years whereas the Allbrook and Highbridge (A&H) drought order would be required once every 140 years. It was previously considered that the drought orders would be needed at a similar frequency.

The report found that the frequent triggering of the Portsmouth Water's Lower Itchen abstraction licence drought order is primarily dictated by demands in our supply system rather than the Portsmouth Water system and our assumption is that the primary purpose of the Portsmouth Water's Lower Itchen abstraction licence drought order would be to allow Portsmouth Water's Itchen abstraction to continue to operate and provide water to Southern Water through the bulk supply to Itchen WSW.

The Portsmouth Water's Lower Itchen abstraction licence drought order is already included, alongside the River Itchen (Allbrook and Highbridge Drought order) within our drought plan, including the associated need to maintain an application ready environmental assessment. This is in accordance with Schedule 5 section 3 of the July 2019 bulk supply agreement with Portsmouth Water; environmental priorities and allowing the bulk supply to continue in preference to abstraction higher up on the River Itchen.

This drought order does not currently have a defined set of flow triggers and under the Section 20 Agreement is a combined action with the application of the River Itchen Drought Order within our Drought Plan.

However, the triggers we are proposing for the Candover and River Itchen Drought Orders (set D and E) have been shown to provide early warning of the 205Ml/d threshold (Set D) and River Itchen at Allbrook and Highbridge HoF crossings (Set D and E) and occur at a higher frequency than the Portsmouth Water's Lower Itchen abstraction licence HoF crossing so would also provide advance warning of potential risk to the Portsmouth Water's Lower Itchen abstraction licence HoF being reached and the risk to supplies and timing of any drought order application would presently be considered through our multi factor assessment and flow forecast modelling

If we (Southern Water) intend to apply for the River Itchen and/or Portsmouth Water's Lower Itchen abstraction licence drought order we would expect to impose TUBs in advance of the application, however, because of the drought coherence between the River Test and the River Itchen we would expect the River Test Flow Recession to precede that of the River Itchen and be below our 35-day River Test Application Trigger (Set A, 1 in 5 year frequency) and hence it is likely that, as in 2022, TUBs will already be in place for the River Test Drought Permit in advance of a River Itchen Drought Order application.

The 'Drought Permits and Drought Orders' supplementary guidance from the Environment Agency (EA), published in March 2021, advises that TUBs must be in place before Drought Permit/order applications between 1st April and the 1st of October.

Implications for Portsmouth Waters Level of Service

We have discussed the implications of the Portsmouth Water's Lower Itchen abstraction licence Drought Order with Portsmouth Water and have agreed that, when the Drought Order is used to support only the bulk supply to Itchen WSW then Southern Water will effectively "own"' the Itchen drought orders.

Portsmouth Water consider that, under the situation that the TUBs requirement would only apply to Southern Water, in which case there would be no risk to their current 1 in 20 year Level of Service (LoS) for TUBs from the Portsmouth Water's Lower Itchen abstraction licence Drought Order.

If the Environment Agency agree this to be the case, then there would be no impact on Portsmouth Water's Level of Service or published Final Drought Plan 2022. None of the updates made since we received the letter from Defra on 21 August 2024 affect Portsmouth Water's level of service.

Conclusions

To summarise, this technical note demonstrates and concludes the following:

