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Drought Plan: Environmental Assessment Report – River Wharfe at Lobwood

Final

Report for Yorkshire Water Services Ltd

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Yorkshire Water Services Ltd

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Glossary

Abstraction Licence

The authorisation granted by the Environment Agency (England) or Natural Resources Wales (for sites in Wales) to allow the removal of water from a source.

Biochemical Oxygen Demand (referred to as BOD)

The amount of oxygen that would be consumed if all the organic material in one litre of water were oxidised by bacteria and protozoa.

Compensation Releases

Water company licences that authorise abstractions from a reservoir may have conditions imposed, whereby specified amount of water has to be released into the watercourse, downstream of the reservoir in order to compensate the river for the abstraction.

Discharge Consent

A written consent issued by the Environment Agency permitting the discharge of specific pollutants into the aquatic environment. Discharge consents have conditions attached to them that limit the amount and concentration that can be discharged to ensure that there is no threat to the environment.

Drought Order

An authorisation granted by the Secretary of State (England) or Welsh Ministers (Wales) under drought conditions which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis.

Drought Permit

An authorisation granted by the Environment Agency (England) or Natural Resources Wales (for sites in Wales) under drought conditions which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis.

Environmental Drought

Environmental droughts arise from reduced water flows in rivers and streams. In the summer raised temperatures may further exacerbate drought conditions. Such conditions cause physiological stress to living organisms, the degree of stress increasing with drought severity and time.

Environmental Quality Ratio (EQR)

EQRs express the current condition of a biological quality element such as macroinvertebrates or fish. This is achieved by comparing the observed value of the appropriate metric (for example WHPTASPT) calculated from samples with the value of the same metric expected at WFD reference state.

Local Wildlife Sites (LWS)

Local Wildlife Sites are non-statutory designations. They are areas which are locally important for the conservation of wildlife. They are identified and selected for the significant habitats and species that they contain.

Lotic-Invertebrate Index Flow Evaluation (referred to as LIFE)

Is a method that allows the aquatic invertebrate community recorded at a site to be scored according to its dependence on current velocity. The LIFE value obtained can be compared to that predicted for the site under normal flow conditions and may show if the invertebrate community is experiencing flow related stress. Comparing observed and predicted scores for each gives an Environmental Quality Index (EQI) that is used as a measure of stress experienced at a site from low flow. A value of 1.0 indicates that the invertebrate community has the flow sensitivity predicted for the site. A value of less than 0.975 indicates the possibility of significant stress due to low flow.

Macroinvertebrate

Macroinvertebrates are small, but visible with the naked eye, animals without backbones (insects, worms, larvae etc.). Waterbodies have communities of aquatic macroinvertebrates. The species composition, species diversity and abundance in a given waterbody can provide valuable information on the relative health and water quality of a waterway.

Natural Environment and Rural Communities (NERC) Act Section 41

The Natural Environment and Rural Communities (NERC) Act came into force on 1 October 2006. Section 41 of the Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The NERC Act Section 41 list contains many of England's rarest and most threatened species. The lists are known as the Section 41 habitats of principal importance (also known as 'priority habitats') and the Section 41 species of principal importance (also known as 'priority species').

pH

A measure of the acidity of alkalinity of a liquid based on a logarithmic scale of concentration of hydrogen ions. < 7 is acidic, > 7 is alkaline.

Ramsar site

Internationally important wetland site.

Special Area of Conservation (SAC)

Special Area of Conservation – Designated under the Habitats Regulations 2018

Special Protection Area (SPA)

Special Protection Area – Classified under the European Birds Directive (1979)

Site of Special Scientific Interest (SSSI)

A site given a statutory designation by Natural England or Natural Resources Wales because it is particularly important, on account of its nature conservation value.

Supply Drought

A supply drought occurs when water sources are at low levels due to a lack of rainfall. Water companies manage resources to ensure public supplies do not run out.

Walley Hawkes Paisley Trigg (referred to as WHPT)

Is a method that allows the aquatic invertebrate communities recorded at a site to be scored according to their tolerance to environmental pressures such as organic pollution. WHPT can be expressed as a score (the sum of values for each taxon in a sample), as an average score per taxon (ASPT) and as the number of scoring taxa (N-taxa). WFD status is based on ASPT and N-taxa. WHPT was introduced as the basis for the UK's river invertebrate status classification under the Water Framework Directive in the second River Basin Management Plans, published in 2015.

Abbreviations

AOD	–	Above Ordnance Datum
BOD	–	Biochemical Oxygen Demand
CIEEM	–	Chartered Institute of Ecology and Environmental Management
DPG	–	Environment Agency (2020) Drought Plan Guideline
EcIA	–	Ecological Impact Assessment
EMP	–	Environmental Monitoring Plan
EQR	–	Ecological Quality Ratio
JNCC	–	Joint Nature Conservation Committee
LIFE	–	Lotic-invertebrate Index for Flow Evaluation
LNR	–	Local Nature Reserve
LWS		Local Wildlife Site
Ml	–	Megalitres (1Ml is equivalent to 1000 cubic metres or 1,000,000 litres)
NERC	–	Natural Environment and Rural Communities (refers to Section 41 of the Act)
NNR	–	National Nature Reserve
RHS	–	River Habitat Survey
SAC	–	Special Area of Conservation
SPA	–	Special Protection Area
SSSI	–	Site of Special Scientific Interest
WFD		Water Framework Directive: Council of the European Communities 2000 Directive 2000/60/EC (OJ No L 327 22.12.2000) (establishing a framework for Community action in the field of water policy). As transposed into UK law by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. Statutory Instrument 2003 No. 3242
WHPT	–	Walley Hawkes Paisley Trigg (see Glossary)
WwTW	–	Wastewater Treatment Works

Executive summary

This Environmental Assessment Report (EAR) provides an independent and robust assessment of the potential environmental effects of the implementation of Yorkshire Water Services Ltd's (YWSL) River Wharfe at Lobwood drought option. The report has been prepared in support of a drought permit application by YWSL in late summer 2022.

The environmental assessment has been conducted in accordance with Government regulations and using the Environment Agency's 2020 Drought Plan Guideline (DPG)[1] and the Environment Agency's July 2020 'Environmental Assessment for Water Company Drought Plans- supplementary guidance'.

In accordance with the DPG, the environmental assessment comprises the following components:

- an assessment of the likely changes in hydrology (flow/level regime) due to implementing the proposed drought options;
- identification of the key environmental features that are sensitive to these changes and an assessment of the likely impacts on these features;
- identification of mitigation that may be required to prevent or reduce impacts on sensitive features; and
- recommendations for baseline, in-drought and post-drought permit monitoring requirements.

The environmental assessment focuses on the potential changes to water availability (levels and flows) and any consequent implications for geomorphology, water quality, ecology and other relevant environmental receptors, for example, landscape, navigation, recreation and heritage.

This EAR considers the impacts of the River Wharfe at Lobwood drought option in Appendix A and Appendix B, with a summary presented in Sections 5 and 6. Cumulative impacts with other drought options listed in YWSL's Drought Plan 2022 are considered. The assessments undertaken confirm the features requiring consideration of monitoring and mitigation; which are summarised in Section 6 and provided in full in the Drought Plan 2022 Environmental Monitoring Plan (EMP).

Throughout the environmental assessment process, YWSL have proactively engaged key stakeholders, including the Environment Agency and Natural England.

This report will be periodically reviewed to ensure the conclusions and recommendations remain valid. Key stakeholders will be further consulted throughout the drought permit application process.

[1] Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

Table of Contents

1 Introduction

1.1 Purpose of document

The Yorkshire Water Services Ltd (YWSL) Drought Plan 2022[2] was developed in line with the Environment Agency's Drought Plan Guideline (DPG) [3]. The DPG requires that water companies must demonstrate in their drought plan that they have met their responsibility to monitor, assess and where possible mitigate for the environmental impact of all their supply side drought options, including drought permits and drought orders.

The objective of this Environmental Assessment Report (EAR) is to provide an independent and robust assessment of the potential environmental effects of the implementation of the River Wharfe at Lobwood drought permit. This EAR has been prepared in support of a drought permit application in late summer 2022 to the Environment Agency, in accordance with the Water Resources Act 1991, as amended by the Environment Act 1995, the Water Act 2003 and subsequently the Water Act 2014.

The environmental assessment has been conducted in accordance with Government regulations and using the Environment Agency's 2020 DPG and the July 2020 'Environmental Assessment for Water Company Drought Plans - supplementary guidance'.

In accordance with the DPG, the environmental assessment comprises the following components:

1. an assessment of the likely changes in hydrology (flow/level regime) due to implementing the proposed drought options.
2. identification of the key environmental features that are sensitive to these changes and an assessment of the likely impacts on these features.
3. identification of mitigation that may be required to prevent or reduce impacts on sensitive features.
4. recommendations for baseline, in-drought and post-drought permit monitoring requirements.

The methodology for this environmental assessment was developed during preparation of the 'shelf copy' environmental assessment[4] in consultation with the Environment Agency, and is documented separately in 'YWSL's Drought Plan 2022 Environmental Assessment Methodology'[5]. A summary of the assessment approach is provided in Section 3.

The assessments undertaken in this EAR confirm the features requiring consideration of mitigation and appropriate monitoring triggering mitigation. Appropriate mitigation actions identified are both available and practicable and reflect previous agreement with the Environment Agency (see Section 1.3). The methodologies and details for monitoring and mitigation requirements are documented in the standalone document 'YWSL's Draft Drought Plan 2022 Environmental Monitoring Plan (EMP)' which accompanies the drought permit application. A summary of the monitoring and mitigation requirements are also included in Section 6 of this EAR.

This EAR should be read alongside the Methodology and EMP documents.

1.2 Background to study

Water companies in England and Wales are required to prepare and maintain Statutory Drought Plans under Sections 39B and 39C of the Water Industry Act 1991, as amended by the Water Act 2003 (and subsequently the Water Act 2014), which set out the short operational steps a company will take before, during and after a drought. The Water Industry Act 1991 defines a Drought Plan as 'a plan for how the

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2 Yorkshire Water (2022) Yorkshire water Final Drought Plan 2022. April 2022, Available at: https://www.yorkshirewater.com/about-us/resources/drought-plan/

3 Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

4 Ricardo Energy & Environment (2021). Drought Plan: Environmental Assessment Report – River Ouse. Report for Yorkshire Water Services Ltd. February 2021.

5 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

water undertaker will continue, during a period of drought, to discharge its duties to supply adequate quantities of wholesome water, with as little recourse as reasonably possible to drought orders or drought permits'.

The Drought Plan (England) Direction 2016 states that Drought Plans should be submitted within 4 years and 3 months after the date on which its Drought Plan, or its last revised Drought Plan, is published. Yorkshire Water Services Limited (YWSL) published their current statutory Drought Plan in April 2022.

The Drought Plan provides a comprehensive statement of the actions YWSL will consider implementing during drought conditions to safeguard essential water supplies to customers and minimise environmental impact.

Drought Plans encompass a number of drought options that will only be implemented if and when required. Each drought is different in terms of its severity, season, location and duration and each combination of these factors may require a bespoke reaction in terms of measures. In the context of drought planning, individual drought options are taken to constitute alternatives. YWSL's Final Drought Plan 2022 comprises a total of 63 drought options (49 ordinary supply-side actions, 9 long term supply-side options, 5 demand options).

This EAR has been prepared in support of a drought permit application in late summer 2022. It provides an update to the 'shelf copy' report which was produced in support of YWSL's Drought Plan 2022.

Following agreement with the Environment Agency[6], the physical environment and environmental features assessments presented in the 'shelf copy' report have been retained for this application EAR. The assessments are considered suitable to support the current application as no significant dry weather events have been experienced in the Yorkshire region subsequent to the completion of the 'shelf copy' assessments in 2021. However, in order to provide sufficient evidence that no changes have occurred to the sensitivity of protected/notable species or the macroinvertebrate or fish communities within the impacted reaches, a full review and analysis of additional baseline monitoring data has been undertaken. This review had included incorporation of the available 2020-21 data from the YWSL and Environment Agency baseline monitoring programmes as well as review of updated Water Framework Directive (WFD) status of designated waterbodies which contain the impacted reaches. The results of this analysis are presented as accompanying spreadsheets in support of the drought permit application. In addition, a review of water quality pressures has been undertaken following progression of the YWSL Storm Overflow Assessment Framework (SOAF) programme since the 'shelf copy' assessments were undertaken. Where applicable, changes have been made to the outcomes of the physical environment assessment to reflect this review.

1.3 Consultation

Throughout the preparation and submission of the Final Drought Plan 2019 YWSL proactively engaged with key stakeholders and regulators regarding the scope and outcomes of the environmental assessment, including with the Environment Agency and Natural England. Discussions were also held between YWSL and the Environment Agency on the scope of monitoring/mitigation in Autumn 2018 following a period of prolonged dry weather. These discussions identified certain issues around the appropriateness and practicality of YWSL's monitoring-led mitigation plan as set out in its Draft Drought Plan 2019 EMP. The outcome of these discussions and resulting agreements have informed the basis of the approach for the update of the environmental assessments and EMP for the Draft Drought Plan 2021.

YWSL then held a number of meetings during the early stages of the preparation of the Draft Drought Plan 2021, including several meetings focused on the proposed approach to the environmental assessments which are documented in the Drought Plan 2022 Environmental Assessment

[6] Email exchange between Yasmina Gallaher (Yorkshire Water), and Ineke Jackson (Environment Agency) on 20 July 2022.

Methodology[7]. Proactive consultation continued to be conducted for the Drought Plan 2022 submission, including on the outcomes of the environmental assessment process.

Further consultation with key stakeholders will be undertaken throughout the drought permit application process.

1.4 Content of report

The structure of this EAR is provided below with reference to other relevant documents.

Section 1: **Introduction**

Section 2: **Drought management proposals** - including an overview of YWSL's water supply system, drought planning, the need for the applications, alternative options and proposed drought permit details (to be completed at the time of a drought permit application)

Section 3: **Approach to environmental assessment** - description of the approach to assessing environmental impacts and identification of mitigation and monitoring requirements, with reference to the details which are provided in YWSL's Drought Plan 2022 Environmental Assessment Methodology[8].

Section 4: **Drought options overview: River Wharfe at Lobwood** - overview of drought permit conditions.

Section 5: **Physical environment effects: River Wharfe at Lobwood** - baseline assessment of physical environment and assessment of potential changes in the physical environment as a result of the drought option, and from cumulative operation with options described in other EARs. Detailed information is provided in **Appendix A** and summarised in Section 5.

Section 6: **Features assessment, monitoring and mitigation: River Wharfe at Lobwood** - impact assessment on environmental features, identification of mitigation and monitoring requirements, including cumulative reaches. Detailed information is provided in **Appendix B** and in YWSL's Drought Plan 2022 EMP and summarised in Section 6. **Appendix C** summarises the full suite of monitoring and mitigation measures as detailed in the EMP.

Appendices

Appendix A Physical Environment

Appendix B Environmental Features

Appendix C Environmental Monitoring and Mitigation Measures

7 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

8 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

2 Drought management proposals

See YWSL drought permit application supporting documentation.

3 Approach to environmental assessment

3.1 Overview

The environmental assessment of the drought options in this report has been prepared in accordance with Environment Agency's 2020 DPG; specifically the Environment Agency's July 2020 'Environmental Assessment for Water Company Drought Plans - supplementary guidance'. The approach to environmental assessment and the bespoke assessment methodologies used have been developed in consultation with the Environment Agency and are documented separately in YWSL's Drought Plan 2022 Environmental Assessment Methodology[9] ('the Methodology').

Depending on the particular ongoing water resources drought, different management options may be available and the full range of drought permits may not be used by YWSL at the same time. This EAR considers the impacts of implementation of the River Wharfe at Lobwood drought permit.

The Environment Agency's 2020 DPG requires the completion of environmental assessment and production of an environmental monitoring plan for each of supply side actions included in a drought plan. The environmental assessments should also include any mitigation measures that could be implemented. The Methodology provides detailed approaches to the specific requirements of the DPG which are:

1. Setting out the likely changes to the hydrology (or hydrogeology) due to a proposed action (see Section 3.4 and Section 3.5 of the Methodology).
2. Identifying the key features of the environment which are likely to be affected by these changes and assess their sensitivity (see Section 3.6 of the Methodology).
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 3.7 of the Methodology).
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 3.8 of the Methodology).

The overall approach taken in completing the environmental assessment to demonstrate an understanding of the impact on the environment of implementing the proposed drought options is illustrated in **Figure 3.1**.

Results of the assessment have also informed the Habitats Regulations Assessment (HRA)[10] and Strategic Environmental Assessment (SEA)[11] which support YWSL's Drought Plan 2022 and are documented separately.

The Environment Agency's 2020 DPG also requires water companies to 'consider the combined environmental effects of your supply side drought options, and where relevant, the combination effects of your actions with those of neighbouring water companies and other abstractors'. The SEA and HRA for a drought plan as a whole has informed these combined assessments.

3.2 Limitations of assessment

Details on the quality of the data collected and used in the assessment, limitations and any assumptions made, are included in the relevant technical appendices (**Appendix A** and **B**).

