



# Thames Water Drought Plan 2022

## Environmental Assessment Methodology

Report for Thames Water Utilities Ltd.

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# 1 Introduction

## 1.1 Purpose of this document

Thames Water Utilities Ltd's (Thames Water) Final Drought Plan 2017 covered the period 2017-2022. Thames Water has updated its Drought Plan (DP) 2022. This reflects the guidance provided in the Environment Agency's Drought Plan Guideline (DPG)<sup>1</sup> which addresses the preparation of Environmental Assessment Reports (EARs), environmental monitoring and mitigation, and the Strategic Environmental Assessment (SEA) and Habitat Regulation Assessment (HRA) of the DP.

The guideline that informed Thames Water's DP 2017 was published by the Environment Agency in December 2015<sup>2</sup>. The supporting documents were issued to Thames Water in July 2016 and together, these documents superseded those previously prepared in accordance with the DPG published by the Environment Agency in 2011<sup>3</sup>.

The updated Environment Agency DPG, which was published in December 2020 (DPG2020 Version 1.2) also includes an updated draft of the supplementary guidance on the environmental assessment for water company drought planning (published in July 2020). The DPG2020 indicates that the planned submission date for all draft drought plans will be March 2021 and final plans to be published by April 2022.

Thames Water's DP 2013, and its subsequent DP 2017, together with its consolidated set of supporting environmental documents, was subject to extensive consultation with the Environment Agency, Natural England and other stakeholders. The methodologies and approaches applied when undertaking the environmental assessments were developed by Cascade Consulting/Ricardo Energy & Environment (REE) for the DP 2013 and was aligned with the requirements of the DPG 2011. Where required, the documentation was subsequently updated to align with the requirements of the DPG 2016 to help inform DP 2017. The methodologies and approaches were developed in close consultation with Thames Water and Environment Agency staff.

This document aims to:

- Set out the methodologies for undertaking the environmental assessments which informed Thames Water's DP 2013 and 2017;
- Identify changes in the methodologies for undertaking the assessments for DP 2022 and those aspects of the existing EARs which have been updated;
- Provide a platform for the Environment Agency and Natural England to influence the methods, data considerations and outputs of the environmental assessment documents;
- Provides an audit trail for identifying contributors and subsequent changes to the methodologies;
- Consolidate the approaches and methodologies used in completing the environmental assessments associated with Thames Water's DP 2022 for review prior to submission of draft EARs to reduce the extent of review required by regulators; and
- To ensure continuity in environmental assessments for future DPs.

It should be noted that this Methodology Report does not cover the approaches proposed for undertaking the SEA or the HRA of the DP. These elements of work are being prepared in addition to the EARs and will be consulted on separately.

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<sup>1</sup> Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

<sup>2</sup> Environment Agency (2016) *How to write and publish a drought plan*, December 2015. Available at <https://www.gov.uk/guidance/drought-plans-environmental-assessment-and-monitoring#carry-out-an-environmental-assessment>, Accessed 1 June 2020.

<sup>3</sup> Environment Agency (2011) *Water Company Drought Plan Guideline*.

## 1.2 Water Resource Zones

Supply demand planning, and thus drought planning, starts at the Water Resource Zone (WRZ) level. A WRZ is defined in the EA's Water Resources Planning Guideline as an area of well-integrated water supply connectivity in which there is the same risk to security of supply. For water resource planning purposes, the Thames Water supply area is divided into six independent WRZs reflecting the different characteristics of the supply areas and associated risks to meeting demand.

The London WRZ is the largest of the six zones and covers the Greater London area. The next largest is the Swindon and Oxfordshire zone (SWOX). The water resources for both of these zones are largely based on abstraction of water from the River Thames, which is stored in large raw water reservoirs. The other zones within the Thames Valley are Kennet Valley (including Reading and Newbury), Henley, Slough/Wycombe/Aylesbury (S/W/A) and Guildford.

The supply-side options associated with each WRZ which have been considered for DP 2022 are provided in **Appendix A**.

## 1.3 Content of the report

This document sets out the approach to undertaking the assessment of the environmental implications associated with the different management options considered in Thames Water's DP 2022. This includes the methodologies associated with the:

- Environmental Assessment Reports (EARs);
- Environmental Monitoring Plan (EMP);
- Water Framework Directive (WFD) Regulations compliance assessment;
- Severe droughts; and
- Summary of permit application process.

In particular, the document sets out the approach to identifying the study area/zone of influence for each drought option (alone and in-combination with other options), identification of the relevant sensitive environmental features within the identified zone of influence (based on the risk of being impacted by a particular drought option during the period of implementation) and the approach undertaken to determine the significance of impacts on these sensitive features leading to the consideration of mitigation actions.

Furthermore, this document also sets out the baseline data that will be used to inform the assessment of sensitivity and impacts on environmental features.

Where required, the methodologies used for DP 2017 have been updated to consider the requirements of the DPG2020 and the consultation responses received from the Environment Agency on DP 2017.

## 1.4 Contributors and Version Log

This section identifies the authors and contributors to this report and provides an on-going audit trail for any changes made.

## Version Log

Version	Date	Author	Content/changes
Version 1	10 July 2020	Ricardo & Thames Water	Original first draft issued to EA and NE for consultation
Version 2	28 July 2020	Ricardo & Thames Water	<p>Following the meeting between Ricardo, Thames Water and the EA on 23 July 2020, certain changes were made to the following sections:</p> <p>3.4.2.1            3.5.2            3.5.4            3.5.5            3.5.6</p>
Version 3	2 October 2020	Ricardo & Thames Water	Report updated following EA comments received 13/08/20. A separate EA comment log includes a summary of where changes have been made (note some responses have been included in the comment log only).
Version 4	23 September 2022	Ricardo & Thames Water	<p>Report updated to reflect minor changes to certain aspects of the assessments due to the requirement for the shelf-copy EARs to be updated to “application-ready” versions. The key changes are those made to the following sections:</p> <p>2.3            3.4.2.2.1            3.4.2.2.3            3.5.2            3.6.2            6            Appendix A</p>

## 2 Consultation

### 2.1 DPG requirements

This report focuses solely on the environmental assessment requirements of Thames Water's Drought Plan. The DPG2020 requires water companies to discuss the environmental assessments (including mitigation measures) and monitoring plans as early as possible with the Environment Agency and Natural England, when developing a drought plan. This should be part of the preliminary discussions held with regulators, other organisations and individuals who could be affected by drought management actions.

The DPG2020 also requires Natural England to be engaged where a plan is likely to affect protected sites (e.g. Natura 2000 sites and SSSIs) in England. The DPG also requires a water company to contact the relevant National Park Authority (including the Broads Authority) about any actions that will take place within their boundaries and relevant local authorities in relation to Local Wildlife Sites.

To ensure the stakeholder and regulatory engagement requirements are met, Thames Water has set out an engagement strategy to discuss the approach to the environmental assessments. Section 2.2 provides an overview of consultation held for previous DPs (DP 2013 and DP 2017), with Section 2.3 identifying consultation undertaken with regulators and / or stakeholders for DP 2022.

### 2.2 Consultation for DP 2013 and DP 2017

To ensure that the stakeholder and regulatory engagement requirements are met, Thames Water continuously consulted with both the Environment Agency and Natural England in preparation of the 2013 and 2017 DPs. This is summarised below.

Following publication of the DP 2013, consultation on the environmental assessments of Thames Water's DP continued between Thames Water, Environment Agency, Natural England and REE (Cascade Consulting).

- Prior to issue of the DP 2013, a series of consultation meetings were held between Thames Water, Environment Agency and REE (Cascade Consulting) during the preparation of the EARs in support of the DP 2013. Specifically, there were meetings in January and March 2012 to discuss the scope and methodology of the environmental assessments used to inform the EARs as set out in the scoping report<sup>4</sup>.
- Following publication of the DP 2013, consultation with Natural England regarding the assessment against designated site conservation objectives was discussed. Further assessment was undertaken in consultation with Natural England. The approach to the assessment and the results were incorporated into each applicable EAR (see section 3.5.1).
- In addition, further to the Environment Agency having reviewed and commented on a number of draft EARs throughout September and October 2012, discussions were held to agree the distinction between the requirements for:
  - finalisation of the EARs for completion of the DP, and
  - finalisation of the EARs for actual drought permit applications.

The following consultation was undertaken in preparation of the DP 2017:

- The Environment Agency commented and reviewed a number of draft EARs for the DP 2013. Any comments not addressed for the DP 2013 were taken into consideration for the DP 2017 DP, as agreed with the Environment Agency.
  - Between February 2015 and April 2015 Cascade Consulting undertook a 'stock take' comprising a rapid review of the current position of environmental data and a review of work undertaken since publishing the DP 2013. The stock take included a review of the outstanding Environment Agency comments on the EARs, a review of recently collected Environment Agency data and a review of the Thames Water baseline data

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<sup>4</sup> Thames Water Utilities Ltd (2012). Drought Plan: London Resource Zone Drought Permit Environmental Assessments Scoping Report. Draft Final. Prepared by Cascade Consulting, 6 January 2012.



(including the RHS Plus walkover surveys). The stock take confirmed a strategy for addressing Environment Agency comments, refined the baseline monitoring programme and reviewed the feasibility of the drought options and their promotability. A briefing note of the findings was shared with the Environment Agency following this work, which the Environment Agency endorsed as a suitable approach for progressing with the environmental assessment work associated with updating Thames Water's DP 2017.

- Following the 'stock take', a meeting between REE (Cascade Consulting), Thames Water and the Environment Agency was held in January 2016 to discuss and confirm the approach to the assessment (including a discussion about the report template) and the programme for preparation of the EARs in support of the DP 2017.
- Subsequently, the Environment Agency have also been consulted during the completion of the Draft EARs for the DP 2017. The comments provided were reviewed and following a strategic meeting with the Environment Agency, some comments were addressed in the draft EARs, but a number of comments were addressed following further consultation after the submission of the draft DP in April 2017.
- Annual reporting of the baseline monitoring results associated with the drought options have been submitted to the Environment Agency for review each year. Following review of the data collected, consultation with the Environment Agency about the monitoring programme was undertaken in spring 2014 and spring 2015, to ensure that sufficient monitoring to inform the baseline was undertaken collaboratively between the Environment Agency and Thames Water. In spring 2016, it was agreed with the Environment Agency that three years of continuous monitoring followed by appropriate intervals for ecological features was sufficient as a minimum to provide a robust baseline<sup>5</sup>. This approach was reviewed annually.

## 2.3 Consultation for DP 2022

The consultation undertaken throughout the preparation of DP 2022 is listed in **Table 2.1**. Further consultation will also be undertaken, as required, at the time of any future applications for drought permits / orders.

The Draft DP 2022 and accompanying environmental reports were issued to Defra on 30 March 2021. Thames Water received approval to consult on the draft Drought Plan on 10 May 2021 and subsequently published the draft Drought Plan 2022 for public consultation on 7 June 2021 for a seven week period up to and including 30 July 2021. The statutory consultation bodies (Environment Agency, Natural England and Historic England), as well as the public and retailers, were invited to express their views on the Draft DP 2022. A Statement of Response was prepared and issued on 20 September 2021 which explains the changes Thames Water made to the Final DP 2022 (and accompanying documents, including the EARs) as a result of the consultation.

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<sup>5</sup> Meeting between the Environment Agency, Thames Water and Cascade Consulting (12 April 2016)

**Table 2.1: Stakeholder/regulatory engagement for DP2022**

Date	Regulator/stakeholder	Type	Aim of meeting/correspond
23/7/2020	Environment Agency (Area)	Teleconference	Discussion of the Environmental Assessment Methodology Document; SEA and HRA approaches.
07/08/2020	Natural England	Teleconference	
13/07/2020 – 14/08/2020.	Environment Agency, Natural England and Historic England	Formal 5 week consultation period	SEA Scoping Consultation comments to be provided to TWUL
25/11/2020	Environment Agency and Natural England	Teleconference	Draft EAR assessment outcomes; and update on SEA and HRA.
07/06/2021 – 30/07/ 2021	Public and regulators	Formal 7-week consultation period	To obtain feedback on the draft DP 2022 and its accompanying documents including the HRA, SEA and EARs.
24/08/2021	Environment Agency and Natural England	Teleconference	Discussion of the general progress with the Draft DP 2022, and feedback on the HRA, SEA and EARs.
02/09/2021	Environment Agency	Teleconference	Discussion of the general progress with the Draft DP 2022, and revisions to the EARs.
23/08/2022 – 23/09/22 ~on-going	Environment Agency and Natural England	Teleconference	Discussion of the 2022 drought permit application process and developments, including revisions to the EARs and the specification of monitoring and mitigation.

## 3 Approach to Environmental Assessment Report

### 3.1 General

The assessment of the potential environmental effects associated with each drought option will be prepared in accordance with Government regulations and good practice guidance, including:

- The updated DPG, published in December 2020;
- Environmental assessment for water company drought planning – supplementary guidance (July 2020);
- Defra (2020) Drought Plan Direction;
- Institute of Environmental Management and Assessment (IEMA) (2004) Guidelines for Environmental Assessment;
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2019) Guidelines for Ecological Impact Assessment;
- UKWIR (2021) Environmental Assessments for Water Resources Planning (21/WR/02/15);
- Conservation of Habitats and Species Regulations 2017;
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive);
- Water Environment (Water Framework Directive) Regulations 2017 including the objectives set out in river basin management plans
- Wildlife and Countryside Act 1981
- The Countryside and Rights of Way Act 2000; and
- Salmon and Freshwater Fisheries Act 1975 and the Eel (England and Wales) Regulations 2009.

### 3.2 Requirements of the DPG

The DPG2020 indicates that water companies must demonstrate in their DP that they have met their responsibility to monitor, assess and, where possible, mitigate for the environmental impact of all their supply side drought management actions. These actions include:

- drought permits and drought orders;
- alternative water sources to those normally used (for example, bringing back on-line un-used but licensed sources);
- temporary water transfers (for example, changes to bulk supplies or temporary pipelines);
- desalination; and
- effluent reuse.

The DPG2020, in particular, requires the completion of environmental assessment and production of an environmental monitoring plan for each **supply side option** included in a DP (see **Appendix A** for those included in Thames Water's DP). The environmental assessments should also include any mitigation measures that could be implemented.

In completing the environmental assessment to demonstrate an understanding of the impact on the environment of the proposed drought action, the updates to the existing EARs will reflect the requirements of DPG2020 as follows (see **Figure 3.1**):

1. Setting out the likely changes to the hydrology (or hydrogeology) due to a proposed action (see **Section 3.4**);
2. Identifying the key features of the environment which are likely to be affected by these changes and assess their sensitivity (see **Section 3.5**);
3. Assess the likely impact on these features, allocate a level of confidence in your assessment and set out the actions you will take to reduce uncertainty (see **Section 3.6**); and
4. Mitigating against the potential impacts and where datasets are considered insufficient to undertake an environmental assessment it is the responsibility of the water company to implement environmental monitoring to generate the information required (see **Section 3.7**).

