



# Drought Plan: Environmental Assessment Report – South Area Reservoirs

Final

Report for Yorkshire Water Services Ltd

**Customer:**

Yorkshire Water Services Ltd

**Customer reference:**

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**Contact:**

Liz Baker  
Ricardo Energy & Environment  
Bright Building, First Floor  
Manchester Science Park  
Manchester, M15 6GZ  
United Kingdom

**T:** +44 (0) 1235 753 501

**E:** liz.baker@ricardo.com

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**Authors:**

Katie Clarke, Paul Cronje, George Day  
Rachel Evans, Anne Fairhead, Martin  
Ferreira, Gareth Martin, Molly Preen, Will  
Twigg, Trevor Wade, Jessie Willcocks.

**Approved by:**

Liz Baker

**Signed**



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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 or 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 European Habitats Directive (1991)

## **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
MI	–	Megalitres (1MI 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) South Area reservoir drought options. The report has been prepared in support of a drought permit/order 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)<sup>1</sup> 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 order 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 South Area reservoir drought options 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.

Key stakeholders will be further consulted throughout the drought permit / order application process.

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

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# 1 Introduction

## 1.1 Purpose of document

The Yorkshire Water Services Ltd (YWSL) Drought Plan 2022<sup>2</sup> was developed in line with the Environment Agency's Drought Plan Guideline (DPG)<sup>3</sup>. 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. Drought permits /orders are management actions that, if granted, can allow more flexibility to manage water resources and the effects of drought on public water supply and the environment. Ultimately, the environmental assessments should inform choices on when and how to use the different supply side drought options considered in a drought plan.

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 South Area reservoir drought permits.

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 Environment Agency's 2019 consultation draft '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 order monitoring requirements.

The methodology for this environmental assessment was developed during preparation of the 'shelf copy' environmental assessment<sup>4</sup> in consultation with the Environment Agency, and is documented separately in 'YWSL's Drought Plan 2022 Environmental Assessment Methodology'<sup>5</sup>. 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 2021 Environmental Monitoring Plan (EMP)' which accompanies the drought permit/order 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.

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

<sup>3</sup> Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

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

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

## 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 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 options, 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<sup>6</sup>, 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

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<sup>6</sup> Email exchange between Yasmina Gallaher (Yorkshire Water), and Ineke Jackson (Environment Agency) on 20 July 2022.

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 Methodology<sup>7</sup>. 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 overall drought permit/order 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/order 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<sup>8</sup>.

**Section 4: Drought options overview: South Area reservoirs** - overview of drought permit conditions.

**Section 5: Physical environment effects: South Area reservoirs** - baseline assessment of physical environment and assessment of potential changes in the physical environment as a result of the drought options, 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: South Area reservoirs** - 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

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

<sup>8</sup> 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 2019 consultation draft '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<sup>9</sup> ('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 all six of the South Area reservoir drought permits.

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)<sup>10</sup> and Strategic Environmental Assessment (SEA)<sup>11</sup> 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**). 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.

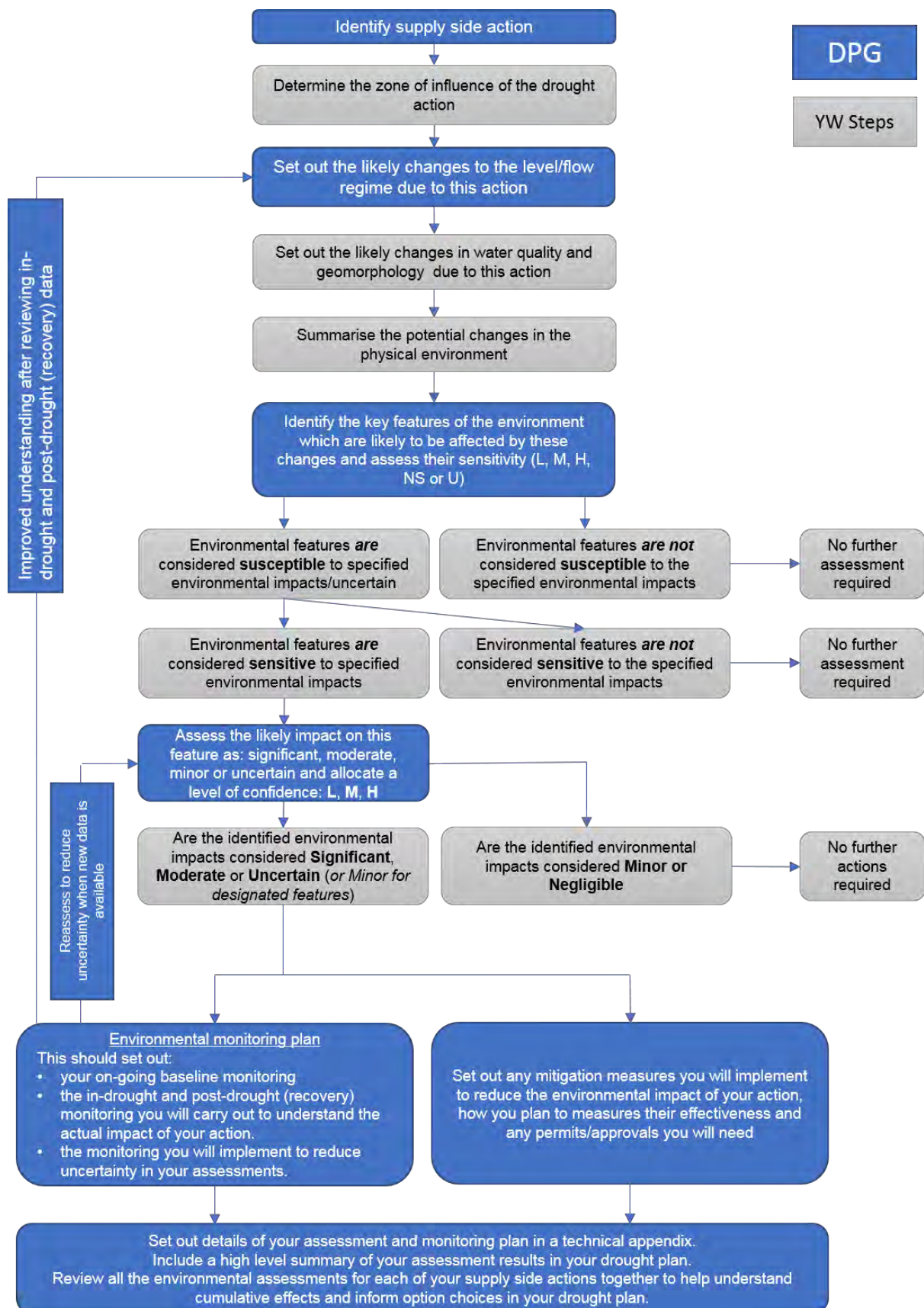
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<sup>9</sup> Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

<sup>10</sup> 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>.

<sup>11</sup> 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>.

**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 South Area during the period of implementation of associated drought options.

The South Area reservoirs comprise six drought options as summarised in **Table 4.1**:

1. Scout Dyke Reservoir drought permit
2. Winscar/Windleden Lower Reservoir drought permit;
3. Underbank Reservoir drought permit;
4. More Hall Reservoir drought permit;
5. Damflask Reservoir drought permit;
6. Rivelin Lower Reservoir drought permit;






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

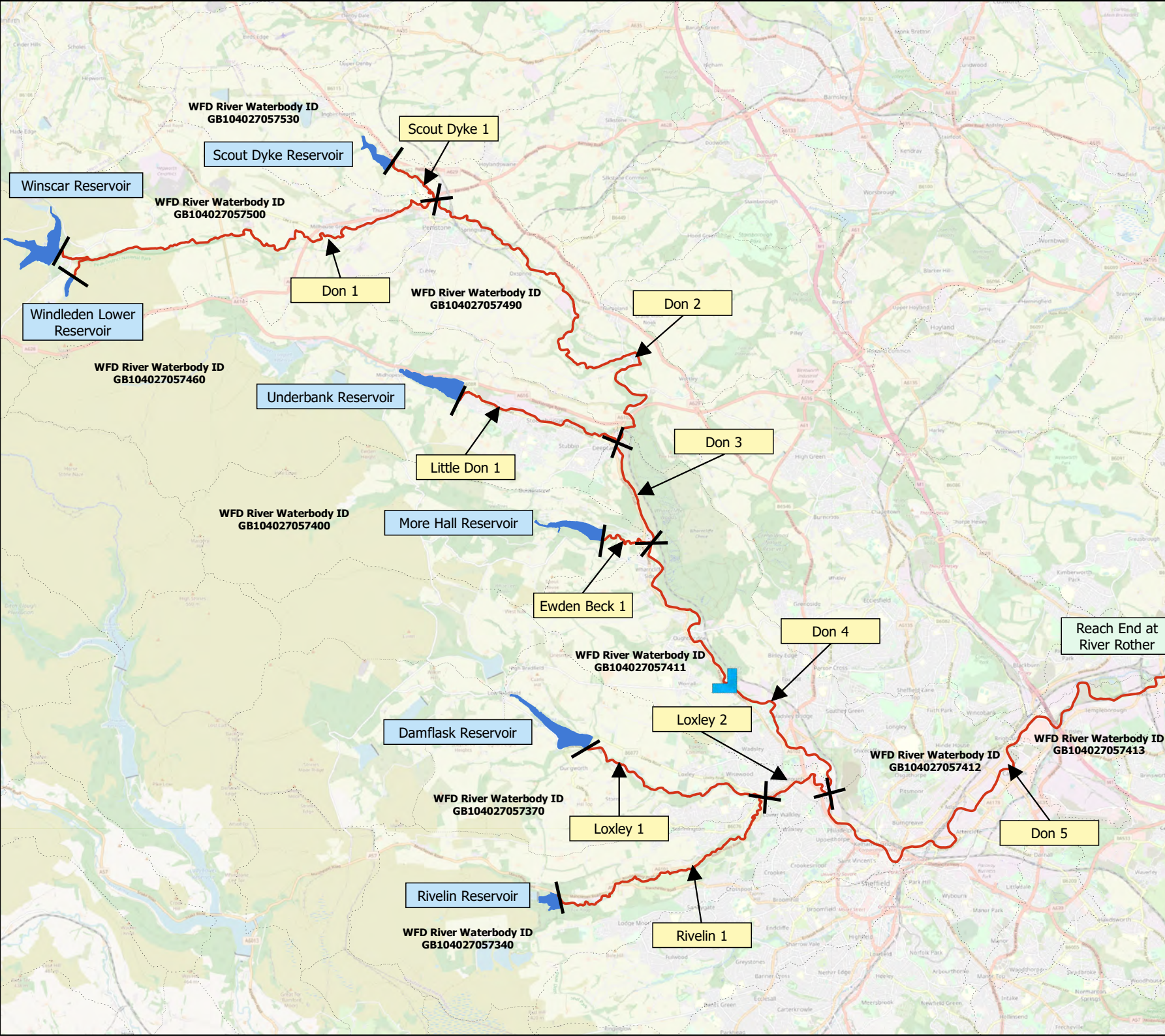
**Table 4.1 South Area reservoirs drought permit descriptions**

Compensation Water Source	Receiving Watercourse	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1 )	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2 )	Benefit MI/d
<b>Scout Dyke Reservoir drought permit</b>						
Scout Dyke Reservoir	Scout Dyke	2.70 or 4.00	1.35	1.35	0.89	1.81
<b>Winscar/ Windleden Lower Reservoir drought permit</b>						
Winscar/Windleden Lower	River Don at the maintained flow point	9.09 or 11.82	4.55	4.55	3.03	6.09
<b>Underbank Reservoir drought permit</b>						
Underbank	River Little Don	16.00 or 21.70	8.00	8.00	5.28	10.72
<b>More Hall Reservoir drought permit</b>						
More Hall	Ewden Beck	9.10 or 12.00	4.55	4.55	3.00	6.10
<b>Damflask Reservoir drought permit</b>						
Damflask	River Loxley	18.00 or 28.00	9.00	9.00	5.94	12.06
<b>Rivelin Lower Reservoir drought permit</b>						
Rivelin	River Rivelin	10.30	5.15	5.15	3.40	6.90



## Legend

-  Reach Divides
-  River Reaches
-  Reservoir
-  WFD Management Catchment
-  Flow Direction



**Project title:**  
Yorkshire Water Drought Plan  
Environmental Assessment

**Figure title:**  
South Overview Map

Figure 4.1 **Date:** August 2020

**NGR:** SK 28187 95862 **Scale:** 1:120000

Note: All locations are approximate

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## 4.2 Potentially impacted reaches

The zone of influence associated with each 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<sup>12</sup> sets out this approach in detail. The reaches for the South Area reservoir drought permits have been defined previously during the environmental assessment of YWSL past drought plans. **Table 4.2** provides details of these reaches, which are illustrated in **Figure 4.1**, and in a schematic below in **Figure 4.2**

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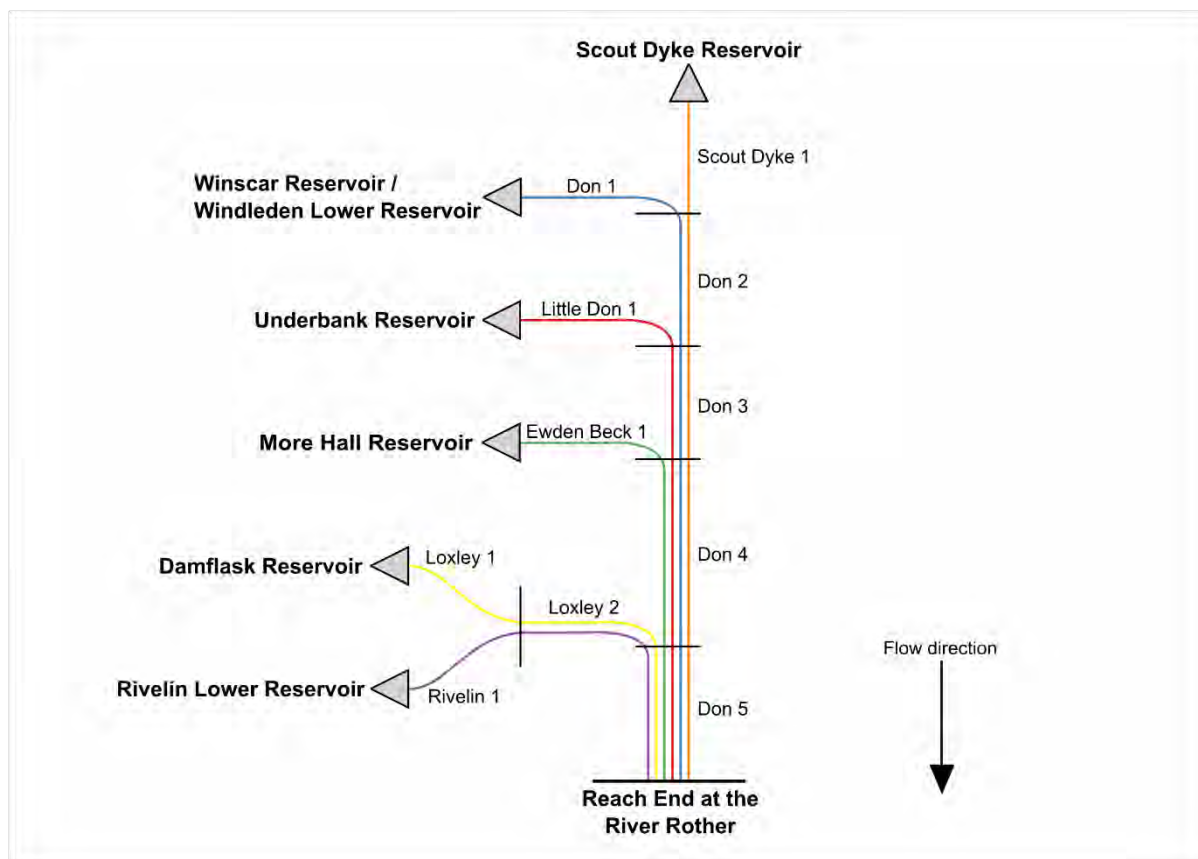
<sup>12</sup> Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.



**Table 4.2 South Area reach details**

Reach name	Watercourse name	Reach start	Reach end	Downstream reach	Drought measure					
					Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Rivelin Reservoir
Don 1	River Don	Winscar/Windleden Lower Reservoirs	Scout Dyke	Don 2		✓				
Don 2	River Don	Scout Dyke	Little Don	Don 3	✓	✓				
Don 3	River Don	Little Don River	Ewden Beck	Don 4	✓	✓	✓			
Don 4	River Don	Ewden Beck	River Loxley	Don 5	✓	✓	✓	✓		
Don 5	River Don	River Loxley	River Rother	N/A Study area end	✓	✓	✓	✓	✓	✓
Scout Dyke 1	Scout Dyke	Scout Dyke Reservoir	River Don	Don 2	✓					
Little Don 1	Little Don River	Underbank Reservoir	River Don	Don 3			✓			
Ewden Beck 1	Ewden Beck	More Hall Reservoir	River Don	Don 4				✓		
Loxley 1	River Loxley	Damflask Reservoir	River Rivelin	Loxley 2					✓	
Loxley 2	River Loxley	River Rivelin	River Don	Don 5					✓	✓
Rivelin 1	River Rivelin	Rivelin Lower Reservoir	River Loxley	Loxley 2						✓

**Figure 4.2 South Area reservoirs drought permits reach schematic**



## 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 **Figures 4.1** and **4.2**.

**Table 4.3 WFD waterbodies considered in the assessment**

Drought Option	Reach	WFD Waterbody
Winscar/Windleden Lower	<b>Don 1</b>	GB104027057500 Don from Source to Scout Dyke
Scout Dyke; Winscar/Windleden Lower	<b>Don 2</b>	GB104027057490 Don from Scout Dyke to the Little Don
Scout Dyke; Winscar/Windleden Lower; Underbank	<b>Don 3</b>	GB104027057411 Don from the Little Don to River Loxley confluence
Scout Dyke; Winscar/Windleden Lower; Underbank; More Hall	<b>Don 4</b>	GB104027057411 Don from the Little Don to River Loxley confluence
Scout Dyke; Winscar/Windleden Lower; Underbank; More Hall; Damflask; Rivelin	<b>Don 5</b>	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother
Scout Dyke	<b>Scout Dyke 1</b>	GB104027057530 Scout Dyke from Source to River Don
Underbank	<b>Little Don 1</b>	GB104027057460 Little Don from Source to River Don
More Hall	<b>Ewden Beck 1</b>	GB104027057400 Ewden Beck from Source to River Don
Damflask	<b>Loxley 1</b>	GB104027057370 Loxley from Strines Dyke to River Don
Damflask; Rivelin	<b>Loxley 2</b>	GB104027057370 Loxley from Strines Dyke to River Don
Rivelin	<b>Rivelin 1</b>	GB104027057340 Rivelin from Source to River Loxley

## 5 Physical environment effects: South Area reservoirs

Potential impacts on the physical environment due to the South Area reservoir drought permits 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 South Area reservoirs drought options**

Reach	River flow impact	Flow depleted reaches and risks*	Risk to river habitats	Risk to water quality
Don 1	Major	None	Moderate	Minor
Don 2	Major	Major	Moderate	Moderate
Don 3	Major	None	Minor	Moderate
Don 4	Major	None	Moderate	Moderate
Don 5	Major	Major	Minor	Moderate
Scout Dyke 1	Major	None	Minor	Moderate
Little Don 1	Major	Major	Moderate	Moderate
Ewden Beck 1	Major	None	Major	Moderate
Loxley 1	Major	Major	Major	Minor
Loxley 2	Major	None	Major	Minor
Rivelin 1	Major	None	Major	Moderate

## 6 Features assessment, monitoring and mitigation: South Area reservoirs

### 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 South Area reservoir drought permits are summarised below in **Table 6.1**.

**Table 6.1 Summary of potential impacts to environmental features as a result of the South Area reservoirs drought options**

Reach	Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
<b>Associated Drought Options</b>	Winscar/Windleden Lower Reservoirs	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir / Damflask Reservoir / Rivelin Reservoir	Scout Dyke Reservoir	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Damflask Reservoir / Rivelin Reservoir	Rivelin Reservoir
<b>WFD Waterbody</b>	GB104027057500 Don from Source to Scout Dyke	GB104027057490 Don from Scout Dyke to the Little Don	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother	GB104027057530 Scout Dyke from Source to River Don	GB104027057460 Little Don from Source to River Don	GB104027057400 Ewden Beck from Source to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057340 Rivelin from Source to River Loxley
<b>NERC and Notable Species Receptors</b>											
White-clawed crayfish				Moderate	Moderate		Moderate	Moderate	Major	Moderate	Major
<i>Sisyr terminalis</i>											Minor
<i>Riolus subviolaceus</i>								Minor			
<i>Oreodytes davisii</i>	Minor										
Otter	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Water vole	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Barbel			Minor		Moderate		Minor				
Brook lamprey					Major						Major
Brown trout	Moderate	Major	Moderate	Moderate	Major	Moderate	Moderate	Major	Major	Major	Major
Bullhead	Minor	Moderate	Minor	Minor	Moderate	Minor	Minor	Moderate	Moderate	Moderate	Moderate
European eel	Moderate	Major	Moderate	Moderate	Major	Moderate				Major	Major
Grayling	Moderate	Major	Moderate	Moderate	Moderate		Moderate			Moderate	
River lamprey					Moderate						
<b>WFD Waterbody WFD Status Receptors</b>											
Fish	Moderate	Major	Moderate	Moderate	Major	Moderate	Moderate	Moderate	Major	Moderate	Major
Invertebrates	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
<b>Local Wildlife Sites/ Local Nature Reserves</b>											
Lower Ewden Beck LWS			Negligible	Negligible				Moderate			
Upper River Don: Deepcar to Hillsborough LWS			Minor	Moderate			Moderate	Minor			
Niddle River Don: Deepcar to Hillsborough LWS				Moderate							
Upper River Don: Station Road, Deepcar LWS			Minor								
Centenary Riverside LNR/LWS					Negligible						
Salmon Pastures LNR/LWS					Negligible						
Lower Little Don, Stocksbridge LWS							Minor				
Dam Flask to Rowel Bridge LWS									Minor		



Reach	Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
Acorn Hill and Little Matlock Wood LWS									Moderate		
Malin Bridge to River Don LWS										Moderate	
Middle Rivelin Valley LWS											Moderate
Lower Rivelin Valley LWS									Negligible		Moderate
Fox Hagg LWS											Moderate
Roscoe Plantation LWS											Moderate
Forge Rocher and Tin Mill Rocher LWS		Minor									
Romticle Viaduct & Thurgoland Tunnels LWS		Minor									
Sandersons Mill Race LWS					Minor						
Kelham Island LWS					Minor						
Blackburn Meadows LWS					Minor						
Lower River Don: River Don (City Centre to Blackburn Meadows) LWS					Minor						
Lower Don Valley: Sheffield and Tinsley Canal LWS					Minor						
Middle River Don: Hillsborough to City Centre LWS					Moderate						
Broadhead Dam to Malin Bridge LWS									Minor		
NERC Habitats* - 452749/447335					Negligible						
<b>Landscape, navigation, recreation and heritage features</b>											
Nether Mill Fisheries						Negligible					

\* Numbers refer to unique codes for each habitat as included in the Natural England 'Priority Habitat Inventory (England)'.

## 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 implement 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 Environmental 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 mitigations recommendations for the South Area reservoir drought permits are provided in **Tables 6.2** and **6.3**.

**Table 6.2 Summary of recommended monitoring for the South Area reservoirs drought options**

Reach		Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
<b>Associated Drought Options</b>		Winscar/Windleden Lower Reservoirs	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir / Damflask Reservoir / Rivelin Reservoir	Scout Dyke Reservoir	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Damflask Reservoir / Rivelin Reservoir	Rivelin Reservoir
<b>WFD Waterbody</b>		GB104027057500 Don from Source to Scout Dyke	GB104027057490 Don from Scout Dyke to the Little Don	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother	GB104027057530 Scout Dyke from Source to River Don	GB104027057460 Little Don from Source to River Don	GB104027057400 Ewden Beck from Source to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057340 Rivelin from Source to River Loxley
<b>Baseline Monitoring</b>												
<b>Routine baseline monitoring</b>												
BMON_1	Routine flow/levels	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMON_2	Routine WQ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMON_3	Macro- invertebrate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMON_4	Fisheries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>Targeted baseline monitoring</b>												
BMON_5	Crayfish				✓	✓		✓	✓	✓	✓	✓
BMON_7	Lamprey					✓						
<b>On-set of Environmental Drought Monitoring</b>												
ODMON_1	River condition walkover survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>In-Drought (During Drought Option Implementation) Monitoring</b>												
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		✓		✓	✓		✓				✓
<b>Post-Drought (Drought Option removed) Monitoring</b>												
PDMON_1	Crayfish			✓	✓	✓	✓	✓	✓	✓	✓	✓

**Table 6.3 Summary of recommended mitigation measures for the South Area reservoirs drought options**

Reach		Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
<b>Associated Drought Options</b>		Winscar/Windleden Lower Reservoirs	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir / Damflask Reservoir / Rivelin Reservoir	Scout Dyke Reservoir	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Damflask Reservoir / Rivelin Reservoir	Rivelin Reservoir
<b>WFD Waterbody</b>		GB104027057500 Don from Source to Scout Dyke	GB104027057490 Don from Scout Dyke to the Little Don	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother	GB104027057530 Scout Dyke from Source to River Don	GB104027057460 Little Don from Source to River Don	GB104027057400 Ewden Beck from Source to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057340 Rivelin from Source to River Loxley
<b>In-drought (Drought Options Implemented)</b>												
IDMIT_1	Third party abstraction		✓			✓		✓		✓		
IDMIT_3	Improving effluent quality		✓	✓	✓	✓	✓		✓			
IDMIT_4	Freshets for water quality	✓	✓	✓	✓	✓	✓		✓	✓		
IDMIT_5	Discharge aeration	✓								✓		
IDMIT_6	Gradual phase in of reduction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_7	Gradual compensation reduction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_8	Temporary abstraction volume reduction / compensation increase	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_9	Freshet	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_10	Refuges	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_11	In-stream structures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_12	Channel narrowing						✓	✓	✓	✓	✓	✓
IDMIT_13	Bird scaring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_14	Gravel washing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_15	Aeration of watercourse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_16	Flow structure modification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_17	Freshet releases for migration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_19	Capture/re-locate over barriers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Reach		Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
Associated Drought Options		Winscar/Windleden Lower Reservoirs	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir / Damflask Reservoir / Rivelin Reservoir	Scout Dyke Reservoir	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Damflask Reservoir / Rivelin Reservoir	Rivelin Reservoir
WFD Waterbody		GB104027057500 Don from Source to Scout Dyke	GB104027057490 Don from Scout Dyke to the Little Don	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother	GB104027057530 Scout Dyke from Source to River Don	GB104027057460 Little Don from Source to River Don	GB104027057400 Ewden Beck from Source to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057340 Rivelin from Source to River Loxley
IDMIT_20	Fish/crayfish rescue and relocate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_21	Fish rescue and retain	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDMIT_23	CSO Prioritisation		✓		✓	✓		✓				✓
Post-Drought (Drought Options Removed)												
PDMIT_1	Habitat enhancement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PDMIT_2	Freshets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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 South Area river catchment during the period of implementation of associated drought options.

