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Portsmouth Water Drought Plan

Testing Drought Triggers

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Client representative	Liz Newall-Smith
Project manager	Zara Barrett
Project director	Andy Ball

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Zara Barrett	Andrew Ball	Andrew Ball

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This appendix provides a description of how Portsmouth Water would typically respond to historic droughts and a range of plausible droughts if they were repeated under the current supply system capability and demand patterns.

1 Drought Scenario Testing

Scenario testing has been used to test the groundwater triggers and demonstrate their validity and how they would be used in a drought situation. The Environment Agency Guideline suggests that a Drought Plan should be able to cope with a range of plausible droughts as set out in the Water Resources Management Plan (WRMP). These should include:

- Short duration one season droughts (6-12 months)
- Medium duration multi-season droughts (1-2 years)
- Long term droughts (2-3 years)

Portsmouth Water's draft Drought Plan 2027 is based on scenarios that range from a 'Dry Year' to a 'Severe Drought. The scenarios are summarised as follows:

- Dry year – 1 in 20 (5% risk)
- Scenario 'A' historic drought – 1 in 40 (2.5% risk)
- Scenario 'B' extended drought – 1 in 80 (1.25% risk)
- Scenario 'C' serious drought – 1 in 125 (0.8% risk)
- Scenario 'D' severe drought – 1 in 200 (0.5% risk)

In terms of Long-Term Average (LTA), rainfall is different for each drought but scenarios can be related to an overall shortage of rainfall:

- Scenario 'A' – 70% LTA rainfall
- Scenario 'B' – 60% LTA rainfall
- Scenario 'C' – 50% LTA rainfall
- Scenario 'D' – Less than 50% LTA

These droughts cover the plausible range that Government has suggested with the reference Level of Service for a severe drought at 1 in 200. Extreme droughts above a 1 in 200 drought event are not covered by the Drought Plan but by the Emergency Plan. This also covers other resilience issues such as flooding or major source works pollution.

1.1 Groundwater triggers

Portsmouth Water does not have any surface water storage reservoirs and therefore does not have any conventional control curves for drought contingency use. Historically, Portsmouth Water has used groundwater levels to monitor the water supply situation and to compare trends with critical years. With no surface water storage, drought management actions are principally to ensure that during the peak demand period (May to August) sufficient supplies will be available to balance demand. Groundwater levels remain the key drought indicator since these levels affects springs, well and borehole yields. Groundwater levels also provide the base flow in the River Itchen which supports one of Portsmouth Water's abstractions (Source A).

The following figures show groundwater control curves with triggers for:

- Implementing the Drought Plan (Level 1)
- Introducing Temporary Use Bans (Level 2)
- Introducing Non-Essential Use Bans, Drought Orders & Permits and extreme drought options (Level 3a and 3b)

- Removing restrictions at the end of the drought (Upper Trigger)

The Level 4 trigger has also been included but for information only as this is covered in Portsmouth Water's Emergency Plan.

To test the robustness of the groundwater control curves developed, historical data has been tested against the curves to establish if the appropriate actions would have been triggered. The following sections set out potential timetables for drought management actions for each of the scenarios. The exact timings will depend on the actual weather conditions and the decisions of the Drought Management Team. There is a danger if the triggers and zones are too prescriptive that this will hamper the efficient management of a future drought.

1.2 Application of Drought Management Actions

The sequence of drought management actions will be determined by Portsmouth Water's Drought Management Team, but will be largely dictated by the severity of the drought situation together with the particular drought scenario being followed. It must be recognised that the critical period for Portsmouth Water to maintain supplies because of the lack of raw water storage will be the peak demand months (May to August). These will be the key periods for action and they may only be required for relatively short durations.

On a monthly basis, Portsmouth Water will assess the impacts of the theoretical scenarios and apply them to current groundwater levels in order to determine the need for possible actions. In the event that the trigger profile is breached, or likely to be breached, the Drought Management Team will be convened in order to determine the necessary actions to be taken. The actions will also be dependent upon the lead-in times needed for development of the options which can vary due to numerous constraints.