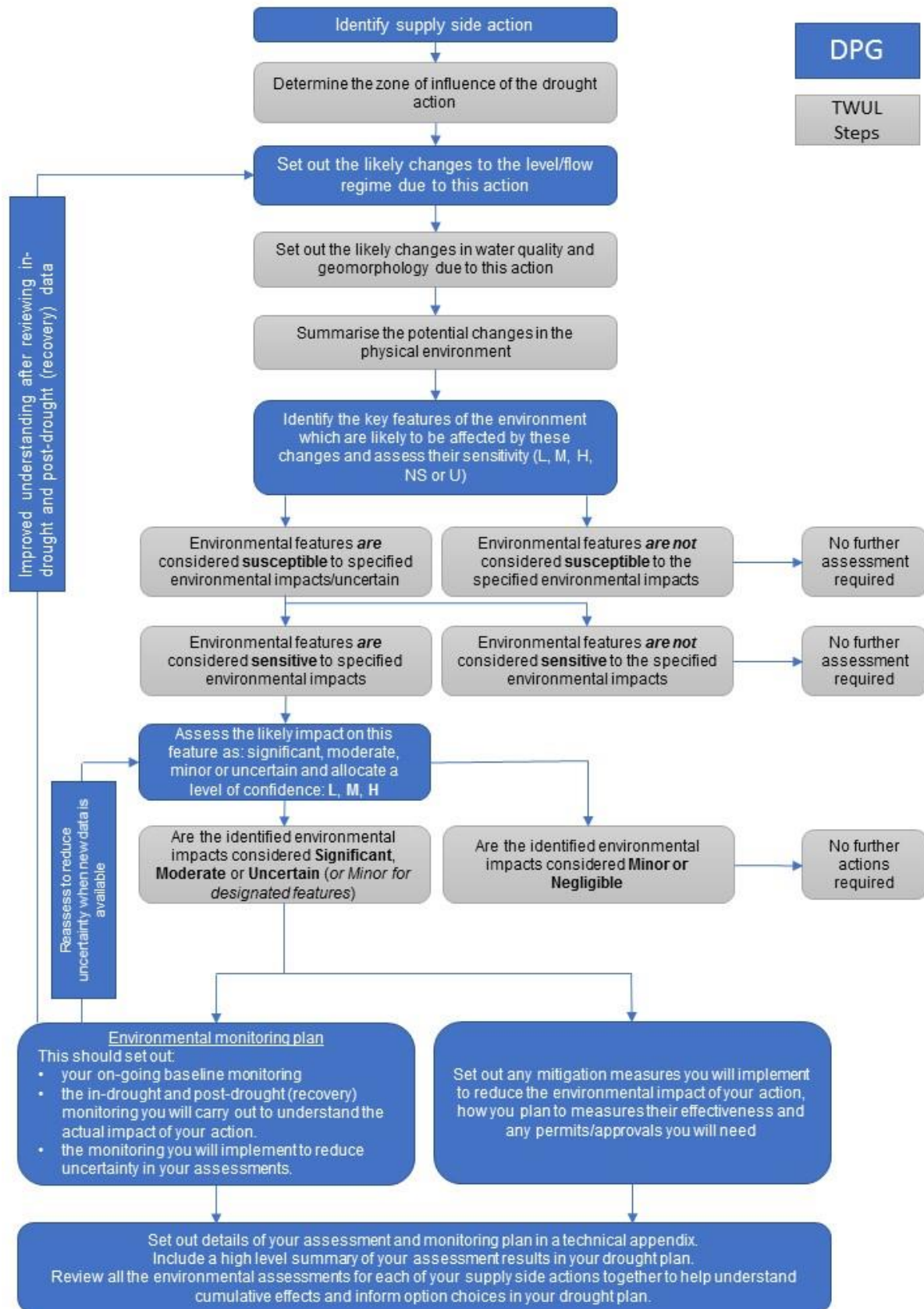
Within each section below, those aspects of the “shelf copy” 2017 EARs which have been updated are identified.

The DPG2020 recommends that environmental assessments (including mitigation measures) and monitoring plans are set out in technical appendices, with a high-level summary included in the main drought plan, which Thames Water intends to fulfil.

Ultimately, the environmental assessments should inform choices on when and how to use the different supply side drought management actions considered in a DP.

The DPG2020 also requires water companies to consider the combined environmental effects of their supply side drought options, and where relevant, the combination effects of their actions with those of neighbouring water companies and other abstractors. The SEA and HRA for DP 2022 will also inform these combined assessments.

Figure 3.1: Approach to undertaking environmental assessments as identified in the 2020 DPG. The steps identified in blue are as per the DPG2022 and the steps indicated in grey are additional /interim steps included by Thames Water



## 3.3 Baseline data

### 3.3.1 DPG requirements

The DPG2020 indicates that baseline data is important to inform both the assessment of the sensitivity to drought options (screening) and assessment of impacts on sensitive features.

With regards to **screening**, the DPG2020 indicates that a key part of the environmental assessments is understanding how sensitive each environmental feature of interest is to the likely changes in hydrology (or hydrogeology) caused by a drought option. To assess environmental sensitivity, the DPG2020 suggests the use of good quality, long-term environmental datasets. This is because long-term datasets are more likely to cover different flow conditions, including drought events, which will help improve the understanding of how the environment responds to changing flow conditions. Modelling tools, where available, could also be used help assess environmental sensitivity.

The DPG2020 also requires the use of the best available data, evidence and analysis methods to inform your environmental assessments. Types of evidence which can be used include:

- observed historical datasets;
- observed datasets from on-going monitoring programmes;
- expert judgement relating to specific habitat types;
- evidence from other nearby sites which are similar to your site of interest; and
- modelled/simulated datasets.

Understanding the environmental datasets that are required and the availability of these datasets will inform the level of confidence that can be assigned to the environmental assessments and sources of uncertainty that will have to be reduced.

The DPG2020 indicates that the Environment Agency will have various environmental monitoring programmes which will provide data that could supplement bespoke monitoring programmes.

Data for the Thames DP 2022 has been mostly obtained from the monitoring programmes being implemented by the Kennet and South London (KSL) and Thames Environment Agency areas. In addition, Thames Water has implemented a baseline monitoring programme since 2012 (see **section 3.7**), to supplement the Environment Agency monitoring programmes. This aims to ensure the maintenance of long-term data sets for each associated waterbody where screening and/or assessment outcomes have identified a risk as a result of the implementation of a drought permit or drought order or where data is considered availability insufficient.

The DPG2020 also indicates that the assessments should also consider other third party sources of environmental monitoring data which. For example, the National Biodiversity Network, County Wildlife Trusts, biological records centres, angling clubs and site managers. The data sources proposed for undertaking the screening and assessment of the impacts of Thames Water's supply-side drought options have been listed in **Section 3.4**, **Section 3.5** and **Section 3.6**.

## 3.4 Likely changes to and as a result of change flow/level

### 3.4.1 Physical environment: Characterisation at a reach scale

The physical environment characterisation and the assessment of likely changes as a result of the implementation of each drought permit or drought order has been set out for each supply-side option each EAR for DP 2017.

The baseline physical environment was described for those aspects which may change as consequence of the drought action, the reference conditions without the drought action and the likely changes from the drought action.

The physical environment characterisation was therefore set out for six aspects:

1. Catchment overview
2. Hydrology

3. River geomorphology
4. Overview of habitats
5. Water quality
6. Environmental pressures (flow and water quality)

**For DP 2022, aspect 3 (geomorphology), aspect 5 (water quality) and aspect 6 (environmental pressures) has been updated to reflect the most recent data available. The remaining aspects will not be updated.**

### 3.4.2 Physical environment: Changes as a result of drought management actions at a reach scale

#### 3.4.2.1 Determining the zone of influence of the drought management action

The zone of influence associated with each drought option was defined through hydrological and hydrogeological effects as part of the assessment process in 2013 and 2017. All of Thames Water's drought options which would require a drought permit or drought order are a change in permit conditions relating to a surface water or groundwater abstraction licence leading to a change in river flow, groundwater levels and/or a delay in groundwater recharge. For surface water abstractions, the change in river flow was used to define the full zone of influence of a drought permit or order. This was taken as being from the point of permit condition change (i.e. river abstraction) to the point at which the flow change compared to river flows without a drought action have reduced to negligible, or the tidal limit (whichever is first). A description of negligible change in river flow is included in the sections below.

It is noted that the zone of influence could extend beyond the point of a negligible hydrological change where, for example, water quality changes as a result of a drought permit or order could impact on environmental features beyond the point where hydrological impacts are considered negligible. This is of particular importance for drought permit and drought orders that are associated with the Thames Tideway where water quality changes are of particular concern.

For groundwater schemes, hydrogeological data, where available, have been reviewed to inform the study area and duration of any impacts (noting impacts on groundwater may extend beyond the six-month period of drought permit implementation - see below).

**The hydrological and hydrogeological impact assessment has not been updated for DP 2022. As such, the extent of the zone of influence for each drought option, as updated in 2017, will remain unchanged. This is discussed further in Section 3.4.2.2 below.**

#### 3.4.2.2 Hydrology and Flow and Level Changes

Consideration is required (by the DPG) of the likely changes in flow/ level regime due to implementing a drought option. The DPG does not provide a methodology for identifying the hydrological impact. As such, TWUL have developed a flexible approach to identifying the spatial extent of the study area from hydrological and hydrogeological information and characterising the hydrological impact within the study area, in terms of the scale, nature, duration and timing of impacts, which was agreed with the Environment Agency and used for the environmental assessment for TWUL DP 2013 and 2017. The hydrological information was used together with information on the other environmental features in the study area from (see below) to identify the environmental risk of the drought permit. Severe environmental drought years (including but not exclusively 1976 and 1995) have been used in groundwater models and through comparison with surface water flow records to inform the potential hydrological and hydrogeological impacts for Thames Water's DP in 2013 and 2017. Those years remain the most relevant scenarios to inform impacts on flow/level as they are more severe environmental droughts than recent years such as 2011, 2017, 2018 where no drought permits were implemented by Thames Water.

**As such, the hydrological and or hydrogeological impact assessment and the extent of the zone of influence has not been updated for DP 2022.**

Core to the approach in hydrological impacts, since 2009, has been the use of relevant flow statistics to inform the scale of hydrological impact and thereby delimit the zone of influence in the downstream

river system. For context, a description of the approach adopted for the previous DPs is presented below (noting the assessments will not be updated for DP 2022).

Potential reductions / increases in flow resulting from implementation of a drought permit, compared with flows without the drought permit in place, was used to determine the scale of potential impact at any particular site / feature using matrices, examples of which are provided in **Figure 3.2** and **Figure 3.3**.

Using a starting point of percentage flow reduction, these considered the inherent environmental sensitivity of upland rivers to flow changes (wetted width, depth and velocity). Two hydrological methodologies were developed, including one for watercourses that do not dry naturally (perennially flowing watercourses) and one for watercourses that naturally dry up for part of the year (intermittently flowing watercourses).

These two approaches are presented below.

#### 3.4.2.2.1 Perennially flowing watercourse hydrological methodology

This methodology was applied to watercourses that flow throughout the year and that are potentially impacted on by the drought option.

**Figure 3.2** illustrates that at the time of implementation of a drought permit during the spring, summer and autumn, upland<sup>6</sup> river systems of relevance to each of these proposed options will exhibit high sensitivity to changes in low flow (represented by Q95, summer<sup>7</sup>) and very high sensitivity to changes in extreme low flow (represented by Q99, summer). As illustrated by **Figure 3.3**, lowland rivers of relevance to each of these proposed options in spring, summer and autumn are considered to be less sensitive to reductions in summer low flows (summer Q95), but similarly sensitive to reductions in extreme summer low flows (summer Q99).

There could also be a need to assess the impacts of drought options on watercourses during the winter, when watercourses have relatively lower sensitivity to changes in low flow (represented by year-round Q95), and moderate sensitivity to changes in moderate flow (represented by year round Q50). Figures 3.4 – 3.5 are appropriate for the assessment of hydrological impacts on low flow regimes in watercourses during the winter. The matrices are used to identify 1) the overall study area – which extends downstream of the abstraction until the hydrological impact has reduced to negligible; 2) reaches with similar scales of impact within the overall study area; and 3) the scale of hydrological impact within each reach. Typically reaches have been delimited by the addition of flow from a significant tributary or discharge; although the similarity of geomorphological characteristics of the reach may also be important in reach specification. The matrices can be applied to a variety of upland or lowland catchments respectively including those dominated by groundwater, and can be applied until the tidal limit.

In addition to the information provided by summary flow statistics in the matrix, information on the timing, duration and relevant seasons of the drought permit impacts have been informed by licence details and river gauging data have also been used to characterise the likely nature of the drought permit impacts.

**Figure 3.2: Hydrological Assessment Matrix (Upland) (Spring, summer and autumn)**

% Reduction in flow		Summer Q99		
		<10%	10-25%	>25%
Summer Q95	<10%	Negligible	Minor	Moderate
	10-25%	Minor	Moderate	Major
	>25%	Moderate	Major	Major

<sup>6</sup> Using the WFD water body typology threshold of 80m above Ordnance datum.

<sup>7</sup> Flow statistics indicate the proportion of days a flow is equalled or exceeded. Therefore, Q95 indicates flow equalled or exceeded on 95% of days in the measured record (equivalent to an average of 347 days per year)



**Figure 3.3: Hydrological Assessment Matrix (Lowland) (Spring, summer and autumn)**

		Summer Q99		
		<10%	10-25%	>25%
Summer Q95	<20%	Negligible	Minor	Moderate
	20-50%	Minor	Moderate	Major
	>50%	Moderate	Major	Major

**Figure 3.4: Hydrological Assessment Matrix (Upland) (Winter)**

		Year round Q95		
		<10%	10-25%	>25%
Year round Q50	<10%	Negligible	Minor	Moderate
	10-25%	Minor	Moderate	Major
	>25%	Moderate	Major	Major

**Figure 3.5: Hydrological Assessment Matrix (Lowland) (Winter)**

		Year round Q95		
		<10%	10-25%	>25%
Year round Q50	<20%	Negligible	Minor	Moderate
	20-50%	Minor	Moderate	Major
	>50%	Moderate	Major	Major

#### 3.4.2.2.2 Intermittently flowing watercourse hydrological methodology

This methodology was applied to watercourses, potentially impacted on by the drought permit, that flow for most of the time but seasonally or occasionally cease to flow in response to decreased water availability, for example due to increased evapotranspiration or bed seepage. Such watercourses were identified from previous investigations and available data. Examples of watercourses where this methodology was applied include winterbournes or watercourses that dry along their route due to losses to underlying aquifers. The impact classification of this methodology was as follows:

- Major - If the drought option resulted in sections drying up that did not dry up anyway
- Moderate - If the drought option resulted in sections drying up earlier (by more than a handful of days (i.e. more than a week)) and/or recovering later (by more than a handful of days (i.e. more than a week)) and hence flow reduction occurring in the channel for more than just a handful of days (i.e. more than a week)
- Minor - If the drought option resulted in sections drying up earlier (by just a handful of days (up to a week)) and/or recovering later (by just a handful of days (up to a week)) and hence flow reduction occurring in the channel for just a handful of days (up to a week) OR if the drought permit were a secondary flow driver (e.g. flow through gravels being primary cause of flow losses rather than the drought permit)
- Negligible - No significant impact

In addition to the derived classifications, information on the timing, duration and relevant seasons of the drought permit impacts have been informed by licence details, available data and findings of previous investigations. These have been used to characterise the likely nature of the drought permit impacts.

#### 3.4.2.2.3 Additional Considerations – groundwater

For groundwater schemes, hydrogeological data, where available, have been reviewed to inform the study area and duration of any impacts (noting impacts on groundwater may extend beyond the six month period of drought permit implementation - see below). An increase in groundwater abstractions would lead to an increased cone of depression in groundwater levels. This impact can affect other

groundwater dependent / non-surface water receptors such as other wells, springs or groundwater dependent ecosystems. It could also mean that surface water impacts would extend upstream of the abstraction point or, in significant instances, to other watercourses some distance from the abstraction.

Groundwater drawdown modelling was completed in DP 2017 to determine the extent groundwater levels are impacted using regional groundwater models. The groundwater models were also used to estimate drawdown as a result of drought permit operation relative to a recent actual baseline run. The sources for which modelling was completed and the regional groundwater models they fall within (where applicable) are summarised in the **Table 3.1**.

The modelling work undertaken in DP 2017 considered a subset of TWUL's sources in the Cotswolds. TWUL have a requirement to update and extend previous modelling work carried out for DP 2017 to support their DP 2022. This update extended the scope of the study to cover additional groundwater sources (see **Table 3.2**). Further, since 2017, the Cotswolds model has been updated, and this work utilised the updated model to assess the impact on groundwater levels of groundwater abstractions operating at drought permit rates.

**Table 3.1: Groundwater drawdown modelling completed for DP 2017**

Source	WRZ	Aquifer	Regional model	Recent actual rate in baseline run (MI/d)
Crayford	London	Chalk	London	9.34
Waddon				6.76
Wansunt				11.18
Eynsford				0.53
Horton Kirby				4.44
Sundridge 1 and Sundridge 2	London	Lower Greensand	Lower Greensand	Unknown
New Ground	SWA/Guildford/Henley	Chalk	Vale of St Albans	0.00
Shalford	SWA/Guildford/Henley	Lower Greensand	N/A	N/A
Albury				
Playhatch	Kennet	Chalk South West	Chilterns (SWC)	4.83
Harpsden	SWA/Guildford/Henley			7.94
Sheeplands	SWA/Guildford/Henley			3.24
Pann Mill	SWA/Guildford/Henley			5.14
Gatehampton	SWOX			69.53
Ogbourne 1 and Ogbourne EBH	SWOX	Chalk	Kennet Valley	3.44
Axford 1 and Axford 2				7.74
Blewbury				0.00
Childrey Warren				2.41
Fobney Direct and Fobney EBH	Kennet			0.00
Pangbourne	Kennet			17.48
Baunton 1 and 2	SWOX	Chalk	Cotswolds	2.49
Latton				12.70
Bibury				7.97
Meysey Hampton				0

\*Sources for which regional models may not be suitable for groundwater drawdown assessment are shown in italics and discussed further below.

