Revised Draft Water Resources Management Plan

Technical Appendix J – Outage

Contents

Figures

Tables

Background and Introduction

Outage is a temporary, short-term loss in supply capability. At the Water Resource Zone (WRZ) level, we include an Outage Allowance in our supply-demand balance. This accounts for the risk to customers' supplies that is posed by planned and unplanned outage events that impact Deployable Output. This is done in order that our stated 'Water Available for Use' appropriately accounts for sources which could become unavailable during drought due to outage events.

It is important to note that our Outage Allowance is not a forecast of outage, nor does it describe the impact of planned outages. Instead it is an allowance that we make to be prudent when determining our supply-demand balance. Our goal is always to have supply sources available, and we do not aim to have a prescribed level of outage. We have not considered reducing outage allowance across the planning period because, while we may resolve some root causes of outage issues, other assets, new or old, may experience outages that compensate for outage reductions that we might achieve. Our aim in calculating outage allowance is to ensure that we leave a prudent gap between supply and demand.

This document does not cover the calculation of Unplanned Outage, the metric used in Performance Commitment reporting to Ofwat.

Changes between dWRMP24 and rdWRMP24

In order to make sure that our supply forecast is fully up to date, we have adopted the outputs from outage allowance modelling conducted as part of our Annual Review 2022 in the rdWRMP24, whereas our dWRMP24 used results from our Annual Review 2021. This includes both our 'base year' update, and the consideration of how improved reliability at the Gateway desalination plant should be reflected in our future outage allowance.

Key Guidance and Methodology Documents

J.1 The determination and classification of outage events and subsequent calculation of outage allowance are subject to prescribed methodologies.

J.2 The primary guidance documents referred to in the determination of Outage Allowance are:

- Environment Agency, April 2022, Water Resources Planning Guideline: This document sets out key requirements for our outage allowance calculations and aspects of our allowance for outage that we should describe
- Environment Agency, March 2021, Water Resources Planning Guideline: Supplementary Guidance – Outage: This supplementary guidance document sets out in more detail the methods that we should follow in outage calculation

J.3 In addition to the Environment Agency (EA) guidance documents, other important methodology documents include:

- UKWIR, 1995, Outage Allowances for Water Resources Planning
- UKWIR, 2016, WRMP19 Methods – Risk-based Planning: This document sets out methods that can be applied to link risk-based/probabilistic methods of assessment to the derivation of deterministic water resource plan inputs. Determination of an appropriate 'outage allowance' involves the consideration of events that have occurred in the past and the risk that is posed in the future. This document sets out different methods that could be applied in the determination of an Outage Allowance

J.4 An important change between WRMP19 and WRMP24 has been the focus on regional groups in water resource planning. Thames Water is part of the Water Resources South East (WRSE) regional group. WRSE has undertaken a project to align methods used in the calculation of outage allowance across WRSE companies. The methodology is documented in detail in WRSE, 2021, Method Statement: Outage and so not all of the content is repeated in this Appendix.

Key Changes Between WRMP19 and WRMP24

Application of WRSE Methods for Outage Event Screening and Outage Allowance Modelling

J.5 The WRSE project investigating methods used in the determination of Outage Allowance resulted in the development of an aligned approach to the screening of outage events and subsequent calculation of outage allowance. This has resulted in an aligned approach across WRSE companies.

J.6 This project included:

- A review of methods used in outage analysis for WRMP19 by different companies, highlighting areas of alignment and difference, alongside review of guidance and an assessment of consistency/departure of different company assessments from guidance
- The development of a methodology to be applied by WRSE companies when considering outage, including:
  - Recording of outage data
  - Data Processing and Analysis
  - Statistical Modelling of Outage Data to Produce an Outage Allowance

J.7 This project also included the development of an outage modelling tool, which companies have used in calculation of outage allowance.

Consideration of an Appropriate Outage Allowance for Consideration in the DYCP Planning Scenario

J.8 For WRMP19 we calculated an Outage Allowance figure for each WRZ and then applied these same figures in both DYAA and DYCP Planning scenarios. The figures calculated were more appropriate for use in the DYAA planning scenario and so, through the WRSE outage project, we have moved to consideration of an Outage Allowance to be used in the DYCP planning scenario.