- We propose to Adopt the River Test Drought Permit Triggers (Set A), as set out in our draft drought plan. The proposed triggers provide adequate warning for the 60 and 35-day conditions for the River Test Drought Permit as required in the Section 20 Agreement.
- We already have stated a reduced level of service for TUBs in our Western area until 2027 in our WRMP in recognition of needing to apply them more frequently, primarily associated with the expected frequency of requiring the River Test Drought Permit whilst the Section 20 agreement is in place. We do not expect the River Itchen triggers to significantly affect our level of service because any application for the River Test is likely to precede that for the Itchen (98% of the time) and hence TUBS are already likely to be in place.
- As described in section 2.4.1 of our main drought plan, we have learned from dry conditions since 2019 in particular from the River Test drought permit applications in 2019 and 2022 that we should use the flow forecasting tool in the future. So, for the Test we would now only apply for a drought permit or drought order if both the triggers have been reached and our flow forecasting shows that crossing of the hands off flow is likely. And for the Itchen and Candover, the decision to apply will be determined by flow forecasting and having reached an application threshold that has been discussed and agreed with the regulators.
- By modifying the Itchen triggers (Set D and Set E) as recommended by the joint modelling report we expect them to be reached less frequently than the original trigger set presented in our draft drought plan (Set C). This is evidenced by our assessment of trigger frequency in recent years and the ongoing experience of the 2022 drought which is providing a real time test. The modified triggers show good agreement with experience.
- Decisions to commence pre-application and apply for any Drought Orders on the River Itchen will be taken under our multi-factor assessment which will include assessment of rainfall SPI and SPEI metrics, timing of trigger breach, groundwater levels and forecast modelling where we believe there to be a credible risk to supplies. The triggers provide early warning of the need to prepare drought orders alongside our drought actions for the River Test and allow us to consider coherent risks and responses across the two rivers.
- Because the primary use of the Portsmouth Water's Lower Itchen abstraction licence Drought Order in low return period droughts would be to support Southern Water via the transfer to Itchen WSW via the Portsmouth Water bulk supply Portsmouth water believe that they would not need to impose TUBs unless their other supplies were also affected by drought, which would only be expected at higher return periods consistent with their stated 1 in 20 year level of service.

Further work

Whilst we propose to adopt this updated suite of flow triggers (as set out in Table 3) there are several refinements we believe are necessary to further improve the triggers and their operational effectiveness. This -includes addressing the recommendations of the joint modelling study to consider the following tasks:

Task 1 – Investigate the impact of abstraction restrictions at Test WSW and potential implications for the frequency and timing of the Candover and River Itchen Drought Orders

The joint modelling study assumed that during drought permit conditions that Test WSW was free to operate and transfer water to neighbouring resource zones. However, there remains a future risk that drought permit conditions similar to those imposed in 2019 might occur again. These restricted output from Test WSW to a 55Ml/d rolling average and limited the amount of water which could be transferred to neighbouring resource zones.

Therefore, there is a risk that any future constraints on the HSW to HSE transfer could increase the frequency of drought interventions on the River Itchen.

The task would be to investigate these potential conditions and their effect on the timing and frequency of River Itchen Interventions.

Task 2 - Further investigate the implications and timing of the Portsmouth Water's Lower Itchen abstraction licence Drought Order

The joint modelling study identified a potential need for earlier implementation of the River Itchen Portsmouth Water's Lower Itchen abstraction licence Drought order in order to allow Portsmouth Water to continue to operate the Bulk Supply to Southern Water during drought and allow supplies to continue while Itchen WSW reduces abstraction to maintain flows above the Allbrook and Highbridge Hands-off-Flow.

This task would be to assess the sequencing which may be expected between the Itchen WSW and Portsmouth Water import Drought Order.

- An assessment made of the time intervals between the need for an Itchen WSW drought order and a Portsmouth Water's Lower Itchen abstraction licence drought order.
- Assess whether independent time-based drought triggers are needed for the Portsmouth Water's Lower Itchen abstraction licence drought order, and to be assessed at which flow gauge and, if required, develop new 60-day triggers.
- Check and review the frequency with which applications will need to be made for the Portsmouth Water import drought order, and the frequency of implementation.

Programme

We expect that this work will be undertaken using the updated joint Pywr water resource model we have developed jointly with Portsmouth Water. We will share the findings of the study with the Environment Agency and intend to incorporate any changes to our drought triggers within our annual reviews and the next update of our drought plan and of PW's drought plan. We continue to work with PW on this programme and

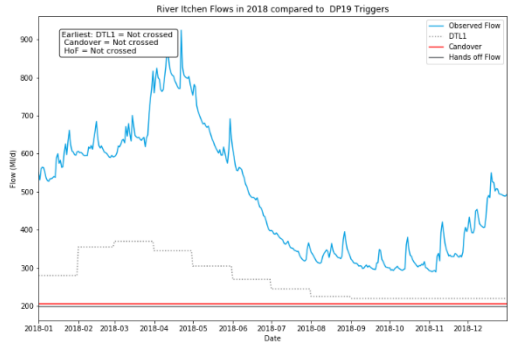
will continue the series of meetings and emails that we have had with them during 2024. For example, we met PW on 9 September 2024 and 11 November 2024 to discuss this programme.