**Table 3.2: Groundwater drawdown modelling completed for DP 2022**

Source	WRZ	Aquifer	Regional model	Recent actual rate in baseline run (MI/d)
Baunton 1	SWOX	Chalk	Cotswolds	2.52
Baunton 2				0
Latton				12.67
Bibury				0.00002
Meysey Hampton				7.57

For groundwater abstractions, the impact of a drought permit could extend beyond the six month period (time limited) of abstraction depending on the local hydrogeology of the area. During drought situations, where there is limited recharge to the aquifer system, the abstraction can be mainly at the expense of groundwater stored in the aquifer. This can, in the long run, delay groundwater level recovery and have a knock on effect on baseflow contributions to watercourses. Flows could, therefore, be reduced for longer than the six month period during which the drought permit could be implemented and, where applicable, has been considered as part of the assessment described in each relevant EAR report.

### 3.4.2.3 Water Quality

In support of understanding the potential changes in the physical environment and the sensitivity of the environmental features associated with each drought option, a review was undertaken of the impacts to water quality for DP 2017.

For WFD classification, the Environment Agency has set out<sup>8</sup>, following UKTAG evidence<sup>9</sup>, what pressures, including water quality pressures, each biological quality element is capable of responding to. For the purposes of assessment for DP 2017, the supporting water quality parameters were set out: for fish and macroinvertebrates (where identified as sensitive features) as dissolved oxygen saturation and total ammonia concentration; and for macrophytes and algae (phytobenthos/diatoms) (where identified as sensitive features) as soluble phosphorus. Specifically, for macrophytes, if the hydrological impacts of drought permit implementation were identified within the main macrophyte growing season (April to September), an assessment of phosphorous was undertaken. In addition to these parameters, the average pH and temperature data over the ten-year period (2009-2019) was also reviewed.

Ten years (2005-2015) of Environment Agency routine monitoring data was for reviewed DP 2017 to provide an overview of water quality in the zone of influence of each drought permit. The impacts associated with water quality was defined for DP 2017 as indicated in **Table 3.3**. Any impacts on water quality identified as significant was considered in both the screening of environmental features, the scope of any detailed assessment of impacts and the extent of any monitoring and mitigation required.

For DP2022, the baseline data has been updated to include the last 4 years of data, i.e. available data between 2009-2019. This includes the location of the survey sites that inform the baseline conditions, the number of surveys completed at each site, and the dates when surveys were undertaken. This information has been used to define the confidence of the assessment. For DP 2022 the impact assessment has been reviewed in consideration of the updated baseline data (including the updated hydrological information to assess water quality trends).

The DPG2020 indicates that environmental assessments should include details of the likely impacts of your actions on the *quantitative* status of groundwater as identified in river basin management plans (RBMPs). The groundwater associated options included in Thames Water's DP2022 may impact on groundwater quantity/level but are considered extremely unlikely to impact on groundwater quality. As such, ground water quality has been screened out for assessment.

<sup>8</sup> Environment Agency (2011) Method statement for the classification of surface water bodies v2.0 (external release) Monitoring Strategy v2.0 July 2011 Table 2

<sup>9</sup> UK Technical Advisory Group on the Water Framework Directive (2008) Recommendations on Surface Water Classification Schemes for the purposes of the Water Framework Directive December 2007 (alien species list updated – Oct 2008 and Nov 2008). Appendix 1

**Table 3.3: Description of the potential impacts on water quality**

Impact	Description
Major	A major risk to water quality under low river flow (without the drought permit/order in place). For surface water bodies, this may affect the suitability of the water quality to maintain the current WFD status for fisheries and macroinvertebrates, with a high risk of deterioration in WFD status; and exacerbation of the risks due to flow reduction from the drought permit/order.
Moderate	A moderate risk to water quality under low river flow conditions (without the drought permit/order in place). For surface water bodies this may affect the suitability of the water quality to maintain the current WFD status for fisheries and macroinvertebrates, with a moderate risk of deterioration in WFD status; or exacerbation of a minor risk due to the flow reduction from the drought permit/order.
Minor	A minor risk to water quality under low river flow conditions (without the drought permit/order in place). For surface water bodies this may have a minor effect on water quality but with no risk to the current WFD status for fisheries and macroinvertebrates; or exacerbation of a minor risk due to the flow reduction from the drought permit/order
Negligible	Indicative of no significant risk without the drought permit/order in place nor exacerbation of risk by the flow reduction/groundwater level reduction from the order/permit.

#### 3.4.2.4 Geomorphology

In support of understanding the potential changes in the physical environment and the sensitivity of the environmental features associated with each drought management action, a review was undertaken of the impacts to fluvial geomorphological processes.

The assessment was informed by considering 10 years of baseline data (2005-2015) for each hydrological reach identified. These data included:

- Information on the presence, location and extent of geomorphological features within a river (e.g. depositional and erosional features, bank morphology, bed substrate, etc.);
- River Habitat Surveys
- Information on suspended solids and channel sediment particle size;
- An understanding of anthropogenic modification of the channel bed and banks, where relevant, including any in-channel barriers to migratory species (e.g. weirs).

These data were supplemented with data available from walkovers undertaken as part of the Baseline Monitoring Programme for the Thames Water DP. Using this information, relevant pressures on the geomorphology within an impacted river will be discussed and the impacts classified. Key impacts that will be considered include:

- Changes in wetted width and depth;
- Changes in exposure of bed and banks;
- Reductions in flow velocity;
- Change in sediment dynamics, particularly sediment deposition; and
- Impact of changes in flow, depth and velocities at relevant anthropogenic structures.

Any impacts on geomorphology identified as significant was considered in both the screening of environmental features, the scope of any detailed assessment of impacts and the extent of any monitoring and mitigation required.

For DP 2022, the baseline data has been updated with the most recent 10 year's of data available (i.e. 2009-2019) obtained from the Environment Agency and Thames' Water Baseline Monitoring Programme. The potential impacts has also been updated to consider the assessment requirements for geomorphology as defined in the draft DPG 2020 (see **Table 3.4**).

**Table 3.4: Geomorphological evidence of the impact of reduced flows**

More dry: lower flows, less water, reduced wetted perimeter	
Impact	Field evidence: what to look out for
<b>Reduced lateral connectivity</b>	Disconnection between the river flow and the channel margins; isolation of the riparian zone; river looks 'shrunk away' from the banks. This is often an early indicator of changing flows.
<b>Reduced connectivity</b> <b>longitudinal</b>	Riffles drying; step-pools and cascades becoming unlinked; flow fragmentation; isolation of backwaters and secondary channels; ponding behind weirs; isolated dry habitats; remnant pools. This often follows after lateral connectivity is reduced. Smaller, headwater streams in upper catchments are often the most vulnerable.
<b>Reduced vertical connectivity</b>	Desiccation of the hyporeic zone – reduced free water; dry patches, cracks and fissures in previously wetted bed and channel margins. This is often the last impact in the sequence of reduced connectivity.
More silty: lower flows, less energy, more deposition	
Impact	Field evidence: what to look out for
<b>Increased siltation</b>	Fine sediment deposition on the channel bed and margins; look for a blanket of sediment and interstitial deposition. Look for deposition that may be greater than natural variability in location and scale – depth and area.
More stable: lower flows, less energy, reduced sediment flux	
Impact	Field evidence: what to look out for
<b>Increased bedform stability</b>	Increased terrestrialsation of bedforms leading to reduced mobility e.g. vegetated point bars; change in microhabitat distribution; shift in channel morphology e.g. cross section, type and number of active bedforms; reduced in-channel sediment supply. Bed concretion due to calcium carbonate precipitation also happens in some river types in response to PDW.
<b>Reduced bank erosion by flow</b>	Dry bank faces; reduced 'fresh' erosion; increased terrestrialsation of banks e.g. re-vegetation

### 3.4.3 Environmental pressures

The overview of the physical environment includes identification of both flow and water quality pressures in the study area.

#### 3.4.3.1 Flow Pressures

During an environmental drought, abstractions can put additional pressure on flow by removing water from rivers and groundwater aquifers and potentially exacerbating natural low flows. It was agreed during the consultation process (see **Section 2**) that for DP completion, licensed abstractions less than 0.5ML/d only need to be identified within the EARs and do not require assessment. In addition, it was agreed that unlicensed abstractions are not required to be identified or assessed within the EARs.

Until recently, many existing abstractions were exempt from requiring an abstraction licence. This included the primary offtake from water courses for managed wetlands. Natural England have indicated that following the implementation of the Water Act of 2003, such exemptions will no longer be in place. This included the abstraction to manage wetlands and designated sites. The potential impacts of the implementation of a drought permit on designated sites has been included in the EAR for each drought permit/option in 2017. During a drought any drought permit will take precedence, but it will still be important to determine the effect of the implementation of a drought permit/option on the abstraction of water for managed wetlands and the conservation of such wetlands.

For a new abstraction licence for a previously exempt abstraction (also known as a new authorisation), the Environment Agency set a deadline of 2 years from 1 January 2018 to apply for a licence. It could take a further three years for each application to be determined.

The list of abstractors to consider in each EAR has been updated with the most recent data for DP 2022 with the relevant data obtained through a data request to the Environment Agency. This includes any new licences (including the abstraction of water for managed wetlands).

### 3.4.3.2 Discharge pressures

Discharges put pressure on water quality during a drought as lower than normal river flows mean that there is less water available to dilute discharges such as final effluent from sewage treatment works (STWs). Discharges impacting the oxygen balance, ammonia concentration and soluble phosphorus concentration in the river reaches have been reviewed. Discharges may be considered as beneficial as they contribute more flow to rivers, however, they may also pose risks to water quality (noting that only abstractions are considered as flow pressures in the section above).

An overview of likely water quality pressures was provided for each drought option in DP 2017. This information included:

- Discharge permits in the zone of influence (including numeric water quality and flow conditions where these are set);
- Routine riverine water quality monitoring data for the water quality determinands of dissolved oxygen saturation and total ammonia for relevant monitoring sites in the zone of influence and significant tributaries (or dissolved oxygen concentration and any other appropriate determinands relevant to ecological receptors for estuarine waters, where applicable);
- River flow and/or levels representative of the zone of influence (daily gauged flow, spot flow surveys, observation borehole records) – all relevant available records.

The concentrations/levels of selected determinands considered as important in the context of the environmental features (dissolved oxygen saturation and total ammonia) was analysed in comparison to baseline flow conditions. The purpose of the analysis was to establish whether concentrations/levels of the selected determinands responds inter-annually to changes in flow.

For DP 2022, the relevant discharges to consider in each EAR has been updated with the most recent data, obtained through a data request to the Environment Agency. As agreed with the Environment Agency (see Section 2), only discharge permits over 0.5 Ml/d will be identified for consideration in the EARs. The risk assessment will also be updated to consider the most recent (2009-2019) hydrological data.

### 3.4.4 Summarising the potential changes in physical environment

The potential changes to the physical environment due to implementation of a drought permit is summarised in each EAR.

This includes a brief summary of the potential risks of:

- Changes in wetted width and depth
- Changes in sediment dynamics
- Impacts of in-channel structures
- Bank stability
- Overall, geomorphology risks
- Water quality
- Environmental pressures

A table summarising these impacts is provided for each drought option, as per example in

**Table 3.5.**

**Table 3.5: Summary of Potential Changes to the Physical Environment of the Impacted Reaches from Implementation of the Drought Permit**

River (Impact)	Reach	Reach 1 River Darent from Park Farm to the confluence with Honeypot Stream	Reach 2 River Darent from the confluence with Honeypot Stream to South Darent
Hydrology		Moderate reduction in flows within this reach for the duration of the drought permit implementation until such time as river flows recover. Residual impacts following drought permit implementation anticipated. Flow reduction would manifest as a combination of velocity and level reductions.	Minor. The impact would be the duration of the drought permit until such time as river flows recover. The impact would manifest as reduction of flows, velocities and levels.
Geomorphology		Low risk. The drought permit may result in a greater loss of wetted perimeter than might otherwise be expected under the current hydrological regime.	Negligible
Water Quality		Medium risk of increasing local dissolved oxygen stressors during environmental drought	Negligible
Additional abstraction pressures groundwater	-	Three South East Water abstractions and one abstraction by Sevenoaks Quarry could be limited by implementation of the drought permit therefore posing a low risk.	No abstractions from impacted aquifer
Additional abstraction pressures – surface water		Unknown	Negligible
Additional water quality pressures from discharges		Negligible	Negligible

### 3.5 Identifying features likely to be affected and assessing sensitivity

The updated DPG (2020) requires firstly to establish whether environmental features are susceptible to drought permit impacts and secondly to establish the sensitivity of features of interest. Sensitivity should be categorised as: High, Medium, Low, Not sensitive, or Uncertain.

With the zone of influence (hydrological reach), and considering the level of impact on the physical environment identified (see **Section 3.4**), potentially sensitive receptors (sites / features) have been identified. The screening exercise undertaken in 2013 and updated in 2017 established the study area for each drought permit together with identification of relevant, susceptible environmental features within those study areas (based on the risk of them being impacted by the drought permit during the period of its operation).

The DPG2020 states that, to assess environmental sensitivity you need good quality, long-term environmental datasets. This is because long-term datasets are more likely to cover different flow conditions, including drought events, which will help improve the understanding of how the environment within the zone of influence responds to changing flow conditions. Furthermore, where modelling tools are available, this could also be applied to inform environmental sensitivity.

Therefore, for Thames Water’s DP 2022, the sensitivity assessment of the environmental features has been reviewed to consider recent baseline data.

This stage fulfils the requirement of the DPG to “Identify the key features of the environment which are likely to be affected by these changes and assess their sensitivity”. The key features that are considered include:



- designated biodiversity sites (Special Area of Conservation (SAC), Special Protected Area (SPA), Ramsar, Site of Special Scientific Interest (SSSI), landscapes including World Heritage sites, European Landscape Convention, marine conservation zones (MCZs), national parks, areas of outstanding natural beauty (AONB), National Nature Reserve (NNR) and Local Nature Reserve (LNR) and NERC species which are located on or within 500m of the impacted reaches;
- NERC priority habitats which are located on or within 100m of the impacted reaches;
- ecological communities and, where identified, Water Framework Directive (WFD) status of designated waterbodies which contain the impacted reaches<sup>10</sup>;
- sensitive ecological features as advised by the Environment Agency and Natural England;
- invasive non-native species (INNS); and
- wider features which should be taken into account in determining the potential impacts of drought action implementation – specifically other abstractors, landscape, navigation, recreation and heritage.

Details regarding the data and approaches to determine the sensitivity of each feature is provided in the sections below (**Section 3.5.1 – Section 3.5.7**).

### 3.5.1 Internationally and nationally designated sites

For DP 2017, the designated sites included SACs, SPAs, Ramsar sites, SSSIs, NNRs and Marine Conservation Zones (MCZs). GIS data was used to map the locations and boundaries of each of the designated site in relation to the different drought options. The designated sites included in DP 2013 was updated to consider the updated groundwater modelling and included Groundwater Dependent Terrestrial Ecosystem (GWDTEs) within the cone of depression for DP 2017 (as per Section 3.4).

For DP 2017 consideration was given to the relative spatial locations of each drought option and designated sites within the same surface water and groundwater catchments and/or estuarine system to ensure that any hydrological connectivity over a longer distance that might affect water-dependent sites, qualifying features and designated mobile species was taken into account.

The data sources that will be considered for the review of susceptibility and sensitivity includes:

- Relevant citation documents;
- Conservation objectives (Special Areas of Conservation and Special Protection Areas) and Supplementary Advice (where available) including the targets and attributes that inform favourable condition status;
- Site Improvement Plans (Special Areas of Conservation and Special Protection Areas);
- Regulation 33 information for European Marine Sites;
- Review of Consents information available from the Environment Agency;
- Favourable condition tables for Sites of Special Scientific Interest;
- Article 12 (Special Protection Areas) and Article 17 (Special Areas of Conservation) status reports;
- Sites of Special Scientific Interest condition assessments;
- Common Standards Monitoring Guidance (where specific targets have been set and agreed by Natural England and Environment Agency);
- Habitat preferences for the qualifying species (e.g. nesting, foraging, commuting) and food preferences; and
- Physical characteristics of the habitats and environment influencing them.

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<sup>10</sup> Under Article 22 of the WFD, the Freshwater Fish Directive (FFD) was repealed on 22 December 2013. Protected waters under the FFD are incorporated within the WFD. Ecological status defined in the WFD sets the same protection to these protected areas for fish. In the case of Salmonid waters, this is assigned a typology in WFD status classification, specifically for dissolved oxygen saturation in rivers and dissolved oxygen concentration in lakes. Salmonid waters are rivers/lakes which, in the Environment Agency's judgement, would support a sustainable fish population dominated by salmonid species; this replaces the system of notices protecting areas through the FFD.