The South Area reservoirs comprise six drought options as reported in this appendix:

- Scout Dyke Reservoir drought permit
- Winscar/Windleden Lower Reservoirs drought permit
- Underbank Reservoir drought permit
- More Hall Reservoir drought permit
- Damflask Reservoir drought permit
- Rivelin Lower Reservoir drought permit.

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<sup>1</sup>.

**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 options

Section A.3 Study area

Section A.4 Physical environment effects – this includes for each reach:

1. Reach introduction
2. Reach setting
3. River flow regime
4. River habitats
5. River water quality
6. Summary of potential changes in the physical environment as a result of the drought options.

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

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

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

## A2 Drought options

The South Area river catchment comprise six drought options at compensation flow reservoirs as reported in this appendix:

- Scout Dyke Reservoir
- Winscar/Windleden Lower Reservoirs
- Underbank Reservoir
- More Hall Reservoir
- Damflask Reservoir
- Rivelin Lower Reservoir.

The licence conditions and drought permit conditions of each are introduced below.

### A2.1 Scout Dyke Reservoir drought permit

YWSL releases water from Scout Dyke Reservoir under conditions defined by the Ingbirchworth Reservoir abstraction licence (2/27/05/012). Under the terms of this licence, the Licence Holder shall discharge from Ingbirchworth Reservoir into Ingbirchworth Dyke not less than 45 cubic metres of water in a continuous flow during every period of 24 hours. Also, the terms of the licence state that YWSL must release flow from Scout Dyke Reservoir to compensate the downstream receiving watercourses, Scout Dyke and the River Don. Under the licence conditions, YWSL must continuously discharge not less than 4.00 MI/d when the reservoir level is above the control line defined in the licence, or 2.70 MI/d when the reservoir level is below the control line. The drought permit application for Scout Dyke Reservoir is to reduce the compensation release required when the reservoir is at or below 25% of its capacity to 2.70 MI/d, then after two weeks, to reduce further to 1.35 MI/d. There would then be a further reduction to 0.89 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the YWSL Drought Plan, or if stocks in the Don Valley supply reservoir group are below its Drought Control Line. This assessment has therefore been undertaken in comparison of a drought permit of 0.89 MI/d and a reference condition of 2.70 MI/d. These conditions are set out in **Table A2.1**.

**Table A2.1 Scout Dyke Reservoir licence data**

Compensation Water Source	Receiving Watercourse	NGR	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
Scout Dyke Reservoir	Scout Dyke	SE 236047	2.70 or 4.00	1.35	1.35	0.89	1.81

### A2.2 Winscar/Windleden Lower Reservoirs drought permit

YWSL is licensed to impound water in Winscar/Windleden Lower Reservoirs for supply to customers under the impoundment licence (2/27/5/152). The terms of the licence state that YWSL must release flow from Winscar/Windleden Lower and/or Lower Windleden Reservoir to compensate the downstream receiving watercourse, the River Don. Under the licence conditions, YWSL must continuously discharge to ensure the flow of water passing over the gauging weir at Dunford Bridge from 1 November to 30 April inclusive shall not fall below 9.09 MI/d. The drought permit application for the Dunford Bridge Maintained Flow is to reduce the flow at the gauging station by 50% to 4.55 MI/d from the date the permit is granted and to reduce further to 3.00 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the YWSL Drought Plan. This assessment has, therefore, been undertaken in comparison of a drought permit of 3.00 MI/d and a reference condition of 9.09 MI/d. The drought permit condition relates to a reduction in compensation

flow from either or both of Winscar/Windleden Lower Reservoirs to meet the maintained flow condition. These conditions are set out in **Table A2.2**.

**Table A2.2 Winscar/Windleden Lower Reservoirs licence data**

Compensation Water Source	Receiving Watercourse	NGR	Normal maintained flow MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
Winscar/Windleden Lower	River Don at the maintained flow point	SE 163024	9.09 or 11.82	4.55	4.55	3.00	6.09

## A2.3 Underbank Reservoir drought permit

YWSL releases water from Underbank Reservoir under coincident conditions defined by the abstraction licence for Langsett Reservoir (2/27/05/032) and the abstraction licence for Midhope Reservoir/Knoll Brook Intake (2/27/05/011). The terms of the licences state that YWSL must release flow from Underbank Reservoir to compensate the downstream receiving watercourses, the Little Don River and the River Don. Under the licence conditions, YWSL must continuously discharge not less than 21.70 MI/d from Underbank Reservoir when the reservoir level is above the control line defined in the Langsett and Midhope licences, or 16.00 MI/d when the reservoir level is below the control line. The two drought permit applications are to reduce the compensation release required when Underbank Reservoir is below the lower of its control lines for more than two consecutive weeks by 50% to 8.00 MI/d from the date the permit is granted and to reduce further to 5.28 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the Yorkshire Water Drought Plan, or if stocks in the Little Don supply group are below its Drought Control Line. This assessment has therefore been undertaken in comparison of a drought permit of 5.28 MI/d and a reference condition of 16.00 MI/d. These conditions are set out in **Table A2.3**.

**Table A2.3 Underbank Reservoir licence data**

Compensation Water Source	Receiving Watercourse	NGR	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
Underbank	River Little Don	SK 253991	16.00 or 21.70	8.00	8.00	5.28	10.72

## A2.4 More Hall Reservoir drought permit

Under conditions defined by the Broomhead Reservoir abstraction licence YWSL must release flow from More Hall Reservoir to compensate the downstream receiving watercourses, Ewden Beck and the River Don. Under the licence conditions, YWSL must continuously discharge from More Hall Reservoir to ensure not less than 12.00 MI/d of flow through the More Hall Gauge to the River Ewden when the reservoir level is above the control line defined in the licence and 9.1 MI/d is released when the level is below the control line. The drought permit application for More Hall Reservoir is to reduce the compensation release when the reservoir is below the lower of its compensation control lines for more than two consecutive weeks by 50% to 4.55 MI/d from the date the permit is granted and to reduce further to 3.00 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the Yorkshire Water Drought Plan. These conditions are set out in **Table A2.4**.

**Table A2.4 More Hall Reservoir licence data**

Compensation Water Source	Receiving Watercourse	NGR	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
More Hall	Ewden Beck	SK 288957	9.10 or 12.00	4.55	4.55	3.00	6.10

## A2.5 Damflask Reservoir drought permit

YWSL releases water from Damflask Reservoir under conditions defined by the Dale Dike Reservoir and Agden Reservoir abstraction licence (2/27/05/030). The terms of the licence state YWSL must release flow from Damflask Reservoir to compensate the downstream receiving watercourses, the River Loxley and the River Don. Under the licence conditions, YWSL must continuously discharge not less than 28.00 MI/d when the reservoir level is above the control line defined in the licence, or 18.00 MI/d when the reservoir level is below the control line. The drought permit application for Damflask Reservoir is to reduce the compensation release required when the reservoir is below the control line for more than two consecutive weeks by 50% to 9.00 MI/d from the date the permit is granted and to reduce further to 6.00 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the YWSL Drought Plan, or if stocks in the Loxley supply group are below its Drought Control Line. This assessment has therefore been undertaken in comparison of a drought permit of 5.94 MI/d and a reference condition of 18.00 MI/d. These conditions are set out in **Table A2.5**.

**Table A2.5 Damflask Reservoir Licence Data**

Compensation Water Source	Receiving Watercourse	NGR	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
Damflask	River Loxley	SK 287905	18.00 or 28.00	9.00	9.00	5.94	12.06

## A2.6 Rivelin Reservoir drought permit

YWSL is licensed to impound water in Rivelin Upper and Lower Reservoirs for supply to customers under the Rivelin Reservoirs and Redmires Reservoirs abstraction licence (2/27/05/029). The terms of the licence state YWSL must release flow from Rivelin Lower Reservoir to compensate the downstream receiving watercourses, the River Rivelin and the River Don. Under the licence conditions, YWSL must continuously discharge from Rivelin Depositing Pond to ensure not less than 10.3 MI/d flows through Rivelin Gauge to the River Rivelin. The drought permit application for Rivelin Depositing Pond is to reduce the compensation release by 50% to 5.15 MI/d from the date the permit is granted and to reduce further to 3.43 MI/d if regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks, as defined in the YWSL Drought Plan, or if stocks in the Rivelin supply group are below its Drought Control Line. This assessment has therefore been undertaken in comparison of a drought permit of 3.43 MI/d and a reference condition of 10.3 MI/d. These conditions are set out in **Table A2.6**.

**Table A2.6 Rivelin Reservoir Licence Data**

Compensation Water Source	Receiving Watercourse	NGR	Normal Compensation Release MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 1)	Benefit MI/d	Proposed Drought Option Compensation Release MI/d (Trigger 2)	Benefit MI/d
Rivelin	River Rivelin	SK 278867	10.30	5.15	5.15	3.40	6.90

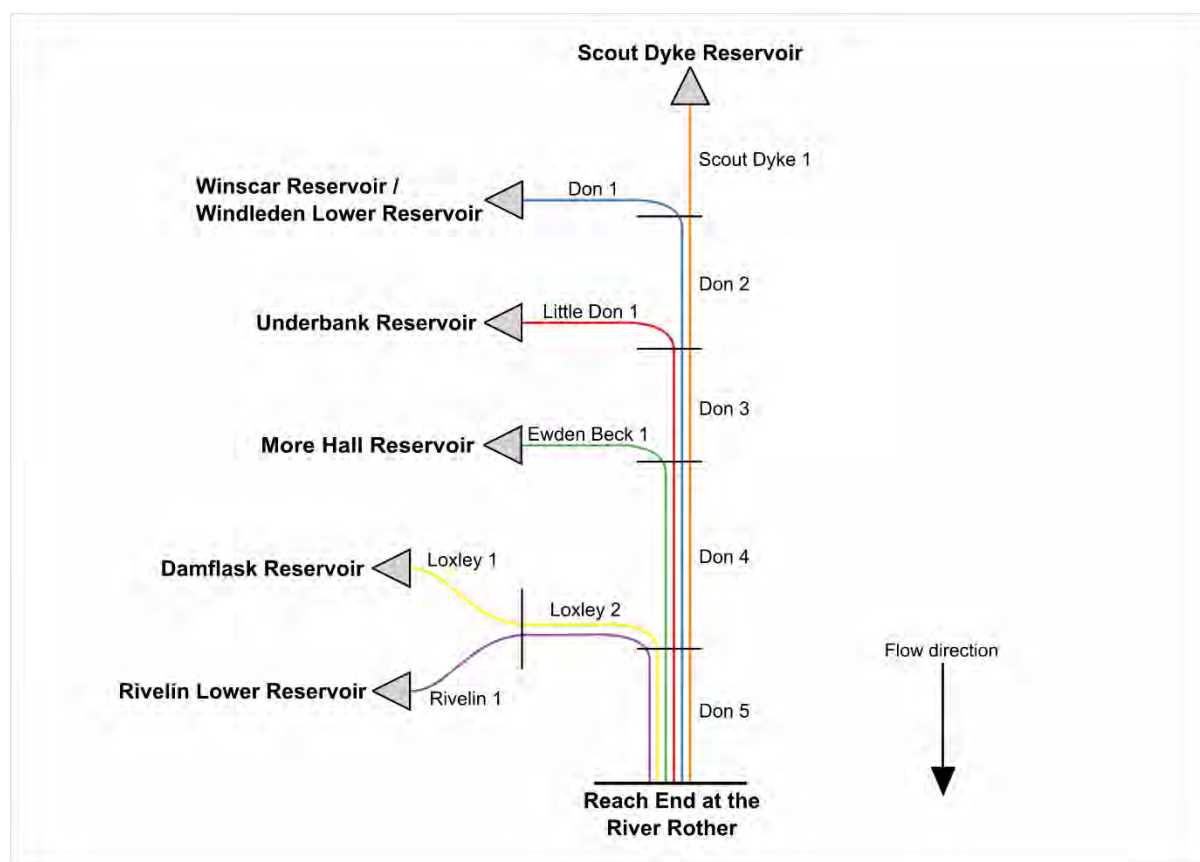
## A3 Study area

The zone of influence associated with each drought option is defined through hydrological effects. Within the overall zone of influence, reaches are then defined on a hydrological basis. YWSL's Drought Plan 2022 Environmental Assessment Methodology<sup>2</sup> sets out this approach in detail in Section 3.4. The zone of influence and individual reaches for assessment of impacts are set out in **Section A3.1** below. Information on the likely timings of drought options are set out in **Section A3.2** below.

### A3.1 Zone of influence of the drought options

The reaches for the South area reservoir drought options have been defined previously during the environmental assessment of YWSL past drought plans. **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 South Area reach schematic**



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

**Table A3.1 South Area reach details**

Reach name	Watercourse name	Reach start	Reach end	Downstream reach	Drought measure					
					Scout Dyke Reservoir	Winscar / Windleden Lower Reservoirs	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Rivelin Reservoir
Don 1	River Don	Winscar/Windleden Lower Reservoirs	Scout Dyke	Don 2		✓				
Don 2	River Don	Scout Dyke	Little Don	Don 3	✓	✓				
Don 3	River Don	Little Don River	Ewden Beck	Don 4	✓	✓	✓			
Don 4	River Don	Ewden Beck	River Loxley	Don 5	✓	✓	✓	✓		
Don 5	River Don	River Loxley	River Rother	N/A Study area end	✓	✓	✓	✓	✓	✓
Scout Dyke 1	Scout Dyke	Scout Dyke Reservoir	River Don	Don 2	✓					
Little Don 1	Little Don River	Underbank Reservoir	River Don	Don 3			✓			
Ewden Beck 1	Ewden Beck	More Hall Reservoir	River Don	Don 4				✓		
Loxley 1	River Loxley	Damflask Reservoir	River Rivelin	Loxley 2					✓	
Loxley 2	River Loxley	River Rivelin	River Don	Don 5					✓	✓
Rivelin 1	River Rivelin	Rivelin Lower Reservoir	River Loxley	Loxley 2						✓



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. No significant impacts related to the drought options occur below these points (see **Table 3.2**).

**Table A3.2 South Area extent of zone of influence**

Reach	Description	Downstream impacts
Don 5	River Don confluence with River Rother	<p>The potential hydrological impact of the drought options on the River Don downstream of the River Rother confluence (downstream of Don 5) is considered at an assessment point on the confluence, using the Rotherham Tesco flow gauge (560m downstream of the Don/Rother confluence).</p> <p>At that assessment point using available data for the period 2005-2019 adjusted to account for the influence of historic compensation flows from reservoirs in the Don catchment reference condition flow statistics were:</p> <ul style="list-style-type: none"> <li>summer Q95 351 MI/d, summer Q99 301 MI/d</li> <li>annual Q50 682 MI/d, annual Q95 368 MI/d.</li> </ul> <p>It is noted that there is ungauged abstraction into the Sheffield &amp; South Yorkshire Navigation canal just upstream of the gauge and river flows prior to the gauging point are higher.</p> <p>Were all of the drought options to be simultaneously in operation, the River Don downstream of the River Rother confluence assessment point statistics identifies the following impacts at the end of the reach:</p> <ul style="list-style-type: none"> <li>summer/autumn: 12% reduction (to 308 MI/d) in Q95 and 14% reduction (to 257 MI/d) in Q99</li> <li>winter: 6% reduction (to 638 MI/d) in Q50 and 12% reduction (to 324 MI/d) in Q95</li> </ul> <p>As the character of the River Don has changed to a broad lowland river with flow moderated by wastewater returns in Don 5 and the significant flow addition from the River Rother, the River Rother confluence is considered a suitable end to the zone of influence of the South area reservoirs drought options.</p>

## A3.2 Timing of drought measure effects

The drought permit application is anticipated to be submitted by YWSL in late summer 2022 and the implementation period would therefore be likely to cover autumn/winter 2022.

## A3.3 Cumulative reaches with other EARs

There are no cumulative hydrological impacts foreseen as a result of simultaneous deployment of drought options within the South Area reservoir group.

## A3.4 Physical environment effects

### A3.4.1 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 habitats (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 each reach within the zone of influence is then provided.

YWSL's Drought Plan 2022 Environmental Assessment Methodology<sup>3</sup> 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)<sup>4</sup> and Section 3 of the Environment Agency's 2019 consultation draft "Environmental Assessment for Water Company Drought Plans- supplementary guidance".

## A3.5 Don 1

### A3.5.1 Reach introduction

Don 1 is potentially impacted by a A2.2 Winscar/Windleden Lower Reservoirs drought permit. A summary of physical environment information for this reach is provided in **Figure A4.1**. The reach includes part of the following river waterbody:

- River Don from Source to Scout Dyke (GB104027057500)

### A3.5.2 Reach setting

Don 1, located on main EAR **Figure 4.1**, comprises a 12.1km stretch of the River Don from the outflow of Winscar Reservoir to the confluence with Scout Dyke (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 31.24km<sup>2</sup> along the length of the reach. Don 2 (see **Section A4.3** below) is downstream.

### A3.5.3 River flow regime

During the implementation of this drought option, it is likely that the levels in Winscar and Windleden Lower reservoirs will be below top water level and therefore the compensation flow from the two reservoirs will be the only inflow at the top of this reach. The compensation flow can be released from either or both of the two reservoirs in order to comply with the maintained flow requirement at Dunford Bridge, downstream of both reservoir outflows. The outflow from Windleden Lower Reservoir joins the main River Don channel approximately 0.5 km downstream of the Winscar reservoir dam.

A reduction of 6.06 Ml/d in the minimum maintained flow at Dunford Bridge (the maximum reduction under this drought option, when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However, the flow reduction at the top of the reach will remain at 67% until either or both of the two reservoirs reach top water level and begin to spill again.

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3 Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.  
4 Environment Agency (2020) Water Company Drought Plan Guideline, April 2020.

The hydrological impact of the drought option on Don 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There is one flow pressure influencing flow in Don 1, a non-consumptive hydropower abstraction licence with a hands-off flow condition of 11.2Ml/d. There is no flow depleted reach associated with this abstraction either with or without a drought permit. There are no significant discharges within Don 1. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

#### A3.5.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 24 October 2018 at a reservoir outflow of 13.3Ml/d.

Don 1 is fairly straight reach which falls ~98m over 11.4km, a slope of 0.5°. The channel is part shaded for much of its length with deciduous riparian tree cover. RHS site 20242 identifies that the upper reach is situated in a deep vee-shaped valley which shallows at site 20241 in the lower section of the reach. Both sites record two river terraces. The channel varies in width along its length. In the upper 0.9km the channel varies between ~8-10m, decreasing to between ~3-7m thereafter and increasing to between ~10-12m in the final 4km of the reach. The initially large channel width suggests channel modification (widening and bank reinforcement) due to the reservoir and mining activity. Several side bars in the mid sections of the reach. There are numerous boulders protruding through the flow immediately downstream of the reservoir outflow and a berm is visible ~7km downstream, protruding boulders were observed at RHS sites 39721, 39742 20242 and 20241. Data for RHS sites 20242 and 20241 have indicated three riffles at the upper site (20242) and ten riffles at the lower site (20241) and no sediment bars. At survey ID 39721, 5 pools and 1 riffle were observed, whilst at survey ID 39742, 6 pools and 8 riffles were observed. Data from the RHS sites indicated that, where visible, cobbles were the dominant substrate, some variation was observed in the more recent surveys (39721 and 39742) where boulders, pebble and bedrock were also observed. In aerial imagery, the flow surface was predominantly smooth with some areas of broken flow and rippled flow. RHS sites 20241 and 24242 contained areas of high velocity chute flow, with rippled flow and broken waves being noted at site 20241. Data for all RHS sites identify that both the left and right banks are predominantly composed of earth and brick and laid stone, with rip-rap being identified at ~10% of spot sample sites for both banks. Significant variation in the left bank composition was observed at Survey ID 39721, where 10% bedrock, 10% boulder; 10% brick and 70% earth was observed. Bank face vegetation was noted as predominantly uniform with some bare areas for the left banks and uniform and simple for the right banks. Bank top vegetation was predominantly uniform on both banks (although simple vegetation was recorded at each site). The left and right banks at all RHS sites were noted as being extensively resectioned and reinforced, however, throughout the mid sections of the reach between ~1-7km, bank erosion was visible on imagery, suggesting limited reinforcement. Surrounding land-use is generally rough pasture and moorland heath in the upper sections with rough pasture and improved grassland in the mid and lower sections of the reach and increasing suburban/urban development towards the end of the reach. In the upper sections of the reach there is evidence of mining activity which has left several spoil heaps adjacent to the channel.

Don 1 contains a mixture of high and low energy environments, indicated by the moderate steepness of the valley, the valley shape and the presence of both erosional and depositional features. Although the dominant substrate is less suitable for supporting spawning habitat, it is considered likely that smaller pockets of suitable types are likely to be present with riffles identified in the RHS reaches. Extensive resectioning and reinforcement of banks have the potential to reduce the amount of juvenile nursery habitat and refuge potential for adults, however in-stream features are likely to provide the refuge required by both. The presence of trees in the riparian corridor will provide some allochthonous energy into the stream. The reinforced banks, albeit limited in extent, may provide some additional habitat opportunities for white-clawed crayfish, with suitable substrate also present. The movement/migration of fish and sediments are likely to be significantly impacted upon by the presence of a significant number of weirs in the channel. Bullhouse Mill Weir, associated with the hydropower scheme, includes a fish pass.

The drought options reduction in flow could lead to several potential impacts within Don 1.

- Major risk of changes in the energy of the system associated with up to 67% reduction in flow for the duration of drought options.
- Potentially minor risk of reduction in wetted aquatic habitat (wetted width reduction) due to channel shape in deep V-shaped valley.
- Potentially moderate risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for duration of drought option, with retention of dominant habitat types.
- Moderate risk to longitudinal connectivity due to steep nature of channel.
- 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. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

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

#### A3.5.5 River water quality

Two water quality monitoring locations are present in Don 1. The second location, River Don at Starling Bridge (NE-49301640) has been selected to account for any influence from the Bullhouse Minewater Project, the discharge from which is not sampled separately by the EA. The average pH between 2010-2020 was 7.53 with a maximum temperature of 18.8°C for the same period. The EA has requested that the effect of change in river dilution of iron in the discharge from the Bullhouse Minewater Project is considered in this reach. There are no significant continuous or intermittent discharges either within Don 1 or at risk from changes in flow in the reach. A summary description of the potential risks to water quality in Don 1 as a result of drought options is presented in **Table A4.1**.

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

	<b>Total ammonia</b>	<b>Oxygen</b>	<b>Phosphate</b>	<b>Iron</b>
General quality	Ammonia concentrations were predominantly consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period with a single result on 31/8/2011 measuring 64%. Some weak seasonality is apparent.	Orthophosphate concentrations were mostly consistent with 'Good' WFD status (0.039 mg/l) throughout the monitoring period however 13% of samples achieved moderate status. Some weak seasonality is apparent.	Total iron concentrations were inconsistent with "Pass" chemical status (1,000 µg/l) with 54% of results falling below this standard. There does not appear to be association between reduced river flows and increased iron concentration
Flow sensitivity (diffuse pollution)	None apparent	None apparent	Weak	Weak
WWTW presenting increased risk	None	None	None	N/A
Intermittent pressures presenting risk	None	None	None	N/A
Other point source pressures presenting risk	None	None	None	Bullhouse Minewater Project (a walkover reach covering this section of the river has been included in the schedule of monitoring for Don 1 on a precautionary basis (see main EAR Section 6)
Summary	Minor risk from drought options	Minor risk from drought options	Minor risk from drought options	Uncertain risk from drought options

### A3.5.6 Summary of potential changes in the physical environment as a result of drought options

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

**Table A4.2 Summary of potential changes in the physical environment of Don 1 as a result of drought options**

<b>Physical environment aspect reviewed</b>	<b>Assessment of risk from implementation of drought options</b>
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 67% in river flows throughout the reach at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Don 1.</li> </ul>
<b>River habitats</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• Potential minor 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.</li> <li>• Moderate risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Minor risk</i>	<ul style="list-style-type: none"> <li>• Reported water quality is mostly with 'Good' status with apparent weak flow sensitivity for SRP. There are no continuous water quality pressures identified as presenting increased risk with drought options implemented and no significant intermittent pressures presenting risk.</li> <li>• There is uncertainty associated with the dilution of iron in the discharge from the Bullhouse Minewater Project in Don 1 and how this may change with drought options as to date no data are available. A walkover reach covering this section of the river has been included in the schedule of monitoring for Don 1 on a precautionary basis (see main EAR Section 6).</li> </ul>



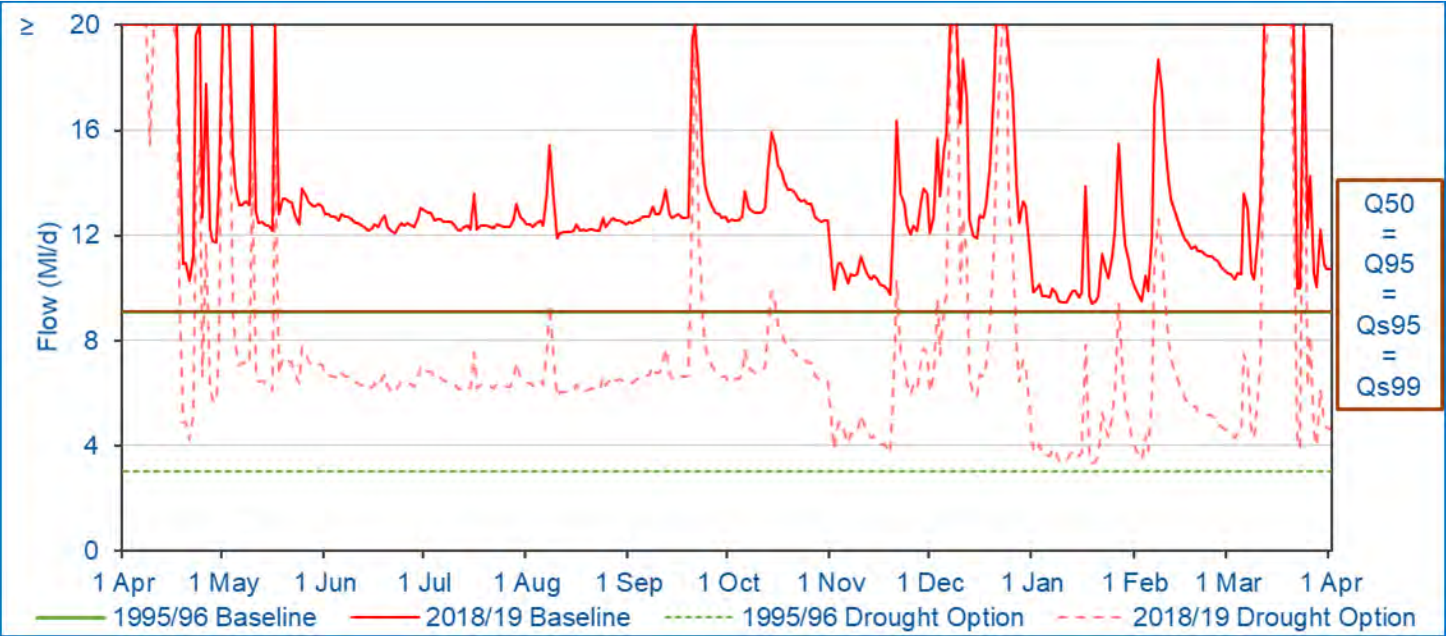
Reach Setting



**Reach Setting Information:**  
The superficial geology is very limited, underlain with alluvium and with spatially-limited river terrace deposits of sand/gravel at the confluence River Don confluence. Soil types are composed predominantly of slowly permeable, wet acid upland soils and slowly permeable, seasonally wet acid loamy and clayey soils. Very acid loamy upland soils and freely draining, slightly acid loamy soils are present in the very upper and lower sections of the reach respectively. Urbanisation increases towards the lower sections of the reach, with Millhouse Green, Thurstone and Penistone located along the reach.