Classification of Long-term Outage Events

J.9 This is not an explicit change and is instead a clarification in Outage Allowance guidance. An outage is a short-term loss of supply capability, which should be recoverable within a reasonable timeframe. Defining 'short-term' can be challenging, considering in particular that engineering projects to return sources to supply can involve months of diagnosis, maintenance, and testing, prior to return to supply. The EA have set out the following definitions regarding how to deal with long-term outage events:

- 0 to 3 months – record as outage
- 3 to 6 months – still record as outage, but also notify regulators and prepare an action plan to reduce outage
- More than 6 months – record as loss of Deployable Output (DO) until rectified unless agreed otherwise by regulators. Inform regulators of the quantity of DO loss

Removal of 'Generic' Outages

J.10 Our WRMP19 outage assessment included 'generic' allowances for several categories within the London and SWOX WRZs. These have been removed for WRMP24 as there

was little evidence of the risk that these generic categories posed and, in some cases, actual outages have been identified within these generic categories.

Approach to Calculation of Outage Allowance

J.11 Figure J-1 is a flow chart showing the processes that we go through to calculate Outage Allowance for each WRZ.

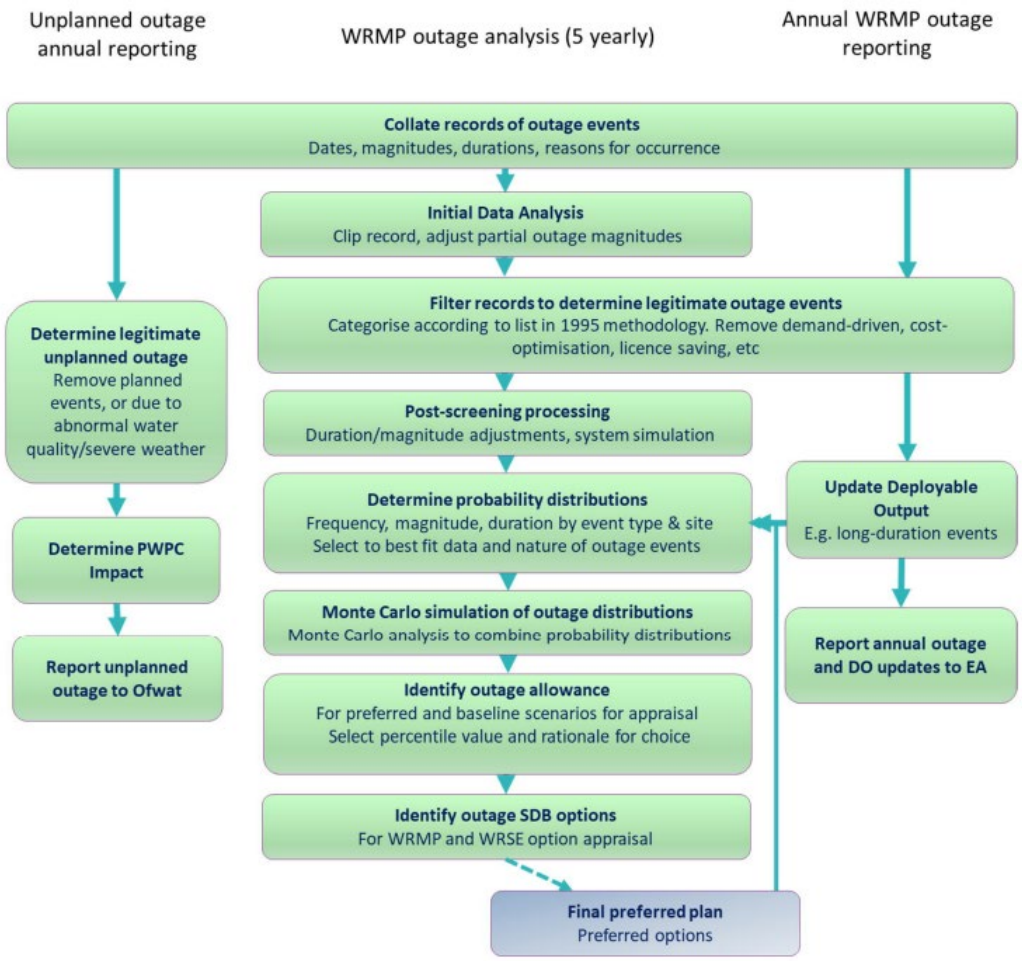

Figure J-1: Approach to Outage Allowance Calculation - Taken from WRSE Outage Method Statement

J.12 As an additional note before we describe the approach followed in the determination of Outage Allowance, we note that Outage Allowance is considered separately from Target Headroom. Specifically, that outage uncertainty is not considered within Target Headroom to avoid double counting.

Data Collection

J.13 EA Supplementary Guidance sets out the requirement that our outage allowance is based on recent, relevant data on 'actual' outages that have occurred.

J.14 The outage dataset is aligned with that used in the derivation of Unplanned Outage (Ofwat Performance Commitment). However, as water source availability is assessed against different performance metrics for Outage Allowance (i.e. DO) and Unplanned Outage (Peak Week Production Capacity), the dataset is assessed carefully to ensure outage

events are identified. In addition, subsequent screening steps differ between Unplanned Outage and Outage Allowance.