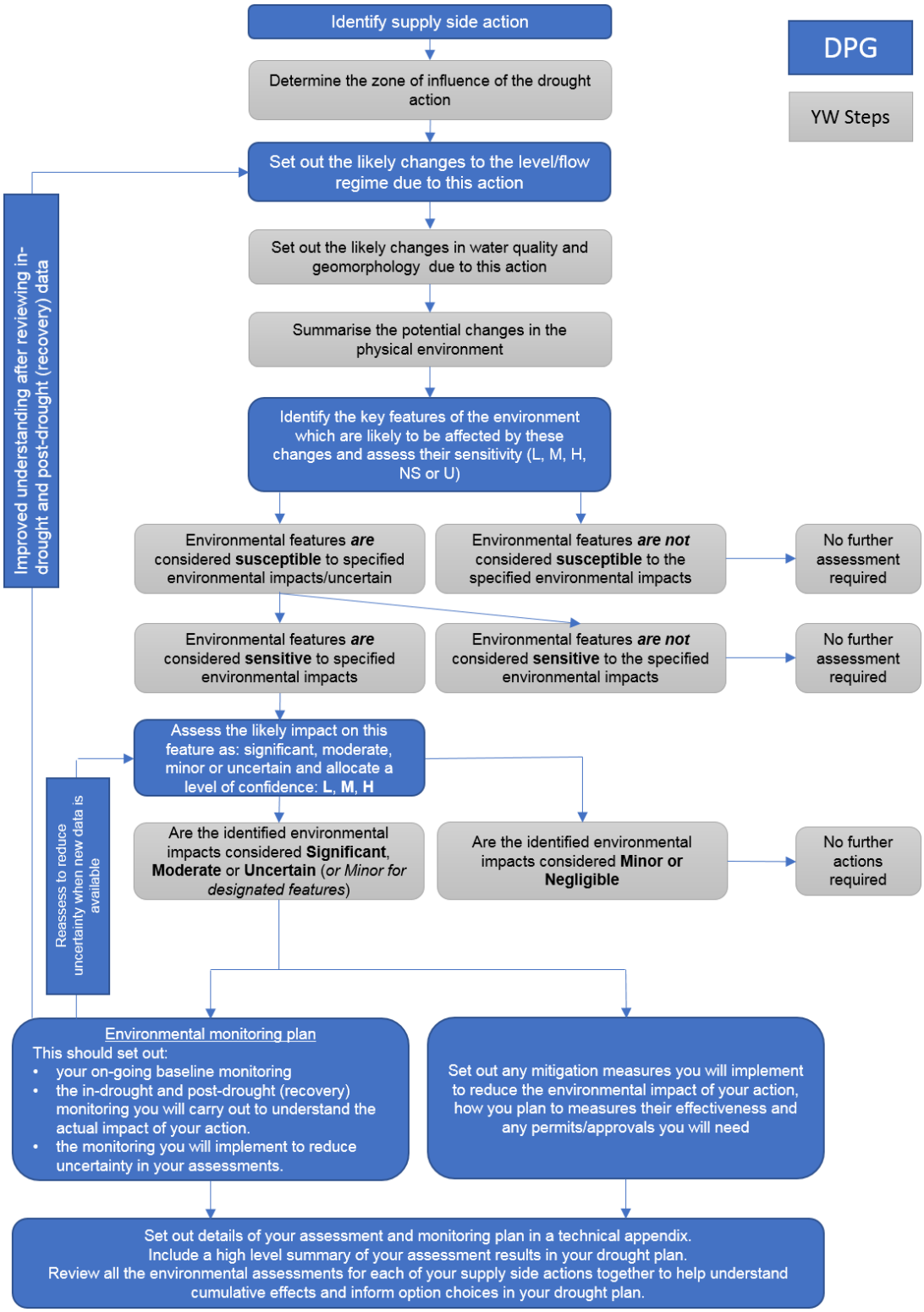
9 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

10 Yorkshire Water (2022) Yorkshire Water Drought Plan 2022 Habitats Regulation Screening Report, April 2022. Available at https://www.yorkshirewater.com/media/vzenyqzb/yorkshire-water-drought-plan-2022-hra.pdf.

11 Yorkshire Water (2022) Yorkshire Water Drought Plan 2022 SEA Environmental Report, April 2022. Available at https://www.yorkshirewater.com/media/c2qgvnsf/yorkshire-water-drought-plan-2022-sea-environmental-report.pdf.

For features where the assessment remains uncertain because of data limitation, the requirement for additional targeted monitoring has been considered and is documented in YWSL's Drought Plan 2022 EMP.

Figure 3.1 Approach to undertaking environmental assessments as identified in the 2020 DPG.
Steps in blue are 2020 DPG tasks. Tasks indicated in grey are YWSL tasks



4 Drought options overview

4.1 Drought permit descriptions

This EAR assesses the potential impacts on the environmental features of the River Wharfe at Lobwood catchment during the period of implementation of associated drought options.

The River Wharfe catchment includes the River Wharfe at Lobwood drought permit as summarised in **Table 4.1**:

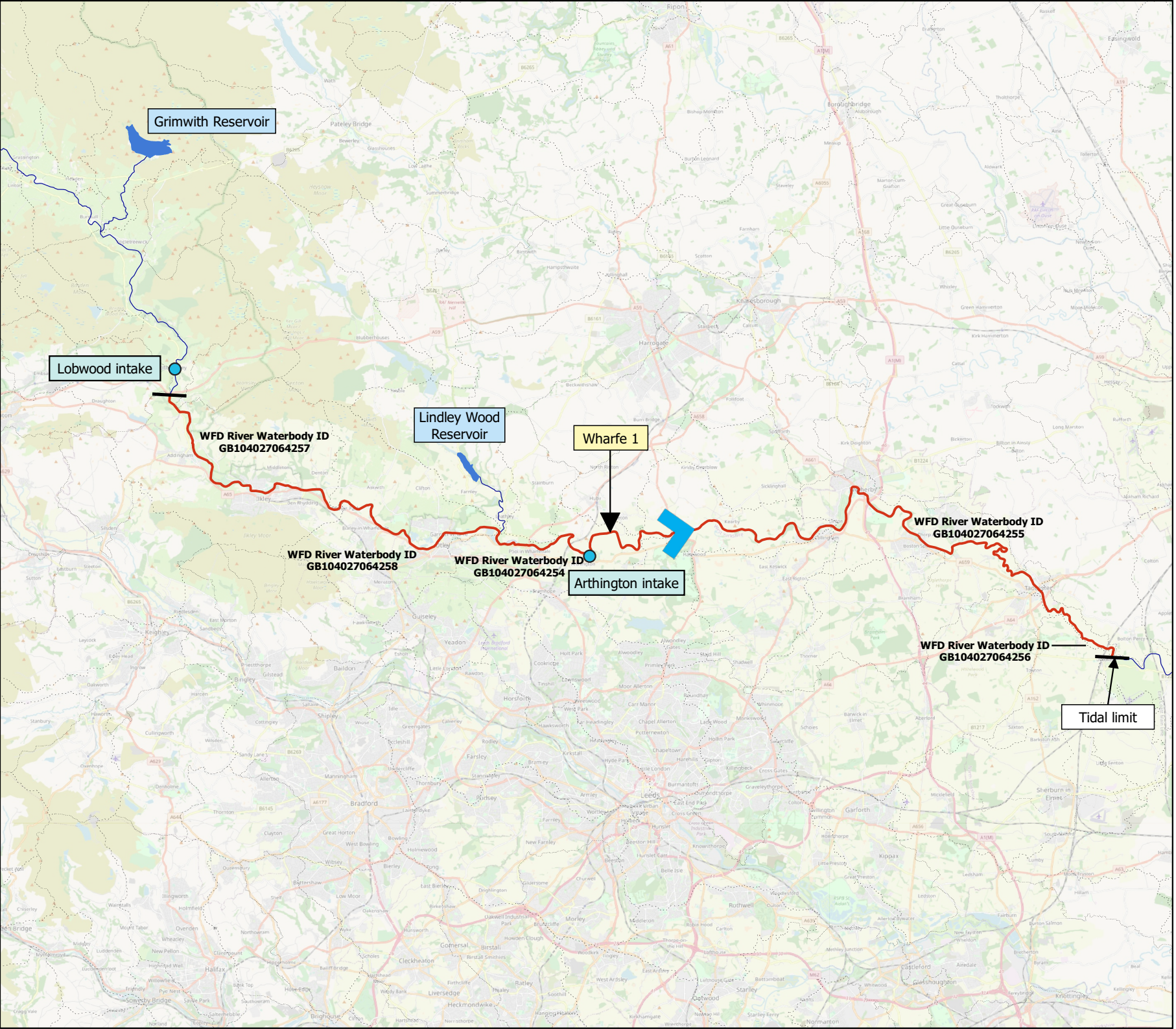
Further details on the existing arrangements at the site and the proposed drought option are found in **Appendix A**, Section A2. The study area is illustrated in **Figure 4.1**.

Table 4.1 River Wharfe at Lobwood drought permit description

Abstraction Water Source	NGR	Normal Abstraction Ml/d[12]	Proposed Drought Option Abstraction Ml/d	Benefit Ml/d
Wharfe	SE075519	88.6Ml/d may be abstracted from the River Wharfe at Lobwood subject to the following conditions: • When flow in the Wharfe (measured at Addingham downstream) is less than 252Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood (and at Arthington13) plus an additional 22.7Ml/d • When flow in the Wharfe (measured at Addingham downstream) is between 252Ml/d and 389Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood less 6.8Ml/d • When flow in the Wharfe (measured at Addingham downstream) is between 389Ml/d and 488Ml/d YWSL may abstract up to 88.6Ml/d (Grimwith releases not required) • When flow in the Wharfe (measured at Addingham downstream) is above 488Ml/d YWSL may abstract up to 93.2Ml/d (Grimwith releases not required)	88.6Ml/d may be abstracted from the River Wharfe at Lobwood subject to the following conditions: • When flow in the Wharfe (measured at Addingham downstream) is less than 252Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood (and at Arthington) (decrease in release of 22.7Ml/d) • When flow in the Wharfe (measured at Addingham downstream) is between 252Ml/d and 389Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood less 6.8Ml/d (NO CHANGE) • When flow in the Wharfe (measured at Addingham downstream) is between 389Ml/d and 488Ml/d YWSL may abstract up to 88.6Ml/d (Grimwith releases not required) (NO CHANGE) • When flow in the Wharfe (measured at Addingham downstream) is above 488Ml/d YWSL may abstract up to 93.2Ml/d (Grimwith releases not required) (NO CHANGE)	Up to 22.7 (when flows are less than 252Ml/d)

12 1Ml/d is 1 million litres per day

13 When flow at Addingham gauge is lower than 252Ml/d, YWSL must also release from Grimwith Reservoir at least what they intend to abstract from Arthington (location of abstraction is indicated on Figure 4.1). They may abstract up to 25Ml/d from Arthington when flow at Addingham is less than 488Ml/d.



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Legend

- Reach Divides
- River Reaches
- Reservoir
- Points of Interest
- WFD Management Catchment
- Flow Direction

Project title:
Yorkshire Water Drought Plan Environmental Assessment

Figure title:
River Wharfe at Lobwood Overview Map

Figure 4.1	**Date:** August 2020
NGR: SE 27604 47362	**Scale:** 1:235000

Note: All locations are approximate

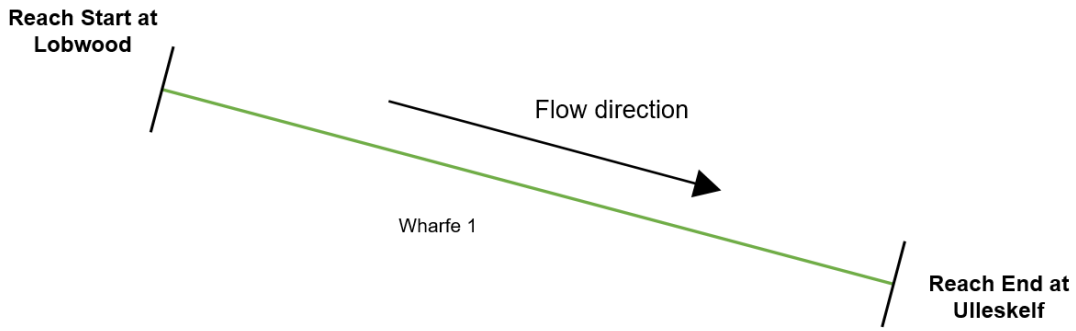
4.2 Potentially impacted reaches

The zone of influence associated for a drought option is defined through hydrological effects. Within the overall zone of influence, reaches are then defined on a hydrological basis. Section 3.4 of YWSL's Drought Plan 2022 Environmental Assessment Methodology[14] sets out this approach in detail. The reach for the River Wharfe at Lobwood drought permit has been defined previously during the environmental assessment of YWSL past drought plans. **Table 4.2** provides details of this reaches, which is illustrated in **Figure 4.1**, and in a schematic below in **Figure 4.2**.

Table 4.2 River Wharfe at Lobwood drought permit reach details

Reach name	Watercourse name	Reach start	Reach end	Down-stream reach	Drought option
					River Wharfe at Lobwood
Wharfe 1	River Wharfe	Lobwood	Ulleskelf	N/A	✓

Figure 4.2 River Wharfe at Lobwood drought permit reach schematic



14 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

4.3 WFD waterbodies in study area

The study area and focus of the environmental assessment covers the WFD waterbodies listed in **Table 4.3.** The WFD waterbodies are also illustrated on **Figure 4.1**.

Table 4.3 WFD waterbodies considered in the assessment

Drought Option	Reach	WFD Waterbody
River Wharfe at Lobwood	Wharfe 1	River Wharfe from Barben Beck/ River Dibb to Hundwith Beck (GB104027064257) River Wharfe from Hundwith Beck to River Washburn (GB104027064258) River Wharfe from River Washburn to Collingham Beck (GB104027064254) River Wharfe from Collingham Beck to Tadcaster Weir (GB104027064255) River Wharfe from Tadcaster Weir to River Ouse (GB104027064256).

5 Physical environment effects: River Wharfe at Lobwood

Potential impacts on the physical environment due to the River Wharfe at Lobwood drought permit are summarised below in **Table 5.1**. Full details are provided in **Appendix A**.

Table 5.1 Summary of potential changes in the physical environment as a result of the River Wharfe at Lobwood drought option

Reach	River flow impact	Flow depleted reaches and risks*	Risk to river habitats	Risk to water quality
Wharfe 1	Moderate impacts (summer/autumn) Minor (winter)	None	Moderate	Moderate

6 Features assessment, monitoring and mitigation: River Wharfe at Lobwood

6.1 Summary of impacts

Potentially sensitive receptors (environmental features) have been identified within each impacted reach considering the level of impact on the physical environment identified in Section 5 and Appendix A. This sensitivity assessment has been used to identify features which have been considered for detailed assessment. Both these stages are documented in full in **Appendix B**.

Potential impacts on environmental features due to the River Wharfe at Lobwood drought permit are summarised below in **Table 6.1**.

Table 6.1 Summary of potential impacts to environmental features as a result of the River Wharfe at Lobwood drought option

Reach	Wharfe 1
Drought Option	**River Wharfe at Lobwood**
WFD Waterbody	GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck GB104027064258 River Wharfe from Hundwith Beck to River Washburn GB104027064254 River Wharfe from River Washburn to Collingham Beck GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir GB104027064256 River Wharfe from Tadcaster Weir to River Ouse
WFD Waterbody WFD Status Receptors	
Fish	Minor
Invertebrates	Moderate
NERC and Notable Species Receptors	
Otter	Negligible
Water vole	Moderate
Fine-lined pea mussel	Negligible
Atlantic salmon	Moderate
Brown trout	Moderate
European Eel	Minor
River lamprey	Moderate
Brook lamprey	Moderate
Barbel	Minor
Bullhead	Minor
Grayling	Minor
Statutory Designated Sites	
River Wharfe, Otley & Mid Wharfedale/Wetherby LWS	Minor
Low Mill, Addingham LWS	Negligible
Ben Rhydding Gravel Pits LWS	Negligible
Otley Sand and Gravel Pits LWS	Negligible

6.2 Monitoring and mitigation

The Environment Agency's 2020 DPG requires YWSL to set out a monitoring plan following assessment of the sensitivity and impacts associated with drought options, as indicated in **Figure 3.1**. In particular the DPG 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.
- the in-drought and post-drought (recovery) monitoring that will be carried out to understand the actual impact of drought options.

As indicated in **Figure 3.1**; the DPG also requires YWSL to set out a mitigation plan following the assessments of potential impacts associated with each drought management action. In particular the DPG 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 options; and
- compensation measures for adverse effects that remain after mitigation measures have been applied.

The DPG requires that this information is set out as a separate document alongside, and linked to, each environmental assessment.

The assessments undertaken in this EAR confirm the features requiring consideration of mitigation and appropriate monitoring triggering mitigation. YWSL's Drought Plan 2022 EMP provides a comprehensive description of the schedule of monitoring and trigger-based mitigation agreed as relevant and practicable based on the nature and timing of permit implementation. The mitigation and monitoring proposals will act as a safeguard that responds and is responsive to both predicted and unpredicted drought impacts.

The monitoring and mitigation recommendations have been developed through agreement with the Environment Agency, in particular during 2018 and 2020 (see Section 1.3). Consultation between YWSL and the Environment Agency is ongoing, and the EMP will be updated as required to reflect future agreements.

The EMP also documents the baseline monitoring recommendations which have been identified as required following the completion of the environmental assessment. Baseline monitoring will ensure that sufficient baseline data is available to inform the sensitivity and impact assessment and to reduce any uncertainty in the assessment.

A summary of the monitoring and mitigation recommendations for the River Wharfe at Lobwood drought permit is provided in **Tables 6.2** and **6.3**. **Appendix C** provides a description of each monitoring and mitigation measure with reference to the codes used in **Tables 6.2** and **6.3**.