	Supplementary Information
Catchment Area at Assessment Point	8.48km <sup>2</sup>
Mean Slope Gradient	0.49°
Length of Reach	12.1km
Additional Catchment Area	31.2km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Don 2

River Flow Regime



	Reference Conditions (Ml/d)	Drought Plan Conditions (Ml/d)	% Reduction	Impact
Q <sub>s</sub> 95	9.09	3.00	67	Summer Major
Q <sub>s</sub> 99	9.09	3.00	67	
Q95	9.09	3.00	67	Winter Major
Q50	9.09	3.00	67	

Significant Flow Additions/Reductions	Flow Rate (Ml/d)	Abstraction / Discharge
RIVER DON - BULLHOUSE MILL - PENISTONE NE/027/0005/007	51.84 (HoF of 11.2)	Abstraction

River Habitats



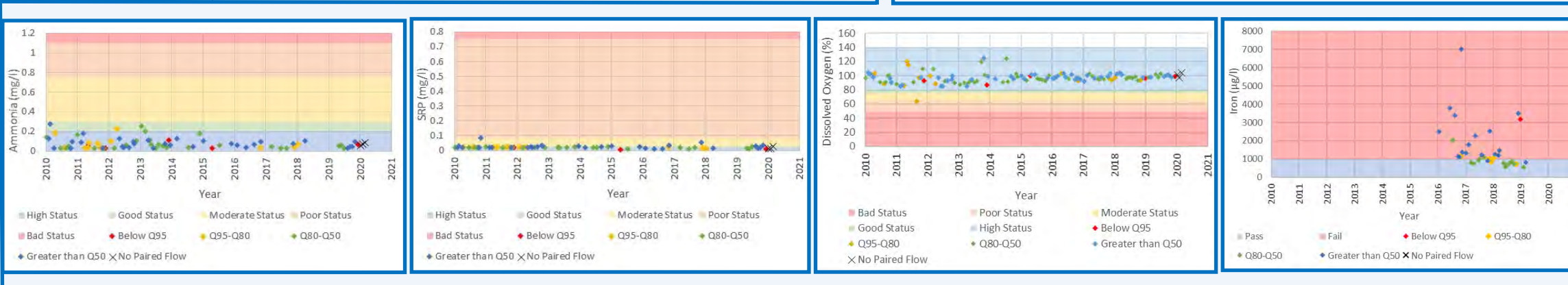
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Bullhouse Minewater Project WRA7526	Descriptive consent

In the River Don at Starling Bridge (NE-49301640) the average pH between 2010-2020 was 7.53 with a maximum temperature of 18.8°C



**Figure A4.1**  
**Don 1: Physical Environment Information**





## A3.6 Don 2

### A3.6.1 Reach introduction

Don 2 is potentially impacted by Scout Dyke Reservoir and Winscar/Windleden Lower Reservoirs drought permits. A summary of physical environment information for this reach is provided in **Figure A4.2**. The reach includes all of the main channel of the following river waterbody:

- River Don from Scout Dyke to the Little Don (GB104027057490).

### A3.6.2 Reach setting

Don 2, located on main EAR **Figure 4.1**, comprises a 12.6km stretch of the River Don from the confluence with Scout Dyke to the confluence with the Little Don River (**Table A2.1**). Don 3 (see **Section A4.4** below) is downstream.

### A3.6.3 River flow regime

River flow in Don 2 is influenced by the Winscar/Windleden Lower Reservoir influenced flows of Don 1 and Scout Dyke Reservoir influenced flows of Scout Dyke 1. As such limited flow variability would be apparent during the implementation of South Area drought options part-reflecting local hydrological response to rainfall conditions during the ongoing environmental drought.

There is no gauged flow data available for this reach of the River Don. Flows at the upstream end of this reach have been estimated using the Gustard flow transposition method, based on catchment parameter ratios and gauged flow data from an available downstream gauge at Sheffield Hadfields. The Sheffield Hadfields record was first adjusted to allow for effluent discharges upstream of the gauge location (from Cheesebottom and Ewden WwTW) and the effects of the reservoirs in the upper catchment including the catchment upstream of the Dunford Bridge maintained flow location. Measured outflows from Scout Dyke reservoir and measured daily flows at the Dunford Bridge maintained flow location were then added back on to the estimated (transposed) data series, to provide an estimated flow record for the River Don just downstream of the Scout Dyke confluence.

It was noted that the reservoir outflow data series included a period in 1996 where the normal minimum compensation and/or maintained flow values were not met, reflecting a historic drought permit implemented in 1996 which allowed compensation flow reductions at several of the Sheffield area reservoir groups. The estimated flow record for the River Don downstream of the Scout Dyke confluence was adjusted to a minimum of 11.79 MI/d over this period, to remove the influence of historic drought permit events on the baseline flow record.

The River Don downstream of the Scout Dyke confluence is influenced by both the Scout Dyke Reservoir and the Winscar/Windleden Lower Reservoirs drought options. The maximum combined flow reduction from these two options is 7.87 MI/d, at times when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks. The combined drought options therefore represent reductions of up to 49% and 63% in the summer Q95 and Q99 flow statistics respectively and would therefore be assessed as a **major** hydrological impact in the summer period. During the winter period, the combined flow reduction represents reductions of up to 46% and 18% in the year round Q95 and Q50 flow statistics, which is assessed as a **major** hydrological impact in winter also.

The hydrological impact of the drought option on Don 2 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are two significant flow pressures influencing flow in Don 2, a non-consumptive abstraction licence leading to a flow depleted reach<sup>5</sup> as described in **Section A4.3.3.1**, and a discharge licence

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5 'Flow depleted reach' refers to the length between the abstraction and discharge point of non-consumptive licences (e.g. aquaculture, hydro-power).

leading to a significant flow addition from Cheesebottom WwTW, with a dry weather flow of 4.48 MI/d. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

#### A3.6.3.1 Flow depleted reaches

There is one separate licensed non-consumptive abstraction depleting flow in Don 2 for the production of energy, with a peak daily licensed abstraction rate of 28.08MI/d. This abstraction is a non-consumptive abstraction for hydroelectric power generation, without a hands-off-flow condition ('River Don – Old Mill – Thurgoland') with potential flow impacts. An abstraction at that rate could reduce flows in the depleted reach, during environmental drought, without or in combination with drought options to zero. A walkover reach covering the section of the river has been included in the schedule of monitoring for Don 2 (see main EAR Section 6).

There is also an offtake channel at Tin Mill Dam to support pond level at Tin Mill Angling Club's stillwater fishery. A reduction in river flows may lead to flows preferentially enter the fishing ponds causing a depleted reach downstream until the outflow from the ponds. A walkover reach covering the section of the river has been included in the schedule of monitoring for Don 2 (see main EAR Section 6).

YWSL will liaise with the abstractors in advance of permit implementation to determine appropriate mitigation measures.

#### A3.6.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 24 August 2018 at an estimated river flow at the flow assessment point for the reach of 19.3MI/d.

Don 2 is a fairly sinuous reach with relatively straight sections throughout the reach. The reach falls ~65m over 12.6km, a slope of 0.3°. The channel is heavily shaded and flows through heavily wooded valley for the last 8km. Where the channel is visible through tree cover, the channel is between ~10-12m wide. The three RHS surveys have indicated the presence of side bars on the right bank at ~40% of all spot sites with only a few on the left side (10% of spot sites), 1 unvegetated point bar was observed at site 37036. Several eroding cliffs were identified on the right banks at site 3335 (40%), site 10745 (20%) and site 20243 (10%); however stable cliffs were identified at site 37036. At site 10745 (~3.7km downstream) channel bed substrate was composed of cobble (60%) and boulders (20%) with gravel/pebble and bedrock composing the remaining substrate. At site 3335 (~4.4km downstream) cobble (40%) and boulder (40%) were the dominant substrates, with gravel/pebble and bedrock forming the remainder. At site 20243 (4.5km downstream) cobble (30%) and pebble (30%) were the dominant substrates with boulder composing 10% of the substrate. The bed was not visible at 30% of the spot sites measured at site 20243. At site 37036, the bed substrate was dominated by cobble (40%), however areas of bedrock (10%) and boulders (20%) were observed. The presence of exposed bedrock and exposed boulders has been noted by four RHS sites in this reach (being present at ~40% of the spot sites). Where visible on aerial imagery, the channel surface indicates that smooth flow predominates. RHS data show varied flow types. At sites 10745 and 3335 rippled flow accounted for 60% and 50% of spot site flow respectively. Broken standing waves (20%) at site 10745 and unbroken standing waves (40%) at site 3335 were also identified. Smooth flow (50%) and rippled flow (30%) dominated site 20243, although unbroken standing wave was also noted (20%). At RHS site 37036, unbroken waves (10%), broken waves (10%), chaotic (10%), rippled (50%) and smooth (20%) flow was observed. Data for the three RHS sites identify that both the left banks are equally composed of earth (~50%) and brick and laid stone (~50%) while the right banks are predominantly earth (~60-80%) with some brick and laid stone (~10-30%). Bank face vegetation at the four sites is mostly uniform (particularly for the right bank at site 3335) or simple (particularly for the left bank at site 10745), with simple and uniform vegetation on both bank tops. The left and right banks at the four RHS sites were noted as being reinforced or resectioned, with whole bank reinforcement most frequent. Vertical or undercut banks and steep banks >45° were present throughout the sites. Surrounding land-use is generally suburban/urban development, improved grassland and arable land and deciduous woodland and plantations. Suburban/urban development is particularly common in the upper reaches while deciduous woodland is common in the lower sections of the reach.



Don 2 also supports a variety of high and low energy environments, with the presence of erosional and depositional features identified. However, as the valley slope of Reach 2 is shallower than Reach 1, slower flows are more likely to dominate; however flow variation was observed. The substrate composition identified suggests some, albeit limited, potential for spawning habitat with the RHS data identifying the presence of some riffles in the surveyed reaches. The substrate composition also provides some refuge for juvenile and adult fish and white-clawed crayfish. Although there is a limited number of pools identified, the presence of vertical/undercut banks and large substrate types will provide cover. The extensive coverage of deciduous trees in the riparian habitat will ensure a high input of allochthonous energy into the stream and provide further cover opportunities for fish. The reinforced banks present may provide additional habitat opportunities for white-clawed crayfish. Modification to the channel will have impacts upon the movement/migration of fish and sediment due to the presence of weirs and a large number of road crossings, some of which could incorporate culverts.

The drought options reduction in flow could lead to several potential impacts within Don 2:

- Major of changes in the energy of the system associated with up to 63% reduction in flow for 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Potentially moderate risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant habitat types.
- Moderate risk to longitudinal connectivity from eight noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Don 2 from drought options is therefore assessed as moderate.

### A3.6.5 River water quality

The first water quality monitoring point present in Don 2, River Don at Oxspring Bridge (NE-49301634), was used. The average pH between 2010-2020 was 7.6 with a maximum temperature of 20.2°C for the same period. Water quality modelling identifies one continuous discharge, YWSL Cheesebottom WwTW, presenting a significant risk to both dissolved oxygen and total ammonia in Don 2. There is one frequently spilling CSO potentially presenting an environmental risk in the reach. A summary description of the potential risks to water quality in Don 2 as a result of drought options is presented in **Table A4.3**.

**Table A4.3 Potential risks to water quality in Don 2 as a result of drought options**

	<b>Total ammonia</b>	<b>Oxygen</b>	<b>Phosphate</b>
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period	Dissolved oxygen saturation (%) values predominantly were consistent with 'Good' WFD status (75%) throughout the monitoring period with a single result achieving 'Poor' status on 31/8/2011	Orthophosphate concentrations were predominantly consistent with 'Good' WFD status (0.03 mg/l) throughout the monitoring period with 43% of results achieving 'Moderate' status or lower.
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, suffocation from oxygen sags) downstream of Cheesebottom WwTW		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 one listed CSO 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 and reduction in dilution of WwTW	Moderate risk from drought options

### A3.6.6 Summary of potential changes in the physical environment as a result of drought options

An overall summary of potential changes in the physical environment of Don 2 as a result of drought options is presented in **Table A4.4**.

**Table A4.4 Summary of potential changes in the physical environment of Don 2 as a result of drought options**

<b>Physical environment aspect reviewed</b>	<b>Assessment of risk from implementation of drought options</b>
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 63% in river flows for periods of time during the duration of the drought option, throughout the reach, at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• One flow depleted reach with potential for periods of time with zero flow without mitigation</li> </ul>
<b>River habitats</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• 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.</li> <li>• Moderate risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia, suffocation from oxygen sags) downstream of Cheesebottom WwTW.</li> <li>• Risk of short term acute, infrequent, temporary water quality pressures locally downstream of one listed CSO during rainfall events.</li> <li>• Reported water quality is predominantly consistent with 'Good' status and no apparent flow sensitivity for dissolved oxygen and ammonia. SRP quality is inconsistent with 'Good' status with moderate flow sensitivity.</li> </ul>



Reach Setting

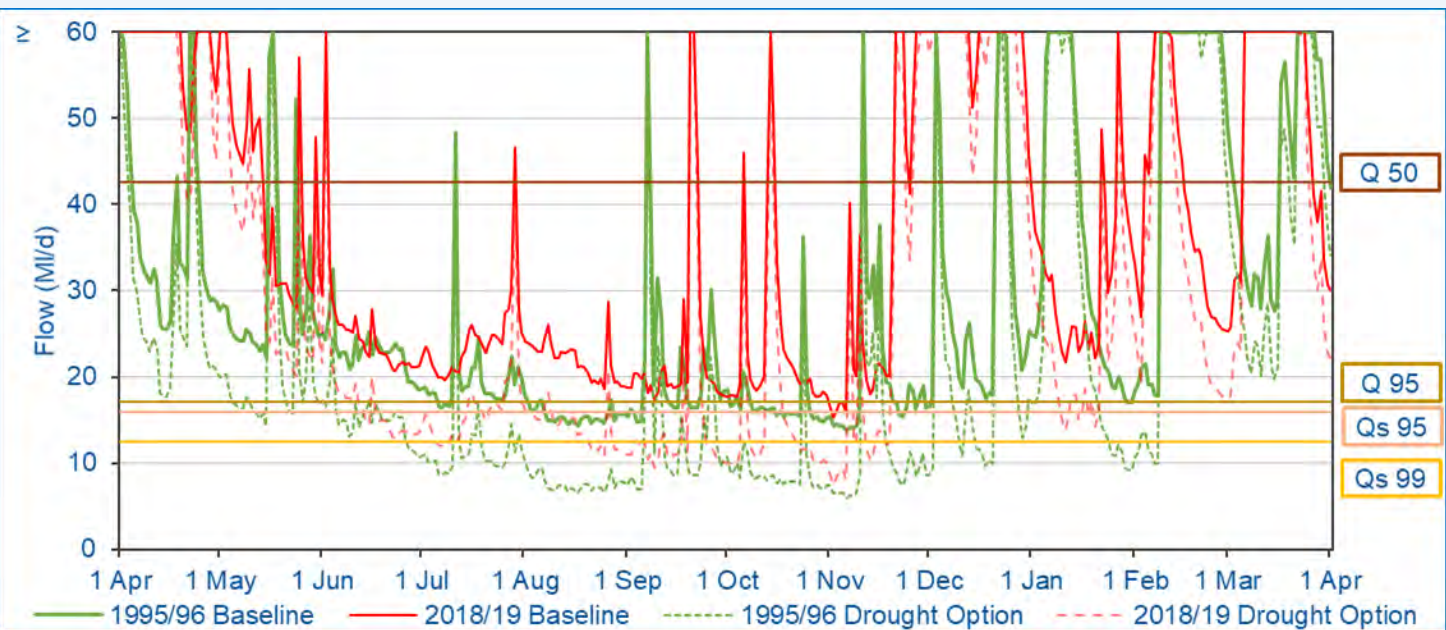


Reach Setting Information:

The superficial geology is composed of alluvium along the channel path with spatially limited river terrace deposits of sand and gravel at the mid to lower sections of the reach around Oxspring. In the upper to mid sections of the reach soils are composed of slowly permeable, seasonally wet acid loamy and clayey soils and freely draining slightly acid loamy soils. In the mid to lower sections of the reach soils are very acid loamy upland soils and slowly permeable, wet acid upland soils, both soils having peaty surfaces. The bedrock geology is comprised of the Millstone Grit Group (sand/gravel) and coal measures. Urbanisation is variable along the reach.

	Supplementary Information
Catchment Area at Assessment Point	51.7km <sup>2</sup>
Mean Slope Gradient	0.29°
Length of Reach	12.6km
Additional Catchment Area	24.7km <sup>2</sup>
Upstream Reach	Don 1/ Scout Dyke 1
Downstream Reach	Don 3

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact	Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
Q <sub>s</sub> 95	15.94	8.07	49	Summer Major	Cheesebottom WwTW 2556	23.24	Discharge
Q <sub>s</sub> 99	12.40	4.53	63		RIVER DON - THE OLD MILL - THURGOLAND 2/27/05/201/R01	28.08	Abstraction
Q95	17.13	9.26	46	Winter Major			
Q50	42.55	34.68	18				

River Habitats



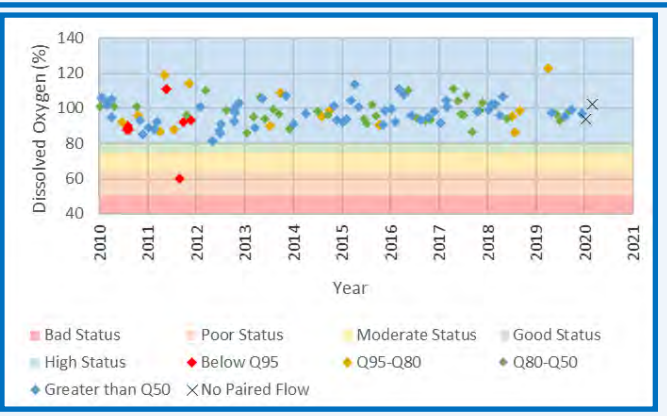
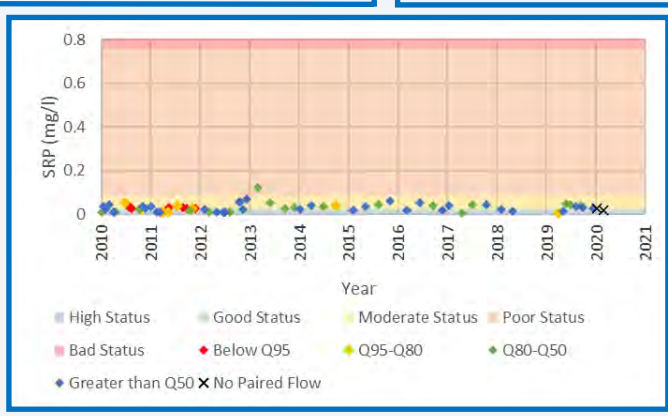
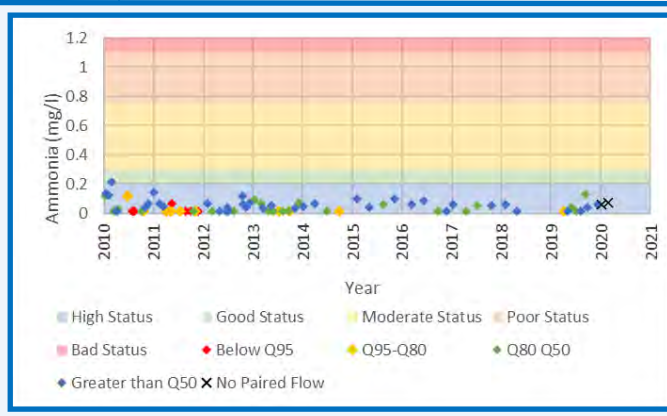
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Thurgoland/ CSO 2992 1	Intermittent Discharge
Cheesebottom WwTW 2556	4.5Ml/d DWF 10mg/l Ammonia (N) 20 BOD ATU

In the River Don at Oxspring Bridge (NE-49301634) the average pH between 2010-2020 was 7.6 with a maximum temperature of 20.2°C



Figure A4.2  
Don 2:  
Physical Environment Information





## A3.7 Don 3

### A3.7.1 Reach introduction

Don 3 is potentially impacted by Scout Dyke Reservoir, Winscar/Windleden Lower Reservoirs and Underbank Reservoir drought permits. A summary of physical environment information for this reach is provided in **Figure A4.3**. The reach includes all of the main channel of the following river waterbody:

- River Don from the Little Don to River Loxley confluence (GB104027057411).

### A3.7.2 Reach setting

Don 3, located on main EAR **Figure 4.1**, comprises a 2.7km stretch of the River Don from the confluence with the Little Don River to the confluence with Ewden Beck (**Table A2.1**). Don 4 (see **Section A4.5** below) is downstream.

### A3.7.3 River flow regime

As outlined under the assessment for the Don 2 reach, flows at the upstream end of the Don 3 reach have been estimated using the Gustard flow transposition method, based on catchment parameter ratios and adjusted gauged flow data from an available downstream gauge at Sheffield Hadfields. Measured outflows from Scout Dyke Reservoir and Underbank Reservoir, measured daily flows at the Dunford Bridge maintained flow location and the dry weather flow (DWF) from Cheesebottom WwTW were added back on to the estimated (transposed) data series, to provide an estimated flow record for the River Don just downstream of the Little Don River confluence. Again as outlined previously, the estimated flow record for the River Don downstream of the Little Don River confluence was adjusted to a minimum of 27.79 MI/d, to remove the influence of historic drought permit events (particularly noted in 1996) on the baseline flow record.

The River Don downstream of the Scout Dyke confluence is influenced by the Scout Dyke, Underbank and Winscar/Windleden Lower reservoirs drought options. The maximum combined flow reduction from these three options is 18.59 MI/d, at times when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks. The combined drought options therefore represent reductions of up to 47% and 55% in the summer Q95 and Q99 flow statistics respectively and would therefore be assessed as a **major** hydrological impact in the summer period. During the winter period, the combined flow reduction represents reductions of up to 45% and 22% in the year round Q95 and Q50 flow statistics, which is assessed as a **major** hydrological impact in winter also.

The hydrological impact of the drought option on Don 3 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are two significant flow pressures influencing flow in Don 3, both discharge licences leading to a significant flow addition. The two discharge licences are from Ewden Water Treatment Works, an intermittent discharge with a max daily flow of 50 MI/d and Ewden Wastewater Treatment Works, with a dry weather flow of 3.48MI/d. There are no significant abstractions within Don 3. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.7.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 22 August 2018 at an estimated river flow at the flow assessment point for the reach of 45.6MI/d.

Don 3 is a fairly sinuous reach with relatively straight sections throughout the reach. The reach falls ~26m over 2.7km, a slope of 0.5°. The channel is heavily shaded with semi-continuous to continuous riparian tree cover. The channel is largely obscured by trees on extant aerial imagery, however, where the channel is visible through tree cover at the start of the reach the channel is ~12m wide. No within channel features are visible on aerial imagery. Surrounding land use is generally suburban/urban, rough pasture and deciduous woodland. Suburban/urban development is dominant on the left bank, notably

as frequently bare waste ground. Within the 500m walkover reach, survey identifies frequent moderate energy flows over coarse substrate including frequent boulders.

Don 3 also contains high and low energy environments, indicated by the moderate slope of the valley. The extensive cover of riparian trees will ensure a high input of allochthonous energy and provide cover/refuge for fish and white-clawed crayfish.

The drought options reduction in flow could lead to several potential impacts within Don 3:

- Major risk of changes in the energy of the system associated with up to 55% reduction in flow for periods of time during the duration of drought option.
- Potentially minor risk of reduction in wetted aquatic habitat (wetted width reduction) with increasing exposure of channel margins and the margins of within-channel features (such as channel bars and islands) for periods of time during the duration of drought option.
- Potentially minor risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant low energy habitat types.
- Negligible 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Don 3 from drought options is therefore assessed as minor.