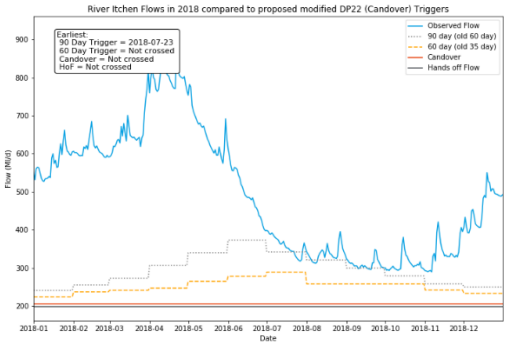
Our provisional timeline for these tasks is set out in the table below:

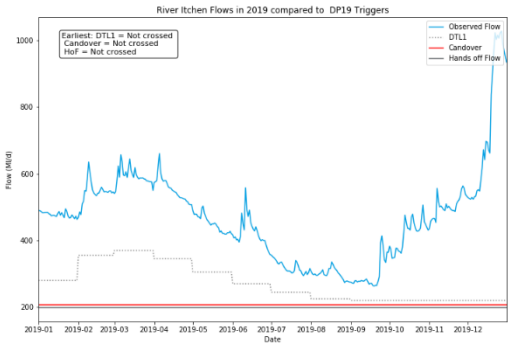
Table 9 - Provisional timeline for joint modelling work

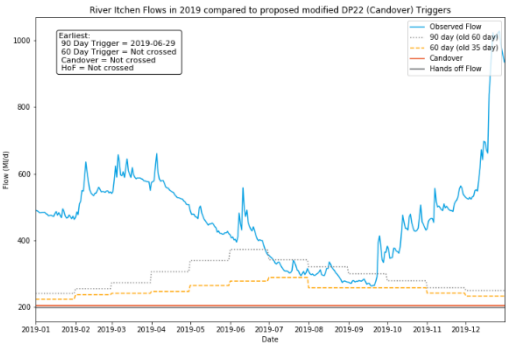
Date	Task
October 2024 to January 2025	Agree parameters and scenarios for upgraded joint Pywr Model Prepare formal scope of works
January – March 2025	Tender Scope of Works and award contract
March – September 2025	Technical work to inform draft drought plan submission. SWS and PW will communicate with regulators during this phase to ensure a 'no surprise' approach to the 2025-26 draft drought plan consultation
Autumn 2025	Submit draft drought plans to Defra requesting permission to consult.
Autumn 2025	Subject to regulatory agreement, SWS and PW commence consultation on the updated draft drought plans.
2026-27	Ongoing Annual Review process continues in which Southern Water is committed to providing updates on this joint modelling work. Subject to regulatory agreement, expected finalisation of SWS and PW Drought Plans for the 2027-2032 period.