Table 6.2 Summary of recommended monitoring for the River Wharfe at Lobwood drought option

River Reach:		Wharfe 1
Drought Option:		**River Wharfe at Lobwood**
WFD Waterbody:		GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck GB104027064258 River Wharfe from Hundwith Beck to River Washburn GB104027064254 River Wharfe from River Washburn to Collingham Beck GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir GB104027064256 River Wharfe from Tadcaster Weir to River Ouse
Baseline Monitoring		
Routine baseline monitoring		
BMON_1	Routine flow/levels	✓
BMON_2	Routine WQ	✓
BMON_3	Macro- invertebrate	✓
BMON_4	Fisheries	✓
Targeted baseline monitoring		
BMON_7	Lamprey	✓
On-set of Environmental Drought Monitoring		
ODMON_1	River condition walkover survey	✓

In-Drought (During Drought Option Implementation) Monitoring		
IDMON_1	Surveillance walkover (habitat quality and ecological stress) prior and post flow reduction	✓
IDMON_2	Surveillance walkover (water quality and ecological stress) prior and post flow reduction	✓
IDMON_3	Storm intensity forecasting to predict likely CSO spill events and the need for pre-emptive mitigation:	✓
Post-Drought (Drought Option Removed) Monitoring		
None		

Table 6.3 Summary of recommended mitigation measures for the River Wharfe at Lobwood drought option

Reach		Wharfe 1
Drought Option		**River Wharfe at Lobwood**
WFD Waterbody		GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck GB104027064258 River Wharfe from Hundwith Beck to River Washburn GB104027064254 River Wharfe from River Washburn to Collingham Beck GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir GB104027064256 River Wharfe from Tadcaster Weir to River Ouse
In-drought (Drought Options Implemented)		
IDMIT_3	Improving effluent quality	✓
IDMIT_4	Freshets for water quality	✓
IDMIT_6	Gradual phase in of reduction	✓
IDMIT_8	Temporary abstraction volume reduction/compensation increase	✓
IDMIT_10	Refuges	✓
IDMIT_11	In-stream structures	✓
IDMIT_13	Bird scaring	✓
IDMIT_15	Aeration of watercourse	✓
IDMIT_16	Flow structure modification	✓
IDMIT_19	Capture/re-locate over barriers	✓
IDMIT_20	Fish/crayfish rescue and relocate	✓
IDMIT_23	CSO prioritisation	✓
Post-Drought (Drought Options Removed)		
PDMIT_1	Habitat enhancement	✓
PDMIT_3	Barrier modification	✓
PDMIT_4	Capture and relocate	✓
PDMIT_5	Juvenile relocation	✓
PDMIT_6	Lamprey restocking	✓
PDMIT_7	Broodstock restocking	✓
PDMIT_8	Coarse fish restocking	✓

Appendices

Appendix A Physical Environment

Appendix B Environmental Features

Appendix C Environmental Monitoring and Mitigation Measures

Appendix A – Physical Environment

A1 Introduction

This appendix assesses the potential impacts on the physical environment of the catchment surrounding the River Wharfe at Lobwood during the period of implementation of the associated drought option.

Details regarding the approaches/methodologies used for assessing susceptibility and sensitivity to drought options and the assessment of the impacts associated with drought options are presented in YWSL's Drought Plan 2022 Environmental Assessment Methodology[1].

This EAR has been prepared in support of a drought permit application in late summer 2022. It provides an update to the 'shelf copy' report which was produced in support of YWSL's Drought Plan 2022. Following agreement with the Environment Agency, the physical environment and environmental features assessments presented in the 'shelf copy' report have been retained for this application EAR (see main EAR Section 1.2).

This appendix is set out in the following sections:

Section A.2 Drought option

Section A.3 Study area

Section A.4 Physical environment effects – this includes:

1. Introduction
2. Setting
3. River flow regime
4. River habitat
5. River water quality
6. Summary of potential changes in the physical environment as a result of the drought option.

Annex 1 provides a list of all regulated abstractions in the reach.

Annex 2 provides a list of all wastewater treatment works (WwTW) and combined sewer overflows (CSOs) considered in the assessment.

1 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

A2 Drought options

A2.1 River Wharfe drought permit

YWSL is currently operating within the terms and conditions of the licence agreement held with the Environment Agency under licence number 2/27/19/129/R01 (the Lobwood Licence). Yorkshire Water is also permitted to abstract water from the River Wharfe at Arthington, West Yorkshire under abstraction licence number 2/27/20/196/R01 (the Arthington Licence). The licence conditions for the abstraction at Arthington also impose an obligation for YWSL to support abstractions from Lobwood and/or Arthington with releases from Grimwith Reservoir. This clause will be amended in the Arthington Licence for the duration of the drought permit, if granted.

Currently, YWSL is authorised to abstract water from the River Wharfe at Lobwood for supply to customers under the terms stated in the abstraction licence. YWSL are permitted to abstract a maximum of 5,060 cubic metres per hour, 93,200 cubic metres per day and 23,742,000 cubic metres per year, at an instantaneous rate not exceeding 1,406 litres per second.

The daily abstraction limit varies depending on flow conditions (bands) in the River Wharfe and upstream releases from Grimwith Reservoir. Under the conditions of the Lobwood Licence, during periods of low flow in the River Wharfe, YWSL are required to support abstraction at Lobwood by releasing water from Grimwith Reservoir. When river flows are above 389 megalitres per day (Ml/d) (Bands A and B in the licence), YWSL do not have to provide any support. When river flows are between 252 and 389 Ml/d (Band C in the licence), YWSL are permitted to abstract the volume of water being released from Grimwith Reservoir plus an additional 6.8 Ml/d. When river flows are below 252 Ml/d (Band D in the licence), YWSL are permitted to abstract the volume of water being released from Grimwith Reservoir less 22.7 Ml/d, up to a maximum of 88.6 Ml/d.

The drought option is to reduce the required Grimwith Reservoir support in the lowest flow band from 22.7Ml/d more than abstraction, to an amount equal to abstraction. This protects reservoir stocks at Grimwith, allowing storage to be maximised during a drought.

Under the terms of an impoundment licence (NE/027/0019/011) issued by the Environment Agency, YWSL must release flow from Grimwith Reservoir to compensate the downstream water course, the River Dibb, a tributary to the River Wharfe. The required volume of flow is dependent on seasonal variations and are by flow trial agreement, with 15.1Ml/d being released between 1st November and 19th April (winter), 7.8Ml/d between 20th April and 10th May and 12th October and 31st October (spring and autumn) and 3.8 Ml/d between 11th May and 11th October (summer). These discharges occur in combination with the existing regulation releases which supports abstraction and the compensation flow can form part of the abstracted flow at Lobwood subject to the other licence conditions.

These conditions are set out in **Table A2.1**.

Table A2.1 River Wharfe at Lobwood drought permit description

Abstraction Water Source	NGR	Normal Abstraction Ml/d[2]	Proposed Drought Option Abstraction Ml/d	Benefit Ml/d
Wharfe	SE075519	88.6Ml/d may be abstracted from the River Wharfe at Lobwood subject to the following conditions: • When flow in the Wharfe (measured at Addingham downstream) is less than 252Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood (and at Arthington3) plus an additional 22.7Ml/d • When flow in the Wharfe (measured at Addingham downstream) is between 252Ml/d and 389Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood less 6.8Ml/d • When flow in the Wharfe (measured at Addingham downstream) is between 389Ml/d and 488Ml/d YWSL may abstract up to 88.6Ml/d (Grimwith releases not required) • When flow in the Wharfe (measured at Addingham downstream) is above 488Ml/d YWSL may abstract up to 93.2Ml/d (Grimwith releases not required)	88.6Ml/d may be abstracted from the River Wharfe at Lobwood subject to the following conditions: • When flow in the Wharfe (measured at Addingham downstream) is less than 252Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood (and at Arthington) (decrease in release of 22.7Ml/d) • When flow in the Wharfe (measured at Addingham downstream) is between 252Ml/d and 389Ml/d YWSL must release the amount abstracted from the Wharfe at Lobwood less 6.8Ml/d (NO CHANGE) • When flow in the Wharfe (measured at Addingham downstream) is between 389Ml/d and 488Ml/d YWSL may abstract up to 88.6Ml/d (Grimwith releases not required) (NO CHANGE) • When flow in the Wharfe (measured at Addingham downstream) is above 488Ml/d YWSL may abstract up to 93.2Ml/d (Grimwith releases not required) (NO CHANGE)	Up to 22.70 (when flows are less than 252Ml/d)

2 1Ml/d is 1 million litres per day

3 When flow at Addingham gauge is lower than 252Ml/d, YWSL must also release from Grimwith Reservoir at least what they intend to abstract from Arthington (location of abstraction is indicated on Figure 4.1). They may abstract up to 25Ml/d from Arthington when flow at Addingham is less than 488Ml/d.

A3 Study area

The zone of influence associated with the drought option is defined through hydrological effects. Within the overall zone of influence, the reach is defined on a hydrological basis. YWSL's Drought Plan 2022 Environmental Assessment Methodology[4] sets out this approach in detail in Section 3.4. The zone of influence for assessment of impacts is set out in **Section A3.1** below. Information on the likely timing of the drought option is set out in **Section A3.2** below.

A3.1 Zone of influence of the drought options

The hydrological impact of the drought option was considered as part of the screening exercise. This determined what the timing, magnitude, zone of influence, nature of change and duration of the drought option would be. **Table A3.1** provides details of these reaches, and the reaches are illustrated in main EAR **Figures 4.1**-**4.2** and in a schematic below in **Figure A3.1**.

Figure A3.1 River Wharfe at Lobwood schematic

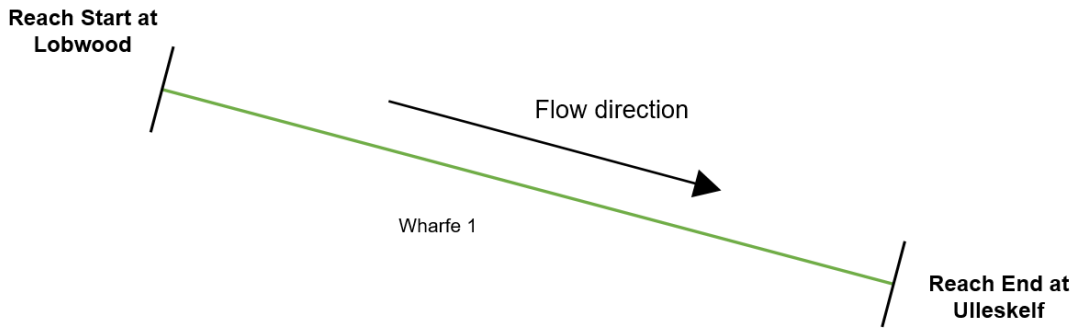


Table A3.1 Wharfe at Lobwood reach details

Reach name	Watercourse name	Reach start	Reach end	Down-stream reach	Drought option: Wharfe at Lobwood
Wharfe 1	River Wharfe	Lobwood	Ulleskelf	N/A	✓

The study area starts downstream of Yorkshire Water's Lobwood abstraction intake. Drought permit conditions would lead to reduction in the releases from Grimwith Reservoir in periods where regulation releases were being made to support the abstraction at the Lobwood intake. This would lead to flows in the River Dibb and River Wharfe being reduced in these river regulation periods. At times without river regulation, the flows in the River Dibb and River Wharfe (between the River Dibb and the Lobwood intake) would be lower, but unaffected by the drought option. Therefore, drought permit flows upstream of the Lobwood intake will remain within the range of managed flows from normal operation.

4 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

The end of each study area has been defined previously from review of hydrological information – either flow gauge data that corroborates that drought option hydrological impacts have reduced to negligible, or by simple review of contributing catchment area where there is an order of magnitude step change in this from confluence with a significantly larger river or joining tributary.

The tidal River Wharfe flows into the tidal River Ouse, which with the tidal River Trent forms the River Humber and ultimately the Humber Estuary, which is designated as SSSI/SAC/SPA and Ramsar Site. A 10% reduction in freshwater low flows (annual Q95) into the River Ouse from the River Wharfe (as would be likely considering the 10% reductions identified in Section A4.2.3 as occurring mid-reach) is within the WFD standards[5] for main river freshwater inflows into transitional waterbodies such as that of the Humber Estuary. Assessment of the impacts of drought option implementation on the integrity of the Humber Estuary SAC/SPA concluded that there would be no significant effect of implementing one or all of the drought permits on relevant features of the Humber Estuary SAC/SPA, i.e. there would be no adverse effect on the integrity of the interest features for which the Humber Estuary SAC/SPA is designated[6].

A3.2 Timing of drought measure effects

In addition to the information provided by summary flow statistics on the zone of influence, information on the timing, duration and relevant seasons of the drought option impacts have been informed by review of WRAPsim water resource modelling, across the area of the EAR, during the modelled critical drought period.

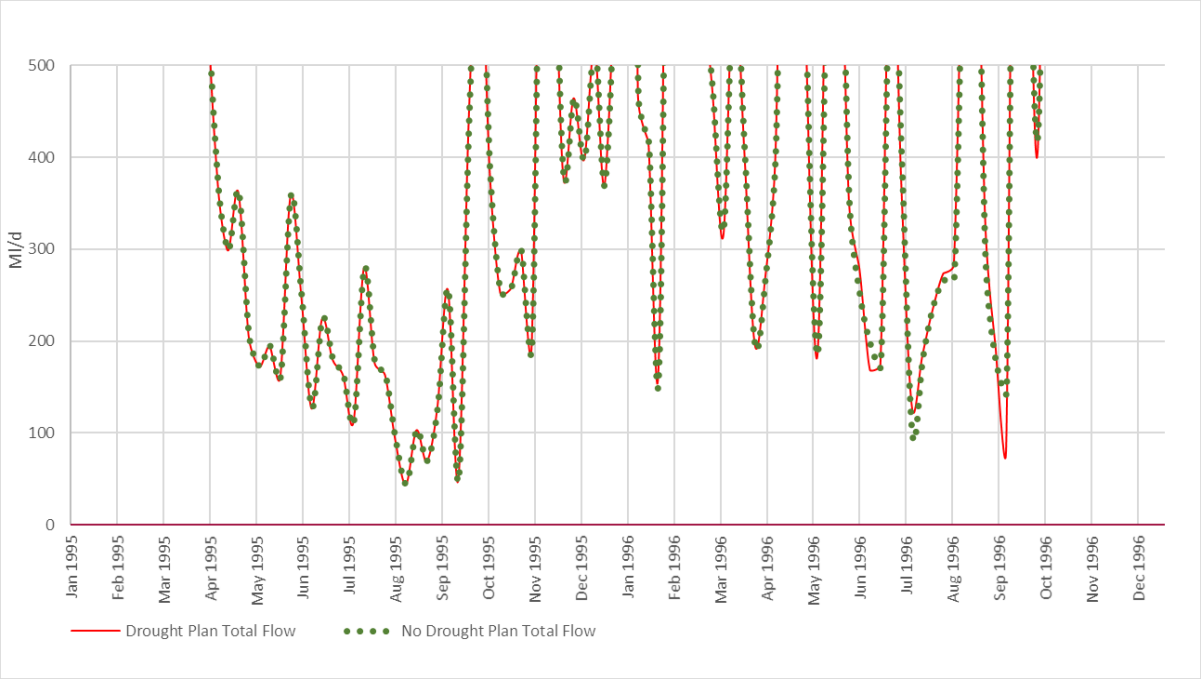
Figure A3.2 shows that the most acute impacts of the drought option on the River Wharfe would be likely to occur between spring and autumn and the impacts would be intermittent (up to 2 months) rather than for long sustained periods.

5 Entec (2007) Water Resource Standards for Freshwater Flows to Transitional Waterbodies *WFD 83* Table 7.5. The lower Wharfe is moderate ecological potential (note it is a heavily modified waterbody) All larger transitional water bodies for example the Thames, Severn and Humber fall into the low sensitivity category. Therefore, the appropriate proposed standard for main river inflows at low flow (<Q95) is a 50% change in flow. This is used for indication purposes only, as this has not been adopted by DEFRA.

6 Scott Wilson (2011). Yorkshire Water Drought Plan: Assessment of Possible Impact on Humber Estuary SPA/SAC. Final Report Revision 2 February 2011. Report for Yorkshire Water.

Figure A3.2 WRAPsim model output for YWSL critical drought period

Downstream Lobwood



A3.3 Cumulative reaches with other EARs

The hydrological impacts of the simultaneous deployment of the Wharfe at Lobwood abstraction drought option and the Lindley Wood drought option on flows in the River Wharfe from the confluence with the River Washburn to the tidal limit have been outlined below.

The River Washburn, which Lindley Wood Reservoir spills into, joins the River Wharfe approximately halfway down the Wharfe 1 reach. On the River Wharfe downstream of the River Washburn confluence the summer Q95 is 201.3 Ml/d and the summer Q99 is 150.6 Ml/d. As a result of the cumulative impact between the Wharfe at Lobwood and Lindley Wood reservoir drought permits there would be a 17.3% and 23.1% reduction in these statistics, respectively. This remains a **moderate** hydrological impact which is the same impact as the Wharfe at Lobwood is assessed at for this reach in summer conditions (see **Section A4.2.3**).

Year round Q95 and year round Q50 statistics at the River Wharfe downstream of the River Washburn confluence are 228.9 Ml/d and 759.0 Ml/d, respectively. There would be no cumulative impact between the Lindley Wood and Wharfe at Lobwood drought permits at year round Q50 conditions due to the Wharfe at Lobwood permit not applying to flows >252 Ml/d at the Addingham gauge. A 15.2% reduction in year round Q95 flows would be observed. This hydrological impact is assessed as **minor** for the cumulative impact on this reach which is consistent with the hydrological impact on the reach associated with the Wharfe at Lobwood license alone.

There is no change between the hydrological impacts associated with the cumulative impacts of the Wharfe at Lobwood and Lindley Wood drought permits and the hydrological impacts associated with the Wharfe at Lobwood permit alone. Thus, additional cumulative assessment is not required.

As the hydrological impact of the Wharfe Annual drought permit is considered negligible, it can be concluded that it's inclusion as a drought option would not increase the hydrological impacts beyond those already identified in other option assessments.

Furthermore, the potential cumulative flow reduction from these drought options into the Humber Estuary would remain within the WFD standards[7] for main river freshwater inflows into transitional waterbodies such as that of the Humber Estuary.

7 Entec (2007) Water Resource Standards for Freshwater Flows to Transitional Waterbodies *WFD 83* Table 7.5. The lower Wharfe is moderate ecological potential (note it is a heavily modified waterbody) All larger transitional water bodies for example the Thames, Severn and Humber fall into the low sensitivity category. Therefore, the appropriate proposed standard for main river inflows at low flow (<Q95) is a 50% change in flow. This is used for indication purposes only, as this has not been adopted by DEFRA.

A4 Physical environment effects

A4.1 Introduction

This section provides a characterisation of the physical environment within the zone of influence (as defined above in **Section A3**) and includes the following information for each reach:

1. Reach setting
2. River flow regime (reference conditions and sensitivity)
3. River habitat (reference conditions and likely sensitivity)
4. River water quality, including water quality pressure (reference conditions and sensitivity).

An assessment of likely changes from drought option implementation for the zone of influence is then provided.