#### A3.7.5 River water quality

Two water quality monitoring points are present in Don 3. For this assessment the second sample in the reach, River Don Downstream Of Stocksbridge S.W (NE-49301683), was used due to its better data quality. The average pH between 2010-2020 was 7.7 with a maximum temperature of 17.7°C for the same period. Water quality modelling identifies one continuous discharge, YWSL Ewden WwTW, presenting a significant risk to both dissolved oxygen and total ammonia in Don 3 and the continuation of the significant risk to dissolved oxygen from Cheesebottom WwTW discharging in Don 2. A summary description of the potential risks to water quality in Don 3 as a result of drought options is presented in **Table A4.5**.

**Table A4.5 Potential risks to water quality in Don 3 as a result of drought options**

	<b>Total ammonia</b>	<b>Oxygen</b>	<b>Phosphate</b>
General quality	Ammonia concentrations were predominantly consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period with 24% of results achieving 'Moderate' status.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent.	Orthophosphate concentrations were inconsistent with 'Good' WFD status (0.036 mg/l) throughout the monitoring period with all results falling below this standard. Some seasonality was apparent with notable peaks in June/ August.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	Moderate
WwTW presenting increased risk	Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ewden WwTW.	Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia, suffocation from oxygen sags) downstream of Ewden WwTW and continued risk from Cheesebottom WwTW (which discharges in Don 2)	None
Intermittent pressures presenting risk	None	None	None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with reduction in dilution of WwTW	Moderate risk from drought options associated with reduction in dilution of WwTW	Moderate risk from drought options

### A3.7.6 Summary of potential changes in the physical environment as a result of drought options

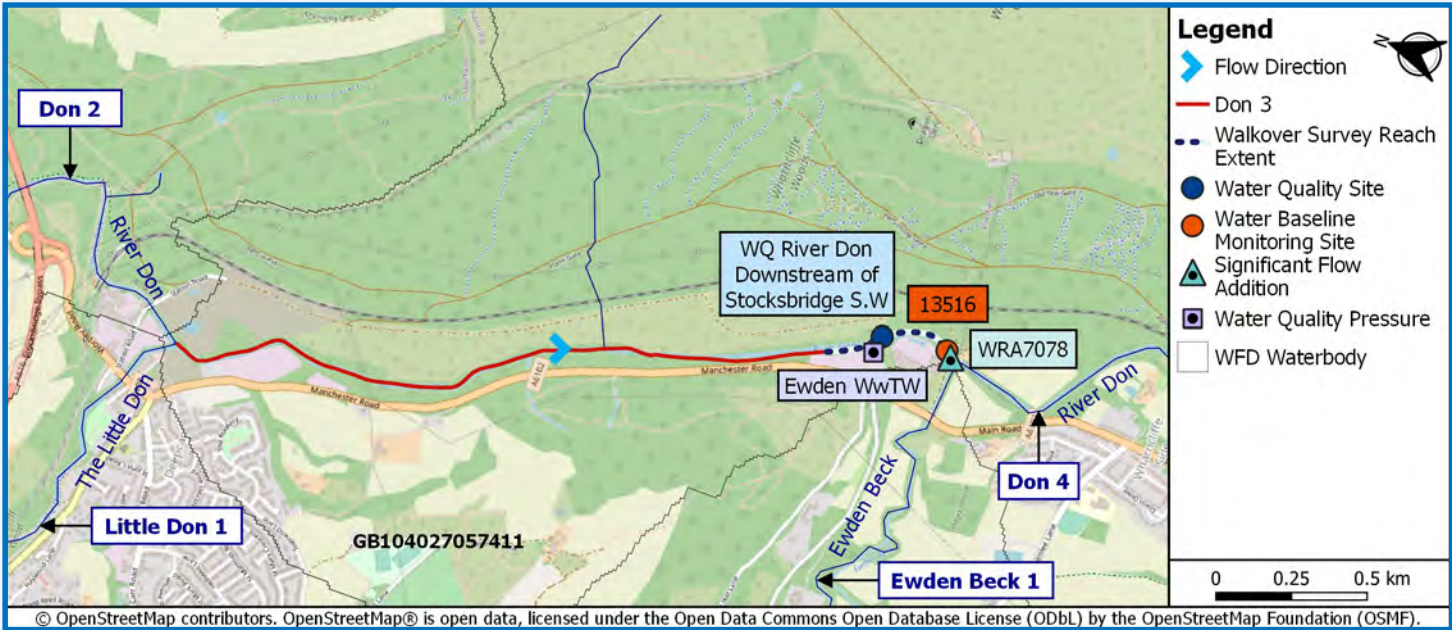
An overall summary of potential changes in the physical environment of Don 3 as a result of drought options is presented in **Table A4.6**.

**Table A4.6 Summary of potential changes in the physical environment of Don 3 as a result of drought options**

<b>Physical environment aspect reviewed</b>	<b>Assessment of risk from implementation of drought options</b>
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 55% in river flows for periods of time during the duration of the drought option, throughout the reach, at any time of year that drought options implemented</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Don 3.</li> </ul>
<b>River habitats</b> <i>Minor impacts</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will present minor change to the current low energy system</li> <li>• Potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained.</li> <li>• Minor risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia, suffocation from oxygen sags) downstream of Ewden WwTW and continued risk to dissolved oxygen from Cheesebottom WwTW (which discharges in Don 2).</li> <li>• No significant intermittent pressures presenting risk.</li> <li>• Reported water quality is consistent with predominantly 'Good' status and with no greater than moderate flow sensitivity for dissolved oxygen and ammonia. SRP quality is inconsistent with 'Good' status with moderate flow sensitivity.</li> </ul>



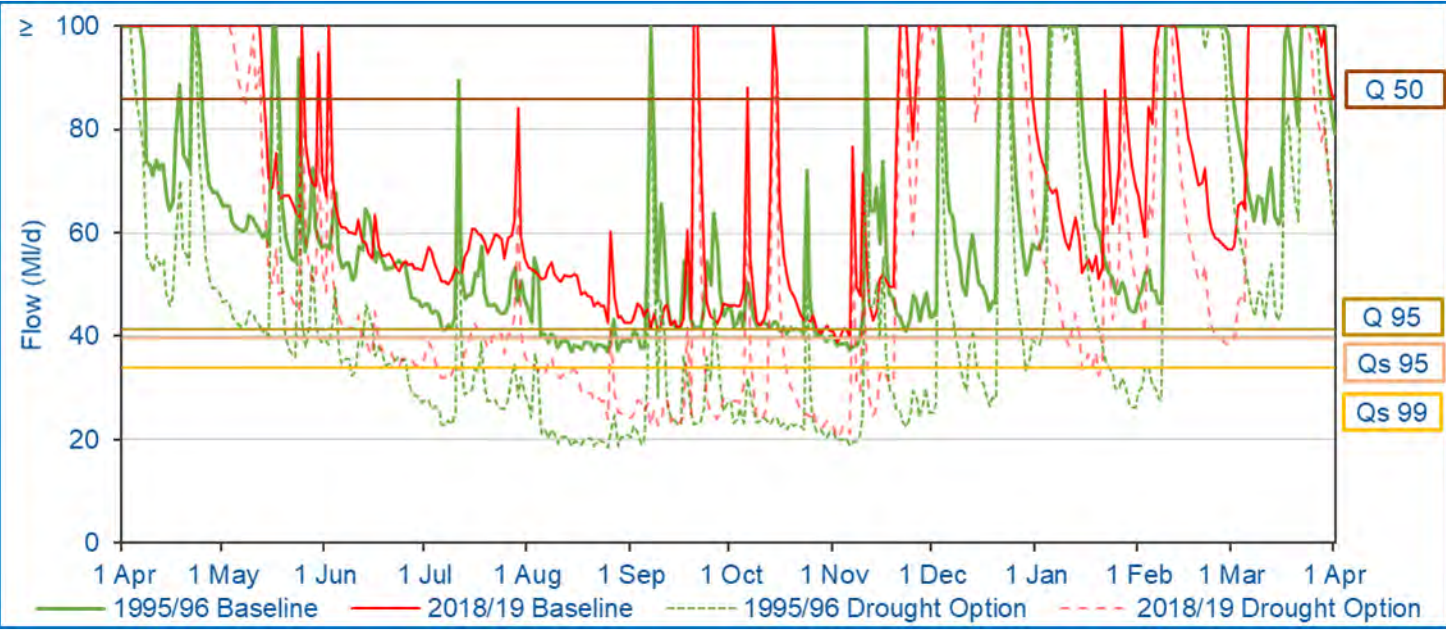
Reach Setting



**Reach Setting Information:**  
The superficial geology is very limited with no extensive deposits identified. Soil types along the reach are composed predominantly of very acid, loamy upland soils (with a peaty surface), with a small area of freely draining, slightly acid loamy soils at the end of the reach. Urbanisation is low limited along the reach with the outskirts of Stocksbridge located near the start of the reach.

	Supplementary Information
Catchment Area at Assessment Point	122.1km <sup>2</sup>
Mean Slope Gradient	0.54°
Length of Reach	2.7km
Additional Catchment Area	4.5km <sup>2</sup>
Upstream Reach	Don 2/ Little Don 1
Downstream Reach	Don 4

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact
Q <sub>s</sub> 95	39.57	20.98	47	Summer Major
Q <sub>s</sub> 99	33.78	15.19	55	
Q95	41.35	22.76	45	Winter Major
Q50	86.00	67.41	22	

Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
Ewden Water Treatment Works WRA7078	50	Discharge
Ewden WwTW EPRMB3797WP	3.482	Discharge

River Habitats



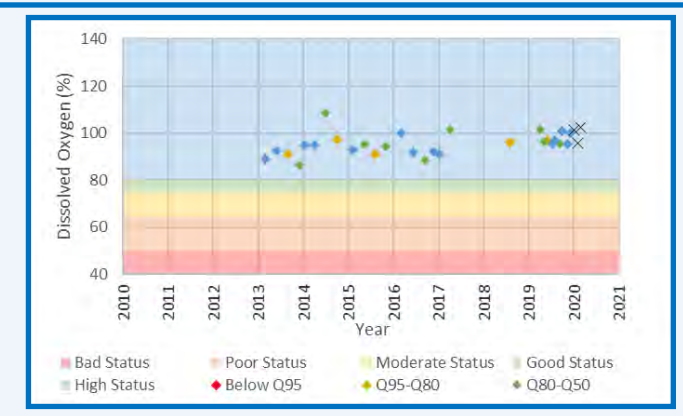
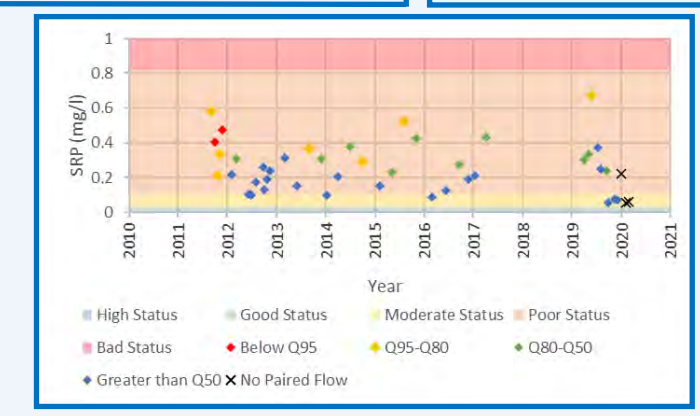
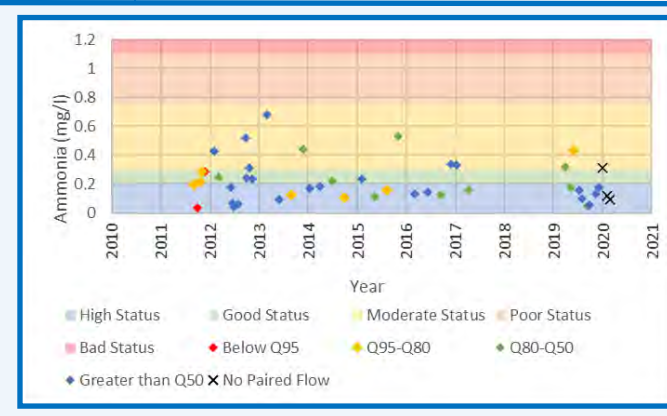
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Ewden WwTW EPRMB3797WP	3.482 MI/d DWF 86.9 l/s FFT 25 mg/l BOD 95 <sup>th</sup> percentile 4.6 mg/l Ammonia 95 <sup>th</sup> percentile
Cheesebottom WwTW 2556 (continued risk from discharge in Don 2)	4.5MI/d DWF 10mg/l Ammonia (N) 20 BOD ATU

In the River Don the Downstream of Stocksbridge S.W (NE-49301683) the average pH between 2010-2020 was 7.7 with a maximum temperature of 17.7°C



**Figure A4.3**  
**Don 3:**  
**Physical Environment Information**





## A3.8 Don 4

### A3.8.1 Reach introduction

Don 4 is potentially impacted by Scout Dyke Reservoir, Winscar/Windleden Lower Reservoirs, Underbank Reservoir and More Hall Reservoir drought permits. A summary of physical environment information for this reach is provided in **Figure A4.4**. The reach includes part of the following river waterbody:

- River Don from the Little Don to River Loxley confluence (GB104027057411).

### A3.8.2 Reach setting

Don 4, located on main EAR **Figure 4.1**, comprises a 9.6 km stretch of the River Don from the confluence with Ewden Beck to the confluence with the River Loxley. (**Table A2.1**). Don 5 (see **Section A4.6** below) is downstream.

### A3.8.3 River flow regime

As outlined under the assessment for the “Don 2” reach, flows at the upstream end of the “Don 4” reach have been estimated using the Gustard flow transposition method, based on catchment parameter ratios and adjusted gauged flow data from an available downstream gauge at Sheffield Hadfields. Measured outflows from Scout Dyke Reservoir, Underbank Reservoir and More Hall Reservoir, measured daily flows at the Dunford Bridge maintained flow location and the dry weather flows (DWF) from Cheesebottom and Ewden WwTWs were added back on to the estimated (transposed) data series, to provide an estimated flow record for the River Don just downstream of the Ewden Beck confluence. Again as outlined previously, the estimated flow record for the River Don downstream of the Ewden Beck confluence was adjusted to a minimum of 36.89 MI/d, to remove the influence of historic drought permit events (noted in 1996) on the baseline flow record.

The River Don downstream of the Ewden Beck confluence is influenced by the Scout Dyke, Underbank, More Hall and Winscar/Windleden Lower reservoirs drought options. The maximum combined flow reduction from these four options is 24.69 MI/d, at times when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks. The combined drought options therefore represent reductions of up to 46% and 53% in the summer Q95 and Q99 flow statistics respectively, and would therefore be assessed as a **major** hydrological impact in the summer period. During the winter period, the combined flow reduction represents reduction of up to 45% and 23% in the year round Q95 and Q50 flow statistics, which is assessed as a **major** hydrological impact in winter also.

The hydrological impact of the drought option on Don 4 is therefore assessed as **major** for both the summer/ autumn period and any winter refill period while drought options remain in place.

There are no significant flow pressures, either abstractions or discharges, influencing flow in Don 4. There are no flow depleted reaches within Don 4. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.8.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 5 September 2018 at a reservoir outflow of 63.5MI/d.

Don 4 is a relatively straight reach with some fairly sinuous sections in the middle of the reach. The reach falls ~50m over 9.6km, a slope of 0.3°. Riparian tree cover is variable along the length of the reach, with the channel surrounded by several woods in the upper and mid reaches, notably Wharncliffe Wood and Beeley Wood. Channel width varies between 12-15m wide throughout the reach. Where riparian tree cover is limited several in channel features are visible, most notably side bars towards the mid sections of the reach as well as several areas of boulders protruding through the channel surface, notably in the upper reaches. The single RHS site (33038) records natural berms at 5 spot sites with a

point bar and vegetated side bars also recorded, one unvegetated bar was recorded in the latest survey; indicating the channel is dynamic. Data from the RHS sites indicates that the river bed substrate is composed predominantly of cobble (50%) and bedrock (30%) at some sites. The bed was not visible at the remaining 20% of the spot sites measured. The presence of exposed bedrock and exposed boulders has been noted as occurring throughout the reach. Where visible on aerial imagery, the channel surface indicates that smooth flow predominates with some areas of broken flow. Flow at the RHS site was recorded as smooth (40% of spot sites and extensive throughout the reach) and unbroken standing wave (30%) with the remaining flow recorded as rippled and broken standing wave. Data for the RHS site identifies the banks are dominated by shallow angles (<45°); however 33% of the banks are steep (>45°). The RHS survey identified the left banks are predominantly composed of earth (with some brick or laid stone) and the right banks were composed of brick or laid stone with minor contributions of earth. Left bank face vegetation was recorded as mainly complex, while the right face was complex (50%) and bare (50%). Bank top vegetation was recorded as mostly bare, with some uniform and complex vegetation. The left and right banks at the RHS site were noted as being extensively reinforced or resectioned. The RHS also noted the presence of natural berms (suggesting readjustment of channel form in response to channel changes). Surrounding land use is generally deciduous woodland for the first 5.3km from the start of the reach, however there is some suburban/urban development around 3.0 - 4.5km (Oughtibridge). Thereafter land-use is predominantly suburban/urban development with scattered parkland and gardens and improved grassland as the reach flows through Sheffield.

Don 4 supports both high and low energy environments, with low energy flows dominating the flow structure. Spawning habitat is considered unlikely to occur within the reach, as cobble and boulder substrates dominate the watercourse and only one riffle was identified within the RHS reach. However, the reduced flows and presence of some features to provide refuge indicate juveniles may utilise the habitat. The variable presence of trees in the riparian habitat indicates some input of allochthonous energy into the watercourse. The reinforced banks may provide additional habitat opportunities for white-clawed crayfish, with suitable substrate also present. Movement/migration of fish and sediments in the reach are likely to be significantly influenced by the presence of weirs. Wharncliffe Side Weir and Niagara Weir include fish passes.

The drought options reduction in flow could lead to several potential impacts within Don 4

- Major of changes in the energy of the system associated with up to 53% reduction in flow for 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Potentially moderate risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant habitat types.
- Moderate risk to longitudinal connectivity from nine noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Moderate 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Don 4 from drought options is therefore assessed as moderate.

#### A3.8.5 River water quality

For this assessment the first sample site in the reach River Don at Oughtibridge (NE-49301628) has been used. The average pH between 2010-2020 was 7.7 with a maximum temperature of 17.7°C for the same period. Water quality modelling identifies one continuous discharge, YWSL Wharncliffe Side

WwTW, presenting a significant risk to dissolved oxygen in Don 4 and the continuation of the significant risk to dissolved oxygen from Ewden WwTW discharging in Don 3. There is one frequently spilling CSO potentially presenting an environmental risk in the reach. A summary description of the potential risks to water quality in Don 4 as a result of drought options is presented in **Table A4.7**.

**Table A4.7 Potential risks to water quality in Don 4 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were predominantly consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period with 7% of samples achieving 'Moderate' status. Some seasonality was apparent.	Dissolved oxygen saturation (%) values predominantly consistent with 'Good' WFD status (75%) throughout the monitoring period with one exception on 03.09.2013 achieving 'Poor' status. Some seasonality was apparent.	Orthophosphate concentrations were inconsistent with 'Good' WFD status (0.046 mg/l) throughout the monitoring period with all samples below this status. Some seasonality was apparent with notable peaks in June/August.
Flow sensitivity (diffuse pollution)	None apparent	Weak	Strong
WwTW presenting increased risk	None	Risk of medium-term chronic, regular, temporary water quality pressures (suffocation from oxygen sags) downstream of Wharnccliffe Side WwTW and continued risk from Ewden WwTW (which discharges in Don 3)	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 one listed CSO during rainfall events		None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with CSO discharge	Moderate risk from drought options associated with CSO discharge and reduction in dilution of WwTW	Moderate risk from drought options associated with change in dilution of diffuse pollution pressures.

### A3.8.6 Summary of potential changes in the physical environment as a result of drought options

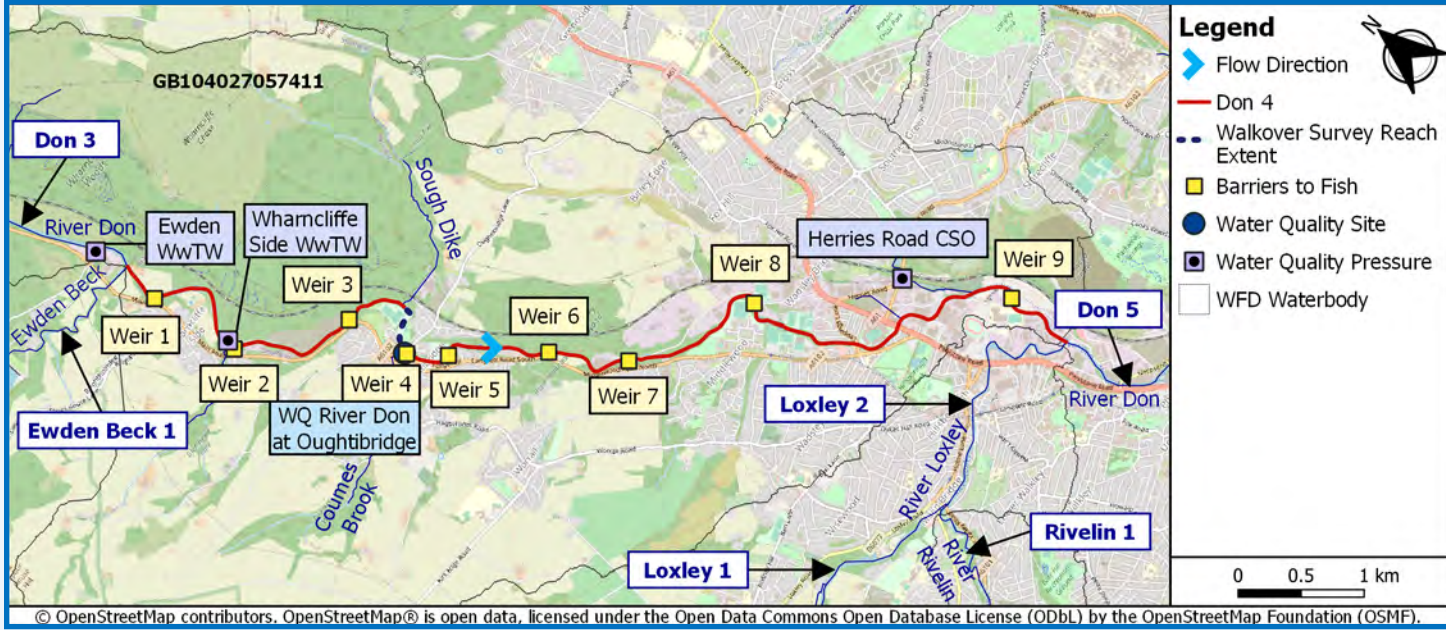
An overall summary of potential changes in the physical environment of Don 4 as a result of drought options is presented in **Table A4.8**.

**Table A4.8 Summary of potential changes in the physical environment of Don 4 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 53% in river flows for periods of time during the duration of the drought option, throughout the reach, at any time of year that drought options implemented</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Don 4.</li> </ul>
<b>River habitats</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• 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.</li> <li>• Moderate risk to longitudinal connectivity</li> <li>• Moderate risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of medium-term chronic, regular, temporary water quality pressures (suffocation from oxygen sags) downstream of Wharnccliffe Side WwTW and continued risk from Ewden WwTW (which discharges in Don 3).</li> <li>• Risk of short term acute, infrequent, temporary water quality pressures locally downstream of one listed CSO during rainfall events.</li> <li>• Reported ammonia and DO % water quality is predominantly consistent with 'Good' status and no more than weak flow sensitivity for dissolved oxygen and ammonia. SRP quality is inconsistent with 'Good' status with strong flow sensitivity.</li> </ul>



Reach Setting

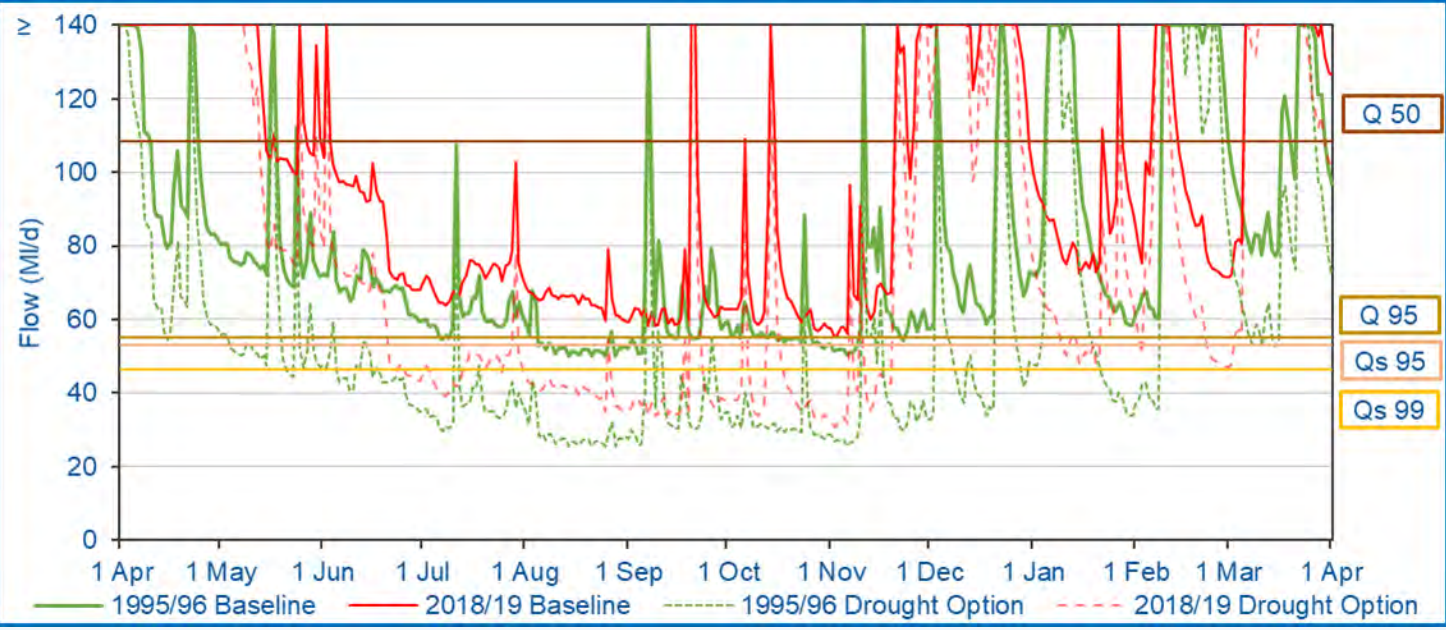


Reach Setting Information:

The superficial geology is composed of alluvium along the channel, becoming noticeably wider in extent towards the end of the reach. In the upper sections of the reach soils are composed of very acid, loamy upland soils, changing to freely draining, slightly acid loamy soils in the mid sections of the reach and to loamy and clayey floodplain soils in the lower sections of the reach. Urbanisation increases as the reach flows through Sheffield.