As an initial guide, the UK Technical Advisory Group on the Water Framework Directive Guidance on the Identification of Natura Protected Areas (final) March 2003<sup>11</sup>, was used to identify water dependent features (although noting this covers habitats and species also reliant on coastal processes). Then professional judgement, informed by relevant information on the ecological requirements for each habitat/species, identified the sensitivity of the feature to the changes resulting from the drought option. This was used as a basis to screen features in and out of needing further assessment and to define the scope of the environmental assessment for DP 2017.

As the zone of influence and the hydrological / hydrogeological impacts remains unchanged, the designated sites considered in DP 2017 have again been considered for DP 2022. Available GIS data has been reviewed to ensure that any newly designated sites are also considered.

A description of the perceived sensitivity to each drought option and any uncertainty was identified in each EAR. This information was used to define the confidence of the sensitivity assessment.

It should be noted that, in 2014, Cascade Consulting completed a detailed review of the SSSI assessments completed for each EAR. This review considered the assessments undertaken for the 2013 Thames Water DP against the targets for Favourable Condition supporting conservation objectives for each qualifying feature. The attributes and targets identified through this review were again considered as the basis for the assessments completed in Thames Water DP 2017.

Where features were considered to have a **high** or **medium** sensitivity to drought management actions, the habitats/species were considered for further assessment. Internationally or nationally designated sites were also considered for detailed assessment where a **low** sensitivity was identified.

Where available, 10 years of baseline data (2009-2019), obtained through the Environment Agency, Natural England, Biological Record Centres and Thames Water monitoring programmes have been reviewed to confirm/update the sensitivity of designated features to a particular drought permit or order for DP 2022.

### 3.5.2 Other protected sites

For DP 2017, GIS was used to identify those NERC Act section 41 Priority Habitats within each hydrological reach. Sites hydrologically connected or within 100m of the zone of influence was considered for screening. This screening exercise was initially undertaken in 2013 and was reviewed for DP 2017 and was also updated to include priority habitats and GWDTE.

The DPG2020 requires **Local Wildlife Sites (LWS)** to be considered. Local Wildlife Sites (LWS) have been considered within the EARs. The approach to their assessment is described further in the Technical Briefing Note<sup>12</sup> which has been agreed in consultation with the Environment Agency.

Ecological data to inform the sensitivity and the assessment of LWSs can be sparse and difficult to obtain. Therefore, a four-step screening exercise was proposed and agreed to identify those LWSs that are considered susceptible to Drought Permit/ Option impacts.

To date, **Step 1** (to identify an area around each of the drought permit / order options and a list of LWSs which are included within it) and **Step 2** ("screening", to determine whether the LWSs are in connectivity with the associated hydrological reach/groundwater zone of influence of any of the drought Permits / Options, and whether there are any water dependant features that could be affected) have been completed on 853 LWSs.

This included obtaining information sourced through the Environment Agency and through the various Local Biological Record Centres (LBRC).

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<sup>11</sup> UK Technical Advisory Group (UKTAG) (2003). UK Technical Advisory Group on The Water Framework Directive. Guidance on the Identification of Natura Protected Areas [Final]. Published 30 March 2003.

<sup>12</sup> Ricardo (2021) Environmental Assessment Reports: Local Wildlife Sites Technical Briefing Note, Version 4. Report for Thames Water. 23 April 2021.

The **Step 2** screening exercise has been shared with the Environment Agency and their agreement obtained on the findings of this to ensure that the relevant LWSs were taken forward to **Step 3**.

For **Step 3**, where LWSs are screened in, they will be addressed in each relevant EAR. This involves assessing the susceptibility and sensitivity to drought option implementation. **Step 3** has been informed by hydrological, geomorphological and water quality assessments presented in the relevant EARs, to assess the susceptibility of each LWS to Drought Permit/ Option implementation. This includes consideration of changes in surface waterbody flow and water level, and drawdown extent on groundwater systems. Sensitivity was then determined via assessment of specific ecological requirements of the water dependent habitats and species associated with the LWS and consideration of susceptibility. The sensitivity of each LWS has been categorised as either: 1) low; 2) medium; 3) high; 4) not sensitive; or 5) uncertain sensitivity in a designated site. An indication as to whether further assessment of each LWS is required (**Step 4**) is also provided.

Further discussion and consultation with the Environment Agency has been undertaken regarding **Step 4** and given that little / no baseline data currently exists for LWS, it is acknowledged that assessments can, at best, be undertaken through professional judgement. It has been agreed that if impacts were concluded to be likely, consideration would then need to be given as to what could be undertaken in the event of a drought permit / order being implemented for each LWS, i.e. what potential monitoring and / or mitigation would be deemed reasonable and / or practical. This will be included in the “Environmental Monitoring Plan and Mitigation” for each drought application EAR and will be further discussed and agreed with the Environment Agency.

### 3.5.3 Protected species

In addition to the macroinvertebrate and fish communities, the sensitivity to drought option impacts of the species that are protected under UK legislation, considered as principle for conserving biodiversity or are considered as threatened or endangered was also considered for DP 2017.

This included species listed as principal importance for the purpose of conserving biodiversity under Section 41 of the NERC Act (2006), species that are protected under Section 9 of the Wildlife and Countryside Act (1981), species listed on the IUCN Red List of threatened species, species previously listed as priorities for conservation action under the UK Biodiversity Action Plan (UK BAP) and the priority fish species listed in Appendix 3 of the DPG2020.

In 2017, the distribution, status and abundances of the protected species with the zone of influence of each drought option was reviewed by considering 10 years of baseline data for each hydrological reach identified (2005-2015). The distribution, status and abundances of the protected species was also informed by open source data, data collated from Environment Agency, Natural England, Thames Water and other third-party monitoring programmes. Where possible, UK Technical Advisory Group on the Water Framework Directive Guidance on the Identification of Natura Protected Areas (final) March 2003 was used to identify whether protected species identified within the zone of influence were considered water depended. The ecology of each water depended species was considered to inform the sensitivity to drought management actions. This included information collated from literature (e.g. Conserving Natura 2000 Rivers Ecology Series) and expert judgement.

Where species were considered to have a **high** or **medium** sensitivity to drought management actions, the communities were considered for further assessment. Species that were internationally or nationally protected ((e.g. Otter (*Lutra lutra*), water vole (*Arvicola amphibious*), Atlantic salmon (*Salmo trutta*)) were also considered for further assessment where a **low** sensitivity was identified.

For DP 2022, the baseline data has been updated to consider the most recent data available (2009-2019). This was in line with the DPG requirements for considering long-term data. The location of the survey sites that informed the baseline conditions, the number of surveys completed at each survey site and the dates when surveys were undertaken has been provided. This information will be used to define the confidence of the sensitivity assessment.

### 3.5.4 Diatom/phytobenthos

For DP 2017, the sensitivity of the diatom communities associated with each drought option was updated to consider 10 years of baseline data (2005 – 2015). This sensitivity of the diatom community

associated with each drought option was determined based on the biological metric scores obtained for each survey site of this 10-year period, noting that data availability was limited.

For DP 2022, the sensitivity analysis instead considers the relationship between diatom communities and the supporting environmental variables. The purpose of the analysis is to establish whether biological metrics/indices responds inter-annually to changes in flow and associated environmental variables including water quality and habitat quality and availability. This sensitivity assessment considers 10 years of baseline data (2009-2019). This is in line with the DPG2020 requirements for considering long-term data. Where available, data from periods representing droughts or extreme low flow conditions has also been considered.

The location of the survey sites that informed the baseline conditions, the number of surveys completed at each survey site and the dates when surveys were undertaken have been provided. This information will be used to define the confidence of the sensitivity assessment.

The biological indices and metrics that will be considered includes the following<sup>13</sup>:

- TDI 4 scores which ranges from 1 (indicating a preference for extremely low nutrient levels) to 100 (indicating a preference for extremely high nutrient levels).
- % Motile which provides an indication of the percentage of the motile diatoms in the sample.
- %Organic Tolerant which provides an indication of the percentage of organic pollution tolerant diatoms in the sample.
- %Saline which provides an indication of the percentage of diatoms tolerant of slightly saline waters.

The biological indices and metrics identified above are used to establish the baseline conditions and variability within the diatom community outside the drought option conditions. The TDI4 scores for each site have been plotted against water quality (in particular soluble phosphorus) to identify any trends in community structure during low flow conditions. It is noted that there are limitations to the use of the metrics listed above in high alkalinity rivers. Such limitations are identified in the confidence assessment of the data.

Where diatom communities are considered to have a **high** or **medium** sensitivity to drought management actions, the communities will be considered for further assessment. The diatom community has also been considered for further assessment where the community is associated with designated sites or where there is low confidence in the baseline data used to inform the assessment. The assessment considers the risk of alteration to community composition, for example, as a result of changes to the flow and/or velocity and water quality as a result of a particular drought order or permit. The assessment of sensitivity has also been used to inform the scope of the impact assessment for the macrophyte community.

### 3.5.5 Macrophyte community

For DP 2017, the sensitivity of the macrophyte communities associated with each drought option was updated to consider 10 years of baseline data (2005 – 2015). This sensitivity of the macrophyte community associated with each drought option was determined based on the biological metric scores obtained for each survey site of this 10-year period.

For DP 2022, the sensitivity analysis instead considers the relationship between macrophyte communities and the supporting environmental variables. The purpose of the analysis is to establish whether biological metrics/indices responds inter-annually to changes in flow and associated environmental variables including water quality and habitat quality and availability. This sensitivity assessment will consider 10 years of baseline data (2009-2019). This is in line with the DPG2020 requirements for considering long-term data. Where available, data from periods representing droughts or extreme low flow conditions has also been considered.

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<sup>13</sup>Kelly MG, Juggins S, Bennion H, Burgess A, Yallop M, Hirst H, Jamieson J, Guthrie R and Rippey B. DARLEQ: Diatom Assessment of River and Lake Ecological Quality Version 2.0 User Guide.

The location of the survey sites that informed the baseline conditions, the number of surveys completed at each survey site and the dates when surveys were undertaken has been provided. This information has been used to define the confidence of the sensitivity assessment.

The biological indices and metrics that have been considered includes the following<sup>14</sup>:

- River Macrophyte Nutrient Index (RMNI) derived from the RMNI scores of the taxa from surveys. High scores are associated with species that dominate under enriched conditions.
- Number of macrophyte taxa (NTAXA) the number of truly aquatic scoring taxa recorded during surveys.
- Number of functional groups (NFG) fully aquatic taxa are allocated to 24 functional groups.
- Cover of green filamentous algae (ALG) percentage cover over the whole of the survey section of river.

The biological indices and metrics identified above have been used to establish the baseline conditions and variability within the macrophyte community outside the drought option conditions. The expected scores for each index for each of the sample sites have been generated via the LEAFPACS2 calculator, using environmental base data provided obtained from the Environment Agency's Ecology and Fish Data Explorer. The Observed (O), also obtained from the environment Agency's Ecology and Fish Data Explorer has been divided by the Expected (E) to produce a O:E ratio which has then been assessed against WFD standards and relevant thresholds.

The O:E indices has then been plotted against flow to identify any hydrologically driven patterns (as per the macroinvertebrate sections below). Care is taken to avoid using periods in the baseline analysis within which a drought option may have been in operation. The sensitivity of the macroinvertebrate community to the changes in the physical environment as a result of drought management actions have been determined and have been informed by considering the 3-month seasonal hydrological summary for the associated catchment as provided by the UK Centre for ecology and Hydrology (UKCEH).

It is noted that the River Macrophyte Hydraulic Index (RMHI) which is based on substrate, depth and stream energy, was dropped from the suite of metrics used for classification. However, as the metric scores are available from Environment Agency's Ecology and Fish Data Explorer, these scores have also been plotted against flow to identify any hydrologically driven patterns in years subsequent to low flow conditions.

It is noted that the impacts on macrophyte communities should not be considered in the context of the metrics and indices alone. Species data to identify species that are particularly sensitive to flow change outside of the main macrophyte growing season have also been considered. As such, species level data will also be obtained from the Environment Agency's Ecology and Fish Data Explorer for consideration in the sensitivity assessment.

It is also noted that for reaches that are considered estuarine (e.g. in the Lower River Thames), the LEAFPACS2 outputs will not be applicable. For these reaches, macro-algae and angiosperm species data have been considered (where available) to inform the sensitivity to drought permit/order related impacts. Available Environment Agency data has been supplemented by data from other studies (where available). It is noted that there are limitations to the use of the metrics listed above in high alkalinity rivers. Such limitations have been identified in the confidence assessment of the data.

Where macrophytes communities are considered to have a **high** or **medium** sensitivity to drought management actions, the communities have been considered for further assessment. The assessment considers the risk of alteration to community composition as a result of the implementation of a drought permit or drought order. This includes, for example, changes in community composition as result of changes to the flow and/or velocity and water quality, the reduction in growth as a result of impacts on water levels and flows, etc.

The macrophyte community has also been considered for further assessment where the community is associated with designated sites or where there is low confidence in the baseline data used to inform

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<sup>14</sup> WFD-UKTAG (2014) River Assessment Method Macrophytes and Phytobenthos. Macrophytes (River LEAFPACS2).

the assessment. The assessment of sensitivity has also been used to inform the scope of the impact assessment for the macrophyte community.

### 3.5.6 Macroinvertebrate community

For DP 2017, the sensitivity of the macroinvertebrate communities associated with each drought option was updated to consider 10 years of baseline data (2005 – 2015). This sensitivity of the macroinvertebrate community associated with each drought option was determined based on the biological metric scores obtained for each survey site of this 10-year period.

For DP 2022, the sensitivity analysis instead considers the relationship between macroinvertebrate communities and the supporting environmental variables. The purpose of the analysis is to establish whether biological metrics/indices responds inter-annually to changes in flow and associated environmental variables including habitat quality and availability. This sensitivity assessment will consider 10 years of baseline data (2009-2019). This is in line with the DPG2020 requirements for considering long-term data.

Where available, data from periods representing droughts or extreme low flow conditions has also been considered. The DPG 2022 also requires the consideration of available macroinvertebrate data analysis tools. These include the Environment Agency Hydroecological Validation (HEV) tool and Hydroecological Modelling (HEM) tool.

While the HEM tool is still under development, the sensitivity of the macroinvertebrate community has been informed by a modified version of the HEV tool (developed by Ricardo) (see **Figure 3.4**). For the purpose of this HEV tool, relevant data (metrics, indices and diversity data) has been obtained through the Environment Agency's Ecology and Fish Data Explorer (<https://environment.data.gov.uk/ecology-fish/>). Where available, these data have been supplemented by other sources including the Thames Water's baseline monitoring programme and data collated from other Thames Water monitoring programmes (e.g. Heavily Modified Waterbody Investigations, Water Industry National Environmental Programme Investigations, etc.).

The location of the survey sites that informed the baseline conditions, the number of surveys completed at each survey site and the dates when surveys were undertaken has been provided. This information has been used to define the confidence of the sensitivity assessment.

The biological indices and metrics that have been considered includes the following:

- WHPT (Whalley Hawkes Paisley Trigg) indices: WHPT was introduced as the basis for the UK's river macroinvertebrate status classification under the Water Framework Directive for River Basin Management Plan 2<sup>15</sup>. It replaces the Biological Monitoring Working Party (BMWP) scoring system and provides updated taxon scores related to susceptibility to pollution, with the most susceptible family scoring the highest. The total abundance of individuals found within each family is also taken into account and will adjust the respective score. Typically, with pollution tolerant families the score is adjusted down when high abundance is present, and the score is adjusted up when low abundance is present. The opposite is true of families which are considered susceptible to pollution. Two further indices are derived, Average Score Per Taxon (ASPT) and Number of Scoring Taxa (NST). By dividing the WHPT score by the NST in the sample ASPT is calculated. The ASPT score is considered less sensitive to differences in sampling effort than the WHPT index alone and therefore provides a more reliable means of assessing biological quality.
- Lotic-invertebrate Index for Flow Evaluation (LIFE): LIFE is a method for linking macroinvertebrate data to prevailing flow regimes. This is an index designed for British Waters and is described in Extence et al., 1999<sup>16</sup>. It may be calculated either at the family level or at the species level. The index is calculated by assigning each taxa to one of 6 groups ranging

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<sup>15</sup> WFD-UKTAG (2014) River Assessment Method for Benthic Invertebrate Fauna, Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT).