YWSL's Drought Plan 2022 Environmental Assessment Methodology[8] provides details of the approach in Section 3.5. The approach has been developed to ensure compliance with the Environment Agency's 2020 Drought Plan Guideline (DPG)[9] and Section 3 of the Environment Agency's July 2020 "Environmental Assessment for Water Company Drought Plans - supplementary guidance".

A4.2 Wharfe 1

A4.2.1 Reach introduction

A summary of physical environment information for Wharfe 1 is provided in **Figure A4.1**. The reach includes part of the following river waterbodies:

- River Wharfe from Barben Beck/ River Dibb to Hundwith Beck (GB104027064257)
- River Wharfe from Hundwith Beck to River Washburn (GB104027064258)
- River Wharfe from River Washburn to Collingham Beck (GB104027064254)
- River Wharfe from Collingham Beck to Tadcaster Weir (GB104027064255)
- River Wharfe from Tadcaster Weir to River Ouse (GB104027064256).

A4.2.2 Reach setting

Wharfe 1, located on main EAR **Figure 4.1,** comprises a 68.4 km stretch of the River Wharfe. The reach has an additional catchment area of 497 km^2 along its length.

A4.2.3 River flow regime

Flows on the Wharfe 1 reach are measured at Addingham gauging station, a short distance downstream of Yorkshire Water's abstraction intake. In order to achieve a representative baseline series, the gauged data for 1990-2019 was adapted to remove the influences from the drought permit conditions in August-November 1995. Additionally, the series was adjusted to account for the current compensation regime at Grimwith Reservoir which has been in place since 2015. As such, whenever the measured YWSL flow at Grimwith Reservoir outflow was less than the current (variable) compensation flow, the difference in flow was identified and that flow added on to the Addingham gauged data on the same date to provide the reference condition dataset.

At low flows below 252 Ml/d the combined drought option flow reduction on this reach is 22.7 Ml/d. This represents flow reductions of 15.0% and 18.0% in the summer Q95 and Q99 flow statistics of 151.2 Ml/d and 125.8 Ml/d respectively and would therefore be assessed as a **moderate** hydrological impact on this reach during the summer months of April to September inclusive.

8 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

9 Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

During the winter months, the year round Q95 flow statistic of 166.7 Ml/d is also affected by a flow reduction of 22.7 Ml/d. This equates to a flow reduction of 13.6%. At the year round Q50 flow statistic of 571.4 Ml/d at the Addingham gauge, no regulation releases are required and, therefore, there would be no flow reduction under this drought permit at Q50 flows (or above). A reduction of 13.6% in the year round Q95 flow statistic, combined with no change to the year round Q50 flow statistic, would be assessed as a **minor** hydrological impact during the winter months of October to March inclusive

An additional mid-reach assessment point has been included downstream of the River Washburn. When assessed alone, the Wharfe at Lobwood drought permit would lead to a reduction of 22.7 Ml/d in summer Q95 and Q99 flows of 11.3% and 15.1% respectively. This would still remain a **moderate** hydrological impact in the summer.

As above, the Wharfe at Lobwood drought permit would lead to a 22.7 Ml/d reduction in year round Q95 flows of 228.9 Ml/d which equates to a 10.0% reduction. There would be no impact on year round Q50 flows of 759.0 Ml/d as a result of the Wharfe at Lobwood drought permit. This combined with a 10.0% reduction in year round Q95 flows equates to the hydrological impact for the winter remaining at **minor**.

There are two significant flow pressures influencing flow in Wharfe 1, one non-consumptive abstraction for energy production, with a peak daily licensed abstraction rate of 864Ml/d without a hands-off-flow condition ('River Wharfe – Burley in Wharfedale') with potential flow impacts, however it is understood that the hydroelectric plant is not able to operate during low flow periods. There is one further abstraction for paper and printing, 'River Wharfe – Pool in Wharfedale' with a maximum daily rate of 14.4 Ml/d. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

A4.2.4 River habitats

River habitats have been characterised at a whole reach scale. No additional information for a representative 500m reach has been surveyed.

Reach 2 is sinuous river surrounded by extensive floodplains. RHS data indicates the presence of up to 2 river terraces in the reach. The reach itself falls ~91m over 71.6km, a slope of ~0.07°. Riparian tree cover varies from none to continuous due to the length of the reach. On average, cover varies between isolated to semi-continuous. Channel widths are generally between 30-40m throughout the entire reach. Widths tend to be greater immediately upstream and downstream of weirs. It is notable that the channel width is significantly narrower around, and downstream of, Tadcaster with widths between 21-26m. There are extensive levees around the channel here and resectioning is apparent. It is likely that channel widths are due to anthropogenic modification of the channel. Extant aerial imagery shows a wide array of in-channel features with 26 mid channel bars (17 of which are vegetated), 61 side bars (14 of which are vegetated) and 26 point bars (5 of which are vegetated). A total of 9 islands have also been identified, with several located downstream of weirs. The sediment bar features suggest particle sizes of pebble and cobble and greater; this is confirmed by RHS Sites 13124, 25480 and 3700. The presence of boulders protruding through the flow surface is common, particularly in the upper to mid sections of the reach. Exposed bedrock and boulders was noted at one upper RHS site (13124) and one mid reach RHS site (33479). Two small deltas were identified in the river around Ilkley in the mid sections of the reach. These were both situated at the mouth of tributary channels. Within-channel features decrease in number as distance downstream increases. Data for RHS sites 13124 and 25480 indicate that cobbles are the predominant substrate with some boulder and gravel/pebble and bedrock is apparent in RHS site 33479. The bed was not visible at the lower RHS site (13134). At least 119 areas of broken flow have been identified in the reach which are likely caused by riffles. The remainder of the channel surface indicates smooth flow. RHS data for the upper and mid site (13124 and 25480) indicate rippled flow is dominant, while at the lower site (13134) smooth flow is dominant. There is likely to be a wide range of flow types, e.g. upwelling, unbroken and broken standing waves etc., throughout the reach given the features present as confirmed by RHS site 33479.

Bank erosion is extensive throughout much of the reach, many of the banks showing numerous failure zones and areas of poaching (e.g., Site 33479). Due to the nature of failure and the vegetation present banks are apparently composed of earth and data for the upper, mid and lower RHS sites confirm this. Some brick or laid stone and bedrock was noted at sites 13124 and 13134 respectively. RHS site 33479 showed significant variation in bank material and bedrock, brick, cobble and earth was observed. Data

for the five RHS sites identify a range of bank forms. At the upper site, 13124, and mid site, 25480 and 33479 steep banks (>45°) and vertical banks with toe are extensive on both sides. At the lower site steep banks (>45°) and composite banks are present along with some reinforced toe and poaching on the right bank. Bank vegetation types were variable at the three RHS sites. At the upper site, left banks were predominantly simple vegetation and right banks were a mixture of simple and complex vegetation. At site 25480, left bank vegetation was mostly simple while the right bank was composed wholly of uniform vegetation. At the lower RHS site, 13134, left bank vegetation is predominantly complex while the right bank is a mixture of complex and simple vegetation. Left bank top vegetation ranged from predominantly simple, uniform and complex at upper, mid and lower RHS sites respectively. Right bank top vegetation was predominantly complex at the upper RHS site and uniform at the mid and lower RHS sites.

The surrounding land-use throughout the reach is a mixture of improved grassland, rough pasture, tilled, broadleaf woodland and suburban/urban development. Tilled land is increasingly dominant from the mid reaches to the end of the reach. RHS data is generally in agreement but tall herbs and rank vegetation were noted at the upper and lower sites and tall herbs, scrub and shrubs at the mid site.

The reach supports geomorphological features typical of a lowland watercourse, with a shallow valley slope and extensive floodplain connectivity. As is typical in watercourses of this type, low energy environments are present, as indicated by the extensive presence of depositional features, and high energy environments, as indicated by the extensive bank erosion, which provide different habitat opportunities. The presence of marginal silt deposits is likely to occur in this watercourse, with sediment provided by the bank erosion, providing suitable habitat opportunities for fine-lined pea mussel and juvenile lamprey. The decrease in depositional features downstream suggests the presence of marginal silts may be limited to the upper parts of the reach. The soft earth banks are suitable for the creation of burrows by white-clawed crayfish, water vole and otter and the presence of reinforcement may provide additional habitat opportunities for white-clawed crayfish and otter. The complex and simple vegetation structures within the riparian corridor suggest that there is sufficient cover and food source for water voles.

There is potential for spawning habitat to be present, with the potential presence of riffles identified and suitable substrate likely to be present in discrete patches. Cover for juvenile and adult fish and white-clawed crayfish is available from the larger substrate types, extensive vertical banks and presence of flow deflectors in the watercourse. The varied presence of trees in the riparian habitat will also provide some cover for fish, refuge opportunities for otter and white-clawed crayfish and an input of allochthonous energy. There are a number of extensive woodlands within the reach that could support breeding otter. The presence of 15 weirs in the reach may have impacts upon the migration/movement of fish and sediment.

The drought options reduction in flow could lead to several potential impacts along the Wharfe 1:

- Minor, short-duration risk of changes in the energy of the system associated with up to 18% reduction in flow for the duration of drought options.
- Potentially moderate risk of reduction in wetted aquatic habitat (wetted width reduction) with increasing exposure of channel margins, the margins of within-channel features (such as channel bars and islands) and protrusion of bed elements (such as larger particles) through the flow surface for duration of drought option.
- Potentially moderate risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for duration of drought option, with retention of pool riffle sequences.
- Minor risk to longitudinal connectivity.
- Minor risk of changes in sediment dynamics for duration of drought option. Reductions in discharge will lead to reductions in velocity and could lead to increased potential for the deposition of any fine sediment in transport noting that sources will be largely dormant during environmental drought. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Wharfe 1 from drought options is therefore assessed as moderate.

A4.2.5 River water quality

The fifth water quality monitoring location in the reach has been used due to its data quality: Wharfe at Denton Bridge, Ben Rhydding (NE-49700247). The average pH between 2010-2020 was 8.2 with a maximum temperature of 20.2^{o}C for the same period. Water quality modelling identifies one continuous discharge, YWSL Ilkley WwTW, presenting a significant risk to total ammonia in Wharfe 1. There are five frequently operating CSOs which potentially present an environmental risk in the reach. A summary description of the potential risks to water quality in the Wharfe 1 as a result of drought options is presented in **Table A4.1**.

Table A4.1 Potential risks to water quality in the Wharfe 1 as a result of drought options

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.6 mg/l) throughout the monitoring period	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period	Orthophosphate concentrations were mostly consistent with 'Good' WFD status (0.061 mg/l) throughout the monitoring period with 18% of results below this value.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	None apparent
WwTW presenting increased risk	Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ilkley WwTW.	None	None
Intermittent pressures presenting risk	Risk of short term acute, infrequent, temporary water quality pressures (acute toxicity of ammonia, suffocation from oxygen sags) locally downstream of six listed CSOs during rainfall events.		None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with CSO discharge and reduction in dilution of WwTW	Moderate risk from drought options associated with CSO discharge	Minor risk from drought options

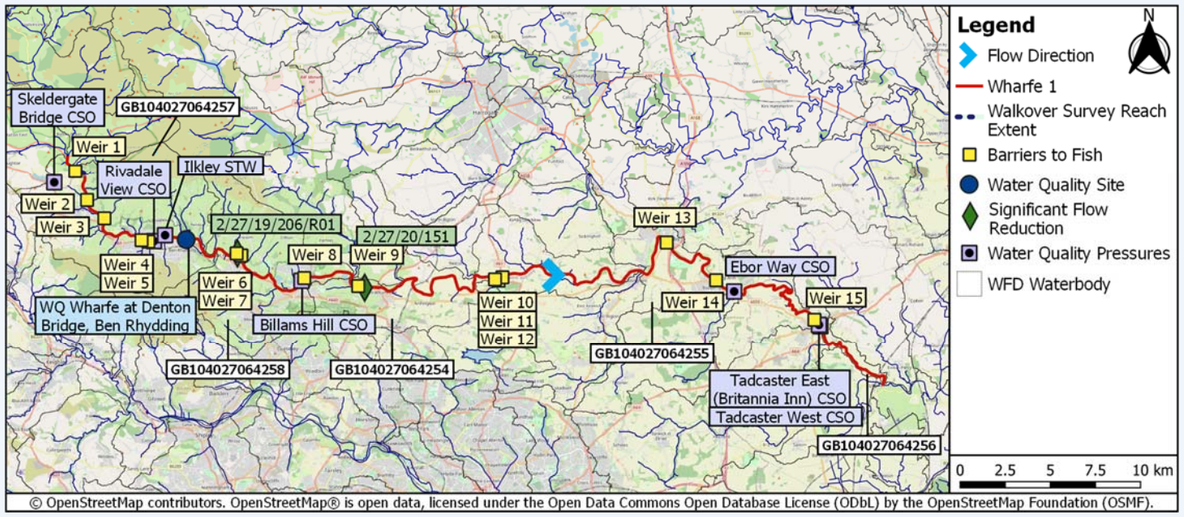
A4.2.6 Summary of potential changes in the physical environment as a result of drought option

An overall summary of potential changes in the physical environment of the Wharfe 1 as a result of drought option is presented in **Table A4.2**.

Table A4.2 Summary of potential changes in the physical environment of Wharfe 1 as a result of drought option

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
River flows *Moderate impacts (summer/autumn)* *Minor impacts (winter)*	• Short duration reductions of up to 18% in river flows in summer and dry autumn conditions, reducing along the length of the reach.
Flow depleted reaches *None*	• There are no flow depleted reaches within Wharfe 1.
River habitats *Moderate risk*	• The moderate reduction in flow will change the energy of the system • Potential moderate risk of reduction in total wetted aquatic habitat in the reach, and moderate risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. • Minor risk to longitudinal connectivity • Minor risk of change in sediment dynamics.
Water quality *Moderate risk*	• Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ilkley WwTW. • Risk of short term acute, infrequent, temporary water quality pressures locally downstream of six listed CSO during rainfall events. • Reported water quality is predominantly consistent with 'Good' status and no apparent flow sensitivity.

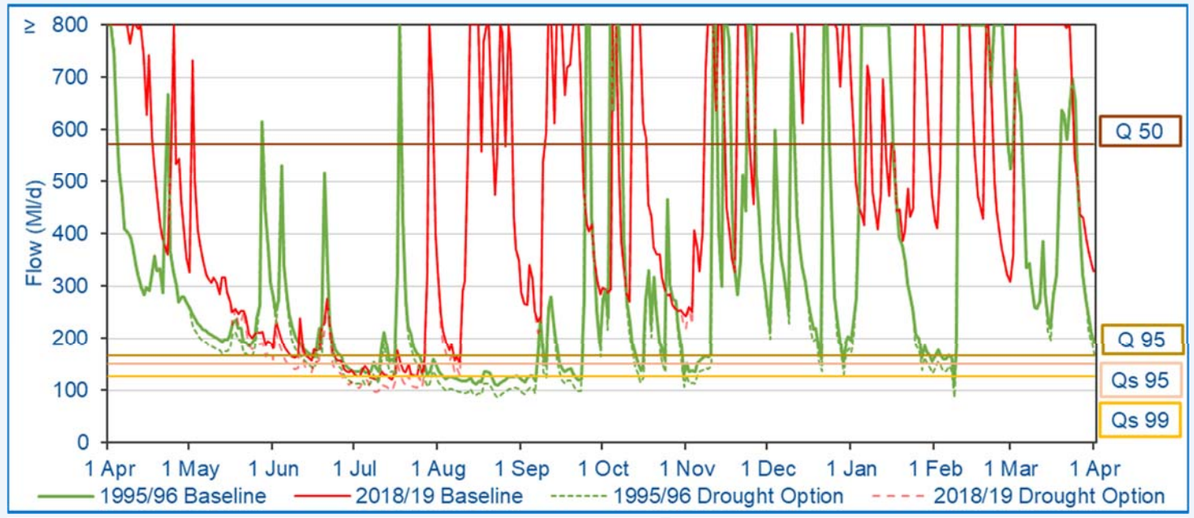
Reach Setting



Reach Setting Information:
The bedrock geology is dominated by the Millstone Grit in the upper part of the reach, becoming more dominant downstream, where lithologies of the Zechstein Group (limestone) and undifferentiated Permian (mudstone, siltstone, sandstone) and Triassic (sandstone and conglomerate) lithologies dominate. The superficial geology is diverse due to the length of the reach. The reach is underlain by alluvium and surrounded, predominantly, by glacial tills. There are scattered river terrace deposits and glaciofluvial deposits along the reach. Soil types beneath the reach are composed predominantly of freely draining lime-rich soils and freely draining floodplain soils with a small section of loamy and clayey floodplain soils at the end of the reach between Tadcaster and the tidal limit.

	Supplementary Information
Catchment Area at Assessment Point	413.3km^2
Mean Slope Gradient	0.07^o
Length of Reach	68.4km
Additional Catchment Area	497.0km^2
Upstream Reach	N/A
Downstream Reach	N/A

River Flow Regime



-	Reference Conditions (Ml/d)	Drought Plan Conditions (Ml/d)	% Reduction	Impact
Q_s95	151.2	128.5	15	Summer Moderate
Q_s99	125.8	103.1	18	
Q95	166.8	144.1	13.6	Winter Minor
Q50	571.4	571.4	0	

Significant Flow Additions/Reductions	Flow Rate (Ml/d)	Abstraction / Discharge
Wharfedale Hydro Power Ltd/ 2/27/19/206/R01	864.0	Abstraction
Whiteley Ltd/ 2/27/20/151	14.4	Abstraction

River Habitats

No walkover survey was carried out during the onset of drought in 2018. This will be included in the EMP.