2 Scenario 'A' Indicative Drought Management Actions

Figure 2.1 represents Scenario 'A' or the 'historic drought' which simulations give a return period of 1 in 40 (2.5% risk of failure). This is based on the lowest groundwater levels recorded at Well 'X'. The initial drought plan trigger 'Level 1' is used to determine the start of the drought planning process. In some years no further actions will be required and calls for restraint (enhanced BAU comms) and additional leakage control and pressure management will be sufficient to meet the supply and demand balance. In this example Temporary Use Bans are triggered by the end of April in the second year.

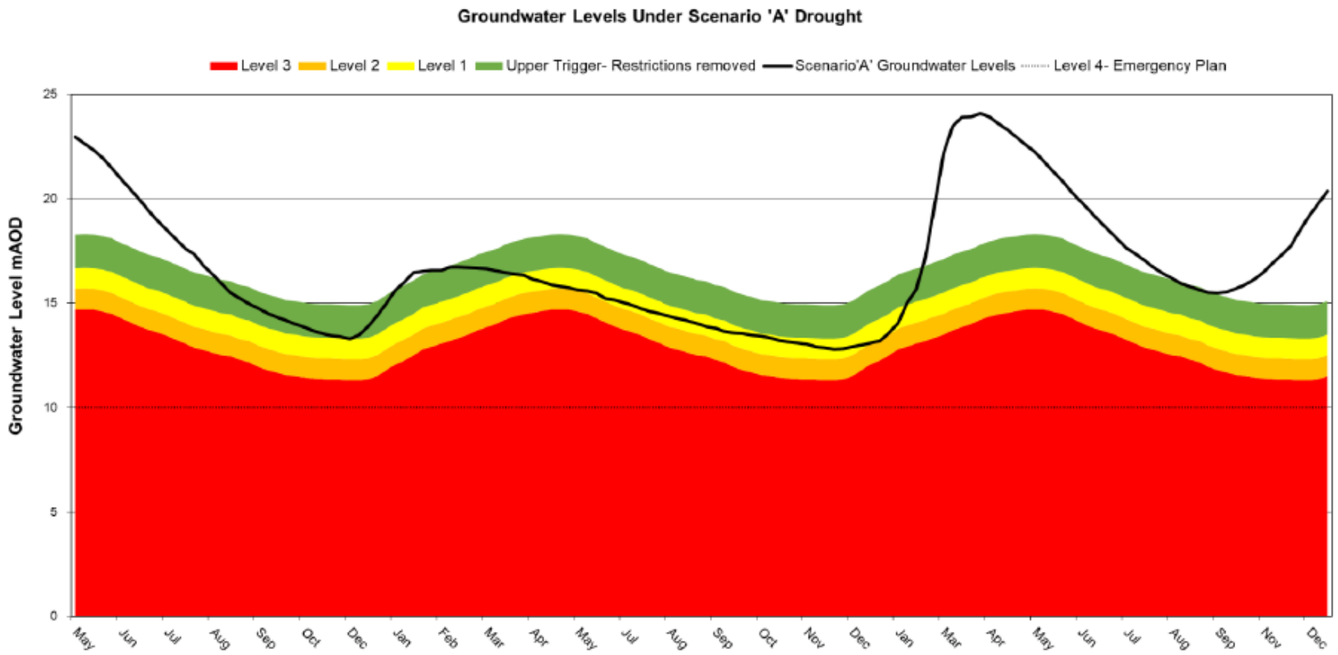

Figure 2.1: Groundwater levels under Scenario 'A' drought

Table 2.1: Scenario 'A' drought actions

	Year 1								Year 2																Year 3											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought stage	Normal					Normal / Developing			Normal			Developing / Drought				Developing						Normal												
Monitoring status	Monitor situation monthly					Establishment of Drought Management Team. Daily monitoring begins and projections based on forecast demand			Potential recovery	Daily enhanced groundwater, rainfall and SMD monitoring. Notification of possible implementation of TUBs		Monitor demand closely coming into peak summer period				Consideration of drought permit implementation if groundwater levels continue declining					Groundwater level recovered. Disband Drought Management Team. Review actions and lessons learned											
Demand side actions	None					Appeals for restraint (enhanced BAU comms) followed by enhanced leakage and pressure management			Prepare for possible TUBs			Implement TUBs										Remove TUBs											
Supply side actions	None															Prepare and review documents for drought permit application						None											

Groundwater levels enter the green zone, which represents calls for restraints to customers and the start of enhanced leakage control and pressure management activities, and just touches the orange zone which represents Temporary Use Bans. None of the other triggers are crossed until the end of the drought in the third year. The Drought Management Team would be working with the Environment Agency and neighbouring water companies.