<sup>16</sup> Extence C, Balbi D and Chadd R (1999). River Flow Indexing Using British Benthic Macroinvertebrates: A Framework for Setting Hydroecological Objectives. *Regulated Rivers Research & Management* 15(6):545-574

from a group primarily associated with rapid flows to a group holding forms frequently associated with drying or drought impacted sites.

- The PSI (Proportion of Sediment-sensitive Invertebrates (PIS): the PSI index (Glendell et al. 2011<sup>17</sup>) is an index which measures the abundance-weighted percentage frequency of taxa which are sensitive to fine sediment deposition and will be used to assess the sensitivity of the macroinvertebrate community to changes in geomorphology.

The biological indices and metrics identified above have been used to establish the baseline conditions and variability within the macroinvertebrate community outside the drought option conditions. The expected scores for each index for each of the sample sites will be generated via River Invertebrate Classification Tool (RICT) for each season, using environmental base data provided obtained from the Environment Agency's Ecology and Fish Data Explorer. The Observed (O), also obtained from the environment Agency's Ecology and Fish Data Explorer has then been divided by the Expected (E) to produce a O:E ratio which has then been assessed against WFD standards and relevant, WHPT scores and ASPT, thresholds.

The O:E results for the various indices has then been plotted against flow to identify any hydrologically driven patterns, as per the Environment Agency's HEV tool. Care has been taken to avoid using periods in the baseline analysis within which a drought option may have been in operation. The sensitivity of the macroinvertebrate community to the changes in the physical environment as a result of drought management actions has been determined and informed by considering the 3-month seasonal hydrological summary for the associated catchment as provided by the UK Centre for ecology and Hydrology (UKCEH).

It is noted that the thresholds to determine whether flow is a stressor for the macroinvertebrate community differs based on waterbody type and that the O:E ratio for the chalk streams associated with the Thames Water DP is 1.0. The Environment Agency has noted that chalk stream habitats and chalk streams and particularly headwaters sections are not that well accounted for in RIVPACS. Therefore, the O:E scores should be interpreted with caution. For soft water / non chalk streams the threshold is 0.94.

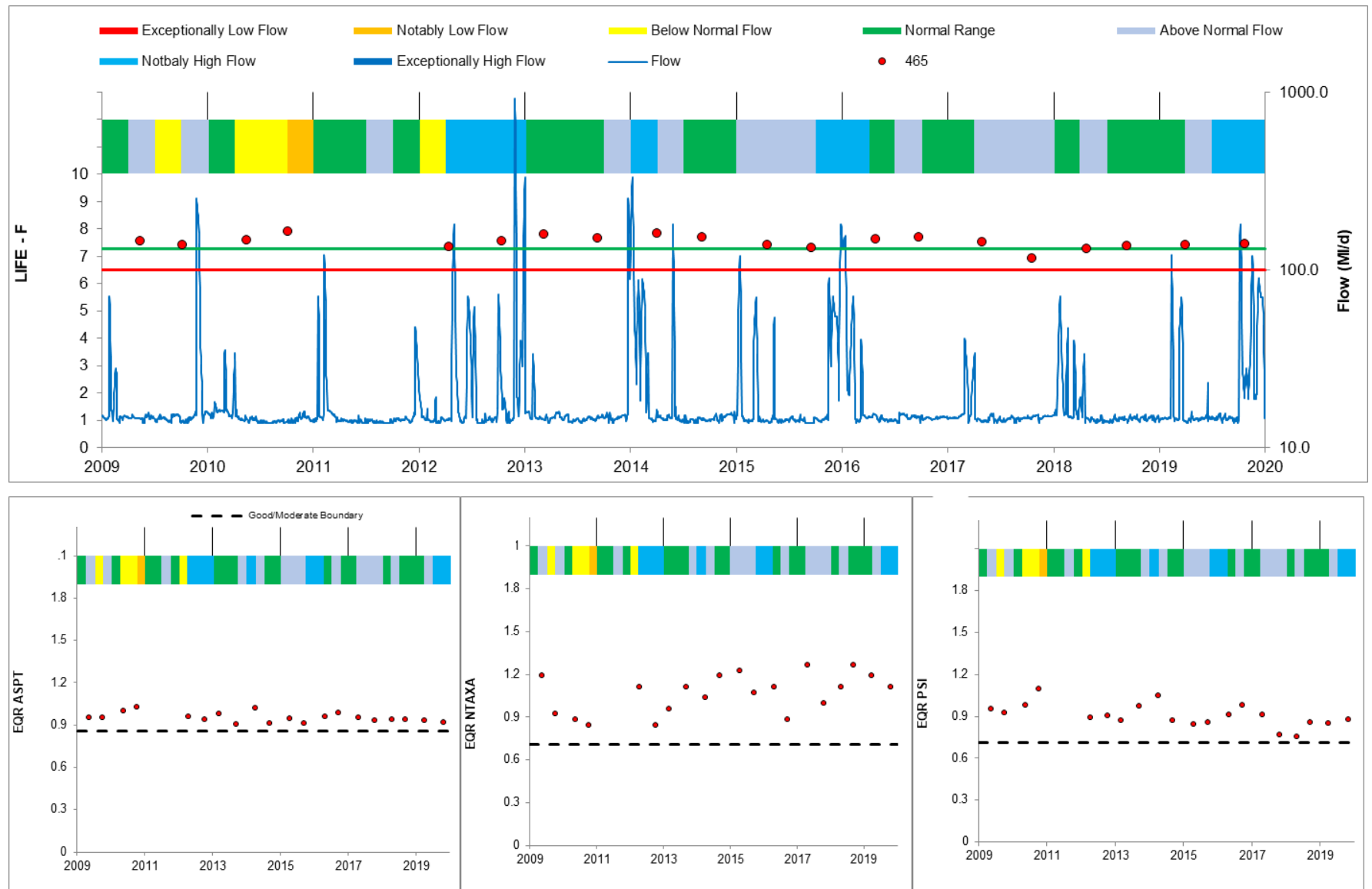
For reaches that are considered estuarine (e.g. in the Lower River Thames), the benthic invertebrate classification tool, the Infaunal Quality Index (IQI) has been developed. The IQI was developed to fulfil the requirements of the WFD with respect to the benthic invertebrate quality element in transitional and coastal (TraC) waters. The IQI consists of three measure including the number of taxa, Simpson's Evenness Index and the AZTI Marine Biotic Index (AMBI). The latter is a measure of the overall pollution sensitivity of a benthic assemblage. The EA has indicated that under low salinity conditions, the IQI is also not a suitable index. For the purpose of the assessment of tidal/estuarine reaches, the diversity data provided by the EA has been used to inform the assessment of the potential drought permit related impacts on the benthic invertebrate community.

Where macroinvertebrate communities are considered to have a **high** or **medium** sensitivity to drought management actions, the communities have been considered for further assessment. The macroinvertebrate community has also been considered for further assessment where the community is associated with designated sites or where there is low confidence in the baseline data used to inform the assessment. The assessment of sensitivity has also been used to inform the scope of the impact assessment for the macroinvertebrate community. The assessments of the macroinvertebrate community considers a range of potential changes to the community structure (depending on the impacts on the physical environment. This could include, for example, the risk of a reduction in species diversity as a result of the loss of flow-sensitive taxa, the risk of a loss of marginal habitats and reduction in abundance and distribution of species utilising such habitats, the reduction in species diversity as a result of sedimentation, etc.

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<sup>17</sup> Glendell M, Extence C, Chadd R and Brazier R (2014). Testing the pressure-specific invertebrate index (PSI) as a tool for determining ecological relevant targets for reducing sedimentation in streams. *Freshwater Biology* 59(2)

Figure 3.4: Example of graphical representation of macroinvertebrate biological indices and hydrology to be included for each hydrological reach (note that LIFE F scores will be replaced by O:E scores for DP2022)





### 3.5.7 Fish community

For 2017, the sensitivity of the fish communities was informed by considering 10 years (2005 – 2015) of baseline data for each hydrological reach identified. Having established the baseline conditions and variability outside the drought option conditions, the sensitivity of the fish community to the impacts on the physical environment was then determined. This included the risk to delayed/restricted migration, loss of habitat (in particular salmonid spawning or nursery habitat), fish stranding, fish distress leading to disease outbreaks, fish kills, transfer of invasive non-native species and impacts on angling (for example, closure of fisheries and/or cancellation of fishing events). The analysis also considered the importance of the study area as a migratory pathway for diadromous fish species and spawning and nursery habitat for protected and notable species.

For DP 2022, the baseline data (indices and diversity data) to inform the sensitivity of the fish community associated with the zone of influence of each drought option has been updated to consider the most recent data (2009-2019). This is in line with the DPG requirements for considering long-term data. Where available, data from periods representing droughts or extreme low flow conditions has also been considered.

Data has been obtained through the Environment Agency's Ecology and Fish Data Explorer (<https://environment.data.gov.uk/ecology-fish/>). Where available, these data have been supplemented by other sources including the Thames Water's baseline monitoring programme and data collated from other Thames Water monitoring programmes (e.g. Heavily Modified Waterbody Investigations, Water Industry National Environmental Programme Investigations, etc). Where applicable, the assessment of salmon stocks and fisheries in England and Wales and the relevant Conservation Limits has also been considered in the assessment along with the distribution of rivers considered as principal to the protection of salmon, sea trout, brown trout and coarse fisheries. The location of the survey sites that informed the baseline conditions, the number of surveys completed at each survey site and the dates when surveys were undertaken has been provided. This information has been used to define the confidence of the sensitivity assessment.

For DP 2022, trends in species distribution and/or abundance has also been informed by data obtained through the Environment Agency's Ecology and Fish Data explorer. In addition, Environment Agency Fisheries Classification Scheme 2 (FCS2) data (obtained from the Environment Agency) have also been considered. These data include an individual species ecological quality ratio (EQR), a site EQR and a Water Body EQR. The individual species EQR is interpreted as the probability of observing the number of individuals which were actually observed, or less, if the site were at reference conditions. The site EQR combines the probabilities obtained for each individual species and the Water Body takes all the Site EQRs relevant to that Water Body and calculates a mean for the Water Body. The data collected through fish population surveys have also been used to further inform the species and life stages to consider in the impact assessment section.

Where fish communities are considered to have a **high** or **medium** sensitivity to drought management actions, the communities have been considered for further assessment. The fish community has also been considered for further assessment where the community is associated with designated sites or where there is low confidence in the baseline data used to inform the assessment. The assessment of sensitivity has also been used to inform the scope of the impact assessment for the fish community.

### 3.5.8 Invasive non-native species (INNS)

It will be considered an offence under the Wildlife and Countryside Act 1981 if any drought option results in the spread of Invasive Non-Native species (INNS) listed in Schedule 9 to the Act. For DP 2017, the risk of the increasing the distribution of any INNS as a result of a drought option was informed by baseline data (2005-2015) for the species, abundance and distribution within the zone of influence of each drought option.

For DP 2022, 10 years of baseline data (2009 – 2019) for each hydrological reach identified has been considered. Anecdotal evidence collected during routine biological monitoring programmes implemented by the Environment Agency, Thames Water, and any third party monitoring programmes targeting INNS surveys has been considered. This includes the open source data available from the National Biodiversity Network (NBN) (<https://registry.nbnatlas.org/public/show/dr827>). These data

sources have been reviewed for the presence and/or abundance for those animals and plants listed in Schedule 9 Wildlife and Countryside Act 1981.

For DP 2022, the current impact assessment completed for INNS has been reviewed to consider updated published information, including the risk assessment completed for many of the species considered as INNS as part of the Great Brittan Non-Native Organism Risk Assessment Scheme (<http://www.nonnativespecies.org/index.cfm?pageid=143>). In particular, the risk assessment considers the existing distribution of the INNS, the potential pathway for distribution, the likelihood of the drought option providing a further pathway for distribution and the likely increase in extent of the INNS distribution as a result of the drought management action.

Where drought options could result in a **high** or **medium** risk to the distribution of INNS, or a **high** or **medium** impact on other ecological features, the particular species has been considered for further assessment. This assessment considers the potential impacts on the associated ecological features.

### 3.5.9 Other users

The Environment Agency's DPG2020 requires water companies to demonstrate that, in addition to environmental features, the implications of drought management actions on elements/features such as aesthetics, recreation, navigation, archaeology and heritage has also been considered.

For DP 2017, the sensitivity assessment was completed by adopting a GIS based analysis of the geographical location of elements/feature in relation to each particular zone of influence. This identified elements/features that are directly and indirectly associated with the drought management actions.

The GIS based analyses were supplemented by data request to identify waterbodies that were considered important for navigation and recreational purpose. In addition, the data obtained from the Environment Agency on other abstractors (see **Section 3.4.4.2**) was also considered to determine the risk to other consumptive and non-consumptive abstractors in each hydrological reach.

The elements/features that were considered in the screening exercise included:

- Impacts on the recreational use of waterbodies;
- Impacts on landscape character and amenity;
- Impacts on sites of archaeology and cultural heritage importance;
- Impacts on waterbodies used for navigation; and
- Impacts on the availability of water for other abstractors.

For DP2022, the screening and assessment of the impacts on other users has been reviewed to consider any updated information available post 2015 up to 2019.

### 3.5.10 Summarising sensitivity of the environmental features

In 2017, where features are considered to have a medium or high sensitivity to drought options, these were considered for detailed assessment. The exception was sites and features that were considered to be of national or international importance. In such cases, features were also be considered for detailed assessment where a low sensitivity has been identified. In addition, where the susceptibility/sensitivity of any feature or the impact on such features is considered uncertain (for example due to low confidence in data), these features have also been considered in the assessment with specific monitoring and mitigation needs specified.

For DP 2017, the outcomes of the screening and sensitivity assessment was tabulated as per the example in

**Table 3.6.** The tables in each EAR have been reviewed during the DP 2022 updates and the sensitivity analysis has been updated in consideration of the updated baseline data (as per Section 3.5.1-3.5.7).

**Table 3.6: Designated Sites, NERC Act Section 41 Species and Other Sensitive Fauna and Flora Within the Zone of Influence of the Sundridge Drought Permit**

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, Moderate/Major, Minor, Negligible)	Further Consideration Required (Yes/No)
Sevenoaks Gravel Pits SSSI	Moderate	Subsequent to the scoping phase the hydrological assessment has identified that whilst the lakes in the Sevenoaks Gravel Pits SSSI are offline, they are in continuity with the impacted reach of the River Darent through the gravels that underlie the lakes.	Moderate	Yes
Otford to Shoreham Downs SSSI	Moderate	Site is not designated for features that are water dependent therefore the drought option will have no impact on the site.	Negligible	No
Farningham Wood SSSI and LNR	Moderate	Despite its proximity to the River Darent, this site is elevated approximately 40m above the river which suggests that due to the local topography, it will not be in connectivity with either the river or the underlying aquifer. Consequently, the site is considered to be of negligible sensitivity and no further assessment is required.	Negligible	No
Farthing Downs & Happy Valley (SSSI)	Groundwater Zone of Influence	The chalk of the North Downs comes to the surface over most of the site but is overlain by clay-with-flints on the western slopes of Happy Valley. The distribution of grassland and woodland communities reflects this variation in geology and the associated changes in soil types. Drawdown will be less than 3cm. Flow is virtually all through fractures and other discontinuities and impact pathways are unlikely.	Negligible	No
Quarry Hangers (SSSI)	Groundwater Zone of Influence	Site underlain by the grey chalk and white chalk subgroups with groundwater flow restricted to fractures and other discontinuities. Drawdown from these areas expected to be less than 4cm. Site includes a mixture of species-rich chalk grassland, scrub and woodland, and supports a number of plants which are rare or local in Surrey, as well as local invertebrates. Vegetation is not considered to be water dependent	Negligible	No
Titsey Woods (SSSI)	Groundwater Zone of Influence	This site, comprising Titsey, Clacket, Church and Square Woods is selected primarily as an example of wet semi-natural woodland on the Gault Clay, which has a limited outcrop in Surrey. Drawdown expected to be less than 5cm, but site underlain by Gault formation and associated with low permeable clays	Negligible	No
Woldingham & Oxted Downs (SSSI)	Groundwater Zone of Influence	Site underlain by the grey chalk and white chalk subgroups with groundwater flow restricted to fractures and other discontinuities. The site includes rich chalk grassland, scrub, and mature and secondary woodland supporting many species of characteristic plants and animals, a number of which are rare. However, drawdown expected to be less than 5cm	Negligible	No
<b>NERC Act Section 41 Species - Crustacea</b>	Moderate (Reach 1)	The NERC act Section 41 states that the species is sensitive to habitat modification from the management of water bodies.	Moderate	Yes
White-clawed crayfish	Minor (Reach 2)	Therefore, they are considered to be sensitive to hydrological impacts, particularly low flows.	Minor	No