River Water Quality

Significant Water Quality Pressures	Permit Conditions
Rivadale View CSO / 3166(SS)	Intermittent discharge
Billams Hill CSO / WADC717 A1	Intermittent discharge
Ebor Way CSO / WA5855	Intermittent discharge
Tadcaster West CSO / 27/20/0112	Intermittent discharge
Tadcaster East CSO / 27/20/0113	Intermittent discharge
Ilkley STW / 27/19/0045	2.361 Ml/d DWF 3.705 Ml/d Max Daily 25 mg/l Ammonia (N) 30 BOD ATU

In the River Wharfe at Denton Bridge, Ben Rhydding (NE-49700247) the average pH between 2010-2020 was 8.2 with a maximum temperature of 20.2^{o}C

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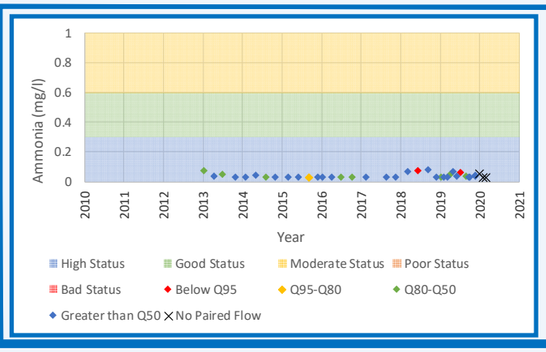
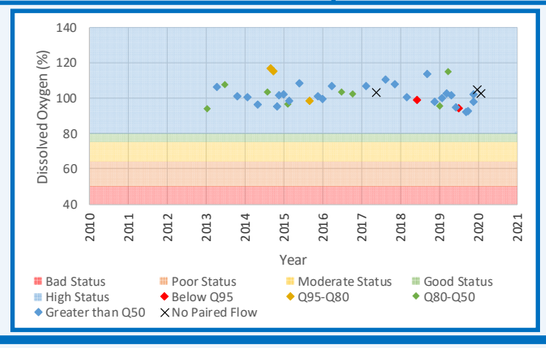
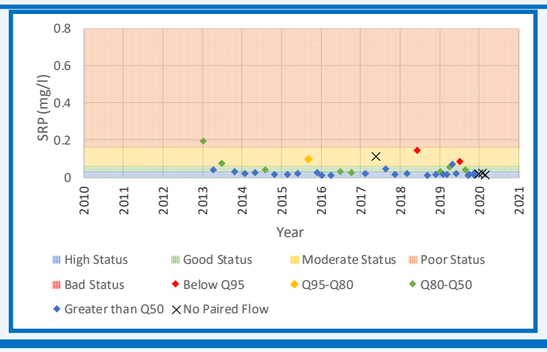
Figure A4.1
Wharfe 1
Physical Environment Information







Annex 1 – Regulated abstractions in the Wharfe 1 reach

DP reach	Licence No.	Use Description	NGR 1	Max Annual Quantity	Max Daily Quantity
Wharfe 1	2/27/19/206/R01	Electricity Production	SE1655047390	315000000	864000
Wharfe 1	2/27/20/038	General Agriculture	SE45194562	27277	681.82
Wharfe 1	2/27/20/038	General Agriculture	SE45994562	27277	681.82
Wharfe 1	2/27/20/096	General Agriculture	SE365461	30000	286.41
Wharfe 1	2/27/20/151	Paper and Printing	SE236455	4318790	14398
Wharfe 1	2/27/20/183	General Agriculture	SE427470	4546	227.3
Wharfe 1	2/27/20/191	General Agriculture	SE315462	20480	512
Wharfe 1	2/27/20/195	General Agriculture	SE42304662	19000	227
Wharfe 1	2/27/20/195	General Agriculture	SE43224576	19000	227
Wharfe 1	2/27/20/313/R01	General Agriculture	SE36004582	8000	918
Wharfe 1	2/27/20/313/R01	General Agriculture	SE37174622	8000	918
Wharfe 1	2/27/20/314/R01	General Agriculture	SE3200046300	6100	206
Wharfe 1	NE/027/0020/025	General Agriculture	SE3930046240	12000	411
Wharfe 1	NE/027/0020/002/R01	Electricity Production	SE2333245552	N/A	N/A
Wharfe 1	NE/027/0020/026	Other Environmental Improvements	SE4216747295	N/A	N/A

Annex 2 – Water quality pressures considered in the assessment

Name	Permit Reference	Outfall NGR	Significant Water Quality Pressure	Intermittent/ Continuous
Hardisty's Farm	2108	SE1450048100	No	Continuous
Pool Paper Mill	1	SE2373045540	No	Continuous
Wheatley Lane	27/19/0042	SE1370048120	No	Continuous
Ben Rhydding (Ilkley) WPC Works, St	27/19/0044	SE1447047480	No	Continuous
Ilkley STW	27/19/0045	SE1254048390	Yes	Continuous
Otley STW	27/20/0046	SE2227346324	No	Continuous
Wetherby STW	27/20/0054	SE4180747052	No	Continuous
Samuel Smith Old Brewery	27/20/0055	SE4875043300	No	Continuous
High Mills	27/20/0061	SE2402045490	No	Continuous
Thorp Arch STW	27/20/0068	SE4511045760	No	Continuous
Pool WPC Works	27/20/0069	SE2621045540	No	Continuous
Tadcaster WPC Works	27/20/0073	SE4957042710	No	Continuous
Langwith Valley SPS	27/20/0083	SE3732045940	No	Continuous
Britannia CSO	27/20/0114	SE4884043370	No	Continuous
Private	27/20/0127	SE3615046070	No	Continuous
Kearby STW	27/20/0128	SE3287046740	No	Continuous
Weeton STW	27/20/0129	SE2966046120	No	Continuous
Sso 250 Metres Downstream	3166(SS)	SE1170048000	No	Continuous
High Mill (Addingham)	C4186	SE0820050100	No	Continuous
Stac Polly	C4239	SE3820046400	No	Continuous
Burley/Menston (Sheffield) STW	E164	SE1860045900	No	Continuous
Otley Sailing Club	EPRCP3828XV	SE1863945756	No	Continuous
Hadfield Farm Barns & Farm House	QC.27/19/0027	SE1050048400	No	Continuous
A Residential Development	QC.27/20/0012	SE3120046100	No	Continuous
Esscroft	QR.27/19/0032	SE1530047250	No	Continuous
Esscroft Cottage	QR.27/19/0033	SE1530147250	No	Continuous
The Woodhall Hotel	QR.27/20/0022	SE3711046600	No	Continuous
Otley Angling Club Silver Mill	WA6080	SE1880045400	No	Continuous
Newton Kyme Hall	WA6243	SE4660045100	No	Continuous
Tadcaster Weir SSO	WADC615	SE4855043650	No	Continuous
Ilkley Road	WADC640	SE1963945309	No	Continuous
Bridge Street SSO	WADC757	SE2017545770	No	Continuous
Wetherby High Street CSO	1553	SE4043048052	No	Intermittent
Wyvil Crescent CSO	27/19/0019	SE1354748017	No	Intermittent
Low Mill Lane 179 CSO	27/19/0092	SE0871049560	No	Intermittent
Kirkby Wharfe/CSO	27/20/0065	SE50734099	No	Intermittent
Warren Lane Otley/CSO	27/20/0079	SE26214498	No	Intermittent
West Busk Lane No 2 CSO	27/20/0101	SE1883645012	No	Intermittent
Arthington Lane CSO	27/20/0130	SE2480045330	No	Intermittent
Wattle Syke CSO	27/20/0161	SE3944046420	No	Intermittent
Boston Spa High St/CSO	C4576	SE4324645665	No	Intermittent
Wheatley Lane CSO, Ben Rhydding Il	QC.27/19/0018	SE1360048120	No	Intermittent
Leeds Road Ilkley No2 CSO	QC.27/19/0024	SE1286848142	No	Intermittent
Scott Lane CSO	WADC1313	SE4030248075	No	Intermittent
Wetherby Bypass CSO	WADC1477	SE4064947691	No	Intermittent
Crook Farm CSO	WADC861	SE2522445342	No	Intermittent
Burley Lodge CSO	WRA6863	SE1713846121	No	Intermittent

Name	Permit Reference	Outfall NGR	Significant Water Quality Pressure	Intermittent/ Continuous
Ebor Way/CSO	WA 5855	SE4407045290	Yes	Intermittent
Tadcaster West CSO	27/20/0112	SE4884843374	Yes	Intermittent
Tadcaster East (Britannia Inn) CSO	27/20/0113	SE4877043450	Yes	Intermittent
Wyvill Road CSO	QC.27/19/0025	SE1340248106	No	Intermittent
Billams Hill/CSO	WADC717	SE2009945880	Yes	Intermittent
Rivadale View CSO	3166(SS)	SE1192448068	Yes	Intermittent

Appendix B – Environmental Features

B1. Introduction

This appendix assesses the potential impacts on the environmental features of the River Wharfe during the period of implementation of the associated drought option.

Details regarding the approaches/methodologies used for assessing susceptibility and sensitivity to drought management actions and the assessment of the impacts associated with drought management actions are presented in Sections 3.6 and 3.7 of YWSL's Drought Plan 2022 Environmental Assessment Methodology[1].

The environmental preferences within which a species can successfully exist and the relationship between populations in stressed river conditions remains subject to debate. The prediction of impacts of hydrological and water quality changes on aquatic ecology remains subject to significant uncertainty and this may be exacerbated where data are limited. This assessment has, therefore, adopted a precautionary approach, with potential impacts highlighted where doubt exists.

The assessment of environmental features is informed by the assessment of the physical environment (which includes hydrology and hydrodynamics; geomorphology; and water quality), this is summarised in Section 5 presented in full in **Appendix A**.

Points of interest referred to throughout the text are indicated in **Figure B1.1**.

This appendix is set out in the following sections:

Section B.2 Baseline and sensitivity– this includes for each reach:

1. Statutory designated sites
2. NERC and local wildlife sites (LWS)
3. NERC and other protected species
4. WFD features
5. Invasive non-native species (INNS)
6. Landscape, navigation, recreation and heritage.

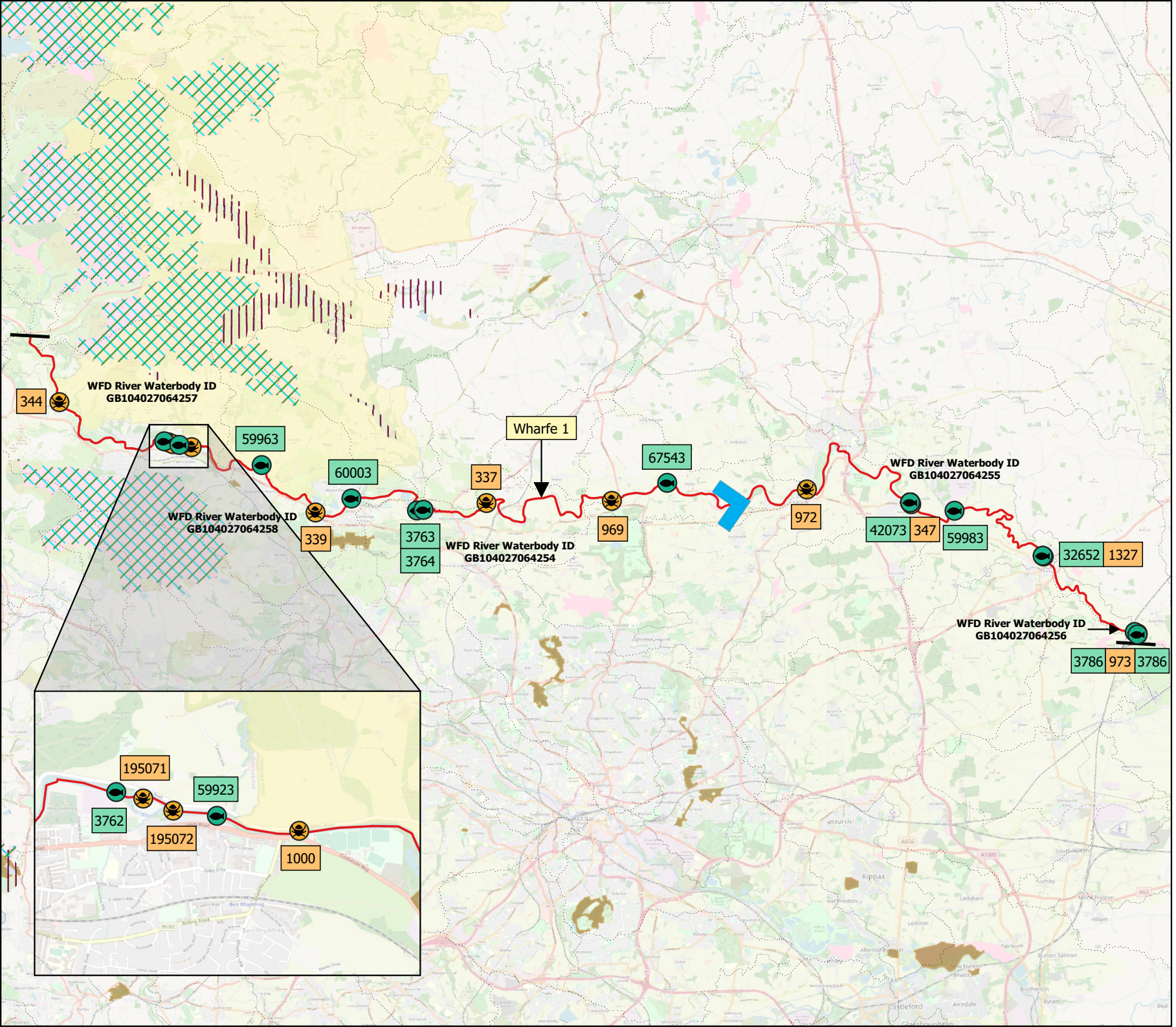
Section B.3 Environmental features screening.

Section B.4 Features assessment, monitoring and mitigation – this includes for each reach:

1. Features assessment
2. Summary of impacts.

Section B.5 Monitoring and mitigation

[1] Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.



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Legend

N

- River Reaches
- Reach Divides
- Flow Direction
- Macroinvertebrate Site
- Fish Site
- Areas of Outstanding Natural Beauty
- Local Nature Reserves
- Local Wildlife Sites
- Special Areas of Conservation
- Special Protection Areas
- Sites of Special Scientific Interest
- WFD Management Catchment

Project title:
Yorkshire Water Drought Plan Environmental Assessment

Figure title:
River Wharfe at Lobwood Ecology

Figure B1.1	**Date:** August 2020
NGR: SE 28693 46598	**Scale:** 1:200000

Note: All locations are approximate

B2. Baseline & Sensitivity

Details regarding the approaches/methodologies used for assessing susceptibility and sensitivity to drought option implementation are presented in Section 3.6 YWSL's Drought Plan 2022 Environmental Assessment Methodology[2].

B2.1 Wharfe 1

B2.1.1 Statutory designated sites

Table B2.1 summarises the sites of international/national importance (SSSI, SAC, SPA, Ramsar, Marine Conservation Zone, NNR, LNR) which are in hydrological connectivity with the impacted reach.

One statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.1**).

Table B2.1Statutory designated sites

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
East Keswick Fitts SSSI	Moderate	Area of willow carr on shingle banks beside the Wharfe. Noted for invertebrate interest, and flooded at high flows. Reduced flows due to option could increase exposure of cobbles and gravels. The risk to East Keswick SSSI from implementation of the Wharfe at Lobwood drought permit was confirmed as negligible following additional screening undertaken by Arup on behalf of Yorkshire Water (see Yorkshire Water Drought Plan: Sites of Scientific Interest Assessment Report – Arup, March 2019).	Not sensitive	No
Linton Common SSSI	Moderate	The site is designated for limestone grasslands. Due to the distance between the site and the impacted hydrological reach, the SSSI will not be affected by the drought option.	Not sensitive	No
Kirkby Wharfe SSSI	Moderate	An area of floodland in the valley of Dorts Dike, a Tributary of the River Wharfe. Due to the distance between the site and the impacted hydrological reach, the SSSI will not be affected by the drought option.	Not sensitive	No

[2] Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

B2.1.2 NERC and local wildlife sites

summaries the NERC Act Section 41 and other notable and/or protected habitats (e.g. LWS) which are located on or within 500m of the impacted reach.

No NERC Act Section 41 or other notable and/or protected habitats that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.2**).