The range of measures employed would be based upon the extent of the projected deficit in supplies as compared to forecast demands, together with the level of effectiveness of each stage of measures. These would be determined by the Drought Management Team as the drought develops. Notification of the possible need for a Temporary Use Ban would be made by the end of March with the aim of introducing restrictions by May.

After the end of May, demand will rise with warmer weather and the impacts of additional personal washing. Under Scenario 'A' some headroom is maintained in the summer between supply and demand.

Headroom is required to allow for the inaccuracies of the demand forecasts and uncertainties about the source yields. Loss of works due to pollution or mechanical failure is already allowed for in the Water Available for Use (WAFU) figure. Under Scenario 'A' the trigger for Drought Orders & Permits is not crossed and additional demand restrictions are not required. It would be prudent to consider a Drought Permit in September (Year 2) and think about implementation if groundwater levels continue to fall. If the Drought Permit is not required then there is no increase in the amount of water available.

When the peak period has passed, demand is expected to fall away rapidly. The final drought trigger is then used to determine when to remove the Temporary Use Bans. Under Scenario 'A' this would be around January as winter rainfall cause groundwater levels to rise rapidly. Even under Scenario 'A' Portsmouth Water would continue to monitor rainfall and groundwater levels after the drought had ended.

3 Scenario 'B' Indicative Drought Management Actions

Under Scenario 'B' there is no recharge in the first winter and groundwater levels continue to fall over the whole of the second year. This scenario represents an 'extended drought' which the simulations give a 1 in 80 year return period (1.25% risk of failure).