	Supplementary Information
Catchment Area at Assessment Point	151.1km <sup>2</sup>
Mean Slope Gradient	0.3°
Length of Reach	9.6km
Additional Catchment Area	29.9km <sup>2</sup>
Upstream Reach	Ewden Beck 1/ Don 3
Downstream Reach	Don 5

River Flow Regime



	Reference Conditions (Ml/d)	Drought Plan Conditions (Ml/d)	% Reduction	Impact
Q <sub>s</sub> 95	53.14	28.45	46	Summer Major
Q <sub>s</sub> 99	46.54	21.85	53	
Q95	55.05	30.36	45	Winter Major
Q50	108.53	83.84	23	

Significant Flow Additions/Reductions	Flow Rate (Ml/d)	Abstraction / Discharge
Ewden Water Treatment Works WRA7078	50	Discharge

River Habitats



River Water Quality

Significant Water Quality Pressures	Permit Conditions
Herries Road/ No. 2 CSO WRA8261 1	Intermittent Discharge
Wharncliffe Side WWTW E704(SS)	0.3Ml/d DWF 15 mg/l Ammonia (N) 40 BOD ATU
Ewden WWTW EPRMB3797WP (continued risk from discharge in Don 3)	3.482 Ml/d DWF 86.9 l/s FFT 25 mg/l BOD 95 <sup>th</sup> percentile

In the River Don at Oughtibridge (NE-49301628) the average pH between 2010-2020 was 7.7 with a maximum temperature of 17.7°C



YorkshireWater

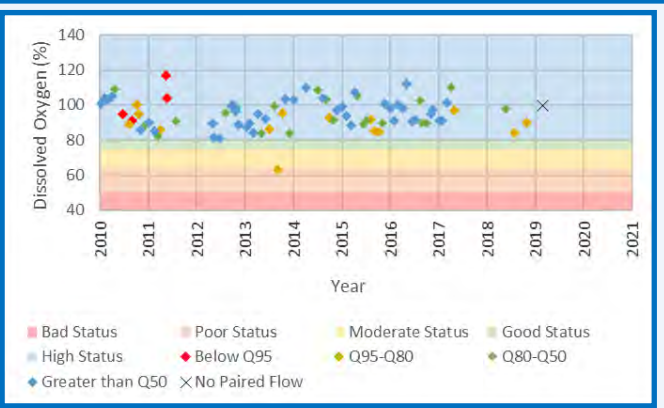
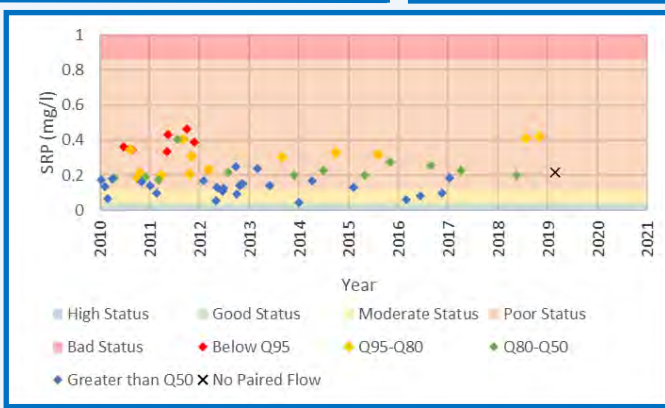
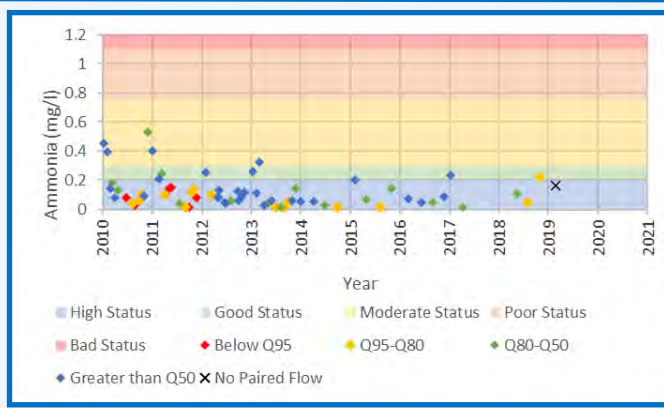


RICARDO

Figure A4.4

Don 4

Physical Environment Information





## A3.9 Don 5

### A3.9.1 Reach introduction

Don 5 is potentially impacted by Scout Dyke Reservoir, Winscar/Windleden Lower Reservoirs, Underbank Reservoir, More Hall Reservoir, Damflask Reservoir and Rivelin Lower Reservoir drought permits. A summary of physical environment information for this reach is provided in **Figure A4.5**. The reach includes part of the following river waterbodies:

- River Don from River Loxley conf to River Don Works (GB104027057412);
- River Don from River Don Works to River Rother (GB104027057413)

### A3.9.2 Reach setting

Don 5, located on main EAR **Figure 4.1**, comprises a 13.7km stretch of the River Don from the confluence with the River Loxley to the confluence with the River Rother (**Table A2.1**).

### A3.9.3 River flow regime

As outlined under the assessment for the Don 2 reach, flows at the upstream end of the Don 5 reach have been estimated using the Gustard flow transposition method, based on catchment parameter ratios and adjusted gauged flow data from the gauge at Sheffield Hadfields which is further downstream within this reach. Measured outflows from Scout Dyke Reservoir, Underbank Reservoir, More Hall Reservoir, Damflask Reservoir and Rivelin Reservoir, measured daily flows at the Dunford Bridge maintained flow location and the dry weather flows (DWF) from Cheesebottom and Ewden WwTW were added back on to the estimated (transposed) data series, to provide an estimated flow record for the River Don just downstream of the River Loxley confluence. Again as outlined previously, the estimated flow record for the River Don downstream of the River Loxley confluence was adjusted to a minimum of 65.19 MI/d, to remove the influence of historic drought permit events (particularly noted in 1996) on the baseline flow record.

The River Don downstream of the River Loxley confluence is influenced by the Winscar/Windleden Lower, Scout Dyke, Underbank, More Hall, Damflask and Rivelin reservoirs drought options. The maximum combined flow reduction from these six options is 43.65 MI/d, at times when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks. The combined drought options therefore represent reductions of up to 50% and 57% in the summer Q95 and Q99 flow statistics respectively, and would therefore be assessed as a **major** hydrological impact in the summer period. During the winter period, the combined flow reduction represents reductions of up to 48% and 25% in the year round Q95 and Q50 flow statistics, which is assessed as a **major** hydrological impact in winter also.

Further down the reach, flows are measured at the Sheffield Hadfields gauge at grid reference SK3893190954. The summer Q95 and Q99 flow statistics, after adjustment for historic drought permit and historic compensation flow regimes, are 94.2 MI/d and 78.2 MI/d respectively, so that the combined flow reduction of 43.63 MI/d represents percentage reductions of 46% and 56% respectively in these flow statistics at the gauged location, and would therefore still be assessed as a **major** hydrological impact during the summer months of April to September inclusive. However it should be noted that the historic gauged record reflects periods when reservoir outflows have been reduced due to previous drought permit implementation (during 1996). Similarly the year round Q95 and Q50 statistics for the Sheffield Hadfields record, after adjustment for historic drought permit and historic compensation flow regimes, are 99.4 MI/d and 235.9 MI/d respectively, so that the 43.63 MI/d flow reduction equates to percentage reductions of 44% and 18% in these flow statistics and would therefore also be assessed as a **major** hydrological impact during the winter months of October to March inclusive, but again noting that the flow statistics are influenced by the effect of previous drought permit flow reductions.

The hydrological impact of the drought option on Don 5 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are three significant flow pressures influencing flow in Don 5, two non-consumptive abstraction licences as described in **Section A4.6.3.1**, and a discharge licence leading to a significant flow addition

from Blackburn Meadows WwTW, with a dry weather flow of 158.00 MI/d. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

#### A3.9.3.1 Flow depleted reaches

There are two separate licensed non-consumptive abstractions depleting flow in Don 5 for industrial services.

One abstraction is for a non-consumptive abstraction for metal production, with a peak daily licensed abstraction rate of 9.09MI/d without a hands-off-flow condition ('River Don – Ickles – Rotherham') with potential flow impacts. An abstraction at that rate could reduce flows in the depleted reach, during environmental drought, in combination with drought options by a further 10.5%.

The other abstraction is for a non-consumptive abstraction for metal production with a peak daily licensed abstraction rate of 26.50MI/d, without a hands-off-flow condition ('River Don Forgemasters Steel') with potential flow impacts. An abstraction at that rate could reduce flows in the depleted reach, during environmental drought, in combination with drought options by a further 30.6%.

A walkover reach covering the section of the river has been included in the schedule of monitoring for Don 5 (see main EAR Section 6). YWSL will liaise with the abstractors in advance of permit implementation to determine appropriate mitigation measures.

#### A3.9.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 4 September 2018 at a local flow of 109.2MI/d.

Don 5 is a fairly sinuous reach which falls ~30m over 13.7km, a slope of 0.1°. Riparian tree cover is semi-continuous along the reach. The channel measured between 23-29m, this width apparently reflecting the confinement of the channel with reinforced banks as it flows through Sheffield. Approximately 3 islands and 2 large berms were noted in the channel. Most islands were downstream of weirs or bridges, the largest situated at ~1.6km downstream. The flow surface of the channel is predominantly smooth with some areas of broken flow. Approximately two areas of broken flow in the upper section of the reach were apparently related to riffles. Aerial imagery shows that most channel banks are reinforced and vertical. Surrounding land use is dominantly suburban/urban with a small area of waste ground towards the top of the reach on the left bank.

Don 5 is likely to be dominated by low energy environments, indicated by the shallow slope of the watercourse, however high energy environments are also likely to be present, with erosional and depositional features identified in the watercourse. The potential presence of riffles within the reach indicates some potential for spawning habitat to be present, with lower energy flows likely to support juvenile fish. The semi-continuous presence of trees in the riparian habitat will provide some allochthonous energy into the watercourse and provide cover/refuge for fish and white-clawed crayfish. Movement/migration of fish and sediments are potentially limited in the reach by the presence of weirs. Ten weirs in this reach have fish passes, including Jordans Dam, Hadfields, Sandersons and Ickles

The drought options reduction in flow could lead to several potential impacts within Don 5:

- Major risk of changes in the energy of the system associated with up to 57% reduction in flow for periods of time during the duration of drought option.
- Potentially minor risk of reduction in wetted aquatic habitat (wetted width reduction) with increasing exposure of channel margins and the margins of within-channel features (such as channel bars and islands) for periods of time during the duration of drought option.
- Potentially minor risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant low energy habitat types.
- Minor risk to longitudinal connectivity from ten in-channel structures for periods of time during the duration of drought option.
- 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 land-based sources will be largely



dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Don 5 from drought options is therefore assessed as minor.

### A3.9.5 River water quality

For this assessment the first sample site in the reach Don: Little Don to Loxley - Ad Hoc (NE-49302465) has been used. The average pH between 2010-2020 was 7.5 with a maximum temperature of 22.0°C for the same period. Water quality modelling identifies one continuous discharge, YWSL Blackburn Meadows WwTW, presenting a significant risk to total ammonia in Don 5. There is one frequently spilling CSO potentially presenting an environmental risk in the reach. A summary description of the potential risks to water quality in Don 5 as a result of drought options is presented in **Table A4.9**.

**Table A4.9 Potential risks to water quality in Don 5 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were predominantly consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period with 7% of samples achieving 'Moderate' status. Some seasonality was apparent.	Dissolved oxygen saturation (%) values predominantly consistent with 'Good' WFD status (75%) throughout the monitoring period with one exception on 03.09.2013 achieving 'Poor' status. Some seasonality was apparent.	Orthophosphate concentrations were inconsistent with 'Good' WFD status (0.05 mg/l) throughout the monitoring period with all but one sample below this status. Some seasonality was apparent with notable peaks in June/ August.
Flow sensitivity (diffuse pollution)	None apparent	Weak	Strong
WwTW presenting increased risk	Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Blackburn Meadows 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 one listed CSO 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	Major risk from drought options associated with change in dilution of diffuse pollution pressures.

### A3.9.6 Summary of potential changes in the physical environment as a result of drought options

An overall summary of potential changes in the physical environment of Don 5 as a result of drought options is presented in **Table A4.10**.

**Table A4.10 Summary of potential changes in the physical environment of Don 5 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 57% in river flows for periods of time during the duration of the drought option, throughout the reach, at any time of year that drought options implemented</li> </ul>
<b>Flow depleted reaches</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• One flow depleted reach with potential for periods of time with flow reduced by 10.5% without mitigation.</li> <li>• One flow depleted reach with potential for periods of time with flow reduced by 30.6% without mitigation.</li> </ul>
<b>River habitats</b> <i>Minor impacts</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will present minor change to the current low energy system</li> <li>• Potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained.</li> <li>• Minor risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Blackburn Meadows WwTW.</li> <li>• Risk of short term acute, infrequent, temporary water quality pressures locally downstream of one listed CSO during rainfall events.</li> <li>• Reported ammonia and DO % water quality is predominantly consistent with 'Good' status and no more than weak flow sensitivity for dissolved oxygen and ammonia. SRP quality is inconsistent with 'Good' status with strong flow sensitivity.</li> </ul>



Reach Setting

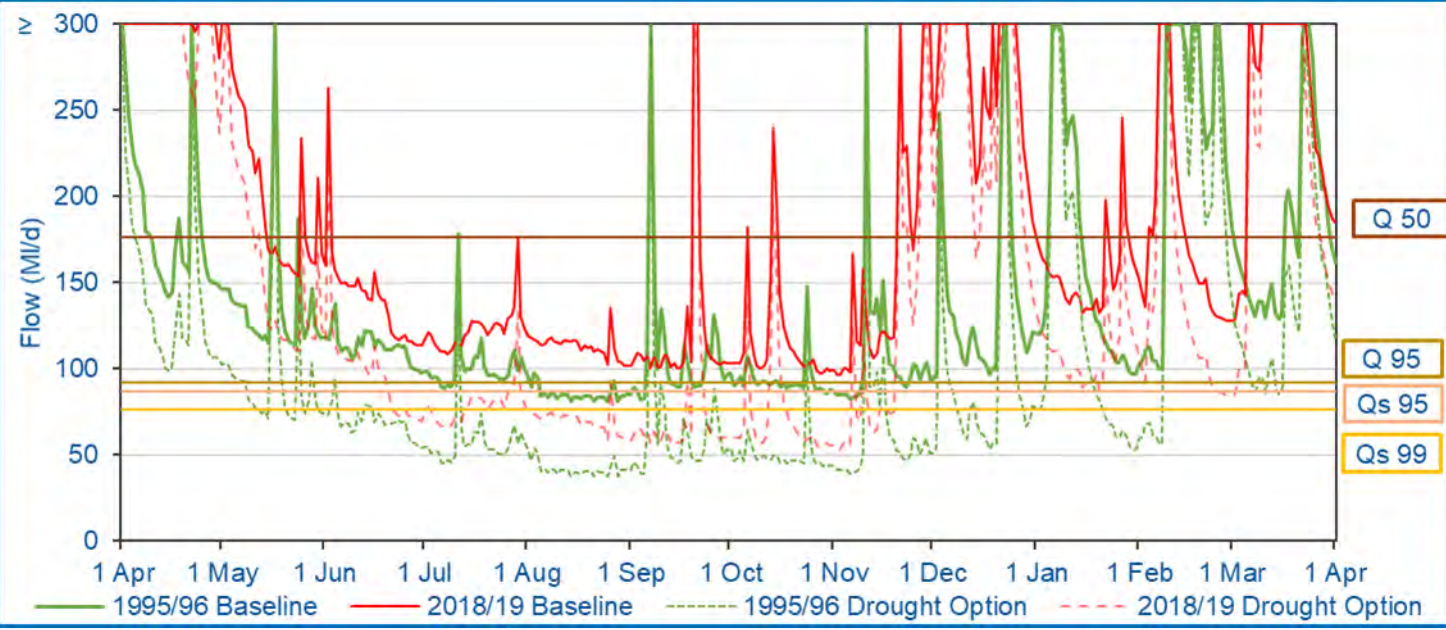


Reach Setting Information:

The superficial geology is composed of alluvium along the channel. In the upper sections of the reach soils are composed of loamy and clayey floodplain soils. This reach is heavily urbanised as the reach passes through the city of Sheffield.

	Supplementary Information
Catchment Area at Assessment Point	269.03km <sup>2</sup>
Mean Slope Gradient	0.13°
Length of Reach	13.7km
Additional Catchment Area	155.7
Upstream Reach	Loxley 2/ Don 4
Downstream Reach	N/A

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact	Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
-					Shepcote Lane Surface Water Sewer WRA7052	8.4	Discharge
Qs95	87.07	43.42	50	Summer Major	RIVER DON - ICKLES - ROTHERHAM 2/27/06/006	9.093	Abstraction
Qs99	76.05	32.40	57		RIVER DON Forgemasters Steel 2/27/06/026	26.5	Abstraction
Q95	91.74	48.09	48	Winter Major			
Q50	176.06	132.41	25				

River Habitats



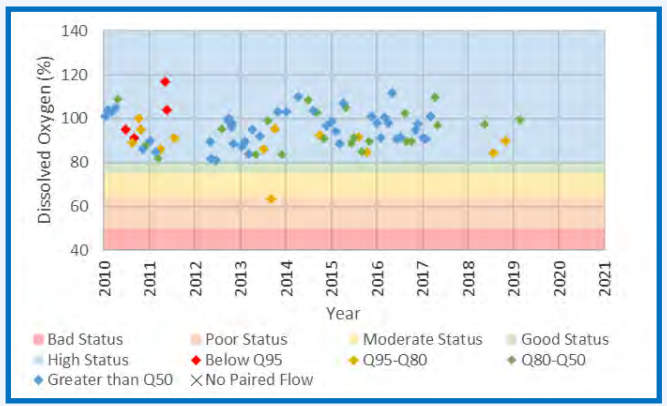
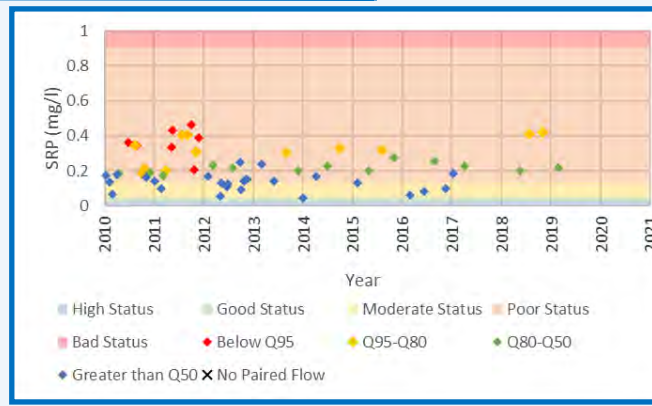
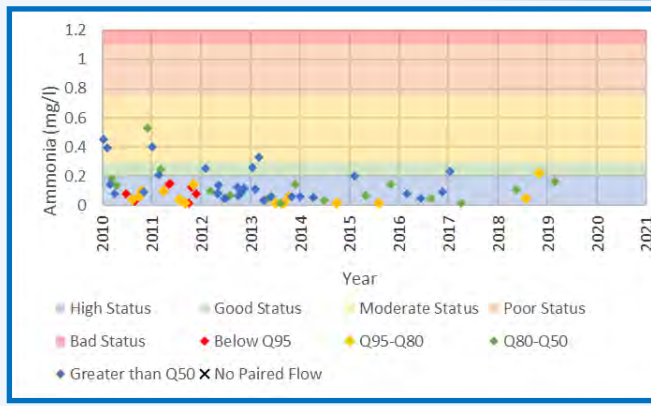
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Vickers Road/ CSO WRA8113 A1	Intermittent Discharge
Blackburn Meadows STW E25	158MI/d DWF 12 mg/l Ammonia (N) 30 BOD ATU

In the River Don at 02: Little Don to Loxley - Ad Hoc (NE-49302465) the average pH between 2010-2020 was 7.5 with a maximum temperature of 22°C



Figure A4.5  
Don 5:  
Physical Environment Information





## A3.10 Scout Dyke 1

### A3.10.1 Reach introduction

Scout Dyke 1 is potentially impacted by a Scout Dyke Reservoir drought permit. A summary of physical environment information for this reach is provided in **Figure A4.6**. The reach includes part of the following river waterbody:

- Scout Dyke from Source to River Don (GB104027057530).

### A3.10.2 Reach setting

Scout Dyke 1, located on main EAR **Figure 4.1**, comprises a 1.8km stretch of Scout Dyke from the outflow of Scout Dyke Reservoir to the confluence with the River Don (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 0.97km<sup>2</sup> along the length of the reach. Don 2 (see **Section A4.3** above) is downstream.

### A3.10.3 River flow regime

During the implementation of this drought option, it is likely that the level in Scout Dyke Reservoir will be below top water level and therefore the compensation flow from the reservoir will be the only inflow at the top of this reach. A reduction of 1.8 MI/d (the maximum reduction under this drought option, when reservoir level is below the control line and when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However, the flow reduction at the top of the reach will remain at 67% until the reservoir reaches top water level and begins to spill again.

The hydrological impact of the drought option of Scout Dyke 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are no significant flow pressures, either abstractions or discharges, influencing flow in Scout Dyke 1. There are no flow depleted reaches within Scout Dyke 1. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.10.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 22 August 2018 at an estimated river flow at the flow assessment point for the reach of 2.7MI/d.

Scout Dyke 1 is a fairly straight reach which falls ~16m over 1.8km, a slope of 0.5°. The channel is heavily shaded with extensive deciduous riparian tree cover along most of its length. The RHS site identifies the presence of one river terrace. The reach flows through two pond systems ~0.3km and ~0.6km downstream of the reservoir outflow. The latter pond is an ornamental water feature, currently managed as a coarse fishery. Where the channel is visible through tree cover, the channel is between ~2m wide in the upper sections, increasing to ~6m wide in the lower reaches next to the confluence with the River Don. At the RHS survey site 39730, the river was recorded as 6m wide. The RHS has indicated approximately 2 side bars, and 4 vegetated point bars, no depositional features were recorded at the RHS survey site. Several stable cliffs were identified, confirmed by the RHS survey site 39730, where 20% of the left bank was recorded as stable cliff. Data from the RHS site survey 335 ~indicates that the river bed at the survey site was predominantly composed of cobble (40%) and pebble (30%). The survey 335 also identified that silt, boulder and bedrock made up a total of 30% of the RHS site. at RHS survey site 39730, a range of bed substrate was recorded including: boulder (20%); cobble (20%), gravel / pebble (40%), bedrock (10%) and artificial material (10%). Further data is available due to the YWSL water baseline monitoring site, where cobble dominated (40%). However, areas of boulder

(35%), pebble/gravel (20%), sand (5%) and silt (2%) were also observed. The presence of exposed bedrock and exposed boulders have been noted by both RHS surveys in this reach. RHS data (Survey ID 335) show that the majority of the flow was smooth, however 14 riffles and 8 pools were counted during the surveys, indicating that other flow types are likely to be present. At RHS Survey site 39730, smooth flow dominated (60%), however areas of rippled flow were also observed (40%); 10 pools and 9 riffles were recorded within the reach. Data from the YWSL water baseline monitoring site also identified flow variation. 50% of flow was riffle, however areas of smooth flow (35%) and backwaters (15%) were also observed. Data for RHS site 335 identified that both the left and right banks are predominantly composed of earth (with brick or laid stone forming 20% of the left and 10% of the right bank) with mostly simple or complex vegetated faces (simple dominant on the left bank, complex on the right bank). At RHS Survey ID 39730, earth dominated, however areas of brick were also observed. There was a mixture of complex and no vegetation on the left bank top and generally no vegetation on the right banktop. The left and right banks at both RHS sites were noted as extensively steep ( $>45^\circ$ ), with the presence of undercut, gently sloping and composite banks throughout the site. Whole bank reinforcement, resectioning and poaching were identified on both banksides throughout the RHS site. Surrounding land use is generally rough pasture and improved grassland in the upper and mid sections of the reach with suburban/development, parkland and gardens and open water towards the end of the reach.

Scout Dyke 1 supports a mixture of high and low energy environments, indicated by the moderate steepness in the valley and the presence of both erosional and depositional features. The presence of a significant number of pools and riffles and favourable substrates identified in the RHS reach suggests that the reach is likely to be an important habitat for spawning and juvenile nursery for fish species requiring clean and unconsolidated gravels, with sufficient pools and features to support resting adults. The extensive coverage of deciduous trees in the riparian habitat will ensure a high input of allochthonous energy into the stream and provide further cover opportunities for fish. The reinforced banks present may provide additional habitat opportunities for white-clawed crayfish, with suitable substrate present.

The drought options reduction in flow could lead to several potential impacts within Scout Dyke 1:

- Major risk of changes in the energy of the system associated with up to 67% reduction in flow for periods of time during the duration of drought option.
- Potentially minor risk of reduction in wetted aquatic habitat (wetted width reduction) with increasing exposure of channel margins and the margins of within-channel features (such as channel bars and islands) for periods of time during the duration of drought option.
- Potentially minor risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant low energy habitat types.
- Minor risk to longitudinal connectivity from four in-channel structures for periods of time during the duration of drought option.
- 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Scout Dyke 1 from drought options is therefore assessed as minor.