Table B2.2 NERC habitats and local wildlife sites

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
River Wharfe, Otley & Mid Wharfedale /Wetherby LWS	Moderate	Rich-fen site, most ecologically important major riverine habitat in the county	Medium	Yes
Wharfeside Woods	Moderate	Predominantly base-rich sycamore and beech woodland. An area of marginal swamp habitat is present beside the river.	Low	No
Low Mill, Addingham	Moderate	Moderately species rich semi-natural woodland.	Low	No
Lumbgill Wood LWS	Moderate	High bluebell cover: County rare plant (Chrysosplenium alternifolium)	Not sensitive	No
Owler Park and Spring Wood, Ilkley LWS	Moderate	Extensive native bluebell cover	Not sensitive	No
Terrace Ghyll, Ilkley LWS	Moderate	Extensive native bluebell cover	Not sensitive	No
Crabtree Ghyll LWS	Moderate	Ancient semi-natural woodland: high bluebell cover	Not sensitive	No
Middleton Woods, Ilkley LWS	Moderate	Ancient semi-natural woodland; species rich acid woodland; over mature trees; good cover of bluebell	Not sensitive	No
West Park Wood/Stubbs Wood LWS	Moderate	Mosaic of habitats including neutral and upland acid grassland.	Not sensitive	No
Ben Rhydding Gravel Pits LWS	Moderate	Species rich swamp; species rich grassland; species rich fen; Local Nature Reserve (part); Mosaic habitats	Medium	Yes
Burley Bypass Verges LWS	Moderate	MG5 rare grassland habitat: species rich neutral grassland	Not sensitive	No
Otley Sand and Gravel Pits LWS	Moderate	Species rich standing water, mixed fen, hedgerow and mixed habitats	Medium	Yes
Knotford Nook LWS	Moderate	Species rich standing water, regionally important ornithologically	Not sensitive	No
Owl Head Wood LWS	Moderate	Ancient or long-standing acid woodland.	Not sensitive	No
Ox Close Wood LWS	Moderate	Ancient semi-natural woodland; species rich woodland; species rich woodland; good bluebell cover	Not sensitive	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
Spring Wood, Sicklinghall LWS	Moderate	Ancient or long-standing woodland.	Not sensitive	No
Lime Kiln Wood LWS	Moderate	Ancient or long-standing neutral to calcareous woodland.	Not sensitive	No
Langwith Wood LWS	Moderate	Species rich neutral woodland: Locally rare species (Green hellebore)	Not sensitive	No
Deepdale / Jackdaw Crag LWS	Moderate	Species rich woodland, most northerly site in Britain for bryophyte Gymnostomum viridulum	Not sensitive	No
Thorp Arch LWS	Moderate	Rare grassland habitat (CG4, CG5): species rich calcareous grassland	Not sensitive	No
Brickyard Pond LWS	Moderate	Lowland mire. The site is not hydrologically connected to the impacted reach. The mire is located approximately 350 metres away from the reach and not streams or inlets are present.	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 326145, 326146, 326147, 326148, 326149	Moderate	Arrhenatherum elatius grassland, Cynosurus cristatus–Centaurea nigra grassland, Lolium perenne–Cynosurus cristatus grassland Arrhenatherum elatius grassland	Not sensitive	No
NERC Priority Habitats - Lowland meadows 425204, 425205, 425206	Moderate	Arrhenatherum elatius grassland, Cynosurus cristatus–Centaurea nigra grassland, Lolium perenne–Cynosurus cristatus grassland Arrhenatherum elatius grassland	Not sensitive	No
NERC Priority Habitats - Lowland meadows 42520, 425208	Moderate	Arrhenatherum elatius grassland, Cynosurus cristatus–Centaurea nigra grassland, Lolium perenne–Cynosurus cristatus grassland Arrhenatherum elatius grassland, Deciduous woodland	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 326132	Moderate	Brachypodium pinnatum grassland	Not sensitive	No
NERC Priority Habitats - Lowland fens 412760	Moderate	Carex acutiformis swamp, Lolium perenne–Cynosurus cristatus grassland	Not sensitive	No
NERC Priority Habitats - No main habitat but	Moderate	Coastal and floodplain grazing marsh	Not sensitive	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
additional habitats present 458335				
NERC Priority Habitats - Deciduous woodland 324364	Moderate	Coastal and floodplain grazing marsh	Not sensitive	No
NERC Priority Habitats - Lowland meadows 423982	Moderate	Cynosurus cristatus–Centaurea nigra grassland	Not sensitive	No
NERC Priority Habitats - Coastal and floodplain grazing marsh 39690	Moderate	Deciduous woodland	Not sensitive	No
NERC Priority Habitats - No main habitat but additional habitats present 445939	Moderate	Fens	Not sensitive	No
NERC Priority Habitats - No main habitat but additional habitats present 446300	Moderate	Fens, Lowland meadows and pastures	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 325749	Moderate	Good quality semi-improved grassland	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 320147	Moderate	Holcus lanatus–Deschampsia cespitosa grassland, other water-margin vegetation	Not sensitive	No
NERC Priority Habitats - Coastal and floodplain grazing marsh 39050	Moderate	Lolium perenne–Cynosurus cristatus grassland	Not sensitive	No
NERC Priority Habitats - No main habitat but additional habitats present	Moderate	Lowland meadows and pastures	Not sensitive	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
438828				
NERC Priority Habitats - Good quality semi-improved grassland 362900	Moderate	Lowland meadows and pastures; Restoration of species-rich, semi-natural grassland	Not sensitive	No
NERC Priority Habitats - Coastal and floodplain grazing marsh 41544, 65946, 65959, 69036, 69038, 69094, 69095, 69102	Moderate	Maintenance of grassland for target features	Not sensitive	No
NERC Priority Habitats - Good quality semi-improved grassland 356855, 357850, 357851	Moderate	Maintenance of grassland for target features	Not sensitive	No
NERC Priority Habitats - Good quality semi-improved grassland 358576	Moderate	Maintenance of grassland for target features, coastal and floodplain grazing marsh	Not sensitive	No
NERC Priority Habitats - Coastal and floodplain grazing marsh 41388, 69040, 69041, 69042	Moderate	Maintenance of wet grassland for breeding waders	Not sensitive	No
NERC Priority Habitats - Lowland fens 413420, 413421	Moderate	Phragmites australis swamp and reed-beds Glyceria maxima swamp Typha latifolia swamp Reedbeds	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 326359	Moderate	Phragmites australis swamp and reed-beds Glyceria maxima swamp Typha latifolia swamp	Not sensitive	No
NERC Priority Habitats - Deciduous woodland 309745, 309746, 309747, 309800, 309801, 309802	Moderate	Reedbeds	Not sensitive	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
NERC Priority Habitats - No main habitat but additional habitats present 433733, 433945, 433946	Moderate	Reedbeds	Not sensitive	No
NERC Priority Habitats - Coastal and floodplain grazing marsh 39483, 44745, 44750, 44751, 44752, 44754, 44797, 45020, 45041, 45177, 45183, 45218, 45267, 51840, 51869, 51889, 60684, 60844, 60891, 60922, 61106, 61155, 68499, 68502, 68852, 69258, 69260, 69266, 69459, 69461, 69532	Moderate	No further information provided	Not sensitive	No
NERC Priority Habitats - Good quality semi-improved grassland 365556	Moderate	No further information provided	Not sensitive	No

B2.1.3 NERC and other protected species

Table B2.3 summaries the NERC Act Section 41 and other protected species which are located on or within 500m of the impacted reach.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of white-clawed crayfish in the impacted reach. The data showed no surveys or records have been recorded in the impacted reach. White-clawed crayfish have been screened out based on targeted survey carried out by the Environment Agency, which did not find any white-clawed crayfish but confirmed the presence of signal crayfish. Based on the absence of suitable habitat and presence of signal crayfish in the impacted reach, the feature is not considered at risk from the drought permit. Based on the available information these species are considered not to be susceptible to drought permit impacts and **not sensitive** to the physical environment impacts identified in **Appendix A.**

Data obtained from the Environment Agency and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of Environment Agency and YWSL records indicates the presence of otter within the impacted reach. However, no information from survey findings was available and although the home ranges of otter can extend over tens of kilometres it is considered appropriate, following the precautionary principle, to consider otter likely to be present in the reach at the time of the implementation of a drought option. Based on the available information

these species are considered not to be susceptible to drought option impacts and have a **low** sensitivity to the physical environment impacts identified in **Appendix A.**

Data obtained from the Environment Agency and a review of available data from NBN gateway was used inform the assessment of water vole in the impacted reach. The data showed no surveys or records have been recorded in the impacted, although historic data does identify the feature to have been present in the impacted reach. However, the distribution of information and survey data for the species was considered to be limited. Therefore, absence cannot be confirmed. It was considered appropriate, following the precautionary principle, to consider water vole likely to be present in the reach at the time of the implementation of a drought option. Based on the limited available information water vole are considered to be susceptible to drought option impacts and have an **uncertain** sensitivity to the physical environment impacts identified in **Appendix A.**

The rare species of fine-lined pea mussel *Pisidium tenuilineatum* has been identified as being present in Wharfe 1. Review of EA records indicates the potential presence of fine-lined pea mussel in the River Wharfe. *Pisidium* sp. was sampled at Harewood and Castley survey sites, but detailed species data and quantitative data on populations of this species in the watercourse have not been made available. YWSL has undertaken targeted Fine-lined Pea Mussel surveys in 2015 and 2016 at Addingham. The results of these surveys indicate that fine-lined pea mussel was not observed during 2015. The River Wharfe population of fine-lined pea mussel is thought to be geographically distant from all other British populations (mainly to central southern England) and is, therefore, of both national and local importance.[3] Fine-lined pea mussel are thought to be found living a wide range of flow and sediment conditions, with a preference to less high-energy conditions amongst, or in the lee of, marginal aquatic plants, downstream of constructions or obstructions, or in shallow embayment's[4]. Based on the information available this feature is considered to be susceptible to drought permit impacts and have a **medium** sensitivity to the physical environment impacts identified in **Appendix A.**

Several NERC act section 41 and notable fish species have been identified as present in the impacted reach, including four NERC Act Section 41 fish species (Atlantic salmon, brown trout and European eel, river lamprey) and four notable fish species (grayling, bullhead, brook lamprey and grayling).

Table B2.3 NERC Act Section 41 and other protected species

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
NERC Species – Crustacea Freshwater White – clawed Crayfish (*Austropotamobius pallipes)*	Moderate	Limited data is available for the impacted reach. White-clawed crayfish are not likely to be present in the impacted reach as signal crayfish are identified as present during a targeted survey.	Not sensitive	No

[3] Killeen, I.J, Williams, S. (1998). The status and distribution of *Pisidium Tenuilineatum* Stelfox, 1918 (Mollusca: *Sphaeriidae*) in the River Wharfe. Naturalist 124: 101-106.

[4] Killeen, I.J, Willing, M.J. (2004). Further surveys to elucidate the distribution of the fine-lined pea mussel Pisidium tenuilineatum Stelfox, 1918. R&D Technical Report W1-054/TR. Environment Agency.

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
NERC Species – mammals Otter *(Lutra lutra)*	Moderate	Otters are known to use the impacted reaches. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Low	Yes
NERC Species – mammals Water vole (*Arvicola amphibious)*	Moderate	Limited data is available for the impacted reach. Changes in water level are the most important factor influencing water vole populations, with species readily inhabiting areas of slow flowing and standing water. As such hydrological and associated impacts as a result of this drought option may reduce habitat availability and alter the species food supply.	Uncertain	Yes
NERC Species – Molluscs Fine-lined pea mussel *(Pisidium tenuilineatum)*	Moderate	Population occurs at the northern most edge of its distribution. Nutrients and inappropriate channel management are listed as threats as is wash out from high flows. Extent to which vulnerable to drought option impacts unknown – may be vulnerable to drying.	Medium	Yes
NERC Species – Fish -Atlantic salmon (*Salmo salar)* -Brown trout (*Salmo trutta)* -European eel *(Anguilla Anguilla)* -River lamprey *(Lampetra fluviatilis)*	Moderate	Potentially susceptible as duration of impacts could include all seasons, and thus could impact spawning, migration, provision of cover etc. Due to the presence of obstructions within the waterbody preventing upstream migrations there is less chance of natural recovery should the fish populations be damaged. In addition, the scale of the change is very high over a long reach of the watercourse. Predation could occur on fish stranded in pools in high densities.	High	Yes
Notable Species – Fish -Grayling (*Thymallus thymallus)* -Bullhead *(Cottus gobio)* -Barbel *(Barbus barbus)* -Brook lamprey *(Lampetra planeri)*	Moderate	Potential for water quality issues to be exacerbated at lower flows. Potential for increased predation at lower flows. Important migratory spawning habitats.	Medium	Yes

B2.1.4 WFD features

B2.1.4.1 Macroinvertebrates

The WFD waterbodies GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck, GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir and GB104027064256 River Wharfe from Tadcaster Weir to River Ouse are all classified as 'High' for macroinvertebrates in 2016, Cycle 2.

Baseline macroinvertebrate data is provided by nine Environment Agency monitoring sites:

- The WFD waterbody GB104027064257 (River Wharfe from Barben Beck/River Dibb to Hundwith Beck) classifies as high for macroinvertebrates in 2015, Cycle 2. Baseline data is provided by two EA monitoring sites at Addingham (ID 344) and Ilkley (ID 1000).
- The WFD waterbody GB104027064258 (River Wharfe from Hundwith Beck to River Washburn) classifies as high for macroinvertebrates in 2015, Cycle 2. Baseline data is provided by one EA monitoring site at Otley (ID 339).
- The WFD waterbody GB104027064254 (River Wharfe from River Washburn to Collingham Beck) classifies as high for macroinvertebrates in 2015, Cycle 2. Baseline data is provided by three EA monitoring site at Castley (ID 337), Harewood (ID 969) and Linton Bridge (ID 972).
- The WFD waterbody GB104027064255 (Wharfe from Collingham Beck to Tadcaster Weir) classifies as high for macroinvertebrates in 2015, Cycle 2. Baseline data is provided by two EA monitoring sites at Boston Spa (ID 347) and downstream of Tadcaster (ID 1327).
- The WFD waterbody GB104027064256 (Wharfe from Tadcaster Weir to River Ouse) which classifies as high for macroinvertebrates in 2015, Cycle 2. Baseline data is provided by one EA monitoring sites at Ulleskelfe (ID 973).

The WFD status of the macroinvertebrate community in Wharfe 1 may be impacted by the implementation of this drought permit. However, low flow impacts of drought option implementation would occur against a baseline of drought conditions (i.e. compensation flow only), and therefore impacts of the drought permit must be considered in the context of environmental drought.

Assessment of the sensitivity of the macroinvertebrate community was undertaken by analysis of recorded LIFE scores. Baseline data indicates that under present conditions, the macroinvertebrate community in Wharfe 1 is highly sensitive to reduced flows (**Figure B2.1**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

Table B2.4 LIFE score sensitivities

LIFE score	Invertebrate community flow sensitivity
7.26 and above	High sensitivity to reduced flows
6.51 – 7.25	Medium sensitivity to reduced flows
6.5 and below	Low sensitivity to reduce flows

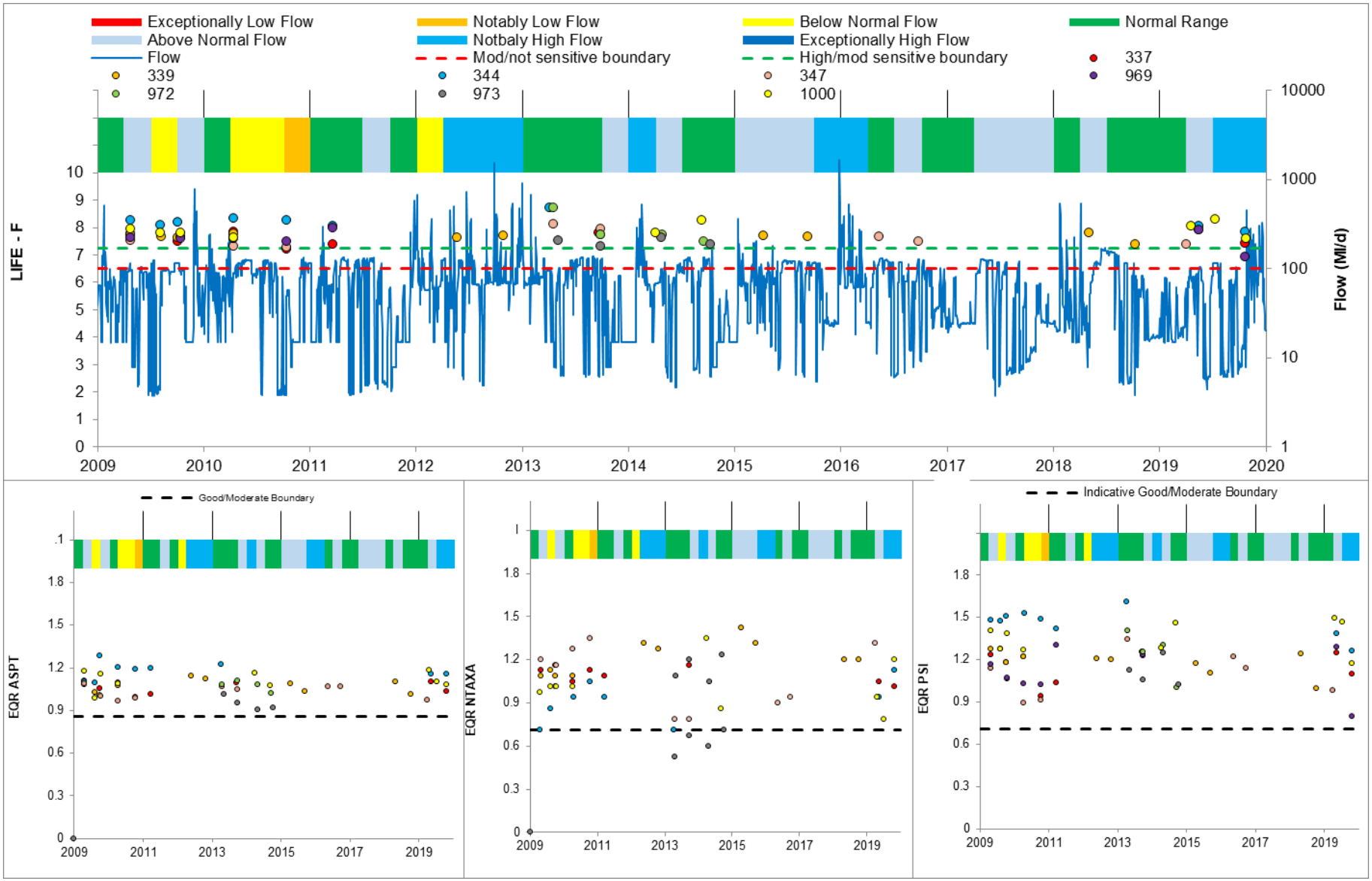
$WHPT_{ASPT}$ and $WHPT_{NTAXA}$ scores are available for the site. WHPT and PSI EQR scores are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for $WHPT_{NTAXA}$ and $WHPT_{ASPT}$, see **Figure B2.1**.

Data from the monitoring site shows variation in $WHPT_{ASPT}$ scores over the period 2009 to 2019 but remain consistent with the standard to achieve good or high WFD status over the monitoring period. $WHPT_{ASPT}$ scores from the site identifies macroinvertebrate communities which are composed of a good proportion of taxa which are sensitive to pressures including water quality, $WHPT_{ASPT}$ scores ranging between 5.43 and 7.70. There are no instances of deterioration to this standard during the monitoring period, as such the community is not expected to have been impaired by water quality pressures historically.

In Wharfe 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with $WHPT_{NTAXA}$ ranging between 14 and 38. $WHPT_{NTAXA}$ EQR scores showed significant variance between seasonal surveys, ranging between 0.53 and 1.43, indicative of poor to high ecological status. Both site 337 and Site 339 remained consistent to achieve high ecological status throughout the monitoring period. This suggests that pressures which impair macroinvertebrate diversity such as habitat loss may influence the baseline community.

Based on the available information the macroinvertebrate community is considered to be susceptible to drought permit impacts and have a **medium** sensitivity to the physical environment impacts identified in **Appendix A**.