<i>Austropotamobius pallipes</i>	Moderate (Reach 1)	Potentially susceptible as the duration of impact could incorporate all seasons, thus could impact on spawning, migration (particularly eel), provision of cover etc.	Moderate	Yes	
<b>NERC Act Section 41 Species - Fish</b>					
Brown / sea trout <i>Salmo trutta</i> European eel <i>Anguilla anguilla</i>	Minor (Reach 2)		Minor	No	
<b>-NERC Act Section 41 Mammals</b>	Moderate (Reach 1)	The species are not expected to be significantly impacted on by the implementation of the drought option against a baseline of reduced flows characteristic of a drought.	Minor	No	
Otter <i>Lutra lutra</i> Water vole <i>Arvicola amphibious</i>	Minor (Reach 2)			Negligible	No
<b>Notable species – fish</b>	Moderate (Reach 1)	Potentially susceptible as the duration of impact could incorporate all seasons, thus could impact on spawning, provision of cover and reduced habitat suitability.	Moderate	Yes	
Bullhead <i>Cottus gobio</i>	Minor (Reach 2)			Minor	No
<b>NERC Act Section 41 Priority Habitats-</b> Coastal and floodplain grazing marsh	Moderate (Reach 1)	NERC priority habitats are of principal importance for the conservation of biodiversity in England. Fifty-six habitats are included on the S41 list. They include terrestrial habitats such as upland hay meadows to lowland mixed deciduous woodland, and freshwater and marine habitats such as ponds and subtidal sands and gravels. Reduction in flow and water level could therefore impact on macroinvertebrates, macrophytes and fish communities associated with these habitats. There are no NERC habitats along reaches 1. As such there is no requirement for further assessment. Coastal and floodplain grazing marsh has been identified in reach 2. As the hydrological impact associated with the drought permit in reach 2 is minor, the NERC habitats have not been included for further assessments. Chalk streams are an important habitat in a national and international context. Chalk stream communities often consist of NERC Section 41 Priority and other notable species. Reduction in flow and water level could therefore impact on macroinvertebrates, macrophytes and fish communities associated with these habitats.	Negligible	No	
	Minor (Reach 2)			Negligible	No
	Moderate (Reach 1)			Negligible	No
<b>Notable habitat - Chalk stream</b>	Moderate (Reach 1)	The drought option will result in abstraction from the Lower Greensand aquifer and impacts on the reaches associated with the chalk aquifers are expected to be minor.	Negligible	No	
<b>Notable Species – Macroinvertebrates</b>	Minor (Reach 2)	Species are considered to be sensitive to changes in either flow or water quality. There is potential for a reduction in species abundance and distribution as a result of impacts of the drought permit	Moderate	Yes	
<i>Riolus subviolaceus</i> <i>Ceraclea senilis</i>	Moderate (Reach 1)			Minor	No
<b>Invasive species - Macroinvertebrates</b>	Moderate (Reach 1)	There is uncertainty surrounding the likely effect of flow and level impacts on invasive species ability to distribute further within the watercourse.	Moderate	Yes	
Signal Crayfish	Minor (Reach 2)			Minor	No

<i>Pacifastacus leniusculus</i> Spiny Cheek Crayfish <i>Orconectes limosus</i> Zebra Mussel <i>Dreissena polymorpha</i> Chinese Mitten Crab <i>Eriocheir sinensis</i> <i>Dugesia tigrina</i> <i>Crangonyx pseudogracilis</i>				
<b>Invasive species – Riparian Flora</b>	Moderate (Reach 1)		Moderate	Yes
Japanese knotweed <i>Fallopia japonica</i> Giant hogweed <i>Heracleum mantegazzianum</i> Himalayan balsam <i>Impatiens glandulifera</i>	Minor (Reach 2)	These invasive plant species can use the flow of the watercourse for dispersal but are not reliant on it. Implementation of the drought permit will do nothing to increase dispersal of these species.	Minor	No
<b>Invasive species - Aquatic Flora</b>	Moderate (Reach 1)		Uncertain	Yes
Australian swamp stonecrop <i>Crassula helmsii</i> ; Parrot's feather <i>Myriophyllum aquaticum</i> ; and Floating pennywort <i>Hydrocotyle ranunculoides</i> .	Minor (Reach 2)	As these invasive plant species do not rely on the flow of the watercourse for dispersal, the implementation of the drought permit may increase their dispersal, although the level of impact beyond that of natural drought is uncertain.	Minor	No

## 3.6 Assessing Impacts

### 3.6.1 Impacts on habitats and species

In 2017, where screening of the drought options identified that an environmental feature is present within the zone of influence of the drought option and screening indicated that it is sensitive to the impacts of a drought option, the potential impact was investigated.

Features were only included for further assessment where the sensitivity was determined to be **medium** or **high** in nature. The exception was habitats and species that has been identified as being of international or national importance. These features were considered for further assessment where a sensitivity of **low**, **medium** or **high** was identified.

The assessments also considered the impacts of the changes in flows, water quality and geomorphology as a result of the drought option, and the consequent impacts on the habitats and species. Potential effects were associated with either:

1. direct reduction in river levels and/or flows;
2. a delay in the recovery of groundwater levels and the subsequent delay in the return to baseline river levels and/or flows;
3. direct reduction in groundwater levels;
4. a reduction in water quality; and

#### 5. secondary effects of reduced velocity, for example on sediment characteristics.

In order to define the potential impacts on habitats and ecological communities in a readily understandable manner, a series of criteria have been defined using both the Chartered Institute of Environmental Management (CIEEM) Ecological Impact Assessment (EclA) 2019<sup>18</sup> guidance and the Environment Agency's DPG2020.

It is important to note that the two pieces of guidance differ in their approach to assigning a significance value.

The CIEEM guidance 2019 advises that the determination should consider whether a given impact will be ecologically significant or not at the geographic level of value assigned to that receptor. This means that the level of significance cannot be higher than that geographic value. It is sometimes possible that an impact may not be significant at the receptor's given level of value due to its low magnitude, duration, etc., but may be significant at a lower geographic scale. For example, the effects of an impact on a species of county value may not be discernible or significant at the county scale, but may be felt at the district scale.

However, the DPG2020 advocates the categorisation of the likely environmental impacts of drought management actions as either significant, moderate, minor or uncertain.

Therefore, a combination of the two guidelines has been used for the assessments; CIEEM guidance for valuing and characterising the impacts, and the EA Drought Plan Guidance for assessing sensitivity, magnitude and providing an overall significance rating.

To do this, two key formulae have been used as follows:

1. Impact Significance = *Value x Effect Magnitude*
2. Effect Magnitude = *Timing (summer or winter) x Scale (extent of impact) x Duration (short term or long term).*

##### 3.6.1.1 Impact Significance

###### **Value of the Ecological Receptor**

When assigning a value, consideration is given to abundance, range and geographical distribution, and historic trends (e.g. if a species is rare and population is in decline). It is important to note that there is a difference between the legislative and conservation status of an ecological receptor i.e. although a species may be identified as an Annex II species, unless the population is contained within a SAC, it is unlikely to warrant an international value. The approach to valuing ecological receptors is detailed in

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<sup>18</sup> CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester. Updated September 2019

**Table 3.7.**



**Table 3.7: Value of Ecological Receptor**

Ecological Value	Example
International	<p>An internationally designated site or candidate site, i.e. a Special Protection Area (SPA), proposed SPA (pSPA), Special Area of Conservation (SAC), candidate SAC (cSAC), Ramsar site, or an area which would meet the published selection criteria for such designation. Other significant areas of Annex I priority habitats<sup>19</sup> listed in the Habitats Directive, the loss of which would significantly change the overall range and area at the European scale in the long term.</p> <p>Internationally significant populations of European Protected Species (Annexe IV), Annexe II species<sup>20</sup>, or species otherwise formally deemed to be rare and threatened in Europe or globally (e.g. IUCN 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the European scale.</p>
National	<p>A nationally designated site, i.e. SSSI, National Nature Reserve (NNR) or discrete area which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A significant area of a non-designated habitat type identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the national scale in the long term.</p> <p>Nationally significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the national scale.</p>
Regional	<p>A significant area of a non-designated habitat type identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the Thames region in the long term.</p> <p>Regionally significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) in the North and North-West region.</p>
County	<p>Sites formally recognised by local authorities, e.g. Sites of Metropolitan Importance for Nature Conservation (SMINC), or considered to meet published ecological selection criteria for such designation.</p> <p>A significant area of a non-designated habitat type identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the county/metropolitan scale in the long term. A significant area of key habitat identified in any County/Metropolitan biodiversity and or conservation plans.</p> <p>Significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the metropolitan scale. Significant and viable populations of other species identified as metropolitan priorities in any County/Metropolitan biodiversity and or conservation plans.</p>
District	<p>Sites formally recognised by local authorities, e.g. Sites of Borough Importance for Nature Conservation (Borough/Local SINC), Local Nature Reserves (LNRs), or considered to meet published ecological selection criteria for such designation.</p>

<sup>19</sup> A sub-set of the Annex I habitat types are defined as being 'priority' because they are considered to be particularly vulnerable and are mainly, or exclusively, found within the European Union (Article 1d). Of the 76 Annex I habitat types that are known to occur in mainland UK, 23 are defined as priority habitat types

<sup>20</sup> Annex II lists 788 species, of which 61 have been recorded in the UK (excluding Gibraltar) since 1900. A sub-set of Annex II species considered to be particularly rare or endangered are defined as 'priority species'. Only one of these, a liverwort, is known to currently occur as a native in the UK.

Ecological Value	Example
	<p>A significant area of a non-designated habitat type identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the greater district/borough scale in the long term. A significant and viable area of habitat identified in any district biodiversity or conservation plan.</p> <p>Significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or priority habitat in the County/Metropolitan BAP or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) in any district biodiversity or conservation plan.</p>
Parish (local)	Semi-natural habitats or species, listed on any of the above-mentioned priority lists, that appreciably enrich District/Borough biodiversity, but which are not in themselves of District/Borough importance.
Site (within zone of influence only)	Areas of habitat and/or species populations of limited ecological importance due to their size, species composition or lack of threat/rarity. The loss of such features would have no discernible impact on the species'/habitat's overall range and conservation status at any administrative scale in the long term

### 3.6.1.2 Magnitude of the impact on habitat or species

The implementation of the drought option, and the resulting changes in the physical environment, could affect habitat quality, population/community status, breeding or migration potential. The following characteristics have, therefore, been considered in determining the impact (as summarised in **Table 3.8**):

- **Positive or Negative Impact** – all impacts are considered to be negative unless otherwise stated in the feature assessment.
- **Extent** – the extent of the impact is the spatial or geographical area over which the impact/effect may occur.
- **Magnitude** – the magnitude of the impact looks to define the potential change in WFD status/change in size, amount, volume of the ecological communities (quantified where possible e.g. % of habitat lost, % of population subject to decline). [Note, this is different to the overall magnitude value produced using the Drought Plan Guidance 2016].
- **Duration** – the duration of impact is considered to be for 6 months, which is the duration for which a drought permit/order is implemented, unless otherwise stated. However, it is noted that the impact duration should also consider the receptor as a 6-month period of implementation could have a much longer impact on certain features. As an indicative guide for this assessment
  - for species receptors:
    - short-term is up to one season (e.g. migration, spawning, flowering and univoltine life cycles associated with fly life, etc.) – as a rough guide, 6 months to a year for fauna;
    - medium-term is up to one typical reproductive life-span (in the wild). This varies greatly depending on species, but generally anything from one year to 5 years as a rough guide for fauna; and
    - long-term is over several (species) generations.
    - permanent is where no reasonable chance of recovery/restoration is evident within the foreseeable future.
  - For habitat receptors:
    - short-term is the typical regrowth period for many submerged macrophytes, grass and herb communities;
    - medium-term is the typical regrowth period for many slower growing aquatic macrophytes, a reed bed, shrub and hedge communities;

- long-term is the typical regrowth period for riparian trees and woodland communities<sup>21</sup>; and
  - permanent is where no reasonable chance of recovery/restoration is evident within the foreseeable future.
- **Reversibility** – all impacts are considered to be reversible unless they are identified to have a likely impact on the overall viability of the ecological receptor. A reversible impact is one:
  - from which spontaneous/natural recovery is possible; or
  - for which effective mitigation is both possible and an enforceable commitment to this can, in theory, be made.
- **Timing and Frequency** – the drought permit/order could be implemented at any point in the year (unless otherwise stated in the assessment), however the different life stages of the ecological species are taken into account. The assessment is based on the operation of a single drought permit/order for a period of 6 months, with subsequent applications for a drought permit/order required to consider cumulative effects of multiple drought permits/orders.
- **Probability** – all impacts are considered to be probable, unless otherwise stated.

**Table 3.8: Magnitude of Impact on habitat or species**

Magnitude of Impact	Description
High	There is a long-term large-scale (i.e. in relation to the size/distribution of the ecological receptor) change in the ecological receptor and/or changes in the overall viability of the ecological receptor.
Medium	There is a short-term large-scale change or long-term short-scale (i.e. in relation to the size/distribution of the ecological receptor) change in the ecological receptor, however no changes in the overall viability of the ecological receptor.
Low	There is a short-term small-scale change in the ecological receptor, but its overall viability is not impacted.
Negligible	No perceptible change in the ecological receptor.

There is little supporting information in the draft DPG2020 to understand exactly how to interpret the overall magnitude and impact significance value. For the purpose of the environmental assessments that will inform Thames Water’s DP 2022, the significance of the impact has been determined using the approach as outlined in **Table 3.9**.

**Table 3.9: Significance of Impact on habitat or species**

Value	Magnitude of Impact			
	High	Medium	Low	Negligible
International	Significant	Significant	Moderate	Negligible
National	Significant	Moderate	Moderate	Negligible
Regional	Moderate	Moderate	Minor	Negligible
County	Moderate	Minor	Minor	Negligible
Local	Minor	Minor	Negligible	Negligible
Site	Minor	Negligible	Negligible	Negligible

As required in the DPG, the significance of the impacts identified have been used to identify:

- environmental monitoring that will be carried out to support and ground-truth environmental assessments (including in-drought and post-drought – recovery monitoring); and
- the level of confidence in the assessment of the likely environmental impacts of drought management actions and how uncertainty will be reduced.

<sup>21</sup> This excludes ancient woodland and veteran trees which, if lost, represent a permanent impact.

For DP 2022, the impact assessment undertaken for DP 2017 has been reviewed. These assessments have been updated, where required, in consideration of the updated baseline data, should the latter identify a change in sensitivity to drought options. Subsequently, the monitoring and mitigation requirements has been updated (if required) to reflect the updated assessments. As per DP 2013 and DP2017, monitoring and mitigation impacts have only be considered where impacts are considered to be moderate or significant (expect for internationally and nationally protected habitats and species where monitoring and mitigation has also been specified where a low impact has been identified).

### 3.6.2 Impacts on WFD status/regulations

The DPG2020 requires Thames Water to consider the implications of drought actions on all water bodies affected and for all relevant classification elements, particularly if deterioration (temporary or otherwise) is likely to occur. Where deterioration is likely to occur as a result of a drought option, the drought plan should clearly set out what this will be and how it will be mitigated. Deterioration is a drop in status class of any element set out in Annex V of the WFD, irrespective of whether this causes a deterioration in status of the water body overall. Where an element is already in the lowest class, any deterioration of that element would constitute a deterioration of the status, i.e. where an element is in its lowest status class (bad), no further deterioration of that element is allowed. Where a two-status classification is used, this also applies to the lower class.

In 2017, for WFD river waterbodies within the zone of influence of the drought options, where screening of the drought options identified a risk to the macroinvertebrate and/or fish element, the potential impact risk to WFD deterioration was investigated. This investigation assessed any risk of deterioration to status, as specified by the Environment Agency's DPG2016.

The screening section of each EAR listed the overall WFD status of the WFD Waterbody associated with each drought management action along with an indication of the WFD status of the individual biological elements. The WFD status was informed by the status as that published in each relevant River Basin Management Plan (2015). Intermediate status updates have been provided by the Environment Agency, where available, and these have been considered in the review of the assessments completed for DP 2022.

The assessment considered the scale and longevity of any macroinvertebrate and fish community impacts as determined using the approach above (see **Section 3.6.1**).

The WFD macroinvertebrate classification is calculated on a 3 year rolling basis. A deterioration in classification would require a long term and significant effect on macroinvertebrate community structure to establish prediction of a deterioration in status. The WFD classification for the fish element is calculated using FCS2 and is based on a six year rolling monitoring programme. A deterioration in classification would require a long term (2+ breeding seasons) and significant effect on fish population structure to allow prediction of a deterioration in status. The potential risk to increased distribution and ecological impacts of INNS has also been considered as part of the WFD assessment. It is noted that, although considered over a 3-year and 6-year rolling average respectively, one annual macroinvertebrate or fish survey might be taken over that time and could be sufficient to trigger a deterioration in status.