### A3.10.5 River water quality

In Scout Dyke 1 the Scout Dike at Don Confluence (A628 Bridge) (NE-49302111) site has been used due to its superior data quality. The average pH between 2010-2020 was 7.6 with a maximum temperature of  $17.7^\circ\text{C}$  for the same period. Water quality modelling identifies one continuous discharge, YWSL Scout Dyke WwTW, presenting a significant risk to total ammonia in Scout Dyke 1. There is one frequently spilling CSO potential presenting an environmental risk in the reach. A summary description

of the potential risks to water quality in Scout Dyke 1 as a result of drought options is presented in **Table A4.11**.

**Table A4.11 Potential risks to water quality in Scout Dyke 1 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were predominantly consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period with four samples exceeding this status. Some seasonality was apparent with concentrations rising in spring and falling in autumn.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were predominantly noncompliant with 'Good' WFD status (0.028 mg/l) throughout the monitoring period with 44% of samples achieving moderate status (0.088 mg/l). Some seasonality was apparent with notable peaks in June/ August.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	Strong
WwTW presenting increased risk	Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Scout Dyke WwTW.	None	None
Intermittent pressures presenting risk	None	None	None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with reduction in dilution of WwTW	Minor risk from drought options	Moderate risk from drought options

### A3.10.6 Summary of potential changes in the physical environment as a result of drought options

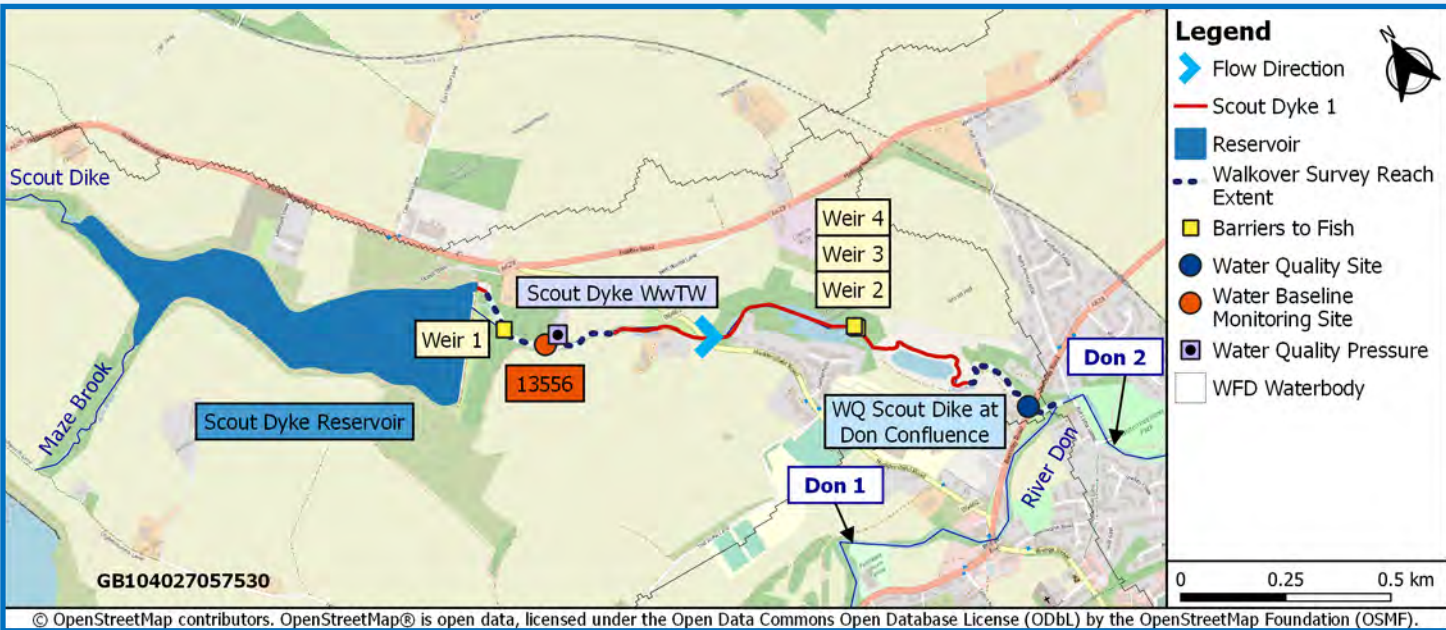
An overall summary of potential changes in the physical environment of Scout Dyke 1 as a result of drought options is presented in **Table A4.12**.

**Table A4.12 Summary of potential changes in the physical environment of Scout Dyke 1 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 67% in river flows at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Scout Dyke 1.</li> </ul>
<b>River habitats</b> <i>Minor impacts</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will present minor change to the current low energy system</li> <li>• Potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained.</li> <li>• Minor risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Scout Dike WwTW</li> <li>• No significant intermittent pressures presenting risk.</li> <li>• Reported ammonia and DO % water quality is predominantly consistent with 'Good' status and no more than weak flow sensitivity. SRP is inconsistent in attaining 'Good' status with a low flow sensitivity.</li> </ul>



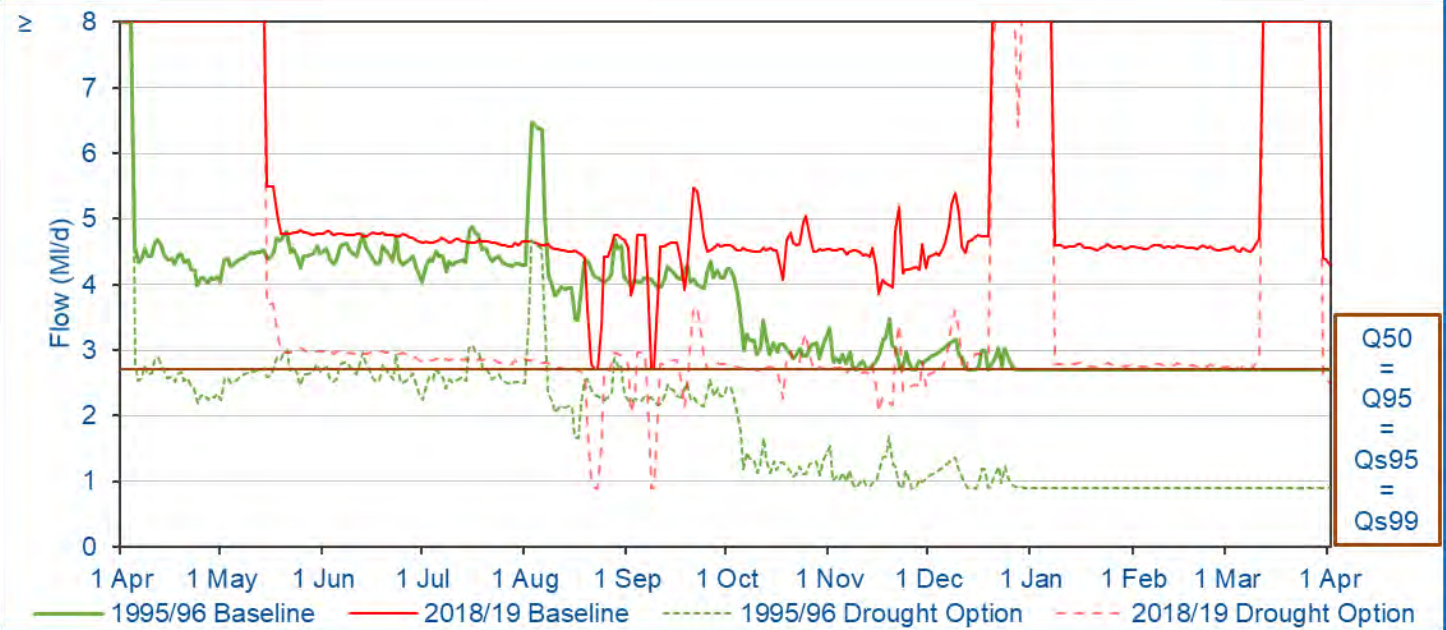
Reach Setting



**Reach Setting Information:**  
The superficial geology is mostly limited to spatially-limited sand/gravel river terrace deposits at the River Don confluence. Soil types are composed of slowly permeable, seasonally wet acid loamy and clayey soils. The bedrock geology is mostly the Millstone Grit Group (sand/gravel) and coal measures. Urbanisation increases towards the lower sections of the reach, with Penistone Grammar School on the right bank.

	Supplementary Information
Catchment Area at Assessment Point	11.0km <sup>2</sup>
Mean Slope Gradient	0.51°
Length of Reach	1.8km
Additional Catchment Area	0.97km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Don 2

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact
Qs95	2.70	0.89	67	Summer Major
Qs99	2.70	0.89	67	
Q95	2.70	0.89	67	Winter Major
Q50	2.70	0.89	67	

**There are no significant flow additions/reductions associated with this reach**

River Habitats



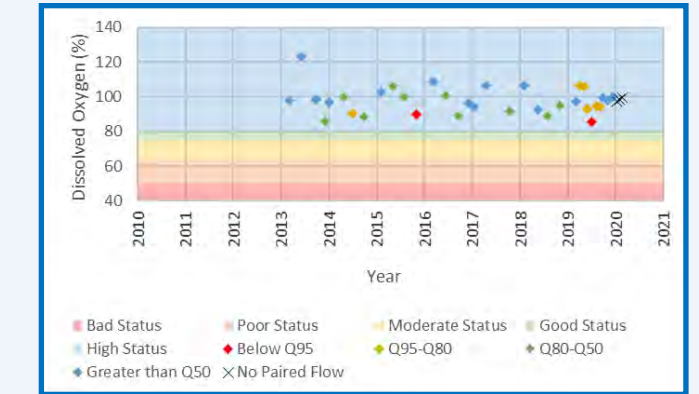
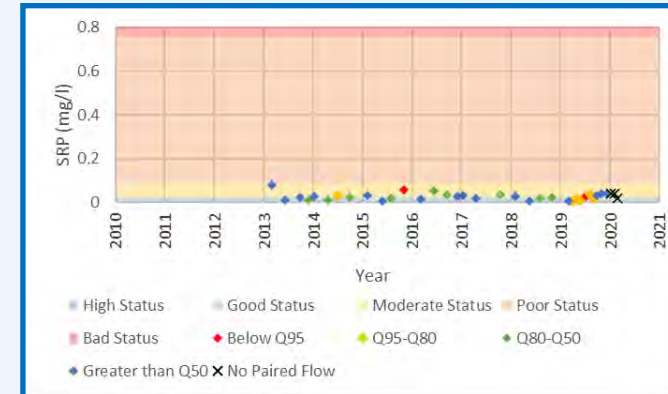
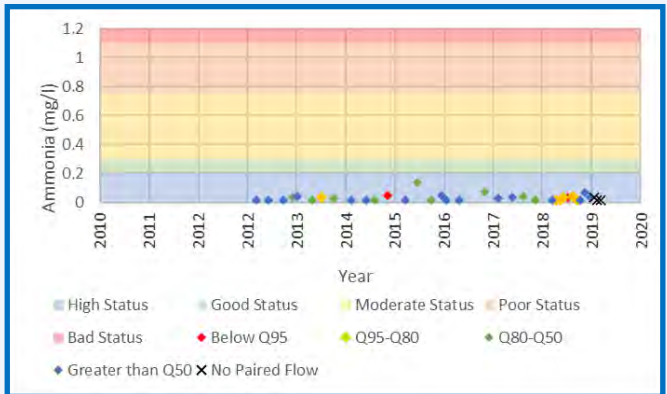
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Scout Dyke STW	0.05MI/d DWF

In Scout Dyke Above the Confluence With River Worth (NE-49400074) the average pH between 2010-2020 was 7.6 with a maximum temperature of 17.7°C



**Figure A4.6**  
**Scout Dyke 1:**  
**Physical Environment Information**





## A3.11 Little Don 1

### A3.11.1 Reach introduction

Little Don 1 is potentially impacted by an Underbank Reservoir drought permit. A summary of physical environment information for this reach is provided in **Figure A4.7**. The reach includes part of the following river waterbody:

- Little Don from Source to River Don (GB104027057460).

### A3.11.2 Reach setting

Little Don 1, located on main EAR **Figure 4.1**, comprises a 4.5km stretch of the Little Don River from the outflow of Underbank Reservoir to the confluence with the River Don. (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 8.7km<sup>2</sup> along the length of the reach. Don 3 (see **Section A4.4** above) is downstream.

### A3.11.3 River flow regime

During the implementation of this drought option, it is likely that the level in Underbank Reservoir will be below top water level and therefore the compensation flow from the reservoir will be the only inflow at the top of this reach. A reduction of 10.72 MI/d (the maximum reduction under this drought option, when reservoir level is below the control line and when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However the flow reduction at the top of the reach will remain at 67% until the reservoir reaches top water level and begins to spill again.

The hydrological impact of the drought option on Little Don 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There is one significant flow pressure influencing flow in Little Don 1, a non-consumptive abstraction licence as described in **Section A4.8.3.1**. There are no significant discharges within Little Don 1. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

#### A3.11.3.1 Flow depleted reaches

There is one separate licensed non-consumptive abstraction depleting flow in Little Don 1 for industrial, commercial and public services. The abstraction is for metal production, with a peak daily licensed abstraction rate of 20.62MI/d without a hands-off-flow condition ('The Porter – Little Don') with potential flow impacts. An abstraction at that rate could reduce flows in the depleted reach, during environmental drought, without or in combination with drought options to zero. A walkover reach covering the section of the river has been included in the schedule of monitoring for Little Don 1 (see main EAR Section 6). YWSL will liaise with the abstractors in advance of permit implementation to determine appropriate mitigation measures.

### A3.11.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 22 August 2018 at an estimated river flow at the flow assessment point for the reach of 16.9MI/d.

Little Don 1 is fairly straight reach which falls ~39m over 4.5km, a slope of 0.5°. The channel is heavily shaded along its length with three sections which are culverted. The upper RHS site (10747) identifies the presence of one river terrace, with two identified at the lower RHS site (3356). The channel was not sufficiently visible on aerial imagery to measure channel widths, at RHS survey ID 39554 the river width is 12m, and this decreases to 9m at RHS survey ID 39665. No within channel features are visible from

aerial imagery. However, vegetated side bars and non-vegetated side bars were noted at spot sample and RHS sites. Two islands were recorded on the OS maps, one being especially large, situated ~0.4km downstream of the start of the reach. An artificial berm was also recorded at RHS site 39954 covering 20% of the survey site. Boulders (70%) were recorded as the dominant channel substrate in the upstream reaches, with cobbles and bedrock also observed. Further downstream cobbles dominated (70%), however some areas of boulder (20%) and gravel / pebble (10%) were also observed, exposed bedrock and exposed boulders were also noted at the most downstream RHS site. Any visible sections of the channel had unbroken surfaces indicating smooth flow. Data from RHS site 10747 indicated rippled (50%) and smooth flow (30%), with smooth flow dominating at RHS site 3356. The more recent surveys recorded more variation in flow, at RHS site 39954, rippled flow dominated (70%), however areas of unbroken standing wave and chaotic flow were also observed. At the most downstream RHS site rippled flow dominated (40%), however areas of unbroken standing wave (30%), chute flow (10%) and smooth flow (20%) were also observed. A total of 21 riffles and 11 pools were counted for all surveys, indicating that other flow types are likely to be present. Data for both RHS sites indicate that the left and right banks are predominantly composed of earth and brick or laid stone. Concrete was noted as a bank material at ~20% of spot sites for both survey sites, gabions were also observed (10%) at RHS site 39954. Bank vegetation varies at both RHS sites. At site 10747 the left and right bank faces are composed predominantly of bare and simple, with some (~20%) complex faces on both bank sides. Bank tops at this site were predominantly uniform or simple vegetation. At RHS site 3356 the left bank faces are composed predominantly of bare and simple vegetation while the right bank faces are predominantly complex vegetation at 60% of spot sites (due to tree cover, 60%) with a mixture of bare, uniform and simple vegetation. Left bank tops at this site were a mixture of bare (30%), uniform (30%) and complex (30%) while right bank tops were predominantly uniform vegetation. The left and right banks at the upper RHS site (10747) were noted as extensively steep (>45°) and reinforced with the presence of vertical banks. At RHS site 39954, the channel had been realigned and over deepened. The banks/ channel had been resectioned and reinforced. At RHS site 3356 banks were resectioned and reprofiled with the presence of reinforced whole banks, top and toe. At the most downstream RHS site (Survey ID 39665) the channel and banks had also been resectioned and reinforced. Surrounding land-use is predominantly suburban/urban on both banks, with residential buildings on the right bank and industrial buildings on the left bank. Towards the end of the reach, there is an increase in rough pasture and woodland, mostly on the left bank.

Little Don 1 supports both high and low energy environments, as indicated by the steep valley slope and presence of depositional and erosional features. Although high energy environments are considered likely to dominate on a watercourse with such a high slope, RHS data indicates the opposite with the possible influence of weirs. Although the dominant substrate identified is less suitable for spawning (although becomes more suitable towards the end of the reach), the watercourse is likely to support discrete patches of suitable substrate and the presence of a significant number of riffles identified indicate spawning habitat is likely to be present. The larger substrate material and bank structure are likely to provide significant cover/refuge for juvenile and adult fish and white-clawed crayfish. The extensive coverage of deciduous trees in the riparian habitat will ensure a high input of allochthonous energy into the stream and provide further cover/refuge opportunities for fish and white-clawed crayfish. The reinforced banks may provide additional habitat opportunities for white-clawed crayfish. Movement/migration of fish and sediments are potentially limited in the reach by the presence of weirs and the culverting of the watercourse in three sections.

The drought options reduction in flow could lead to several potential impacts within Little Don 1

- Major of changes in the energy of the system associated with up to 67% reduction in flow for 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.

- Potentially moderate risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with retention of dominant habitat types.
- Moderate risk to longitudinal connectivity from three noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

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

### A3.11.5 River water quality

There is one water quality monitoring sites in Little Don 1. As such the Little Don D/S Underbank Reservoir (NE-49301804) has been used. The average pH between 2010-2020 was 7.6 with a maximum temperature of 17.7°C for the same period. There are no significant continuous discharges either within Little Don 1 or at risk from changes in flow in the reach. There is one frequently spilling CSO potentially presenting an environmental risk in the reach. A summary description of the potential risks to water quality in Little Don 1 as a result of drought options is presented in **Table A4.13**.

**Table A4.13 Potential risks to water quality in Little Don 1 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period. Some seasonality was apparent with concentrations rising in spring and falling in autumn.	Dissolved oxygen saturation (%) values were predominantly consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were predominantly consistent with 'Good' WFD status (0.028 mg/l) throughout the monitoring period with one example exceeding this with 0.25 mg/l on 30.08.2011. Some seasonality was apparent.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	None apparent
WwTW presenting increased risk	None	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 one listed CSO during rainfall events.		None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with CSO discharge	Moderate risk from drought options associated with CSO discharge	Minor risk from drought options

### A3.11.6 Summary of potential changes in the physical environment as a result of drought options

An overall summary of potential changes in the physical environment of Little Don 1 as a result of drought options is presented in **Table A4.14**.

**Table A4.14 Summary of potential changes in the physical environment of Little Don 1 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 67% in river flows throughout the reach at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• One flow depleted reach with potential for periods of time with zero flow without mitigation</li> </ul>
<b>River habitats</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• 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.</li> <li>• Moderate risk to longitudinal connectivity</li> <li>• Minor risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of short term acute, infrequent, temporary water quality pressures locally downstream of one listed CSO during rainfall events. There are no continuous water quality pressures identified as presenting increased risk with drought options implemented.</li> <li>• Reported water quality is predominantly consistent with 'Good' status and no apparent flow sensitivity.</li> </ul>



Reach Setting

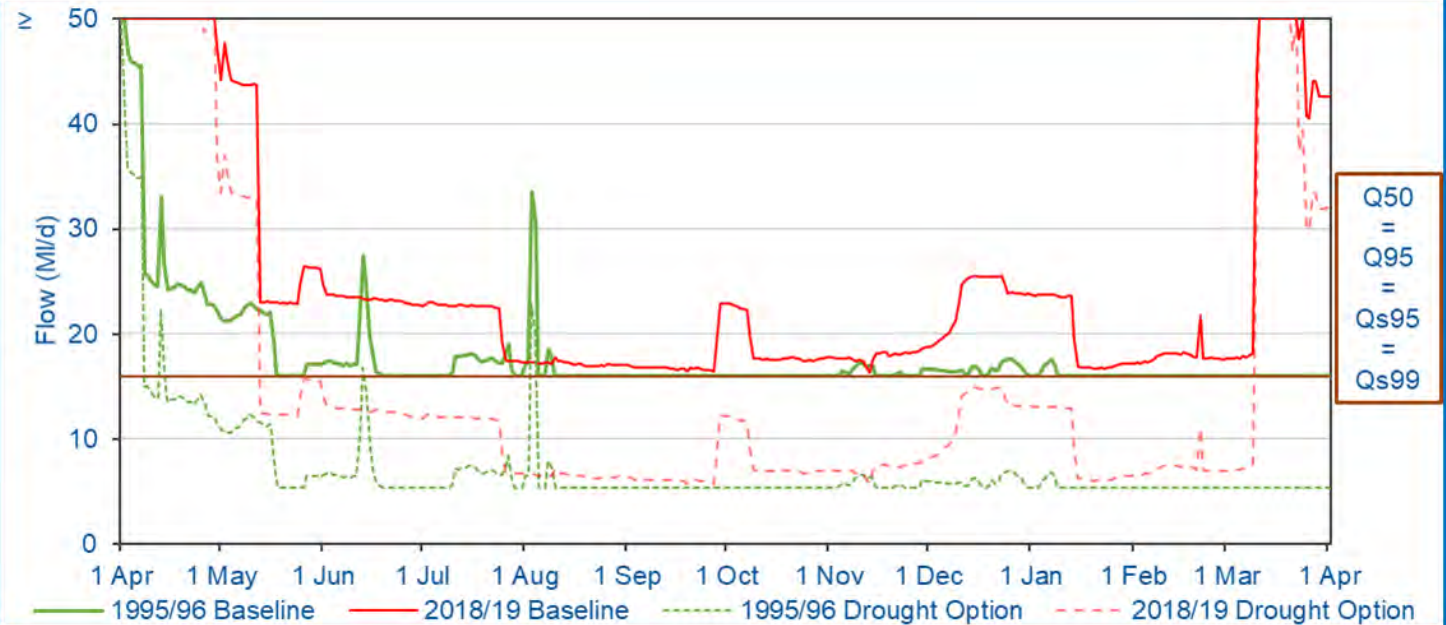


Reach Setting Information:

The superficial geology is very limited with only alluvium underlying the river channel. Soil types along the reach are composed of slowly permeable, seasonally wet acid loamy and clayey soils. Urbanisation is extensive throughout the reach, with the urban areas of Stocksbridge on the right bank and a large industrial site (steel processing works) along most of the left bank.

	Supplementary Information
Catchment Area at Assessment Point	37.0km <sup>2</sup>
Mean Slope Gradient	0.49°
Length of Reach	.4.5km
Additional Catchment Area	8.7km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Don 3

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact
Q <sub>s95</sub>	16.00	5.28	67	Summer Major
Q <sub>s99</sub>	16.00	5.28	67	
Q95	16.00	5.28	67	Winter Major
Q50	16.00	5.28	67	

Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
THE PORTER - LITTLE DON 2/27/05/097	20.62	Abstraction

River Habitats



River Water Quality

Significant Water Quality	Permit Conditions
Manchester Road Weir/ CSO WRA8523 A1	Intermittent Discharge

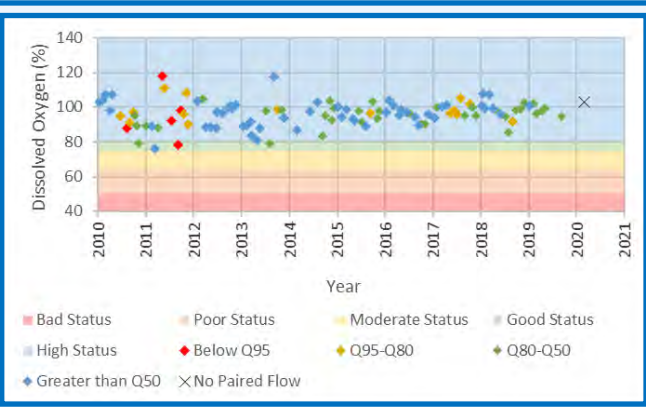
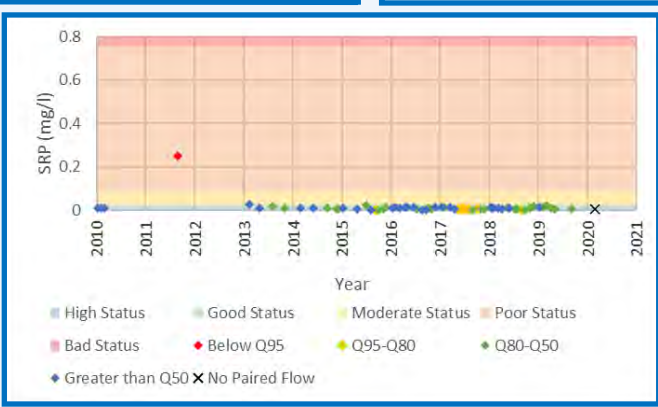
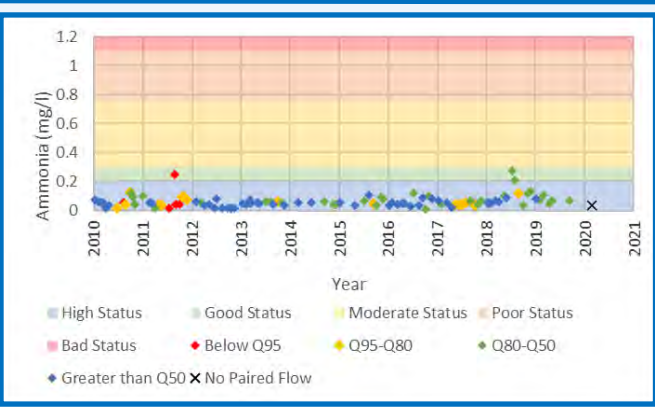
In the Little Don D/S Underbank Reservoir (NE-49301804) the average pH between 2010-2020 was 7.6 with a maximum temperature of 17.7°C



Figure A4.7

Little Don 1:

Physical Environment Information





## A3.12 Ewden Beck 1

### A3.12.1 Reach introduction

Ewden Beck 1 is potentially impacted by a More Hall Reservoir drought permit. A summary of physical environment information for this reach is provided in **Figure A4.8**. The reach includes part of the following river waterbody:

- Ewden Beck from Source to River Don (GB104027057400).