Figure B2.1 LIFE score sensitivities, EQR values for $WHPT_{NTAXA}$, $WHPT_{ASPT}$ and PSI score



*PSI EQR scores are not used to inform the WFD status of macroinvertebrates, instead these values are used to provide supplementary information to the assessment

B2.1.4.2 Fish

The WFD Waterbody GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck is classified under Cycle 2 (2016) as moderate. The waterbodies GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir and GB104027064256 River Wharfe from Tadcaster Weir to River Ouse are not classified for fish under Cycle 2 (2016). Baseline fisheries data within the impacted reach is informed by eleven sites; Ilkley ID3762, Knotford ID3763, Pool Mill ID3764, Ulleskelf ID3786, Tadcaster post 2006 ID32652, Boston Spa - Fry Survey ID42073, Ilkley stepping stones riffle ID59923, D/S Burley weir ID59963, Newton Kyme ID59983, D/S Otley weir ID60003 and Netherby (discretionary only) ID67543. No FSC2 data was available for the Environment Agency monitoring site within the impacted reach. **Table B2.5** sets out the available fish survey data from these sites.

EA survey sites where fish surveys were undertaken included the following:

- Two EA monitoring sites (Ilkley and Ilkley stepping stones riffle) within WFD waterbody GB104027064257 (River Wharfe from Barben Beck/River Dibb to Hundwith Beck),
- Two EA monitoring sites (downstream of Burnley Weir and downstream of Otley Weir) within GB104027064258 (River Wharfe from Hundwith Beck to River Washburn),
- Three EA monitoring sites (Knotford, Pool Mill and Netherby (discretionary only)) within GB104027064254 (River Wharfe from River Washburn to Collingham Beck),
- Three EA monitoring sites (Boston Spa, Newton Kyme, and Tadcaster) within GB104027064255 (Wharfe from Collingham Beck to Tadcaster Weir), and
- One EA monitoring site (Ulleskelf) within GB104027064256 (Wharfe from Tadcaster Weir to River Ouse)

The WFD status of the fish community in Wharfe 1 may be impacted by drought permit implementation. However, low flow impacts of the drought option implementation would occur against a baseline of drought conditions (i.e. compensation flow only), and therefore impacts of drought permit implementation must be considered in the context of environmental drought.

D/S Burley weir ID59963, Newton Kyme ID59983, D/S Otley weir ID60003 were surveyed in 2014 only. A low to moderate abundance of trout were observed at most sites, with the exception of Ulleskelf and Newton Kyme where the species was absent. A low to moderate abundance of Atlantic salmon were present at Newton Kyme and D/S Otley weir, which are located further downstream then the other two monitoring sites. Bullhead were present at all sites, with a low abundance observed at Ilkley, while an estimated 100 to 999 individuals were recorded at all other sites. A high abundance of bullhead is therefore thought to be present in the impacted reach. Individual European eels were observed at Ilkley stepping stones riffle and D/S Otley weir, a low abundance of the species in thought to be present. A low abundance of grayling were recorded at all sites. Two lamprey were recorded at Ilkley though no individuals were recorded at the other sites, however given the lack of targeted lamprey surveys in the reach the abundance of the species in the reach is uncertain. It is likely that lamprey are present in isolated areas in the impacted reach.

Netherby (discretionary only) ID67543was surveyed in 2016 only. A low abundance of both Atlantic salmon and brown trout were recorded at the site, while a moderate abundance of grayling were present. Bullhead were present at the site, with an estimated 1 to 9 individuals recorded. A low abundance of barbel were recorded at the site, with other species including chub, gudgeon, minnow and stone loach also present.

Knotford ID3763, Pool Mill ID3764, and Ulleskelf ID3786 were all surveyed in 2010, 2011 and 2014. Brown trout were present at pool mill in a moderate abundance each survey, while a single brown trout was recorded at Knotford in 2014. Atlantic salmon were also recorded at pool mill in both the 2010 and 2014 surveys, with a single salmon recorded at Ulleskelf in 2014.Grayling were observed in a high abundance at pool mill during all three surveys, with a low abundance observed at Ulleskelf in 2014. Lamprey were present in a low abundance at all sites, though were not recorded at pool mill in 2011 and Ulleskelf in 2010/11. Additionally European eels were observed at all sites, though were not recorded at Ulleskelf in 2011 and 2014. A low abundance of barbel were recorded at Ulleskelf in 2014.

Bullhead were not present at Ulleskelf, with a moderate to high abundance recorded at pool mill. Bullhead were present at Knotford in a two of the surveys, 2011 and 2014, with only a single individual recorded in 2011 and an estimated 1 to 9 individuals recorded in 2014. Ulleskelf (the furthest downstream site) recorded a low abundance of flounder during all three surveys.

Fry surveys at Boston Spa ID42073 were completed in 2010, 2012 and 2014 to 2017. A low to moderate abundance of coarse fish were infrequently observed at the site, with chub dace and gudgeon recorded with varied numbers of individuals annually. Additionally, a single bullhead was observed in 2010 and two individuals in 2010. A low abundance of barbel were recorded at the site in 2016. Minnow were observed in high abundance at the site throughout the survey years and 3-spined stickleback were similarly recorded with varied numbers of individuals annually. The 2017 survey recorded a reduced number of species combined to previous years, with bullhead, barbel, chub, dace and gudgeon all absent.

Tadcaster post 2006 ID32652 is the second most downstream site in the impacted reach, and was surveyed in 2010 and 2014. A low abundance of both Atlantic salmon and brown trout were recorded at the site in 2010 with only a single trout observed in 2014. During the 2014 survey a single brown trout x salmon hybrid was also recorded. The site recorded a low abundance of flounder during both surveys. Both grayling and barbel were recorded at the site in 2010 and 2014, though both species showed a reduced number of individuals in the 2014 survey.

Fisheries survey information from the River Wharfe (provided by the Environment Agency), presented in **Table B2.5,** indicates a significant number of brown/sea trout, bullhead and grayling are present along the River Wharfe, with the three species likely to have large populations in the watercourse. Significant numbers of barbel have also been identified in certain areas of the watercourse and the European eel abundances vary between sites from low to very high numbers. Low numbers of lamprey were also identified throughout the surveyed reach, however the presence of Atlantic salmon was sporadic between those sites sampled. Minor species were present throughout the sites with particularly high abundances of minnows.

Based on the available information the fish community is considered to be susceptible to drought permit impacts and have a **medium** sensitivity to the physical environment impacts identified in **Appendix A**.

Table B2.5 Fish survey data from Wharfe 1

Site ID	Site Name	Event Date	Method	Atlantic salmon	Brown / sea trout	Brown / sea trout x salmon hybrid	Bullhead	Barbel	Bleak	Chub	Common bream	Dace	European eel	Flounder	Grayling	Gudgeon	Lamprey sp.	Minnow	Perch	Pike	Roach	Roach x common bream hybrid	Stone loach	Tench	3-spined stickleback
3762	Ilkley	01/09/2014	Single catch sample		67		11					1			14	3	2						7		
3763	Knotford	01/07/2010	Single catch sample										4			40	3	100 to 999 †	1			3	1 to 9 †		
		01/09/2011	Single catch sample				1			1		2	3			15	5	60	1	2			5		3
		23/06/2014	Single catch sample		1		1 to 9 *						1 to 9 *				1 to 9 †	10 to 99 *	1				1 to 9 *		
3764	Pool Mill	01/07/2010	Single catch sample	11	29		100 to 999 †			4		3	6		95	2		100 to 999 †	1	8			10 to 99 †		
		01/09/2011	Single catch sample		22		175			7		1	5		100	2	3	175	3	4			36		
		23/06/2014	Single catch sample	12	47		10 to 99 *			4			4		119		1 to 9 *	100 to 999 *	1	1			1 to 9 *		
3786	Ulleskelf	08/07/2010	Single catch sample							1		2	2	9		5		10 to 99 †	2	2	2		10 to 99 †		
		31/08/2011	Single catch sample						2			14		3				16		9	8				
		16/07/2014	Single catch sample	1				4	2	6		3		8	4	2	1 to 9 *	10 to 99 *	2	1	5				
32652	Tadcaster post 2006	09/07/2010	Single catch sample	4	9		10 to 99 †	31		114	1	140	5	13	22	1	1 to 9 †	100 to 999 †	2	7	14		10 to 99 †	1	1 to 9 †
		24/06/2014	Single catch sample		1	1		21	2	41		31		2	8				9	1	4				
42073	Boston Spa - Fry Survey	25/10/2010	Single catch sample (part width)				2			2		3						465							9
		30/08/2012	Single catch sample				1											1692					1		9
		19/08/2014	Single catch sample							40		4				18		504							272
		28/08/2015	Single catch sample							76								1076					2		282

Site ID	Site Name	Event Date	Method	Atlantic salmon	Brown / sea trout	Brown / sea trout x salmon hybrid	Bullhead	Barbel	Bleak	Chub	Common bream	Dace	European eel	Flounder	Grayling	Gudgeon	Lamprey sp.	Minnow	Perch	Pike	Roach	Roach x common bream hybrid	Stone loach	Tench	3-spined stickleback
		17/08/2016	Single catch sample					7		3		2				78		1136					3		53
		21/08/2017	Single catch sample															2214		1			12		12
59923	Ilkley stepping stones riffle	02/09/2014	Single catch sample		20		100 to 999 †						1		8			1 to 9 †					1 to 9 †		
59963	D/S Burley weir	03/09/2014	Single catch sample		15		100 to 999 *								4			100 to 999 *					1 to 9 *		
59983	Newton Kyme	03/09/2014	Single catch sample	12			10 to 99 *								1			10 to 99 *					1 to 9 *		
60003	D/S Otley weir	01/09/2014	Single catch sample	28	8		100 to 999 *						1		11			10 to 99 *					1 to 9 *		
67543	Netherby (discretionary only)	26/07/2016	Single catch sample	5	5		1 to 9 *	4		15					28	4		10 to 99 *					1 to 9 *		

*Best Run, †Survey

B2.1.4.3 WFD waterbody status

Table B2.6 summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.6** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where the objective is to meet good status is in 2027. This is displayed for overall, fish and macroinvertebrate elements and provides comparison with 2016 status, the table also displays the measures which have been assigned to the waterbody in order to reach their objective.

Table B2.6 WFD classifications

Waterbody ID & Name		GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck	GB104027064258 River Wharfe from Hundwith Beck to River Washburn	GB104027064254 River Wharfe from River Washburn to Collingham Beck	GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir	GB104027064256 River Wharfe from Tadcaster Weir to River Ouse	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Moderate					
RBMP Cycle 2 Status/ Potential	Overall	Moderate	Moderate	Moderate	Moderate	Moderate	
	Fish	Moderate	-	-	-	-	Medium
	Macroinvertebrates	High	High	High	High	High	Medium
Hydro-morph designation		Heavily modified	Heavily modified	Heavily modified	Heavily modified	Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	Good	Good	Good	Good	
	Fish	Good	Good	Good	Good	Good	
	Macroinvertebrates	High	High	High	High	High	
Waterbody Measures		None	None	None	None	None	

B2.1.5 Invasive non-native species (INNS)

Table B2.7 summarises the wider features which should be taken into account in determining the potential impacts of drought option implementation.

No INNS features that are sensitive or susceptible to drought permit impacts have been identified (see **Table B2.7**).

Table B2.7 INNS Features

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
INNS Macroinvertebrates - -Caspian Mud Shrimp (*Chelicorophium curvispinum*) -New Zealand Mud Snail (*Potamopyrgus antipodarum*) -Signal Crayfish (*Pacifiastacus leniusculus*) -Northern River Cranonyctid (*Crangonyx pseuogracilis*)	Moderate	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
INNS Fish – -Fish Rainbow trout (*Oncorhynchus mykiss*)	Moderate	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
INNS Terrestrial plants - -Himalayan balsam (*Impatiens glandulifera*) -Giant Hogweed (*Heracleum mantegazzianum*) -Japanese Knotweed (*Fallopian japonica*)	Moderate	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
INNS Aquatic plants - -Canadian pondweed (*Elodea canadensis*)	Moderate	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

B2.1.6 Landscape, navigation, recreation and heritage

Table B2.8 summarises the wider features which should be taken into account in determining the potential impacts of drought option implementation.

No features that are sensitive or susceptible to drought permit impacts have been identified (see **Table B2.8**).

Table B2.8 Landscape, navigation, recreation and heritage features

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
Nidderdale AONB	Moderate	The AONB comprises certain water dependent habitats which depending on their location will have taken into account through consideration of designated sites.	Not sensitive	No
Anglo-Saxon Cemetery and Medieval Manorial Centre – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Churchyard cross at the Church of St Peter	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Medieval Settlement and part of the open field system immediately south of Middleton – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Old Bridge – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Site of Roman Fort, Ilkley – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Otley Bridge – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Cup and Ring marked rock in Wharfemeadows Park – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Rougemont Castle Ringwork and Bailey and	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
associated fishponds and outwork				
Wetherby Bridge – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Two Roman Forts, Two Roman Camps, Vicus, Iron Age Enclosure, Bronze Age Barrows, and Neolithic Henge Monument West of Newton Kyme – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Settlement site revealed by aerial photography near Moat House – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Fortified manor house known as Kyme Castle	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Tadcaster Motte and Bailey Castle – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Roman Villa – Scheduled Ancient Monument	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Bracken Ghyll Golf Club	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Ilkley Golf Club	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Dales Way – National Trail	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Ebor Way – National Trail	Moderate	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Angling on the River Wharfe	Moderate	flows during a drought will be low such that further reduction in flows would not be likely to further reduce the angling quality of the reach.	Low	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, High, Medium, Low, Not sensitive)	Further Consideration Required (Y/N)
Navigation on the River Wharfe	Moderate	Navigable from Tadcaster to confluence with Ouse. Drought option unlikely to affect river levels on this stretch, most of which is tidal.	Not sensitive	No

B3. Environmental features screening summary

Table B3.1 Environmental features summary of the Wharfe 2

Reach	Wharfe 1
Associated Drought Options	**Wharfe at Lobwood**
WFD Waterbody	GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck, GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir, GB104027064256 River Wharfe from Tadcaster Weir to River Ouse
Designated Sites	
East Keswick Fitts SSSI	*X*
River Wharfe, Otley & Mid Wharfedale/Wetherby LWS	✓
Ben Rhydding Gravel Pits LWS	✓
Otley Sand and Gravel Pits LWS	✓
NERC and Notable Species Receptors	
White-clawed crayfish	*X*
Otter	✓
Water vole	✓
Fine-lined pea mussel	✓
Atlantic salmon	✓
Brown / sea trout	✓
European eel	✓
River lamprey	✓
Barbel	✓
Bullhead	✓
Brook lamprey	✓
Grayling	✓
WFD Waterbody WFD Status Receptors	
Fish	✓
Invertebrates	✓

Further assessment required = ✓ No further assessment required = *x*

B4. Features assessment, monitoring & mitigation

Details regarding the approaches/methodologies used for the assessment of the impacts associated with drought option implementation are presented in Section 3.7 of YWSL's Drought Plan 2022 Environmental Assessment Methodology[5]. The potential changes to the physical environment as a result of drought option implementation are described in **Appendix A**.

B4.1 Wharfe 1

B4.1.1 Feature assessment

B4.1.1.1 Statutory designated sites/Local wildlife sites

River Wharfe, Otley & Mid Wharfedale/Wetherby LWS

The River Wharfe flows west to east from Lob Wood, west of Addingham to Thorp Arch near Wetherby. This site includes the river, its southern banks and any islands. The land use is varied with the river passing through grassland, woodland, arable land and the urban areas of Ilkley, Otley and Wetherby, although much of the length of the river passes through rural areas. The river varies in character along the route, with the upper areas near Addingham being relatively fast flowing and with a fine gravel and shingle substrate. The lower stretches have a silt or mud substrate and are slower flowing. The Wharfe features many riffles, pools, islands and runs. The river banks range from shallow sloping sand and gravel beaches to steep sided banks. These features contribute to the diversity of habitats along the Wharfe. The Wharfe is an important fishery with populations of grayling, barbel and brown trout. **Appendix A** highlights the potential for a moderate risk of reduction in total wetted aquatic habitat in the reach, and moderate risk of changes in available habitat for different species requirements, however noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to the River Wharfe, Otley & Mid Wharfedale/Wetherby LWS is deemed to be **minor**.

Ben Rhydding Gravel Pits LWS/LNR

The Ben Rhydding Gravel Pits Nature Reserve has a variety of habitats, with some areas undisturbed by the gravel extraction have mature trees present. Elsewhere colonization of the workings has resulted in tree cover, mostly birch and willow approximately 40 years old. There are lagoons in the centre of the site and a number of informal paths, The Dalesway long distance footpath runs through the site. This site is one of a patchwork of interlinking woods throughout this part of the Wharfe valley**.** Disused millponds are often standing water with limited inflow from adjacent waterbodies. The lagoon covers an area of 3200m^2 and is shallowest at the eastern end. The height of the water varies by several metres depending on height of the river with water seeping through the banks; there are no water courses feeding directly into it[6]. The habitats on the site have been greatly influenced by its former status as gravel pits that have largely been in-filled. The tipped material has been compacted and drainage is severely impeded. The impeded drainage provides a delay in draw down of the water level of the lagoons as a response to the change in flows in the river.

Based on the available information these lagoons are hydrologically connected with the impacted reach, though via water passing through the banks and not via dedicated inlets. A reduction in flows within the River Wharfe will unlikely result in a disconnection of the lagoons with the impacted reach as the transfer of water will likely be maintained. The assumed hydrological regime the risk from the implementation of the drought option to Ben Rhydding Gravel Pits LWS/LNR is deemed to be **negligible**.

[5] Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

[6] City of Bradford District Council (2013). Ben Rhydding Gravel Pits Nature Reserve- Management Plan Agreement.