In order to define the potential WFD status impacts for the biological elements in a readily understandable manner, a series of criteria was defined. The assessment used the following criteria, based on the potential severity of the drought option impacts during an ongoing drought.

- **Significant:** A significant impact is one that results in deterioration in the WFD classification of the waterbody, or specifically biological (fish and/or macroinvertebrate) element of the classification. Where drought options occur in heavily modified waterbodies (HMWB) (and hence fish and/or macroinvertebrate status is not currently material to classification) the deterioration in fish biological element classification grade (e.g. Good to Moderate) will normally take precedence.
- **Moderate:** A moderate impact on fish and/or macroinvertebrate status occurs when the populations are predicted to be materially influenced, including effects on density, abundance or community composition, but where no deterioration in WFD classification is predicted.

Consideration should be given to the scale of the impact and the potential for recovery of the populations.

- **Minor:** A minor impact occurs when there is a predicted impact on fish and/or macroinvertebrate abundance, density or community composition that is within the usual variability for the site and which will recover within a short timescale.
- **Negligible:** A negligible impact is one where the predicted impact will not result in a detectable change in the fish population.

The assessments in DP 2017, adopted a precautionary approach, with potential impacts highlighted where doubt/uncertainty exists. Monitoring and mitigation proposals for the drought management actions were then specified so that, should an option be implemented, the actual impact can be recorded, and adaptive mitigation/management of the option undertaken to safeguard where possible the macroinvertebrate and/or fish community.

For DP2022, the updated RBMP information (2019) has been used to update the assessment of the risk to deterioration completed for DP 2017.

For DP 2022, the assessment has also considered the water body status objectives and, where applicable, the protected area objectives and the implications of drought options on the programmes of measures required to achieve those environmental objectives. Where data are not available, the assessment has been undertaken using expert judgement and drawing on broad-scale evidence from other similar catchments within the reservoir group.

With regards to the WFD risks associated with ground waterbodies, one needs to consider the effects at the water body scale for the groundwater quality and quantity tests and, more locally specific GWDTEs. WFD groundwater body status is a relatively 'coarse' feature to use for screening with respect to groundwater impacts. WFD groundwater bodies can be significant in size and the assessment for groundwater status involves the use of long term average data sets for the groundwater body as a whole. Hence, for DP 2017, WFD groundwater body status was considered at the screening stage for context, however, no further assessment of any impacts on the status has been made. It is noted that the potential drought permits, and orders could result in a decrease in groundwater level and/or a delay in recovery of groundwater levels, but groundwater infiltration rates will not be impacted. In addition, drought permits or orders will be extremely unlikely to result in water quality impacts and will not result in any changes in groundwater infiltration rates. However, as groundwater levels could be impacted, the potential risk to WFD status in the context of GWDTEs has been considered in DP2022.

As described above, the Section 3.4 the hydrogeological assessment of groundwater related impacts were updated for DP 2017 to consider GWDTEs. Where applicable, the risk to GWDTE has been considered for DP 2022, although the risk to WFD deterioration of the ground water body is a whole has not been undertaken. The methodology for hydrogeological impacts is necessarily specific to the drought permit and relies on consultation with relevant Environment Agency staff which has been undertaken in order to understand issues at a local and more appropriate level.

### 3.6.3 Cumulative impacts

In accordance with the DPG2020, the assessments should also consider how proposed drought actions may affect the environment in combination with the effects of existing licences, permits and plans.

There are a range of types of cumulative impacts that would require addressing, in particular:

1. Existing abstraction licences that operate within the hydrological zone of influence of the drought options, as well as other abstraction and discharge permits;
2. Assessment of the most likely cumulative impacts of the drought permit with other Thames Water supply side and drought permit / order options within the hydrological zone of influence (including both intra- and inter- zone options);
3. Potential cumulative impacts with other third parties' drought schemes (e.g. EA environmental drought schemes and the West Berkshire Groundwater Scheme).

Extensive work has previously been undertaken on the assessment of cumulative impacts of the implementation of various Thames Water’s drought options and cumulative impacts of Thames Water’s drought options with other water company drought plans during the preparation of DP 2017.

Not all potential cumulative assessment was undertaken to the same level of detail, as can be seen from **Table 3.10** below, e.g. a brief summary of potential impact was included for the cumulative implementation of Wansunt and Crayford, and for Farmoor and Gatehampton, but more detailed assessments were undertaken for other options, e.g. Latton and Meysey Hampton, etc. Potential cumulative assessments were also identified for Thames Water’s options with other water company drought options, e.g. the Lower Thames drought option when implemented with three different Affinity water abstractions, but no assessment was undertaken.

The cumulative assessments listed in **Table 3.10**, have been updated for DP 2022. The current assessments have been reviewed and updated (where required) to reflect any changes in the existing sensitivity and impact assessment completed for each EAR. As per Section 3.5, this review and update has not included the hydrological/geohydrological impacts associated with each drought option and associated cumulatives.

**Table 3.10: List of drought options considered in DP2017 for cumulative assessment and the level of details pertaining to each assessment\*.**

WRZ	Thames Water Drought option	Cumulative Level of Assessment	Interaction with other Water Company Drought Plans	Level of Assessment
SWOX	Farmoor and Gatehampton	High level	N/A	
	Latton and Meysey Hampton	Detailed	N/A	
	Axford 1 and Ogbourne 1	Detailed	N/A	
	Ogbourne 1 and Ogbourne EBH	Detailed	N/A	
	Axford 2 and Ogbourne 1 and Ogbourne EBH	Detailed	N/A	
	Baunton (2) and Latton	Detailed	N/A	
	Baunton (2) and Meysey Hampton	Detailed	N/A	
	Baunton (2) and Bibury	Detailed	N/A	
	Lower Thames		Affinity (3 abstractions)	None
	Waddon		SES (Hackbridge)	Detailed
London	Wansunt and Crayford	High level	N/A	
	Sundridge 1 and Eynsford	Detailed	Kemsing (South East Water) - to be confirmed by South East Water	None
	Sundridge 2 and Eynsford	Detailed	Kemsing (South East Water) - to be confirmed by South East Water	None
Kennet	Fobney Direct and Fobney EBH	Detailed	N/A	

\*excludes any cumulatives with Compton drought permits (1 and 2) and the Sor Brook, Blewbury and New Ground drought permits

## 3.7 Environmental Management Plan (EMP)

### 3.7.1 Requirements of the DPG

As indicated in **Figure 3.1**; the DPG2020 requires Thames Water to set out an Environmental Management Plan (EMP) indicating the monitoring and mitigation required following assessment of the sensitivity and impacts associated with drought options. In particular, the DPG2020 indicates that any drought plan should be accompanied by an EMP that sets out:

- on-going baseline monitoring to inform sensitivity and impact assessments;
- the monitoring that will be implemented to reduce uncertainty identified in the assessment of either the sensitivity of the environment or impacts on features considered in the detailed assessment; and
- the in-drought and post-drought (recovery) monitoring that will be carried out to understand the actual impact of drought management actions.

The DPG requires monitoring programmes to be designed to understand the difference between the natural impact of drought on the environment and that caused by implementing supply side drought management action and normal level of licensed abstraction. This can only be achieved by planned, effectively designed monitoring programmes. The DPG2020 suggests using a Before-After-Control-Impact (BACI) approach. Paired control and impact sites monitored under baseline, in-drought and post-drought (recovery) stages could assist with understanding the differences between the impacts of natural droughts and drought management actions.

As indicated in **Figure 3.1**; the DPG2020 also requires Thames Water to set out a mitigation plan following the assessments of potential impacts associated with each drought management action. In particular, the DPG2020 indicates that any drought plan should be accompanied by an EMP that sets out:

- mitigation measures to reduce adverse impacts on the environment of supply side drought management actions; and
- compensation measures for adverse effects that remain after mitigation measures have been applied.

The draft DPG2020 requires that this information is set out as a separate document alongside, and linked to, each of the environmental assessments.

### 3.7.2 Thames Water's Drought Plan 2022 EMP

A summary of the monitoring and mitigation for each drought option was provided in each EAR chapter for DP 2017, with details regarding the monitoring and mitigation provided in separate chapters.

The current EMP fulfils several requirements of the DPG 2020, including:

- Establishing required baseline environmental monitoring and data acquisition to maintain and update the understanding of the environmental baseline conditions;
- Pre-drought permit monitoring which will allow for describing the prevailing environmental conditions prior to drought permit or order implementation. This will inform the implementation and management of mitigation actions during the drought;
- During-drought permit monitoring which will describe the environmental conditions during the implementation of the drought permit. Surveillance monitoring of sensitive locations, informed by walkover surveys and the results of the pre-drought monitoring, will provide early warnings of any unpredicted environmental impacts and ensure the mitigation actions are operating as designed;
- Post-drought monitoring to describe the recovery of environmental conditions following the cessation of a drought permit and establishes whether the affected ecosystems have recovered to conditions prevailing in the pre-drought period; and
- Specification of monitoring to provide an understanding of the effects of a drought and implementing a drought permit on the environment by assessing the impacts of drought management actions during and after a drought.

The EMP sections that accompanied Thames Water's Drought Plan 2017 provided a framework for monitoring and mitigation that would be followed during a drought permit/order. The EMP built on the information presented in the previous EMP, prepared for Thames Water's Drought Plan 2013 and has also considered the outcomes of consultation with the Environment Agency and Natural England.

In 2017, the monitoring and mitigation associated with each drought option was updated to reflect the comments provided by the Environment Agency. In particular, this included updates to include relevant control sites and the approach to walkovers at the onset of drought.

The structure/details of the EMP for DP 2017 is provided in the sections below and has been reviewed and updated (where changes to impacts have been identified) for DP 2022.

### 3.7.2.1 Monitoring to inform sensitivity, impact assessments and reduce uncertainty (baseline monitoring)

The level of monitoring identified in each EMP was risk-based. It was tailored to the characteristics of the study area and was informed by the knowledge and assessment of environmental sensitivity as described in each EAR.

Monitoring outside of drought conditions was recommended to address any baseline data limitations to the environmental assessment identified and ensure a robust baseline exists for all sensitive features. Specification of baseline monitoring was also recommended, where relevant, to help inform, and provide a better understanding of, the potential effects of a drought and implementing a drought permit or order on the environment.

Baseline monitoring to inform Thames Water's DP has been ongoing since 2012. This baseline monitoring takes into consideration availability of other data gathered, including monitoring programmes undertaken by the Environment Agency, to avoid any duplication. Regular consultation with the Environment Agency and Natural England has been undertaken in order to clarify the approach, methodologies and specifications relating to the baseline monitoring.

This monitoring programme comprised a walkover using a bespoke methodology using a bespoke Drought Plus River Habitat Survey (RHS Plus) approach. The initial walkover survey also identified key 'monitoring/surveillance' reaches, based on selection of the most appropriate or significantly impacted reaches.

Targeted macroinvertebrate, macrophyte and fisheries surveys have also been undertaken and, where required, samples for water quality analysis and spot flows have also been undertaken to inform the risks associated with several drought options.

This initial monitoring programme was implemented between 2012 and 2015. Since the publication of the DP2013, this baseline monitoring programme has been updated annually to:

- Reflect the changes in risks and impacts as determined in each EAR;
- To ensure that a minimum three-year baseline is available for the environmental features at risk of drought permit impacts.
- To ensure that the three-year baseline was continuous (i.e. spring and autumn macroinvertebrates were completed in the same year); and
- To ensure that monitoring for environmental features are completed on a 1:3 year frequency.

The baseline monitoring programme has been developed using best practise guidelines where appropriate, including JNCC Common Standards Monitoring Guidance<sup>22</sup> and WFD classification requirements<sup>23</sup>. This monitoring programme was developed based on the 2011 DPG<sup>24</sup> and also complies with the ecological monitoring methods in the revised 2015 DPG<sup>25</sup>.

The baseline monitoring programme has been updated to reflect any changes to the environmental assessments and baseline data requirements following the review and update of DP 2022.

### 3.7.2.2 Control sites

Control sites are crucial in assessing the ecological impact of flow pressure resulting from water resource activities. They can help determine whether any ecological impact being observed is a result of the water resource activity being investigated, rather than wider environmental influences.

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<sup>22</sup> JNCC (2014) Common Standards Monitoring Guidance for Rivers, ISSN 1743-8160

<sup>23</sup> European Parliament (2000) Directive 2000/60 EC The Water Framework Directive: Annex V

<sup>24</sup> Environment Agency (2011). Water Company Drought Plan Guideline. June 2011.

<sup>25</sup> Environment Agency (2016) How to write and publish a drought plan, December 2015. Available at <https://www.gov.uk/guidance/drought-plans-environmental-assessment-and-monitoring#carry-out-an-environmental-assessment>, Accessed 1 March 2016.



Good control sites for hydroecological assessment should be chosen where there are no significant water quality problems or pressures which could undermine relationships between ecology and flow. They must not be affected by the water resource activity being investigated nor have additional water resource activity upstream that could affect the flow regime. It is imperative that they are as similar in nature to the baseline conditions of the impact sites as possible, most importantly stream size and channel gradient.

For the Thames Water DP 2017, potential control sites have been identified for each drought option. The location of these control sites have been reviewed and been subject to consultation with the Environment Agency for DP 2022.

### 3.7.2.3 Walkover surveys

Walkover surveys have been recommended in Thames Water DP 2017 to identify location and extent of flow sensitive habitats. In order to monitor/highlight habitat conditions and inform at an early stage any requirement for further survey and mitigation, walkover surveys have been specified to be carried out during the onset of environmental drought.

These surveys should provide a reliable yet efficient method of assessing the current environmental situation within potentially impacted reaches and are not intended to be detailed quantitative surveys. The need for further quantitative monitoring surveys, with detailed parameter analysis, should be determined following the walkover surveys and should encompass hydrology and water quality assessments. The locations should remain consistent throughout the subsequent walkover surveys.

The DP 2017 identified that additional locations, where impacts increase in magnitude or extent at the later stages of the drought, should be incorporated. The DP 2017 also identified that walkover surveys should be conducted by experienced field surveyors, with knowledge and understanding of walkover surveys, river habitats and ecological features associated with this environment.

Preliminary information, as provided by the existing baseline monitoring programme, was captured in the EMP section of each EAR. This information has been updated to reflect any changes in the assessment following the review for DP2022.

### 3.7.2.4 Monitoring to inform the actual impacts of drought management

DPG2020 requires a water company to set out the monitoring that will be undertaken in-drought and post-drought (recovery) to understand the actual impact of a drought management action.

Due to the nature of drought periods and the environmental stress under which the sensitive riverine fauna exist at this time, non-invasive techniques and walkover surveys are considered to be more appropriate to establish the impacts of the drought options and identify relevant mitigation required. The long-term impacts of drought permits may be identified through the assessment of baseline surveys undertaken prior to and following a drought period.

The monitoring and mitigation requirements for each drought option has been tabulated in each EAR for DP 2017 and includes information on:

- The feature and associated hydrological reach where monitoring is required,
- Monitoring required pre-drought (baseline) and the key locations;
- Monitoring required at the on-set of environmental drought;
- Monitoring and mitigation required during drought;
- Monitoring and mitigation required post-drought;
- Reference to preferred monitoring method and standard of assessment;
- Frequency of monitoring; and
- Roles/responsibilities.

These requirements have been reviewed to consider any changes in the monitoring and mitigation requirements following the review of the sensitivity and impact assessment for DP2022.

### 3.7.2.5 Mitigation measures

The DPG 2020 requires water companies to set out any mitigation measures that will be implemented to reduce the environmental impact of a drought management action, how the water company plans to measure their effectiveness and any permits/approvals that will be required.

As indicated above, the monitoring and mitigation requirements for each drought option has been tabulated in each EAR for DP 2017. These requirements have been reviewed to consider any changes in the monitoring and mitigation requirements following the review of the sensitivity and impact assessment for DP2022. It is noted that additional mitigation measures could be planned/implemented at waterbodies associated with the various drought permits and orders. These include mitigation works undertaken by the Environment Agency for WFD purposes or projects specified in the Water Industry National Environmental Programme (WINEP) by Thames Water. Where such mitigation works are ongoing, the implications of the drought permit or orders have been considered in the impact assessment and will be reviewed at the time of application (see Section 6).