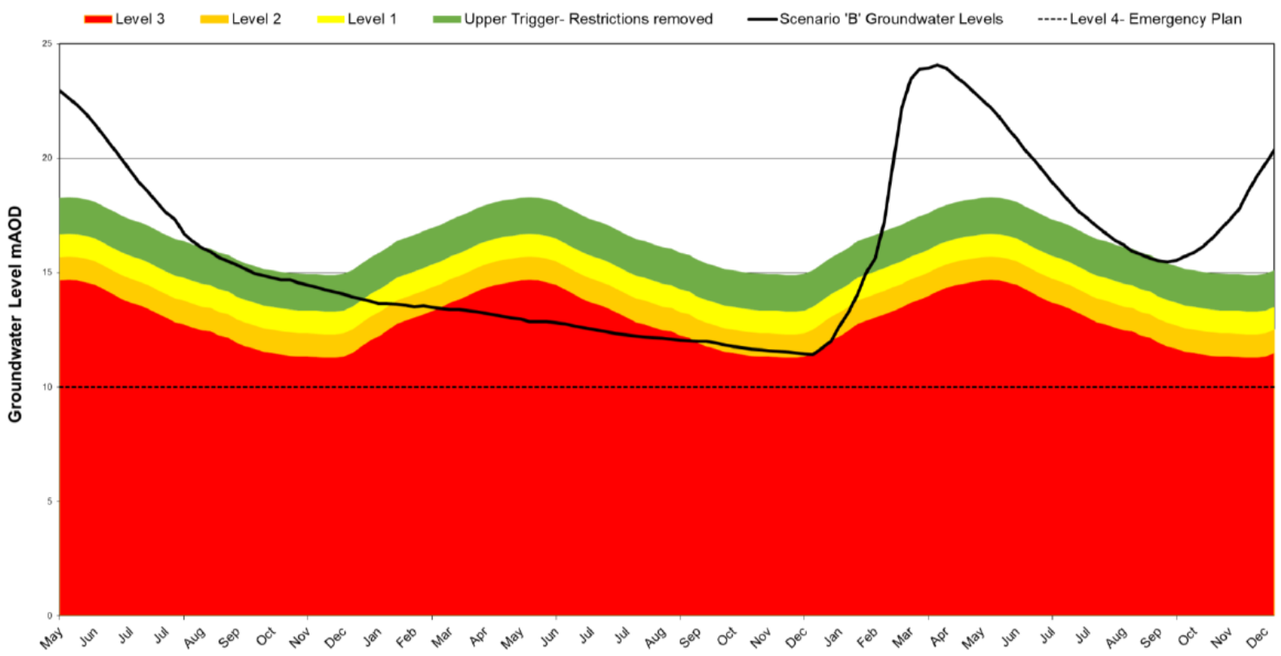

Figure 3.1: Groundwater levels under Scenario 'B' drought

Table 3.1: Scenario 'B' drought actions

	Year 1									Year 2													Year 3											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought stage	Normal							Developing	Drought			Severe						Drought				Normal											
Monitoring status	Monitoring situation monthly							Establishment of Drought Management Team. Daily monitoring (groundwater, rainfall) & projections based on forecast demands					Continue daily monitoring with close attention to groundwater levels, rainfall and SMD. Drought Management Team to develop actions to balance supply and demand								Groundwater level recovered. Disband Drought Management Team. Review actions and lessons learned											
Demand side actions	None							Appeal for restraint to customers followed by enhanced leakage and pressure management. Prepare for TUBs		Implement TUBs and prepare for NEUBs			Continue with TUBs and implement NEUBs									Remove TUBs and NEUBs											
Supply side actions	None									Prepare for drought permit application		Prepare for extreme 'More before 4' drought actions. Drought Management Group to decide whether Drought Permit and extreme options are to be implemented, based on conditions and forecasting.										None										

The first trigger is crossed at the end of December and there are calls for restraint to customers and extra leakage control and pressure management activities. The second trigger is crossed in January and Temporary Use Bans are introduced in time to influence the spring and summer garden watering season. If there has been a sufficient shortage of rainfall then Non-Essential Use Bans will be introduced to restrain non-household demand in the summer. This is the third trigger and takes groundwater levels into the red zone.

In this example the Temporary Use Bans restrictions stay in place for more than six months and the Non-Essential Use Bans are not removed until the drought has ended in February of the third year.

As described previously, Scenario 'B' assumes a dry winter following average conditions in the preceding summer. Scenario 'B' anticipates insufficient rainfall to provide any recharge during the winter and this is followed by a dry summer and autumn through to December. It is anticipated that the first trigger level will be crossed in December and that groundwater levels remain below the trigger until the following spring. Scenario 'B' would have a shorter time sequence of drought management actions compared to Scenario 'A'. There would be less time to prepare Temporary Use Bans and drought permits but the lack of winter recharge makes the need for restrictions more obvious.

Notification of the need for a Temporary Use Bans would be made by the end of December with the aim of introducing restrictions by the end of January. With falling groundwater levels in the spring, an application would be made for a Drought Permit with further restrictions on demand and the possibility of relaxed licence conditions at Source S. Although included in this plan, it is unlikely that the Drought Permit would be available before August under any scenario. From April in Year 2 the plan for implementation of 'More before 4' drought actions begin.

The lowest groundwater levels would be reached in December with recovery starting in January or February. The Temporary Use Bans would remain in force in case the drought continued into a third year. The 'Upper Trigger' would be used to help decide when to remove the remaining restrictions. This decision would be taken by the Drought Management Team but would also be influenced by the national situation and the actions of neighbouring companies.

4 Scenario 'C' Indicative Drought Management Actions

The figure below shows data for Scenario 'C' a 'serious drought' with lower rainfall in the first Autumn and no recharge over the whole of the next year. The graph indicates that a Temporary Use Ban would have been introduced in December.

Figure 4.1: Groundwater levels under Scenario 'C' drought

Table 4.1: Scenario 'C' drought actions

	Year 1												Year 2												Year 3									
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought stage	Normal					Developing		Drought		Severe drought															Normal									
Monitoring status	Monitoring situation monthly					Daily monitoring and projections based on forecast demands			Continue daily monitoring. Drought Management Team to develop actions to balance supply and demand in the summer								Monitor effects of drought actions								Groundwater level recovered. Disband Drought Management Team. Review actions and lessons learned									
Demand side actions	None					Appeals for restraint and enhanced leakage control & pressure management activities			Implement TUBs		Prepare for NEUBs		Implement NEUBs						Further leakage control and pressure management activities						Removal of demand restrictions									
Supply side actions	None								Prepare for drought permit application		Apply for drought permit. Drought Management Group to decide whether Drought Permit and extreme options are to be implemented, based on conditions and forecasting.					Implement drought permit. Prepare for extreme 'More before 4' actions					Consider extension on drought permit			None									

The Non-Essential Use Ban would be instigated in January and would need to be in place for the peak demand period in August. The drought would have ended at the beginning of the third year with winter recharge. The green zone shows removal of the Temporary Use Ban and Non-Essential Use Ban when recharge was confirmed.