Otley Sand and Gravel Pits LWS

The site consists of water areas, recently-planted woodlands and reedbeds, rough grassland and stream edges. The large stand waters are used extensively for sailing, with Otley Sailing Club present of the largest waterbody (Weston Water). The site includes an extensive area of Common Spotted Orchids, Marsh Orchids and some Bee Orchids, Red Bartsia, Creeping Jenny, Changing Forget-me-not and Gypsywort, all of which are local in the area. These waterbodies may potentially be offline but some connectivity is likely and cannot be ruled out, and a precautionary approach has been adopted. Based on the available information these stand waters may potentially be hydrologically connected and a reduction in flows within the River Wharfe may result in a disconnection of the waterbodies with the impacted reach, but given the assumed hydrological regime and the large size of the standing waters the risk from the implementation of the drought option to Otley Sand and Gravel Pits LWS is deemed to be **negligible**.

B4.1.1.2 NERC and other protected species

Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Wharfe 1 as a result of the implementation of the drought option is not feasible. However, as suitable habitat is present within the reach, in particular suitable habitat in the banks, burrows may potentially become exposed leading to an increased susceptibility to predators such as stoat and weasels.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.1.** The combined physical environment changes (river flows, river habitat and water quality) as a result of the implementation of the drought option are considered to be short-term and reversible.

Table B4.1 Impacts on water vole in Wharfe 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	• Risk of deterioration in water quality has been identified as moderate and will not impact on this feature • Species has a preference for waterbodies that do not have extreme fluctuations in water level[7]. • Increased predation as a result of decreased water width and exposure of burrows. • The reduction in wetted width could result in an increased distance between water vole food source and the burrows. • Impacts could occur throughout the breeding season for this species. • Alteration to food supply could occur although the species has been known to feed upon crayfish at times[8] and the potentially increased density of this species could lead to increased predation efficiency	National	Medium	Moderate

[7] English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

[8] Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
	• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts. • There are uncertainties relating to the presence of this species with the impacted reach.			

Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.2.**

Table B4.2 Impacts on otter in Wharfe 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	• Increased efficiency in predation as a result of higher densities of prey species (fish and white-clawed crayfish) as species are forced into smaller areas. • Species could remain within the reach for longer. • Otter likely to move to unaffected reaches.	International	Negligible	Negligible

Fine-lined pea mussel

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.3**.

Table B4.3 Impacts on fine-lined pea mussel in Wharfe 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Fine-lined pea mussel	• Exposure/loss of marginal habitat is unlikely as impacts on wetted width and sediment dynamics is considered minor • Stranding and mortality of individuals as a result of a reduction in depth and/or wetted width is also considered unlikely. • The species is considered to be particularly vulnerable to water quality changes (eutrophication), but water quality risks to the species are considered unlikely	National	Negligible	Negligible

Fish

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.4.**

Table B4.4 Impacts on NERC and notable fish species in Wharfe 1

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Atlantic salmon	• Siltation of spawning gravels could occur as a result of increased sediment availability from the collapse of river banks • Decreased growth, morphological change and/or alteration to feeding and migration • Mortality as a result of water quality deterioration (oxygen stress, gill clogging) – Salmonids and grayling • Fragmentation of habitats and increased significance of obstacles/barriers • Fragmentation of habitats and increased significance of obstacles/barriers • Stranding of individuals as a result of a reduction in velocity, depth and/or wetted width, possibly resulting in the exposure of the river bed • Increased mortality (density dependant) as a result of increased predation • Exposure/loss of important habitats (wetland habitats for juveniles and adults) for eel • It is noted that depth of water is not critical to Bullhead and the species is also widespread within the catchment	National	Medium	Moderate
Brown trout		National	Medium	Moderate
Grayling		Regional	Low	Minor
Bullhead		Regional	Low	Minor
Barbel		County	Low	Minor
River lamprey		National	Medium	Moderate
Brook lamprey		National	Medium	Moderate
European eel		National	Low	Minor

B4.1.1.3 WFD features

Invertebrates

The potential changes to river flows is likely to result in major reduction in flow and will lead to a moderate reduction in wetted width and depth which will directly reduce the overall habitat availability within the reach. As indicated by the $WHPT_{NTAXA}$ EQRs, the macroinvertebrate community shows a good to high level of diversity, and consequently, loss of habitat may reduce the diversity of the community as a result of habitat loss for certain species. Furthermore, the increased friction between flow and channel bed may reduce flow velocity, as the macroinvertebrate community is sensitive to flow velocity reductions, as indicated by high LIFE scores. This may reduce the suitability of the reaches to species which require high flow velocities. The community is considered to be sensitive to water quality pressures as indicated by high $WHPT_{ASPT}$ EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a moderate risk. Water quality deterioration as a result of the drought option may potentially have a short-term acute impact on invertebrate community, associated with additional temporary water quality pressures locally downstream of three listed CSO's during rainfall events. Additionally, the risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ilkley WwTW is identified in **Appendix A**.

The combined physical environment changes (river flows, river habitat and water quality) as a result of the implementation of the drought option are predicted to present a moderate risk to the macroinvertebrate component of the WFD waterbodies; WFD waterbodies GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck, GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir and GB104027064256 River Wharfe from Tadcaster Weir to River Ouse. The duration of impacts could be up to 6 months. However, the macroinvertebrate community recovery is expected to be relatively quick

due to effective re-colonisation strategies in macroinvertebrates[9'10]. Therefore, the risk to deterioration of the WFD status of the waterbody is considered to be **moderate**.

Fish

The combined physical environment changes (river flows, river habitat and water quality) as a result of the implementation of the drought option are predicted to present a **moderate** risk to the fish component of the WFD waterbodies GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck. The fish component is not classified for the WFD waterbodies GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir and GB104027064256 River Wharfe from Tadcaster Weir to River Ouse. The duration of impacts could be up to 6 months. Therefore, the risk to deterioration of the WFD status of the waterbody is considered to be **minor**.

B4.1.2 Summary of impacts

Table B4.5 summarises the outcomes of the environmental features assessment and includes deterioration to fish and invertebrate features within WFD waterbodies and significance of impacts to statutory designated sites, NERC Act Section 41 features and other significant receptors.

Table B4.5 Summary of impacts identified in Wharfe 1's environmental features assessment

Reach	Wharfe from Lobwood intake to tidal limit	
	Significance of Impact	**Mitigation Required (Y/N)**
Statutory designated sites/Local wildlife sites		
River Wharfe, Otley & Mid Wharfedale/Wetherby LWS	Minor	No
Ben Rhydding Gravel Pits LWS	Negligible	No
Otley Sand and Gravel Pits LWS	Negligible	No
NERC and Notable Species Receptors		
Otter	Negligible	No
Water vole	Moderate	Yes
Fine-lined pea mussel	Negligible	No
Atlantic salmon	Moderate	Yes
Brown trout	Moderate	Yes
European eel	Minor	No
River lamprey	Moderate	Yes

9 Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

10 Mackay, R. J. (1992) Colonisation by lotic macroinvertebrates: a review of process and patterns. *Canadian Journal of Fisheries and Aquatic Science* 49, pp 617 – 628.

Reach	Wharfe from Lobwood intake to tidal limit	
Brook lamprey	Moderate	Yes
Barbel	Minor	No
Bullhead	Minor	No
Grayling	Minor	No
WFD Status Receptors	**Risk of Deterioration**	
WFD Waterbody	GB104027064257 River Wharfe from Barben Beck/ River Dibb to Hundwith Beck, GB104027064258 River Wharfe from Hundwith Beck to River Washburn, GB104027064254 River Wharfe from River Washburn to Collingham Beck, GB104027064255 River Wharfe from Collingham Beck to Tadcaster Weir, GB104027064256 River Wharfe from Tadcaster Weir to River Ouse	
Fish	Minor	No
Invertebrates	Moderate	Yes

B5. Monitoring and mitigation

Onset of drought, in-drought and post-drought monitoring and mitigation has been specified for all impacted reaches following identification of environmental features within in the reaches susceptible to the drought option(s) implementation. Where applicable YWSL have undertaken onset monitoring in advance of the drought permit application.

The baseline monitoring programme to inform the susceptibility, sensitivity and assessment of environmental features has been specified and requirements have been included in YWSL's ongoing baseline monitoring programme.

On the assumption that otter and water vole can be potentially be present in all impact reaches, no further baseline monitoring surveys have been included for these species. Mitigation measures and protection for sensitive species such as brown trout which are screened in should provide adequate protection where required of water levels and flows to ensure that riparian species such as water vole and otter are adequately protected for the duration of the drought permits in the impacted reaches.

Walkover surveys and non-invasive techniques are the preferred method to establish the impacts of drought options and to target mitigation. Where appropriate this will be supplemented by quantitative survey during the on-set of drought and post-drought; but in the interests of avoiding further distress to the riverine ecology, not in-drought. Existing long-term monitoring of the physical environment will continue (flow gauging and water quality monitoring).

The onset of drought, in-drought and post-drought monitoring would establish the need for and appropriate type of mitigation for drought option impacts.

Full details of monitoring and mitigation requirements for all impacted reaches can be found in Appendix A.5 of YWSL's Drought Plan 2022 EMP and a summary is provided in the main EAR Section 6.2.

Reach specific actions are included in Appendix A.5 for significant water quality pressures related to YWSL WwTWs:

- **Wharfe 1:** the assessment has identified a significant water quality pressure in the reach associated with Ilkley WwTW.

YWSL have identified that for the period of implementation of the drought option, sewage treatment can be enhanced, reducing the water quality pressure on the impacted features from ammonia, and oxygen balance. Further information can be found in the YWSL WwTW optimisation plan[11] which provides details on enhancement for WwTW that discharge into rivers where compensation flows may be reduced under drought permit implementation.

During any future on-set of drought periods (14 weeks before drought control lines are crossed) YWSL will consult with the Environment Agency regarding any WwTWs not identified as significant water quality pressures at the time of the writing of this EAR, but which may be a cause for concern. Additional sites will be added to the priority list of sites for optimisation as required.

A 'Combined Sewer Overflows Optimisation and Maintenance for Drought Plan' has also been developed by YWSL and in consultation with the Environment Agency. This has been updated in 2022 in support of the drought permit application[12] and includes includes all significant intermittent water quality pressures identified in this EAR.

11 YWSL (2022) Wastewater Treatment Works Optimisation and Maintenance for Drought Plan.

12 YWSL (2022) Combined Sewer Overflows (CSOs)

Appendix C Monitoring and ecological mitigation measures

Table C1.1 Monitoring and mitigation measures included in the YWSL Drought Plan 2022 EMP

Baseline Monitoring - to ensure an adequate baseline dataset exists to describe non-drought conditions for those receptors likely to be impacted by drought permit implementation and to fill any data gaps and reduce uncertainty identified during the environmental assessment	
Routine baseline monitoring	
BMON_1	EA/YWSL to continue monitor river flows and levels/reservoir levels and spill at key monitoring sites
BMON_2	EA to continue routine water quality monitoring at existing network of sites on current monthly programme, which includes those on un-impacted reaches suitable as control sites.
BMON_3	Macroinvertebrate monitoring at a number of locations, including rivers potentially affected by drought measures; to continue in low flow/drought years pending agreement with the EA regarding aquatic species welfare.
BMON_4	Fish monitoring at a number of locations, including rivers potentially affected by drought measures; to continue in low flow/drought years pending agreement with the EA regarding aquatic species welfare.
Targeted baseline monitoring	
BMON_5	White-clawed crayfish surveys to determine distribution and abundance in reaches under serious (i.e. moderate or major) hydrological stress
BMON_6	Fine-lined pea mussel survey to determine distribution and abundance in reaches under serious hydrological stress
BMON_7	Targeted juvenile lamprey surveys to identify distribution of habitat and an indicative population status within reaches subject to serious hydrological stress
On-set of Environmental drought – monitoring leading to selection and implementation of appropriate mitigation measures	
ODMON_1	Walkover surveys of habitat quality and identification of drought sensitive habitats such as areas of riffle, pools and artificial features such as weirs and sluices that may be isolated or impassable during low flows. Results to be captured by annotated walkover maps and completion of a 'River Conditions Observation Form - Low Flows' form.
In-Drought (during drought option implementation) – monitoring leading to selection and implementation of appropriate mitigation measures	
IDMON_1	Surveillance walkover surveys of habitat quality and ecological stress, recording signs of environmental problems (reaches to match those in OMON_1)
IDMON_2	Targeted surveillance walkover surveys of water quality and ecological stress local to 'significant' water quality pressures', to include water quality spot sampling in priority areas such as pools and weirs where aquatic species may become isolated during low flows.
IDMON_3	Storm intensity forecasting to predict likely CSO spill events and the need for pre-emptive mitigation
In-Drought (During Drought Option Implementation) – Mitigation	
IDMIT_1	Negotiation with the licence holder of a temporary reduction of third party abstractions presenting 'significant' impacts to sensitive features, including financial compensation by Yorkshire Water.
IDMIT_2	At identified SSSIs, mitigation would comprise the temporary cessation of impacting drought options by Yorkshire Water.
IDMIT_3	Improving the effluent quality from Yorkshire Water WwTWs presenting 'significant' impacts to sensitive features, thereby reducing the water quality pressure (ammonia and oxygen balance) on the impacted features.
IDMIT_4	Artificial freshet release to dilute/displace water quality reduction
IDMIT_5	Negotiation with permit holder and aeration of discharge from third party facility identified as a 'significant' water quality pressure
IDMIT_6	Gradual phase-in of reduction in water volume/flow to avoid stranding of individuals (fish, white-clawed crayfish, fine-lined pea mussel)
IDMIT_7	Gradual phase-in of compensation release increases to avoid stranding or displacement of individuals (macroinvertebrates, fish, white-clawed crayfish, fine-lined pea mussel)

IDMIT_8	Temporary reduction in volume of abstraction or increase in compensation release (fish)
IDMIT_9	Artificial freshet release to provide temporary variation in the flow regime (fish, white-clawed crayfish, fine-lined pea mussel, water vole, otter)
IDMIT_10	Creation of alternative refuges in deeper water where walkover surveys identify the loss of important deep water habitat or high densities of fauna in refuges (fish, white-clawed crayfish, water vole)
IDMIT_11	Provision of in-stream structures and flow baffles to create functional refuges to support flow sensitive species where walkover surveys identify a projected loss of habitat inundation (macroinvertebrates, fish, white-clawed crayfish, water vole, otter)
IDMIT_12	Artificial channel narrowing to provide functional refuges and support habitat requirement for species, enabling a quick natural recolonisation of the reach post-drought (fish, macroinvertebrates, white-clawed crayfish, fine-lined pea mussel, otter, water vole)
IDMIT_13	Provision of piscivorous “visual” bird scaring measures (e.g. using streamers in riparian trees) to control predation upon species using refuges (fish). These visual measures would only be implemented following consultation with the EA, Natural England and bird specialists, particularly taking account of protected species under the 1981 Wildlife and Countryside Act. Implementation would follow best practice guidance.
IDMIT_14	Gravel washing of spawning habitats where walkover surveys and routine monitoring identifies likely habitat degradation as a result of sedimentations (fish)
IDMIT_15	Aeration of watercourse where significant mortality or change in species abundances are likely to be attributed to water quality deterioration
IDMIT_16	Modification of flow structure across barriers to retain favourable conditions to facilitate the movement/migration of species (fish)
IDMIT_17	Provision of freshet releases to enable migration of fish across significant obstacles (fish)
IDMIT_18	Regular inspection and clearing of screens to ensure they retain their correct working function (fish, white-clawed crayfish)
IDMIT_19	Capture and relocate individuals across significant barriers, taking into account migratory periods (immigration and emigration) (fish) and ensuring biosecurity measures are in place at all times.
IDMIT_20	Rescue of individuals or groups, in consultation with the EA or NE as appropriate, and relocation to suitable habitat where they are seen to be in distress or where artificially high densities are likely to result in significant impacts (fish, white-clawed crayfish). Measures will be taken to ensure biosecurity at all times. It should be noted that movement of crayfish requires licensing which can take up to 8 weeks. Movement of crayfish would only take place after consultation agreeing that this was the best course of action.
IDMIT_21	Rescue of individuals or groups, in consultation with the EA or NE as appropriate, and retention for later release where they are seen to be in distress or where artificially high densities are likely to result in significant impacts (fish, white-clawed crayfish). Measures will be taken to ensure biosecurity at all times. It should be noted that movement of crayfish requires licensing which can take up to 8 weeks. Movement of crayfish would only take place after consultation agreeing that this was the best course of action
IDMIT_22	Implementation of navigation controls in the channel to reduce disturbance damage upon vulnerable species and/or populations.
IDMIT_23	For CSOs identified as significant water quality, prioritise planned maintenance work on and reactive pollution prevention work, including visits by operators.
IDMIT_24	Cessation of water transfer should it be identified that fish disease has been spread between catchments and notify the EA and Cefas
Post-Drought (Drought Options Removed) – Monitoring	
PDMON_1	White-clawed crayfish sampling to monitor recovery of their distribution and abundance
PDMON_2	Fine-lined pea mussel sampling to monitor recovery of their distribution and abundance
Post-Drought (Drought Options Removed) – Mitigation	
PDMIT_1	Enhancement of habitat beyond the impacted reach (macroinvertebrates, fish, fine-lined pea mussel, white-clawed crayfish, water vole)

PDMIT_2	Provision of artificial freshets to ensure fish are capable of migrating where survey identifies insufficient water depth or volume across structures to facilitate migration (fish)
PDMIT_3	Modification to barriers and/or flows to improve passage where walkover survey identifies insufficient water depth or volume at obstacles (fish)
PDMIT_4	Capture and relocate across barrier (taking migratory period into account) where significant numbers of migratory fish congregate at obstacles (fish)
PDMIT_5	Relocation of juveniles where walkover surveys identify the likely desiccation of marginal habitats or loss of water depth at important habitats (fish, fine-lined pea mussel)
PDMIT_6	Restocking using juvenile lamprey ammocoetes within the catchment where monitoring indicates loss of fish abundance or recruitment (fish)
PDMIT_7	Restocking using offspring from broodstock from the catchment where monitoring indicates loss of fish abundance or recruitment (fish)
PDMIT_8	Restocking of coarse fish from the catchment where monitoring indicates loss of fish abundance or recruitment (fish)
PDMIT_9	Removal/treatment of giant hogweed where monitoring indicates an increase in abundance or distribution

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