J.15 The key sources of data considered for Outage Allowance analysis are:

- Data and information on the timing and duration of outage events longer than 24 hours, or seven hours for large surface water treatment works whose output is important in meeting peak demand, and the water supply source output during the event. This is collated by Strategic Control Engineers in London and the Thames Valley operational areas
- Information collated from daily production reports by the Water Resources Modelling Team to provide any further information on the cause of outage events
- Operational SCADA data accessed by the Water Resources Modelling Team via PI. This aids in verification of data provided from Strategic Control as well as identifying other potential outage events

J.16 This information is collected and collated periodically (usually at the end of each quarter) throughout the regulatory reporting year (April to March); end of September, end of December, year-end in March. Continued collection of outage event data is necessary to develop an historical record, which is important in enabling an assessment of outage risk for planning purposes. Currently, the historical record of outage events across London and the Thames Valley extends back to 2007-08, i.e. reporting year AR08, with new data extending the period of record each year.

J.17 The outage event information is collated into Outage Recording forms for London and the Thames Valley areas, as shown in Figure J-2. Data collected includes the source/sourceworks affected, the start and end dates for potential outage events and, to establish the magnitude of the impact, the source/sourceworks output during the outage event. We include partial outages in our outage assessment.

9 MONTH UPDATE Outages from 1/04/2019 to 3

Outage Recording Form for Period April 1st 2019 to End Decem

SITE	WATER RESOURCE ZONE	OPTIONAL FURTHER COMMENTS	Outage Model Event Description	OUTAGE START DATE	OUTAGE END DATE	TOTAL NO. OF DAYS OUTAGE	OUTPUT CAPABILITY REDUCED TO (Ml/d)	Avg SDO (Ml/d) @ March 2019	Outage (Ml/d)		Outage ? Y or N	Comment
Mandatory Data	Mandatory Da			Mandatory Da	Mandatory D	Calculat	Mandatory Da					
Ashford	NW			08/04/2019	13/04/2019	6	650	674.00	24.00		Y	
Ashford	NW			24/04/2019	26/04/2019	3	650	674.00	24.00		Y	
Ashford	NW			12/09/2019	20/09/2019	9	600	674.00	74.00		Y	
		Additional delay to KGV Res refilling due to work on KGV										

Figure J-2: Example Outage Event Recording Form

J.18 As DO values for water supply sources are the baseline numbers against which the magnitude of outage events are compared, these are reviewed and updated to current or forecast values as appropriate. This applies to those supply sources that have a defined source DO. The source DO values are reviewed and updated as necessary by the Water Resources Modelling Team in both Outage Event Recording Forms and the Outage Modelling Tool.

Screening of Legitimate Outage Events

J.19 As part of the data collection process, data regarding the cause of outage events is collected. This data is used to classify outage events. EA Supplementary Guidance sets out the requirement that we differentiate between planned and unplanned outage events, with classification of the type of unplanned outage as follows:

- Pollution of source

- Turbidity
- Nitrate
- Algae
- Power failure
- System/asset failure
- Cryptosporidium failure
- Other

J.20 All screened outage events are input to the Outage Modelling Tool.

Processing of Outage Events

J.21 Processing of outage events takes place in the Outage Modelling Tool.

J.22 Outage events identified through data collection and screening are processed to ensure an appropriate consideration within Outage Allowance calculation. For instance, on some occasions it is found that operating philosophy, rather than an asset outage, is the reason for reduced output at a source.

J.23 Where investment has been made to reduce/eliminate the risk of outage events, outage events within the database are either removed, or their magnitude/likelihood for consideration in modelling is reduced.

J.24 If outage events are very unlikely to coincide with drought periods (e.g. flooding) then they may be screened out at this stage. In addition, in some cases, planned outages are excluded from Outage Allowance calculation on the basis that they would not have been undertaken or the sources returned to supply during a drought event.

J.25 The Outage Modelling Tool contains the functionality to define 'DYCP' and 'DYAA' risk explicitly – this is done by defining the DYCP period of interested. Only outages which have occurred during the DYCP period are considered in the determination of DYCP outage.

J.26 Consideration of mitigation of outage events via supply system operation is considered. For example, if the impact of an outage event could be offset at the WRZ level such that its impact can be mitigated its contribution towards Outage Allowance is reduced. Similarly, if a short-duration outage occurs at a source which could be offset across an annual average planning period then its contribution to DYAA outage allowance is reduced/removed; this is possible either by use of the source of interest at peak licence, or via use of other sources within an aggregated group licence.