Assuming that the first trigger 'Level 1' is breached in the autumn of the first year this would enable the Drought Management Team to put in place the actions needed to balance supplies with demand in the summer.

Due to the serious nature of this drought scenario, no concession would be offered for micro irrigation. Impacts on the environment mean that as little water should be used on gardens as possible, even at night.

With lower yields available from sources in a 'serious drought' it might be necessary to apply for the Drought Permit in year two. This would produce an additional 8.5 Ml/d of supply for a short time during the summer. The application process would start in May with implementation expected in August when groundwater levels were already low.

As with the previous scenarios it would be for the Drought Management Team to make the appropriate decisions as the drought develops. At this point, the planning for the possible implementation of 'More before 4' actions begins.

The source yields at lowest groundwater levels have been simulated and are subject to uncertainty. As demand falls in the Autumn of year two the output of Source S could be reduced. It would be prudent not to remove the demand restrictions until groundwater levels rise about the 'Upper Trigger'.

5 Scenario 'D' Indicative Drought Management Actions

Scenario 'D' is based on Scenario 'C' but with the groundwater recession extended into a third year with very low rainfall. Under Scenario 'D' the first year is a bit wetter than Scenario 'C' but instead of recovering at the end of year two groundwater levels, and therefore deployable output, continue to fall in year three. This is defined as a 'severe drought' and recovery only occurs in year four with winter rainfall.

In addition to Temporary Use Bans, which would need to be extended, and a Non-Essential Use Ban imposed, this drought would require the Drought Permit to reinforce supplies.