### A3.12.2 Reach setting

Ewden Beck 1, located on main EAR **Figure 4.1**, comprises a 1.7km stretch of Ewden Beck from the outflow of More Hall Reservoir to the confluence with the River Don. (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 1.2km<sup>2</sup> along the length of the reach. Don 4 (see **Section A4.5** above) is downstream.

### A3.12.3 River flow regime

During the implementation of this drought option, it is likely that the level in More Hall Reservoir will be below top water level and therefore the compensation flow from the reservoir will be the only inflow at the top of this reach. A reduction of 6.10 Ml/d (the maximum reduction under this drought option, when reservoir level is below the control line and when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However, the flow reduction at the top of the reach will remain at 67% until the reservoir reaches top water level and begins to spill again.

The hydrological impact of the drought option on Ewden Beck 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are no significant flow pressures, either abstractions or discharges, influencing flow in Ewden Beck 1. There are no flow depleted reaches within Ewden Beck 1. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.12.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 22 August 2018 at an estimated river flow at the flow assessment point for the reach of 12.9Ml/d.

Ewden Beck 1 is sinuous reach which falls ~18m over 1.7km, a slope of 0.6°. The channel is heavily shaded along its length. Two river terraces have been recorded at both sites. The channel was not sufficiently visible on aerial imagery to measure channel widths. No within channel features are visible from aerial imagery. However, a total of 8 un-vegetated point bars, 2 unvegetated point bars, and 1 vegetated point bar were recorded for all RHS sites. Side bars were recorded at 30% of the spot check sites at Site 25472. Channel substrate was recorded as predominantly cobble at all RHS sites, although boulders (10%) were noted at site 25472. Some variation was recorded in the more recent surveys, boulders (10%) and gravel / pebble (10%) were recorded at RHS Site 39731 and boulders (40%) at RHS Site 40001. The presence of exposed bedrock and boulders have been noted by the RHS in this reach. Data from the upper RHS site (25533) indicated rippled (40%) and unbroken standing waves (30%) with some chute flow (20%). Rippled flow (50%) dominated RHS Site 39731, however areas of unbroken standing wave (50%) and smooth flow (10%) were also recorded. Unbroken standing wave dominated RHS Site 40001 (70%), however areas of rippled flow (30%) were also recorded. Rippled (30%) and smooth (30%) flow dominated at site 25472. A total of 13 riffles and 24 pools were counted for all surveys, indicating that other flow types are likely to be present. Data for all RHS sites indicate



that the left and right banks are predominantly composed of earth and brick or laid stone. Bedrock and boulders were also noted as minor constituents of the left banks at sites 25472 and 25533. Peat was recorded as a minor component for the left and right banks at RHS Sites 39731 and 40001. Concrete was noted as forming the left bank material at ~20% of spot sites at site 25472 and 10% of sites at RHS site 39731. Bank face vegetation at both RHS sites is predominantly simple (70%) with some bare faces (20%) and the remainder as uniform vegetation. Bank tops at site 25533 were predominantly simple (60%) with uniform vegetation (30%), while at site 25472 bank top vegetation was wholly uniform. A range of bank types were noted at all RHS sites, with vertical and undercut banks, extensively steep (>45°), resectioned and reprofiled and reinforced banks all been present. Gentle and composite banks were also noted. Surrounding land-use is predominantly deciduous woodland and improved grassland.

Ewden Beck 1 is relatively sinuous with a high slope, indicating the likely presence of high energy environments within the reach. The presence of depositional features also indicates the presence of low energy environments, with the RHS data identified supporting these, including the flow structure present. Although the dominant substrate is unlikely to provide spawning opportunities, suitable habitat is likely to be present in discrete patches and a low number of riffles were present. The low energy flows have potential to support juvenile fish with cover/refuge for both juveniles and adults provided by the undercut banks and large substrate present, which also provides suitable habitat for white-clawed crayfish. The extensive coverage of trees in the riparian habitat provides an input of allochthonous energy into the stream and provide additional cover for fish and white-clawed crayfish. Movement/migration of fish and sediments is likely to be impacted by the presence of weirs in the watercourse.

The reduction in flow could lead to several potential impacts within Ewden Beck 1:

- Major risk of changes in the energy of the system associated with up to 67% reduction in flow for duration of drought option.
- Potentially major 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Potentially major risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with changes to the range and abundance of flow types.
- Minor risk to longitudinal connectivity from two noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Moderate 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Ewden Beck 1 from drought options is therefore assessed as major.

### A3.12.5 River water quality

For this assessment the only sample in the reach, Ewden Beck at More Hall Bridge (NE-49300690) has been used. The average pH between 2010-2020 was 7.7 with a maximum temperature of 18.7°C for the same period. Water quality modelling identifies one continuous discharge, YWSL Ewden Village WWTW, presenting a significant risk to total ammonia in Ewden Beck 1. A summary description of the potential risks to water quality in Ewden Beck 1 as a result of drought options is presented in **Table A4.15**.

**Table A4.15 Potential risks to water quality in Ewden Beck 1 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were consistent with 'Good' WFD status (0.032 mg/l) throughout the monitoring period.
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 Ewden Village WwTW	None	None
Intermittent pressures presenting risk	None	None	None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with reduction in dilution of WwTW	Minor risk from drought options	Minor risk from drought options

### A3.12.6 Summary of potential changes in the physical environment as a result of drought options

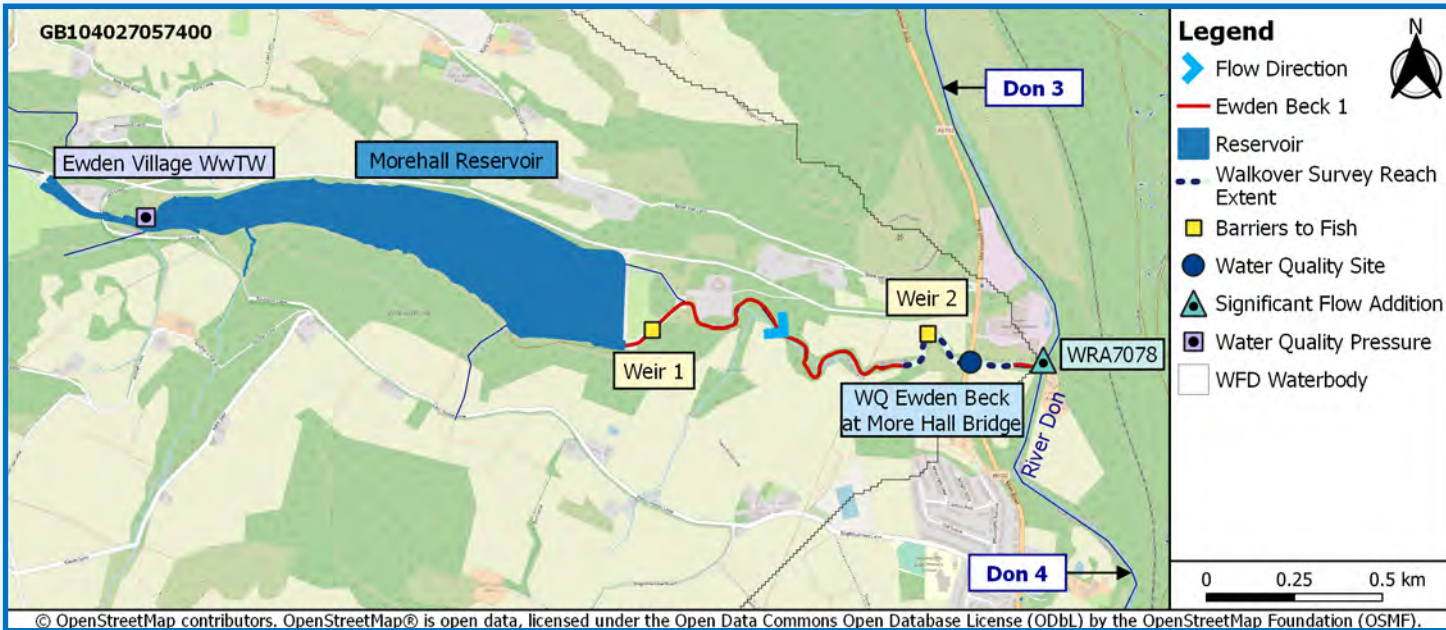
An overall summary of potential changes in the physical environment of Ewden Beck 1 as a result of drought options is presented in **Table A4.16**.

**Table A4.16 Summary of potential changes in the physical environment of Ewden Beck 1 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>Reductions of up to 67% in river flows throughout the reach at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>There are no flow depleted reaches within Ewden Beck 1.</li> </ul>
<b>River habitats</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>The major reduction in flow will change the energy of the system</li> <li>Potential major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting a significant variety of wetted habitats are present.</li> <li>Major risk to longitudinal connectivity</li> <li>Moderate risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>Risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ewden Village WwTW</li> <li>No significant intermittent pressures presenting risk.</li> <li>Reported water quality is predominantly consistent with 'Good' status and no apparent flow sensitivity.</li> </ul>



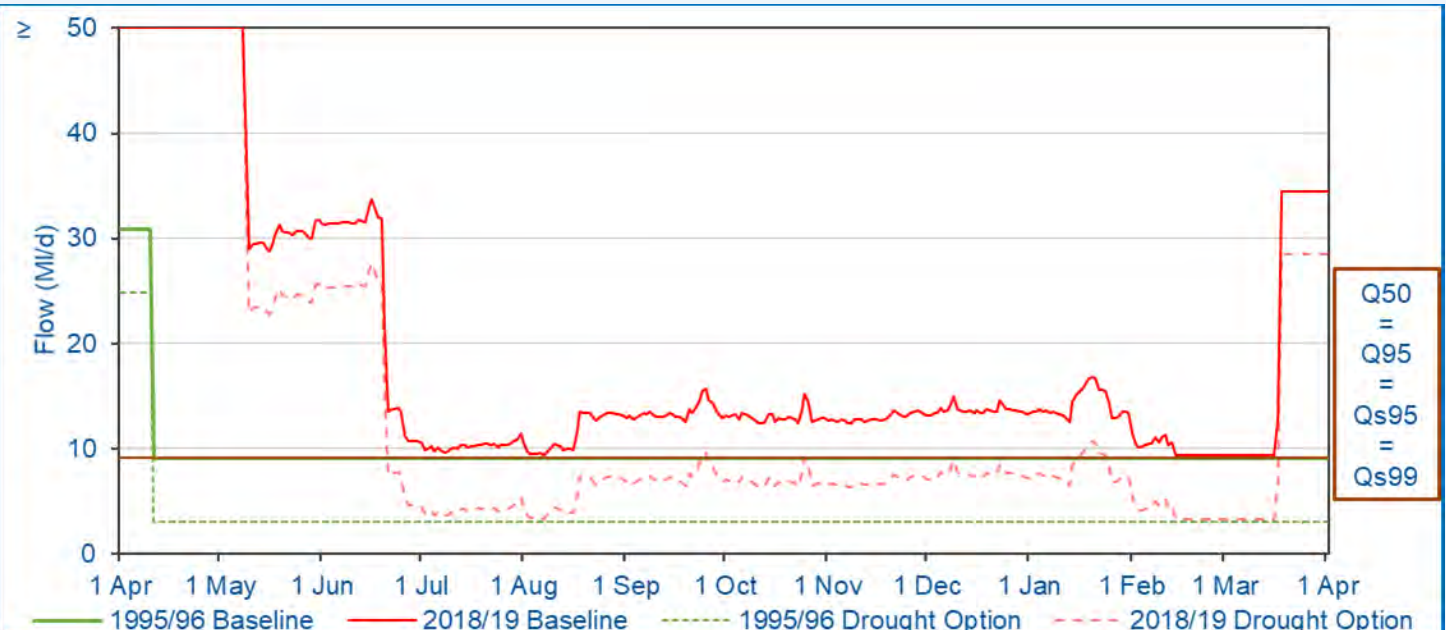
Reach Setting



**Reach Setting Information:**  
The superficial geology is very limited with only alluvium underlying the river channel. Soil types along the reach are composed wholly of freely draining, slightly acid loamy soils. Urbanisation is very low in the reach

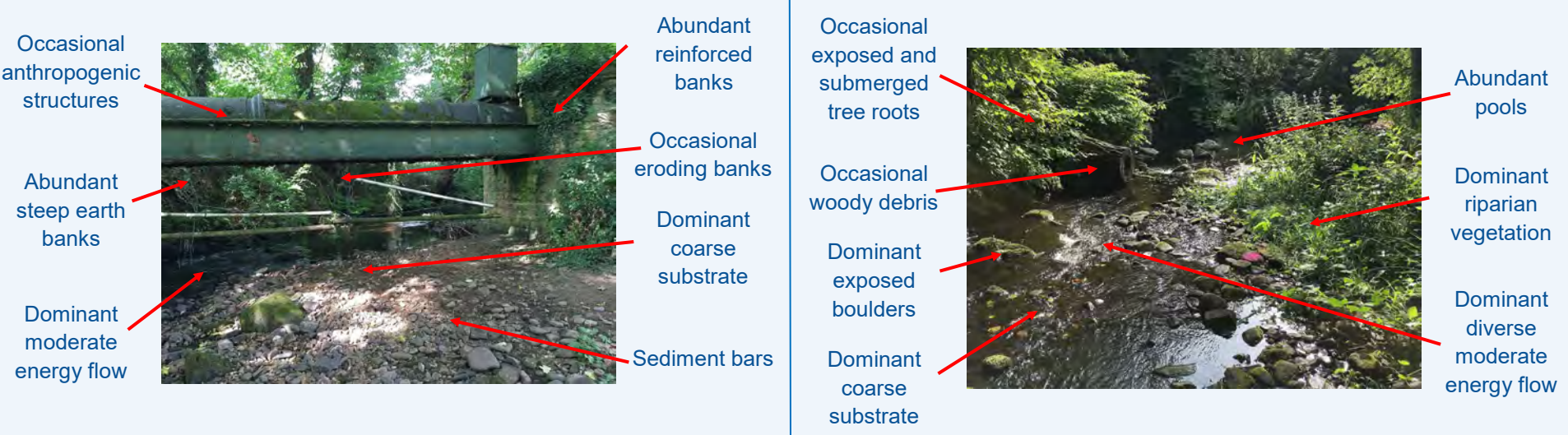
	Supplementary Information
Catchment Area at Assessment Point	26.3km <sup>2</sup>
Mean Slope Gradient	0.63°
Length of Reach	1.7km
Additional Catchment Area	1.2km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Don 4

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact	Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
-					Ewden Water Treatment Works WRA7078	50	Discharge
Q <sub>s</sub> 95	9.10	3.00	67	Summer Major			
Q <sub>s</sub> 99	9.10	3.00	67				
Q95	9.10	3.00	67	Winter Major			
Q50	9.10	3.00	67				

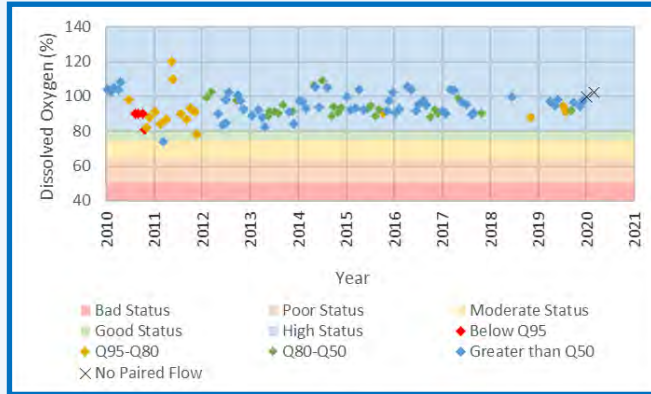
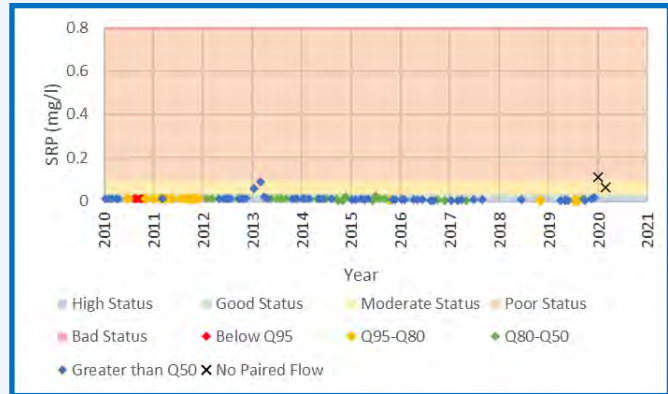
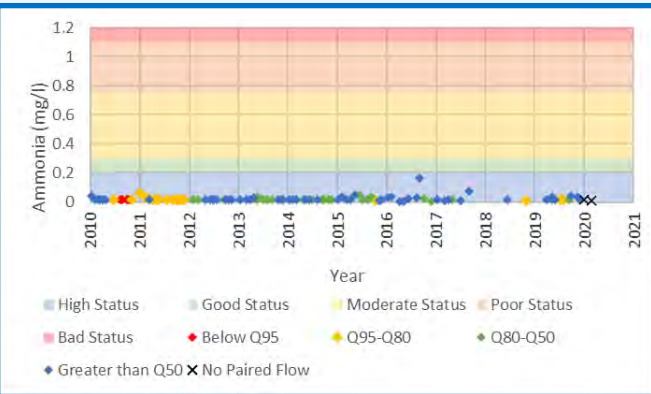
River Habitats



River Water Quality

Significant Water Quality Pressures	Permit Conditions
Ewden Village WwTW C5298	Descriptive consent

In Ewden Beck at More Hall Bridge. (NE-49300690) the average pH between 2010-2020 was 7.7 with a maximum temperature of 18.7°C



**Figure A4.8**  
**Ewden Beck 1:**  
**Physical Environment Information**



## A3.13 Loxley 1

### A3.13.1 Reach introduction

Loxley 1 is potentially impacted by a Damflask Reservoir drought permit. A summary of physical environment information for this reach is provided in **Figure A4.9**. The reach includes part of the following river waterbody:

- River Loxley from Strines Dyke to River Don (GB104027057370).

### A3.13.2 Reach setting

Loxley 1, located on main EAR **Figure 4.1**, comprises a 5.3km stretch of the River Loxley from the outflow of Damflask Reservoir to the confluence with the River Rivelin (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 13.04km<sup>2</sup> along the length of the reach. Loxley 2 (see **Section A4.11** below) is downstream.

### A3.13.3 River flow regime

During the implementation of this drought option, it is likely that the level in Damflask Reservoir will be below top water level and therefore the compensation flow from the depositing pond will be the only inflow at the top of this reach. A reduction of 12.0 MI/d (the maximum reduction under this drought option, when the reservoir level is below its control line, regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks or if stocks in the Loxley supply group are below its Drought Control Line) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However, the flow reduction at the top of the reach will remain at 67% until the reservoir reaches top water level and begins to spill again.

To supplement the assessment an additional assessment point approximately halfway down the reach has been considered. Flow is gauged at Loxley Rowel Bridge at grid reference SK302895. The summer Q95 and Q99 flow statistics are 31.45 MI/d and 24.85 MI/d respectively, based on a daily flow record from 2001 to 2019 inclusive with some short periods of missing data (as outlined in the assessment for the Loxley 2 reach later in this section). The flow reduction of 12.06 MI/d therefore represents percentage reductions of 38% and 48% respectively in the summer Q95 and Q99 flow statistics at the gauged location, and would therefore still be assessed as a major hydrological impact during the summer months of April to September inclusive. Similarly the year round Q95 and Q50 statistics for the 2001-2019 Rowel Bridge record are 33.87 MI/d and 45.45 MI/d respectively, so that the 12.06 MI/d flow reduction equates to percentage reductions of 35% and 26% in the year round Q95 and Q50 statistics and would therefore also be assessed as a major hydrological impact during the winter months of October to March inclusive, at the gauged location.

The hydrological impact of the drought option on Loxley 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are two significant flow pressures influencing flow in Loxley 1, a non-consumptive abstraction licence as described in **Section A4.10.3.1**, and a discharge licence leading to a significant flow addition from Loxley Water Treatment Works, an intermittent discharge with a max daily flow of 45.00 MI/d. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

#### A3.13.3.1 Flow depleted reaches

There is one separate licensed non-consumptive abstraction depleting flow in Loxley 1 for the production of energy. The abstraction is for a non-consumptive abstraction for hydroelectric power generation, with a peak daily licensed abstraction rate of 56.16MI/d without a hands-off-flow condition ('River Loxley at Wisewood Weir') with potential flow impacts. An abstraction at that rate could reduce flows in the depleted reach, during environmental drought, without or in combination with drought

options to zero. A walkover reach covering the section of the river has been included in the schedule of monitoring for Loxley 1 (see main EAR Section 6). YWSL will liaise with the abstractors in advance of permit implementation to determine appropriate mitigation measures.

### A3.13.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 21 August 2018 at a reservoir outflow of 28.2Ml/d.

Loxley 1 is a fairly sinuous reach which falls ~55m over 5.3km, a slope of 0.6°. The channel is heavily shaded along its length. All three RHS sites record the presence of two river terraces. The channel was not sufficiently visible on aerial imagery to measure channel widths. No within channel features are visible from aerial imagery. However, non-vegetated side bars were noted at spot sample sites 6 and 1 within RHS sites 10748 and 20804 respectively. One unvegetated point bar was also observed at RHS sites 39683 and 39630, respectively. Vegetated side bars were noted at 7 spot sample sites at RHS site 20803. Stable cliffs were noted at RHS sites 10748, 39683, 39630 and 20803. Cobbles were the dominant channel substrate at sites 10748, 2803 and 2804, with boulder frequently making up 30% of all spot sites. 30% of spot samples at site 10748 recorded silt as the dominant channel substrate. At RHS site 39683, boulders dominated (60%), and cobbles (20%) and artificial material (10%) were also recorded. At RHS site 39630, cobbles dominated (50%), however boulders (40%) and gravel / pebble (10%) were also recorded. The presence of exposed bedrock and exposed boulders have been noted by the RHS in this reach. RHS data indicate a wide range of flow types. At site 10748 smooth flow (50%) and rippled flow (40%) dominates while at sites 20804 and 20803 unbroken standing waves are dominant (50-60%). Chute flow, broken standing waves and rippled flow were also noted at sites 20804 and 20803. At RHS site 39683, unbroken standing wave dominated (50%), however smooth flow (40%) and rippled flow (10%) was also recorded. At RHS site 39630 unbroken standing wave dominated (50%), however rippled flow (40%) and smooth flow (10%) was also observed. A total of 22 riffles and 17 pools were counted by all surveys (with 11 riffles noted at site 10748 alone), indicating that other flow types are likely to be present. Data for both RHS sites indicate that the left and right banks are predominantly composed of earth with brick and laid stone frequent. Bedrock was noted as composing some of the right banks at sites 20803 and 20804 and both banks of RHS site 39630, while boulders were noted as bank material on the right bank at site 20804, and both banks of RHS site 39683. Bank face vegetation was predominantly simple at all sites, although complex vegetation was noted at 40% of the spot sample on the right bank at site 20804. Bank tops at this site were noted as predominantly uniform or simple vegetation. At site 20803 the right bank faces are composed predominantly of complex vegetation. A diverse range of bank types were noted for each of the three RHS sites. Vertical and undercut, extensively steep (>45°), reinforced banks, gentle and composite banks were noted as present and extensive. Surrounding land-use is predominantly woodland and improved grassland, increasing to suburban/urban towards the end of the reach. A large series of industrial buildings exists on the left bank between 0.4-1.5km downstream. There are scattered small lakes along the banks of this reach, mostly in the upper to mid sections of the reach.

Loxley 1 contains a mixture of high and low energy environments, indicated by the moderate steepness of the valley and the presence of both erosional and depositional features. Although the dominant substrate is less suitable for supporting spawning habitat, it is considered likely that discrete patches of suitable substrate will be present and the presence of a significant number of riffles indicates the likely presence of spawning habitat. The larger substrate material and bank structure are likely to provide cover/refuge for both juvenile and adult fish. The extensive coverage of trees in the riparian habitat will ensure a high input of allochthonous energy into the stream and provide further cover/refuge opportunities for fish and white-clawed crayfish. The reinforced banks may provide additional habitat opportunities for white-clawed crayfish. Movement/migration of fish and sediments are potentially limited in the reach by the presence of in-channel structures.

The reduction in flow could lead to several potential impacts within Loxley 1:

- Major risk of changes in the energy of the system associated with up to 67% reduction in flow for duration of drought option.



- Potentially major 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Potentially major risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with changes to the range and abundance of flow types.
- Major risk to longitudinal connectivity from nine noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Moderate 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

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

#### A3.13.5 River water quality

For this assessment the first sample in the reach, River Loxley At Rowel Lane (NE-49301815) has been used. The average pH between 2010-2020 was 7.7 with a maximum temperature of 16.5°C for the same period. The EA has requested that the effect of change in river dilution of iron in the discharge from abandoned minewater discharges is considered in this reach. There is no iron data available for this reach. There are no significant continuous or intermittent discharges either within Loxley 1 or at risk from changes in flow in the reach. A summary description of the potential risks to water quality in Loxley 1 as a result of drought options is presented in **Table A4.17**.

**Table A4.17 Potential risks to water quality in Loxley 1 as a result of drought options**

	<b>Total ammonia</b>	<b>Oxygen</b>	<b>Phosphate</b>	<b>Iron</b>
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period. Slight seasonality was apparent with concentrations rising in spring and falling in autumn.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were predominantly consistent with 'Good' WFD status (0.032 mg/l) throughout the monitoring period. Slight seasonality was apparent with peaks in June/August.	N/A
Flow sensitivity (diffuse pollution)	None apparent	None apparent	None apparent	N/A
WwTW presenting increased risk	None	None	None	N/A
Intermittent pressures presenting risk	None	None	None	N/A
Other point source pressures presenting risk	None	None	None	Abandoned minewater discharges at Loxley Bottom and Myers Grove (a walkover reach covering this section of the river has been included in the schedule of monitoring for Loxley 1 on a precautionary basis (see main EAR Section 6))
Summary	Minor risk from drought options	Minor risk from drought options	Minor risk from drought options	Uncertain risk from drought options

### A3.13.6 Summary of potential changes in the physical environment as a result of drought options

An overall summary of potential changes in the physical environment of Loxley 1 as a result of drought options is presented in **Table A4.18**.