## 4 Reporting

### 4.1 Environmental Assessment Reports

The DPG2020 recommends that environmental assessments (including mitigation measures) and monitoring plans are set out in technical appendices, with a high-level summary in the main drought plan.

Following the water resource pressures at the beginning of 2012, Thames Water reviewed its drought options during the preparation of the 2013 DP and determined which drought options would be required as a priority if drought conditions resulted in the requirement for Thames Water to apply for a drought permit/order option. This resulted in a “tiered” approach. For those options identified as a priority, Thames Water produced comprehensive application ready EARs (also known as “Tier 1 EARs”). For the remaining drought permit / order options, whilst these options were less likely to be implemented, Thames Water prepared EARs which were intended to comply with the DPG, but which were less comprehensive than the Tier 1 EARs. These were referred to as “Tier 2 preliminary EARs (pEARs)”.

Further to changes to the DPG in 2016, the extensive feedback received from the Environment Agency, and subsequent revision of the EARs, this resulted in there being no difference in the extent and detail of the assessments undertaken for the Tier 1 and 2 EARs for Thames Water’s DP 2017.

As such, for Thames Water’s DP 2022, the “tiered” approach has been replaced with a “Water Resource Zone” (WRZ) approach following a similar structure to the current Tier 2 reports.

Thames Water has, therefore, produced a report for each of the six WRZs (i.e. Swindon and Oxford, Kennet Valley, London and Slough/Wycombe/Aylesbury, Guilford and Henley) (see Section 1.2) which consisted of:

- Section 1: An introductory chapter which sets out the background and purpose of the EARs, the consultation process and the structure and content of the following sections;
- Section 2: Background to the drought management options, comprising: an overview of Thames Water’s Supply system; the drought planning process; the associated drought options in the WRZ; and supporting documentation that would be required at the time of a potential drought option application;
- Section 3: Reference is made to this document (i.e. Thames Water Drought Plan 2022 Environmental Assessment Methodology) for the approach to be followed for undertaking and describing the environmental assessments, monitoring and mitigation;
- Section 4+: the EAR for each applicable drought permit/order is then provided as separate sections. Each drought option section includes sub-sections describing: detailed assessments setting out the zone of influence associated with the drought option, the distribution and sensitivity of environmental features identified as associated with the drought option, the baseline conditions, data used to inform the baseline conditions, the potential changes in the physical environment as a result of the drought options, the detailed assessment of impacts associated with the drought options and the residual impacts after consideration of mitigation measures; and

The subsequent three separate sections comprise:

- Section on mitigation requirements and the principal of mitigation measures and an indication of potential mitigation options to consider for the drought permits/orders considered in each WRZ;
- A section providing details regarding proposed monitoring including information on the principal of monitoring, baseline monitoring requirements, monitoring at the on-set of drought, monitoring during drought permit/order implementation, monitoring post drought permit/order implementation and details of the specific mitigation requirements for each drought permit/order;
- Section on cumulative impacts: the assessment considers the potential cumulative effects of Thames Water implementing other drought permits within a similar timeframe within the WRZ,

and drought permits in other Thames Water WRZs, and also the potential for cumulative impacts of drought permits implemented by neighbouring water companies.

The 2022 EARs act as 'shelf-copy' reports for Thames Water which have been consulted on and which would be updated to support an actual application to the Environment Agency should one be required by Thames Water in the future.

## 5 Severe droughts

In April 2018, Defra reviewed the Thames Water draft DP 2017, the representations received in response to the public consultation, the SoR, and the EA's advice to the Secretary of State. Thames Water prepared the final draft of the Drought Plan taking into account the directions received from the Secretary of State.

Following the review of the above documents, Defra indicated that it would like to see additional considerations made to the revised draft DP 2017. Defra indicated that it made a recommendation to the Secretary of State that the revised draft DP 2017 should be published as a final plan. Defra also noted that Thames Water had provided further information on the timing and sequencing of its actions and provided detailed assessments of the environmental impacts associated with the re-application of two of its drought permit options (Latton and Lower Thames options for a further six-month period). These two options were selected to provide examples of the methodology that would be used to provide detailed assessments of the environmental impacts associated with re-application of drought permit options. Defra then requested a high-level summary covering the remaining drought actions to understand the significance of the environmental impacts of these actions.

Subsequently, Thames Water provided a methodology for assessing the environmental impacts of severe droughts and a high-level summary of the environmental impacts of Thames Water's drought actions in droughts worse than record ('severe droughts')<sup>26</sup>. In the context of the assessments, severe droughts referred to droughts with a return period of 1:200 or greater. These droughts were considered to be multi-season droughts that could require a re-application for drought permits/orders beyond their original 6 months.

Not all of the drought permit options included in the DP 2017 would be available to Thames Water during a severe (multi-season) drought and will require an assessment of the available yield for some drought options for continued abstraction beyond a six-month drought permit abstraction for drought permit re-application purposes. The recent WRMP Guideline requires assessment of DO for each Drought Permit option and so this will provide the required assessment of yield, noting that in some cases there will be uncertainty of the yield in such a severe drought. The summary of the potential impacts relating to a multi-season drought include a total of 20 drought permit options:

- Latton<sup>27</sup> and Lower Thames<sup>28</sup> (documented in detail),
- Baunton 2, Farmoor, Meysey Hampton, Pangbourne, Sundridge 2, Waddon, Ogbourne 1, Ogbourne Emergency Boreholes, Axford 2, M2 Licence, Eynsford, Horton Kirby, Fobney Direct, Harpsden & Sheeplands, New Ground, Shalford, Albury, and Pann Mill (high-level summaries).

The EARs of the drought options, which were prepared to support DP 2017 were used as a basis to inform this high level environmental assessment of the 20 drought permit options. The assessment considered potential impacts on key physical environment features (e.g. hydrological, geohydrological, water quality, etc.) and key environmentally sensitive features (e.g. fish communities, designated sites and species, etc.).

It was concluded that additional impacts, as a result of the re-application of drought permits/orders beyond their original 6 months, ranged from negligible to major adverse. The most significant changes to the physical and environmental features following re-application of a drought permit could be observed at the following drought permits/orders:

- Lower Thames
- Baunton 2
- Sundridge 2

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<sup>26</sup> Thames Water Utilities Limited (2018) Environmental Assessment of Severe Droughts – Summary Report. *Prepared by Ricardo Energy & Environment*. August 2018

<sup>27</sup> Cascade Consulting (2017). Environmental Assessment of the Latton Drought Permit (re-application). Revised Draft. March 2017

<sup>28</sup> Cascade Consulting (2017). Environmental Assessment of the Lower Thames Drought Permit (re-application). Revised Draft. March 2017

- Ogbourne 1
- Ogbourne Emergency Boreholes
- Axford 2
- Eynsford
- Pangbourne
- Meysey Hampton

The assessment of the potential changes in the significance of impacts on the environmental features did not consider any mitigation measures beyond those identified in the original EARs. Additional mitigation measures, over and above those stated in the EARs, were identified for consideration. However, it should be noted that discussions would need to be held between Thames Water and the regulators to determine and agree the specific mitigation measures to be implemented, which would depend on the specific conditions in the event of a severe drought and the preceding antecedent conditions during the first 6 months of implementation.

The screening exercise undertaken to inform the Habitat Regulations Assessment for DP 2017 was also reviewed to determine whether any changes in the impacts associated with the re-application of a drought permit option could have implications on any European sites. The changes considered included changes in: the likely periods (timing) for re-application; the extent of the study area associated with the selected drought options; the recovery periods; and the impacts on the physical and environmental features. The review indicated that no European sites (Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) and Ramsar sites) will be impacted by any drought options in a severe drought.

Thames Water are developing resilience to 1:500 for the WRMP and so are preparing the drought severity assessments for that in time to include in our draft DP2022.

**The assessment undertaken to inform the severe drought methodology and the high-level summary has not been updated for DP 2022. The impacts associated with a subsequent six-month re-application would require a consideration of the antecedent conditions after a 6-month implementation. As such, there remains uncertainty with regards to the baseline against which impacts are assessed and the high-level summary provided to date is considered sufficient for DP purposes (e.g. screening of features at risk and monitoring and mitigation requirements).**

## 6 Drought permit application

The DPG 2020 indicates that water companies **must** carry out as much preparation work as possible in advance of a drought event. Applications for drought permits and orders should, in the majority of cases, be ready to submit prior to being needed. As a minimum, the Environment Agency expect water companies to be application ready for drought permit or order sites that would be required more frequently and for those sites identified during the Water Resource Management Plan (WRMP) process as required to maintain their planned level of service. This should include an environmental assessment for each permit and order.

The DPG2020, and experience highlights a number of areas that require consideration by water companies to ensure applications are permit ready.

- Identify whether any further assessments may be required.
- Carry out all appropriate environmental assessment before you need to make your application.
- Discuss impacts or risks of your permits/orders with stakeholders.
- Prepare and justify the order of use.
- Prepare arrangements for advertising the application.
- Prepare your case for 'exceptional shortage of rain'.
- Draft the permit you expect to get.
- Regularly update your drought plan and the permits/orders in it.

Error! Reference source not found. sets out the sections of the EARs, and associated amendments that are proposed to be updated at the time of application to ensure that the most up to date information is included. The actual updates required will be discussed and agreed with the Environment Agency, and Natural England (if required) prior to the application of the specific drought permit(s). An indicative timescale for updating of an EAR for submission of a drought permit application is 2-3 weeks. As such, EARs completed as part of Thames Water's DP2022 will undergo an update at the time of application and the updated EARs will inform planning, assessment and monitoring.

**Table 6.1: Summary of tasks for the updating EARs at the time of application**

Report Section		Amendments to EAR at the time of application
1	Introduction	General review
2	Background to the Drought Permit	General review, noting that the statement of need and review of alternative options will be completed.
3	Approach	
4	<b>Each Drought Option</b>	
4	Key Environmental Issues	General review of hydro-geology and hydrology.
4	Hydrology and the Physical Environment	As, above.
4	Baseline Review	Update to incorporate antecedent conditions and describe appropriate reference conditions.
4	Assessment of Hydrology and Physical Environment Impacts	Review/update to include antecedent conditions and updated list of other abstractors and discharges
4	Environmental Features Assessment	
4	Environmental Sensitivity	Review/update to include antecedent conditions. As noted in Section 3.6, the drought permit/order could be implemented at any point in the year (unless otherwise stated in the assessment). Where the drought permit application period is different to the period considered in the EAR for the drought plan, the sensitivity of the features is reconsidered.
4	Features Assessment	Update to baseline data that inform the assessments. This will require submitting data requests to regulators and other 3 <sup>rd</sup> parties to obtain latest baseline data.
		Review/update to include antecedent conditions and LWSs

Report Section		Amendments to EAR at the time of application
		assessment. As noted in Section 3.6, the drought permit/order could be implemented at any point in the year (unless otherwise statement in the assessment). Where the drought permit application period is different to the period considered in the EAR for the drought plan, the impact assessment of the features is reconsidered.
		Incorporating baseline data collected by TWUL as part of baseline monitoring.
4	Summary	General review
4	Summary of Residual Impacts	General review in light of antecedent conditions
5	Mitigation	General review in light of antecedent conditions and to determine which are implemented. This would include a review of the planned, on-going or completed mitigation measures under the WFD or through Thames Water's WINEP obligations.
6	Environmental Monitoring Plan (EMP)	General review in light of antecedent conditions and determine what to implement
7	Cumulative Impacts	General review in light of antecedent conditions



## Appendix A: Details of Drought Permits/Orders included in DP2022

Thames Water have included drought options in the following table in their Drought Plan 2022.

Water Source	Potential Drought Permits/Orders
<b>London Water Resource Zone</b>	
Sundridge 1	0 - 6.64 MI/d - relax the annual average licence rate so that for the 6 months of the drought order, 8MI/d could be abstracted each day (1,470 MI over 6 months).
Sundridge 2	10.64 MI/d -relax the annual average licence rate and increase the peak licence rate so that for the 6 months of the drought order, 12 MI/d could be abstracted each day (sequential to Sundridge 1).
Lower Thames	100 – 200 MI/d – to reduce the minimum pass-forward flow over Teddington Weir to 100 MI/d or 0 MI/d depending on agreement with the Environment Agency
Crayford	2.8 MI/d - increase in abstraction beyond existing licence limit.
Horton Kirby (Aquifer Storage & Recovery (ASR))	5 MI/d - the option would be to bring forward the Aquifer Storage and Recovery (ASR) scheme which abstracts from the Greensand aquifer.
Eynsford	Disaggregate the Eynsford and Horton Kirby abstraction licences to allow a peak abstraction at Eynsford of 7.33 MI/d.  The Horton Kirby abstraction will remain at a maximum daily peak rate of 11.36 MI/d.
Wansunt	6.0 MI/d - increase in abstraction beyond existing licence limit.
Increase in M2 annual licence	Increase the annual maximum abstraction permitted under the M2 licence by up to 5 %. Abstractions would still be restricted when flows are medium to low (as per normal operations).
Waddon	0 – 7MI/d - increase in abstraction beyond existing licence limit (average rate per year of 7.6MI/d).
<b>Swindon Oxford Water Resource Zone</b>	
Baunton 1	6.3 MI/d - a temporary suspension of the 32 MI/d flow constraint on the River Churn at Cirencester. When flows in the River Churn are less than 32 MI/d, abstraction would be permitted to a maximum rate of 6.3 MI/d.
Baunton 2	17 MI/d – a temporary suspension of the 32 MI/d flow constraint on the River Churn at Cirencester. When flows in the River Churn are less than 32 MI/d, abstraction would be permitted up to a maximum rate of 17 MI/d (compared to the Baunton 1 drought permit maximum rate of 6.3 MI/d).
Latton	5 MI/d - a 5 MI/d increase in the average licence limit (to 20 MI/d) for the duration of the drought permit. The annual licence limit would be increased from 5,475 MI to up to 6,390 MI.
Meyse Hampton	11.37 MI/d - additional abstraction from the Great Oolite boreholes when preceding flow (mean 5 days before) in the River Coln at Bibury is less than 68 MI/d (i.e. as per the terms of the revoked 'summer' licence).
Farmoor	30.9 MI/d - proposed back-pumping of river flows from further downstream to help maintain a minimum flow in sensitive reaches.
Axford 1	7.1 MI/d - remove the flow constraint of 6 MI/d and increase abstraction to a daily average and peak of 13.1 MI/d
Axford 2	14 MI/d - removal of flow constraint and increase of average and peak abstraction from 6 MI/d to 20 MI/d.
Bibury	5 MI/d - increase peak daily abstraction at the current boreholes from 6.819 MI/d to 11.819 MI/d.

Water Source	Potential Drought Permits/Orders
Gatehampton	3.5 MI/d - increasing the normal operating licence of 101.5 MI/d to a total abstraction of 105 MI/d.
Ogbourne emergency boreholes	Abstract 4 MI/d from existing boreholes located 1 km away from the boreholes used in Thames Water's now revoked licence.
Oxford Canal - Banbury	5 -10 MI/d - no abstraction normally occurs, permit for abstraction from the Bradley and Perry Hills boreholes via the Oxford Canal for transfer to Grimsbury Reservoir.
Childrey Warren	4.5 MI/d - resume historical abstraction to previous licence limit following revocation of licence to abstract.
Ogbourne	Abstract 3.5 MI/d from the Ogbourne boreholes used in the now revoked licence.
<b>Kennet Valley Water Resource Zone</b>	
Fobney Emergency Boreholes	12 – 30 MI/d - bringing emergency abstraction licence online with output limited by groundwater resource available.
Pangbourne	7 MI/d – removes flow constraint and allows the full amount of the Pangbourne licence to be abstracted.
Playhatch	2.8 - 4.1 MI/d - increase in peak abstraction of existing licence from 8.2 MI/d to 12.3 MI/d.
Fobney Direct	Variable, up to 20 MI/d – manipulation of the Arrowhead control structure at extreme low flows (<173 MI/d gauged at Theale) to allow abstraction from River Kennet at expense of flows to Holy Brook.
<b>Guildford Water Resource Zone</b>	
Albury	6.8 MI/d- extension of abstraction when flow constraint on the Law Brook is in force.
Shalford	5 MI/d - increase the existing surface water abstraction from the River Wey and removing the licence aggregates.
<b>SWA Water Resource Zone</b>	
Pann Mill	7.3 MI/d - increase from revised licence of 9.5 MI/d up to old deployable output of 16.8 MI/d
<b>Henley Water Resource Zone</b>	
Harpsden / Sheeplands	6 MI/d – the total DO from the sources is 11.4 MI/d (Sheeplands) and 16.5 MI/d (Harpsden) which is 27.9 MI/d, removing the aggregate condition with increased abstraction at Harpsden.