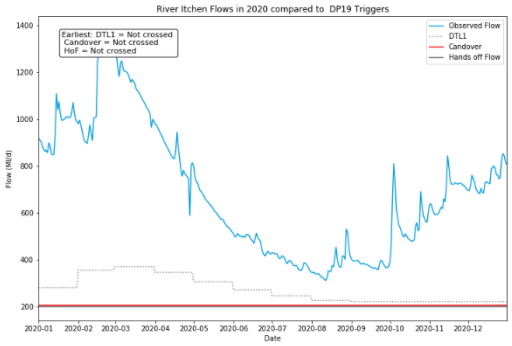
2018-2022 Trigger crossings

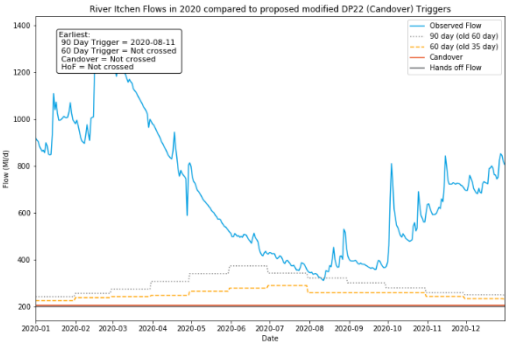


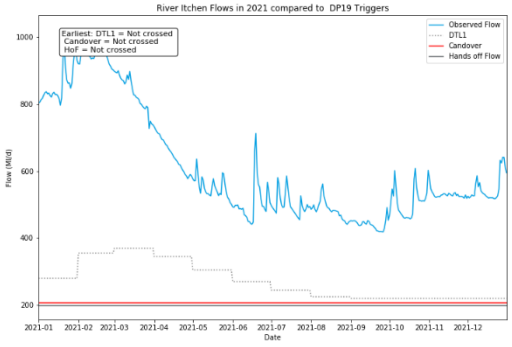


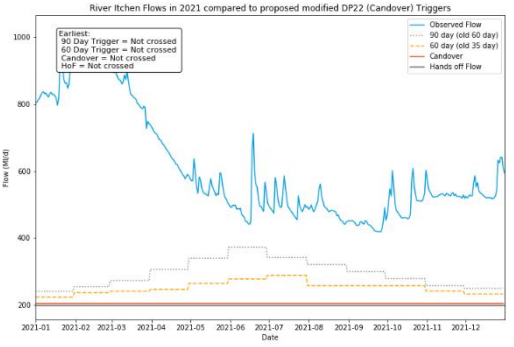


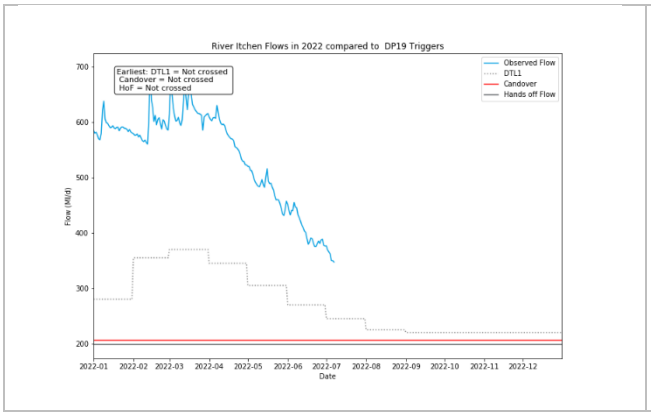


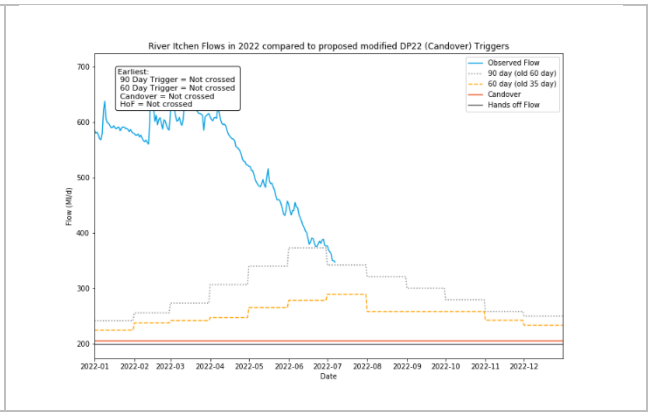









River Itchen Flows in 2022 compared to DP19 Triggers
Earliest: DTL1 = Not crossed
Candover = Not crossed
HoF = Not crossed
Observed Flow
DTL1
Candover
Hands off Flow
Flow (Ml/d)
Date


River Itchen Flows in 2022 compared to proposed modified DP22 (Candover) Triggers
Earliest:
90 Day Trigger = Not crossed
60 Day Trigger = Not crossed
Candover = Not crossed
HoF = Not crossed
Observed Flow
90 day (old 60 day)
60 day (old 35 day)
Candover
Hands off Flow
Flow (Ml/d)
Date