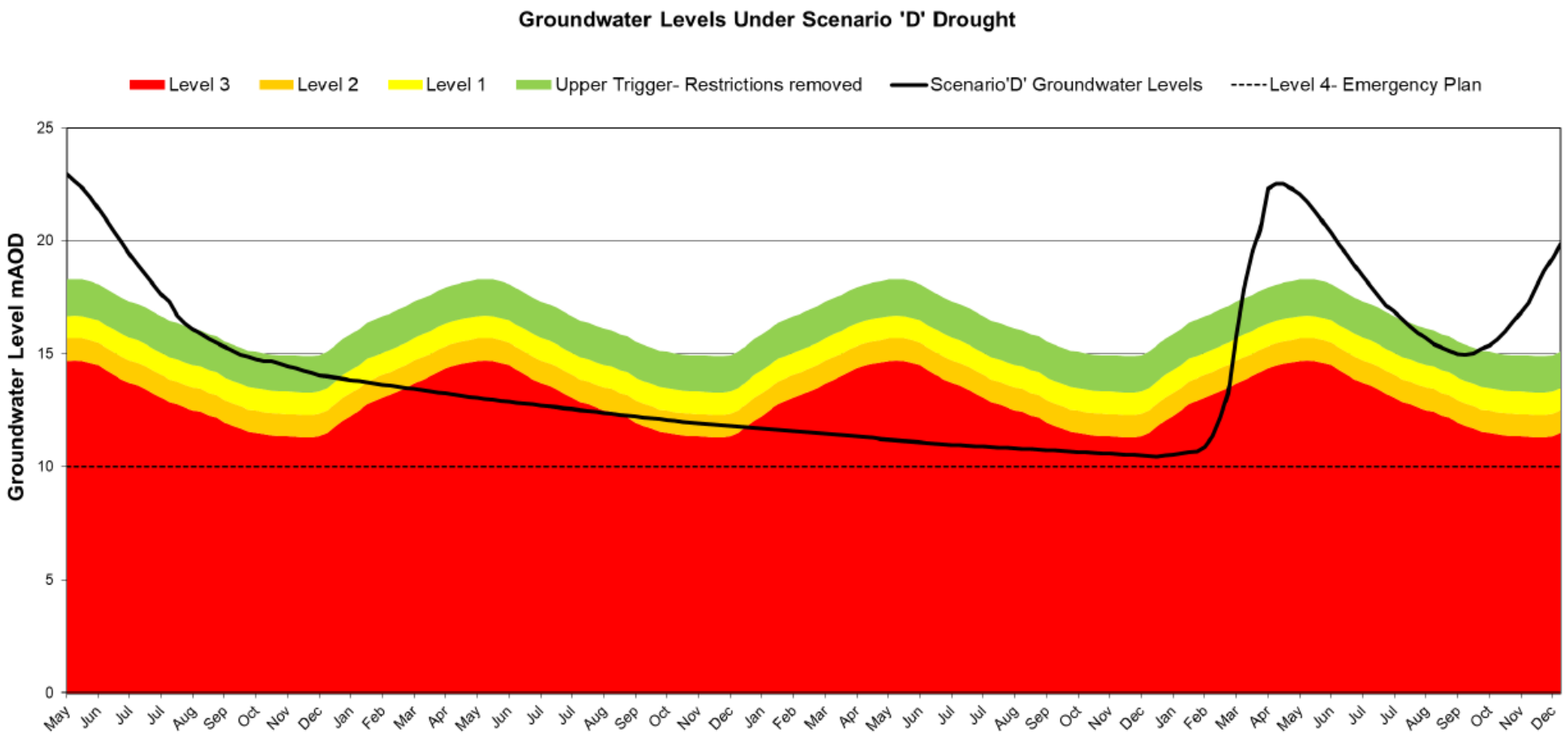

Figure 5.1: Groundwater levels under Scenario 'D' drought

Table 5.1: Scenario 'D' drought actions

	Year 1											Year 2												Year 3												Year 4											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought stage	Normal								Developing		Drought	Severe drought																								Normal										
Monitoring status	None								Daily monitoring and projections based on forecast demand				Drought Management Team to develop actions to balance supply and demand in the summer					Continue daily monitoring. Monitor effects of drought actions. Drought Management Team publishing prospects of a third party dry year. Prepare for prospect of enacting the Emergency Plan									Consider extreme drought actions. Liaise with regulators and water companies								Groundwater level recovered. Disband Drought Management Team. Review actions and le										
Demand side actions	None								Appeals for restraint to customers and enhanced leakage control and pressure management activities			Implement TUBs		Implement NEUBs and further leakage control and pressure management activities											Extension of TUBs and removal of some concessions											Remove of demand restrictions										
Supply side actions	None									Prepare for drought permit application					Apply for drought permit. Drought Management Group to decide whether Drought Permit and extreme options are to be implemented, based on conditions and forecasting.									Drought Permit and 'More Before 4' Options implemented									Potential drought permit extension									Removal of drought permit and 'more before 4' options										

Groundwater levels would drop to 10.5 mAOD and deployable output would be significantly constrained. Portsmouth Water would already have been working closely with the Environment Agency and other stakeholders during the first two years of the drought. By the spring of the third year, the Drought Management Team would be publicising the prospects of a third dry summer. This would involve the extension of the existing Temporary Use Ban and the removal of some concessions.

By the end of May, the danger of rising demand would require the introduction of the Non-Essential Use Ban. This would impact on commercial customers such as window cleaners, gardeners and car washing facilities.

With lower groundwater levels than ever recorded before, and lower yields, it might be necessary to apply for a Drought Permit for Source S. This would produce an additional 8.5 Ml/d of supply for the whole of year three. In this example, groundwater levels return to normal in the spring of year four following winter rainfall.

As groundwater levels approach the Emergency Plan level (Level 4), Portsmouth Water will start to explore the need to prepare for extreme drought actions. Portsmouth Water will implement actions from 'More before 4', with the aim to delay the implementation of the Emergency Plan. It is essential to liaise with regulators and regional water companies to discuss these options and possible collaborative regional solutions. Portsmouth Water will also consider the need to extend the drought permit and prepare the application.

As with previous scenarios it would be for the Drought Management Team to make the appropriate decisions as the drought develops.

This scenario is assumed to have a return period of around 1 in 200 years. With no historical data to base this drought on the source yields are highly uncertain. The table only represents an indication of what the company might do under the influence of a 'severe drought'.

It would not be prudent to remove demand restrictions until groundwater levels rose about the 'Upper Trigger' at the beginning of year four.

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HR Wallingford
Howbery Park
Wallingford
Oxfordshire OX10 8BA
United Kingdom

+44 (0)1491 835381

info@hrwallingford.com

www.hrwallingford.com

bsi PAS 99 Integrated Management Systems CERTIFIED
IMR 719286

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