J.27 For the London WRZ, where the large surface water treatment works' contribution to drought supply capability is considered at a WRZ level, source DO values are not defined for these larger works. As a result, to assess the impact of outage events at the large works, Walton WTW, Kempton WTW, Ashford WTW, Hornsey WTW, Coppermills WTW, Hampton WTW, Chingford WTW and Gateway WTW, capability profiles are created. The impact on the London WRZ DO from outage events at the large surface water treatment works is calculated by the Water Resources Modelling Team using the WARMS2 system model. It should be noted that the impact of outages at smaller, mainly groundwater, treatment works in London are not assessed using this WRZ DO approach.

J.28 After events have been processed, we are left with a comprehensive lists of outage events that have occurred at different sourceworks, categorised by cause, and processed such

that they are ready for Outage Allowance modelling. The database of outage events is held within the Outage Modelling Tool, which is then used to derive Outage Allowance.

Outage Modelling

J.29 An Outage Modelling Tool exists for each WRZ. The Outage Modelling Tool processes outage events such that distributions for frequency, magnitude and duration are defined for each combination of source/sourceworks and outage category. On occasion these distributions are edited using expert judgement.

J.30 The Outage Modelling Tool for each WRZ is then used to conduct Monte Carlo simulation, sampling from the distributions of frequency, magnitude, and duration to ascertain the outage risk that is posed to each WRZ. In a given Monte Carlo iteration, for each combination of source and outage category the distributions are sampled to produce a data-informed outage in Ml/d that may be experienced in a year; all sampled outage values are summed to give a total WRZ outage value for that iteration. Multiple (3000+) Monte Carlo iterations are carried out, and total WRZ outage values are stored; the 95th percentile of the values calculated is selected as the Outage Allowance value to be taken forward to the supply-demand balance. The Outage Modelling Tool calculates values for DYAA and DYCP outage separately.

Base Year Outage Allowance

J.31 The methodology outlined was followed and applied using data up to the AR22 reporting period. The outage allowance values produced are:

Zone	WRMP19 DYAA Outage Allowance (Ml/d)	rdWRMP24 DYAA Outage Allowance (Ml/d)
London	99.76	107.44
SWOX	17.23	6.69
Slough, Wycombe and Aylesbury	9.46	15.49
Kennet Valley	2.49	1.95
Guildford	1.40	1.55
Henley	0.36	1.15

Table J-1: rdWRMP24 DYAA Outage Allowance Values

J.32 It can be seen that Outage Allowance for most WRZs had not materially changed since WRMP19. SWOX's Outage Allowance has reduced, mainly due to the removal of 'generic' outage events from the record as there is little evidence of a risk being posed from them, especially as, in some cases, actual outages have been identified within these generic categories. As a result, an element of double counting of outages has been removed.

J.33 Please note that the figures in the Table above for the London WRZ assume that the capability of the Gateway desalination plant is 100 Ml/d. As is discussed in Section 4, the DO assumption for the desalination plant impacts outage allowance; the DO assumed for the desalination plant varies over the planning period, and so our outage allowance also varies (Table J-2). When we reduce the stated capability of the Gateway desalination plant in our supply forecast, our reliance on that plant reduces, and so outage also reduces.

Planning Period	Gateway WTW Capability (Ml/d)	rdWRMP24 London WRZ Outage Allowance (Ml/d)
2022	100	107.44
2023-2030	50	73.89
2031 onwards	75	82.44

Table J-2: Gateway WTW Stated Capability and Outage Allowance Across the Planning Period

Zone	WRMP19 DYCP Outage Allowance (Ml/d)	rdWRMP24 DYCP Outage Allowance (Ml/d)
London	N/A	N/A
SWOX	17.23	3.06
Slough, Wycombe and Aylesbury	9.46	3.26
Kennet Valley	2.49	0.99
Guildford	1.40	0.38
Henley	0.36	0.17

Table J-3: rdWRMP24 DYCP Outage Allowance Values

J.34 The DYCP Outage Allowance for all WRZs has reduced due to the explicit calculation of DYCP Outage Allowance. In WRMP19, DYCP Outage Allowance was assumed to be the same as DYAA Outage Allowance, but it appears that relatively fewer outage events occur during our peak demand period.

Annual Reporting of 'Actual Outage'

J.35 As described, we have included Outage Allowance in our supply-demand balance for WRMP24. When we report on progress against our WRMP, and in producing the Supply-Demand Balance Index, we will also report on Actual Outage.

J.36 The calculation of Actual Outage relies on the same, screened outage event dataset. However, only outage events that occurred during the year of interest are considered, and no statistical modelling is carried out.


Thames
Water