**Table A4.18 Summary of potential changes in the physical environment of Loxley 1 as a result of drought options**

<b>Physical environment aspect reviewed</b>	<b>Assessment of risk from implementation of drought options</b>
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 67% in river flows throughout the reach at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>Major</i>	<ul style="list-style-type: none"> <li>• One flow depleted reach with potential for periods of time with zero flow without mitigation.</li> </ul>
<b>River habitats</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• Potential major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting a significant variety of wetted habitats are present.</li> <li>• Major risk to longitudinal connectivity</li> <li>• Moderate risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Minor risk</i>	<ul style="list-style-type: none"> <li>• Reported water quality is predominantly consistent with 'Good' status and no more than weak flow sensitivity. There are no continuous water quality pressures identified as presenting increased risk with drought options implemented and no significant intermittent pressures presenting risk.</li> <li>• There is uncertainty associated with the dilution of iron in the discharge from abandoned minewater discharges and how this may change with drought options as to date no data are available. A walkover reach covering this section of the river has been included in the schedule of monitoring for Loxley 1 on a precautionary basis (see main EAR Section 6).</li> </ul>



Reach Setting

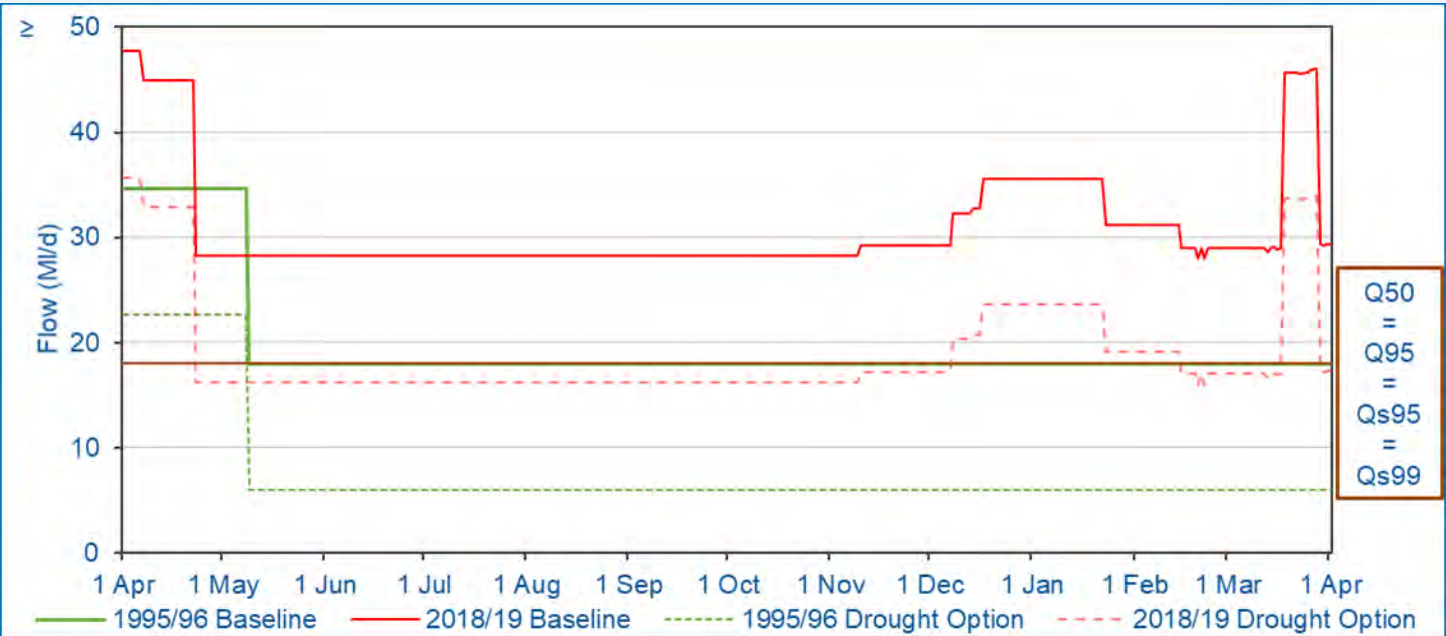


Reach Setting Information:

The bedrock geology is comprised of Carboniferous deposits of sandstone, mudstone, siltstone and coal (Milestone Grit Group and Pennine Coal Measures). The superficial geology of the reservoir catchment is very limited with only some deposits of peat identified. Soils in the reservoir catchment are predominantly a mixture of freely draining, slightly acid loamy soils, slowly permeable, seasonally wet acid loamy and clayey soils and very acid upland soils. Some blanket bog peat soils occur at the southern extent of the reservoir catchment. Urbanisation is limited.

	Supplementary Information
Catchment Area at Assessment Point	43.84km <sup>2</sup>
Mean Slope Gradient	0.59°
Length of Reach	5.3km
Additional Catchment Area	13.04km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Loxley 2

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact	Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
Q <sub>s95</sub>	18.00	5.94	67	Summer Major	Loxley Water Treatment Works WRA7130	45	Discharge
Q <sub>s99</sub>	18.00	5.94	67				
Q95	18.00	5.94	67	Winter Major	RIVER LOXLEY AT WISEWOOD WEIR NE/027/0005/020	56.16	Abstraction
Q50	18.00	5.94	67				

River Habitats



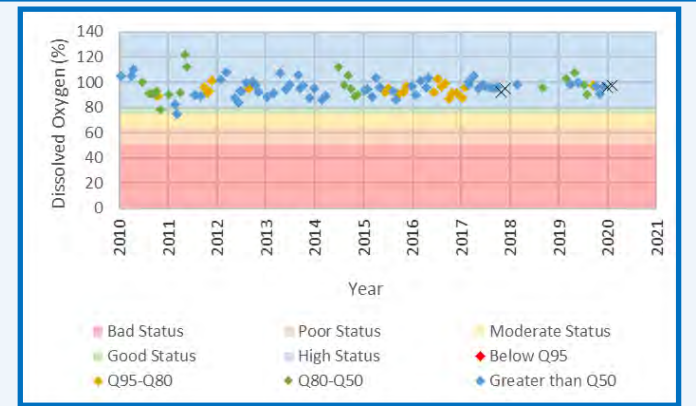
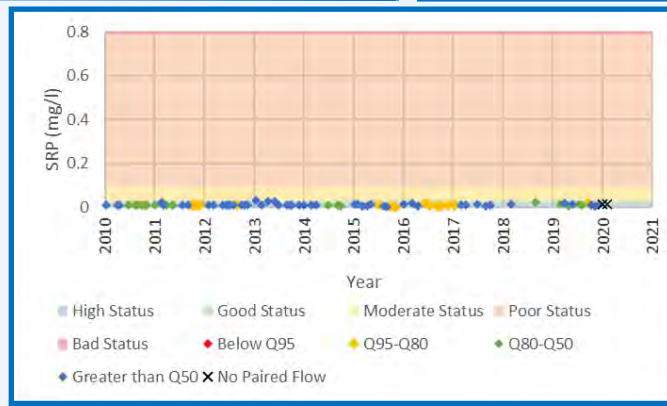
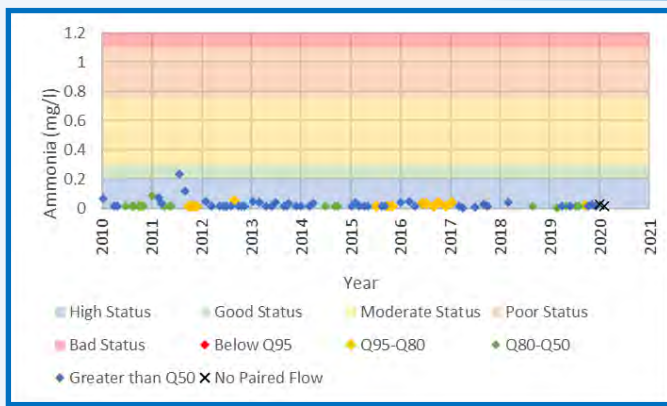
River Water Quality

Significant Water Quality Pressures	Permit Conditions
Abandoned minewater discharges at Loxley Bottom and Myers Grove	No consent

In the River Loxley At Rowel Lane (NE-49301815) the average pH between 2010-2020 was 7.7 with a maximum temperature of 16.5°C



Figure A4.9  
Loxley 1:  
Physical Environment Information





## A3.14 Loxley 2

### A3.14.1 Reach introduction

Loxley 2 is potentially impacted by both Damflask Reservoir and Rivelin Lower Reservoir drought permits. A summary of physical environment information for this reach is provided in **Figure A4.10**. The reach includes part of the following river waterbody:

- River Loxley from Strines Dyke to River Don (GB104027057370).

### A3.14.2 Reach setting

Loxley 2, located on main EAR **Figure 4.1**, comprises a 2.2km stretch of the River Loxley from the confluence with the River Rivelin to the confluence with the River Don (**Table A2.1**). Don 5 (see **Section A4.6** above) is downstream.

### A3.14.3 River flow regime

There is no gauged flow data available for this stretch of the River Loxley, however the rivers Loxley and Rivelin are both gauged upstream of their confluence. Downstream of the confluence, therefore, a daily flow series was produced by summing the daily gauged flows at the Loxley Rowel Bridge (River Loxley) and Hollins Bridge (River Rivelin) gauges, and an estimate of the flow accretion due to the increase in catchment areas downstream of these two gauges to their confluence. The ungauged portion of the catchment downstream of the confluence is approximately 5.5% of the catchment area at this location. The daily flow accretion for this small portion of the catchment was estimated by using the Gustard flow transposition method based on relative catchment parameter ratios and the gauged flow record of the River Loxley at Rowel Bridge, adjusted to remove the influence of the reservoirs in the upstream catchment.

It was observed that the Hollins Bridge data record includes some periods when the gauged flow is less than the normal compensation release from Rivelin Reservoir. This is due to a change in the minimum compensation rate from Rivelin Reservoir implemented in 2004. An adjustment was therefore applied to the Hollins Bridge record, before summing with the Rowel Bridge record and estimated flow accretion downstream of the gauges, by setting the Hollins Bridge daily mean flow to a minimum of 10.3 Ml/d (the Rivelin compensation rate from 2004 onwards).

The River Loxley downstream of the River Rivelin confluence is influenced by both the Rivelin and Damflask reservoir drought options. The maximum combined flow reduction from these two options is 18.96 Ml/d, at times when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks. The combined drought options therefore represent reductions of up to 37% and 47% in the summer Q95 and Q99 flow statistics respectively and would therefore be assessed as a **major** hydrological impact in the summer period. During the winter period, the combined flow reduction represents reduction of up to 35% and 23% in the year round Q95 and Q50 flow statistics, which is assessed as a **major** hydrological impact in winter also.

The hydrological impact of the drought option on Loxley 2 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There are no significant flow pressures, either abstractions or discharges, influencing flow in Loxley 2. There are no flow depleted reaches within Loxley 2. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.14.4 River habitats

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

Loxley 2 is a fairly sinuous reach which falls ~15m over 2.2km, a slope of 0.4°. Riparian tree cover is semi-continuous along the reach. The single RHS site (33040) identifies the presence of two river terraces. The channel was visible towards the mid to lower reaches and channel width varied between



12-13m, at the YWSL monitoring site the river is 12.78m wide. This small variation in width likely reflects the confined and modified nature of the channel in this reach. No in-channel depositional features are visible from aerial imagery, however, non-vegetated side bars were noted at 2 spot sample sites in the RHS survey. Cobbles were noted as the dominant substrate at the RHS site, with some boulders present (10%); this is confirmed by the YWSL water monitoring site, where boulders (35%), cobble (35%), gravel/cobble (25%) and sand (5%) were noted. Exposed bedrock was noted as extensive throughout the RHS site, however, is not dominant. Any visible sections of the channel had predominantly smooth surfaces with several small sections of broken surfaces. Data from the RHS site indicate a mixture of smooth (40%) and rippled flow (30%) with some unbroken standing wave and chaotic flow noted; similar flow variability was noted during the later RHS survey and at the YWSL water monitoring site. A total of 3 riffles were counted during the survey. Data for the RHS site indicates that the left and right banks are composed predominantly of earth with some brick or laid (20-40%). Bank vegetation varies along the RHS site. The left bank faces are a mix of bare, uniform and simple vegetation types, while the right bank is generally complex vegetation (50%), the remainder of bare, simple and uniform vegetation. Bank tops at this site were composed of predominantly bare and uniform vegetation. The left and right banks at RHS site were noted as extensively steep ( $>45^\circ$ ) with resectioned or reprofiled banks, reinforced banks and gentle banks noted as being present throughout the site. However, shallower sections were also noted. Surrounding land use is predominantly suburban/urban on both banks as the reach passes through Sheffield.

Loxley 2 also contains a mixture of high and low energy environments, indicated by the presence of erosional and depositional features within the reach. The presence of spawning habitat is likely to be limited, with few riffles identified as present and cobble substrate dominating, but nonetheless suitable habitat is present. The larger substrates and features, such as exposed bedrock, will provide cover/refuge opportunities for juvenile and adult fish and white-clawed crayfish. The semi-continuous presence of trees in the riparian habitat will provide some allochthonous energy into the system and will provide further refuge/cover potential for fish and white-clawed crayfish. The reinforced banks may provide additional habitat opportunities for white-clawed crayfish. Movement/migration of fish and sediments are potentially limited in the reach by the presence of weirs and the culverting of the watercourse in three sections.

The reduction in flow could lead to several potential impacts within Loxley 2:

- Major risk of changes in the energy of the system associated with up to 46% reduction in flow for duration of drought option.
- Potentially major 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 protrusion of bed elements (such as larger particles) through the flow surface for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Potentially major risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with changes to the range and abundance of flow types.
- Major risk to longitudinal connectivity from four noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Moderate 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

The overall risk to river habitats on Loxley 2 from drought options is therefore assessed as major.

#### A3.14.5 River water quality

For this assessment the first sample in the reach, Loxley 120M Upstream of Confluence With Don (NE-49301811), has been used. The average pH between 2010-2020 was 7.8 with a maximum temperature

of 16.6°C for the same period. There are no significant continuous or intermittent discharges either within Loxley 2 or at risk from changes in flow in the reach. A summary description of the potential risks to water quality in Loxley 2 as a result of drought options is presented in **Table A4.19**.

**Table A4.19 Potential risks to water quality in Loxley 2 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period. Some seasonality was apparent with concentrations rising in spring and falling in autumn.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were consistent with 'Good' WFD status (0.048 mg/l) throughout the monitoring period however SRP data is highly limited at this location. Upstream reach conditions suggest "Good" status is likely.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	None apparent
WwTW presenting increased risk	None	None	None
Intermittent pressures presenting risk	None	None	None
Other point source pressures presenting risk	None	None	None
Summary	Minor risk from drought options	Minor risk from drought options	Minor risk from drought options

### A3.14.6 Summary of potential changes in the physical environment as a result of drought options

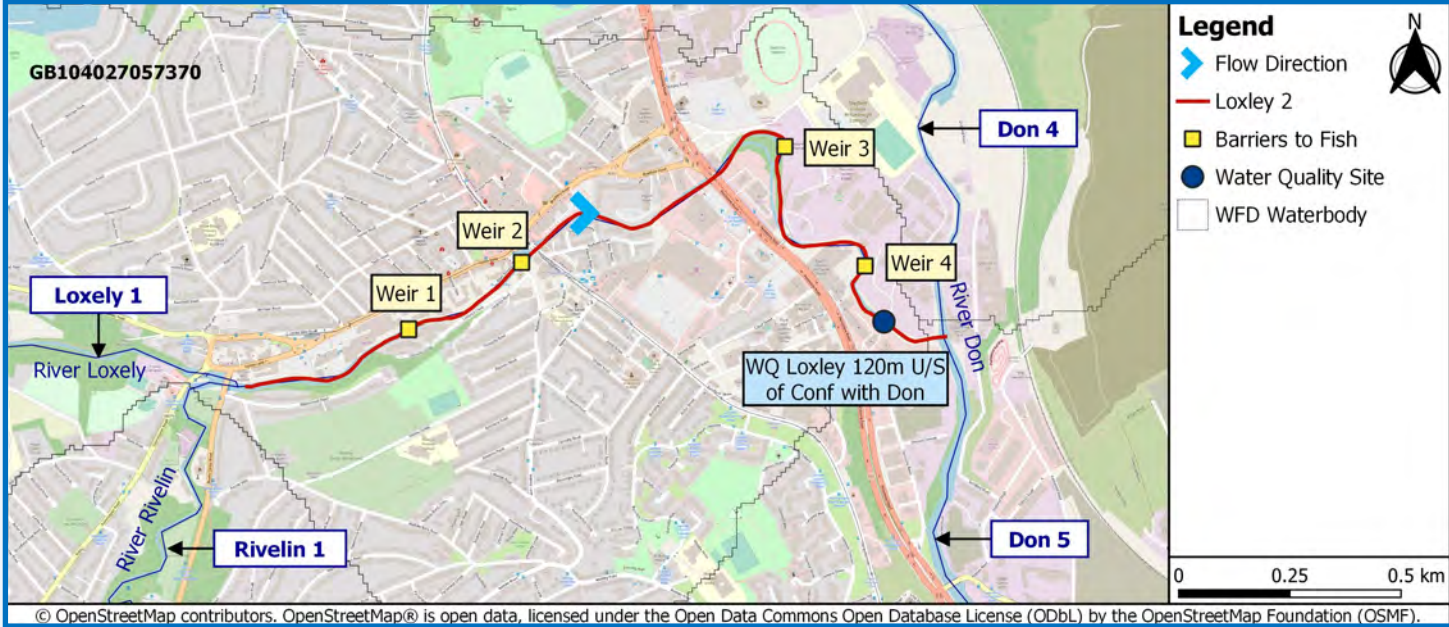
An overall summary of potential changes in the physical environment of Loxley 2 as a result of drought options is presented in **Table A4.20**.

**Table A4.20 Summary of potential changes in the physical environment of Loxley 2 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 46% in river flows for periods of time during the duration of the drought option, throughout the reach, at any time of year that drought options implemented</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Loxley 1.</li> </ul>
<b>River habitats</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• Potential major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting a significant variety of wetted habitats are present.</li> <li>• Major risk to longitudinal connectivity</li> <li>• Moderate risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Minor risk</i>	<ul style="list-style-type: none"> <li>• Reported water quality is predominantly consistent with 'Good' status and no more than weak flow sensitivity. There are no continuous water quality pressures identified as presenting increased risk with drought options implemented and no significant intermittent pressures presenting risk.</li> </ul>



Reach Setting

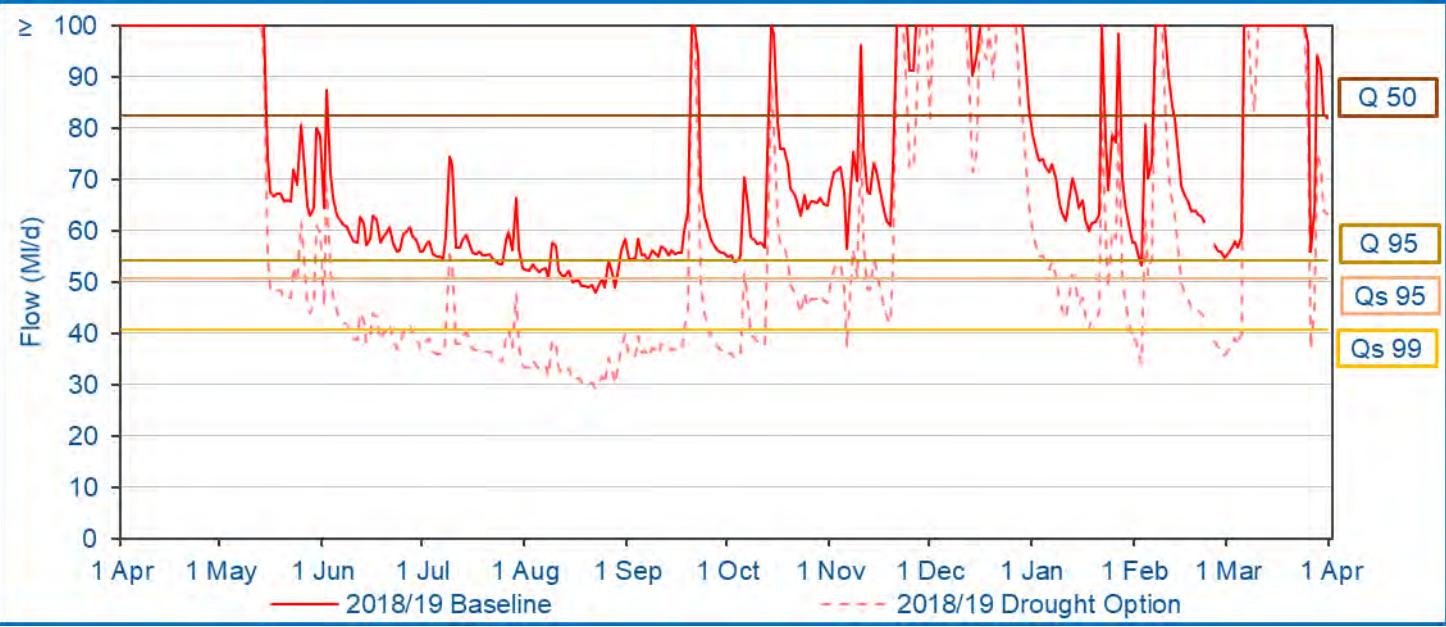


Reach Setting Information:

The superficial geology is composed of alluvium underlying the river channel. Soils along the reach are composed of freely draining, slightly acid loamy soils. This reach is highly urbanised as it passes through Sheffield.

	Supplementary Information
Catchment Area at Assessment Point	86.07km <sup>2</sup>
Mean Slope Gradient	0.4°
Length of Reach	2.2km
Additional Catchment Area	1.88km <sup>2</sup>
Upstream Reach	Loxley 1 / Rivelin 1
Downstream Reach	Don 5

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact
Q <sub>s</sub> 95	50.72	31.76	37	Summer Major
Q <sub>s</sub> 99	40.75	21.79	47	
Q95	54.30	35.34	35	Winter Major
Q50	82.43	63.47	23	

There are no significant flow additions/reductions associated with this reach

River Habitats

No walkover survey was carried out during the onset of drought in 2018 along this reach as the reach was deemed inaccessible. This will be included in the EMP.

River Water Quality

There are no significant water quality pressures associated with this reach

In the River Loxley 120M Upstream of Confluence With Don (NE-49301811) the average pH between 2010-2020 was 7.8 with a maximum temperature of 16.6°C



YorkshireWater

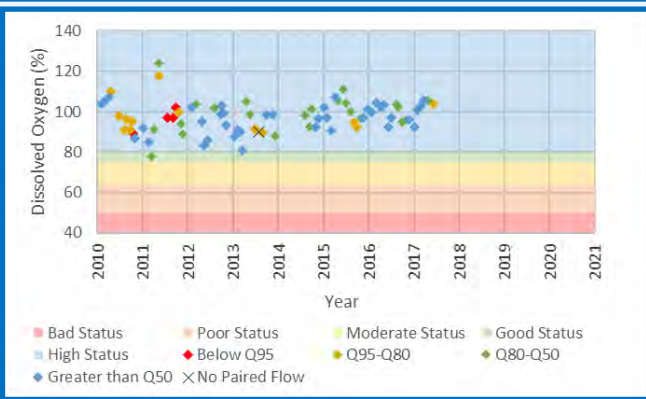
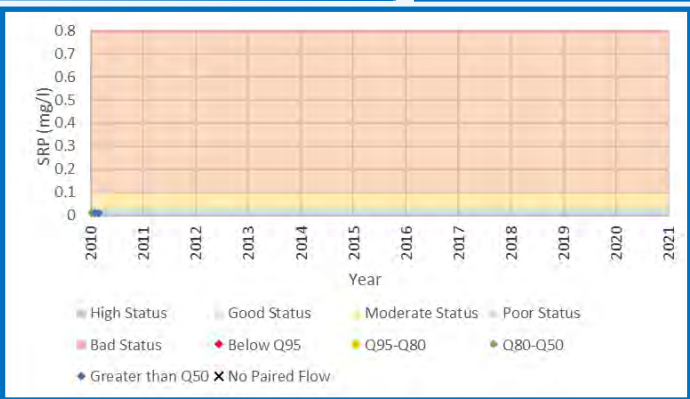
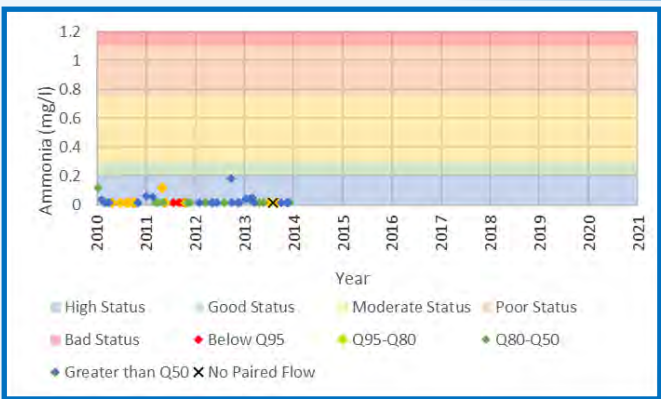


RICARDO

Figure A4.10

Loxley 2:

Physical Environment Information



## A3.15 Rivelin 1

### A3.15.1 Reach introduction

Rivelin 1 is potentially impacted by a Rivelin Lower Reservoir drought permit. A summary of physical environment information for this reach is provided in **Figure A4.11**. The reach includes part of the following river waterbody:

- River Rivelin from Source to River Loxley (GB104027057340).

### A3.15.2 Reach setting

Rivelin 1, located on main EAR **Figure 4.1**, comprises a 7.3km stretch of the River Rivelin from the outflow of Rivelin Depositing Pond to the confluence with the River Loxley (**Table A2.1**). The reach is dominated by reservoir outflows with an additional catchment area of 10.7km<sup>2</sup> along the length of the reach. Loxley 2 (see **Section A4.11** above) is downstream.

### A3.15.3 River flow regime

During the implementation of this drought option, it is likely that the level in Rivelin Reservoir will be below top water level and therefore the compensation flow from the depositing pond will be the only inflow at the top of this reach. A reduction of 6.90 MI/d (the maximum reduction under this drought option, when regional reservoir stocks are below the regional Drought Control Line for more than four consecutive weeks or if stocks in the Rivelin supply group are below its Drought Control Line) therefore represents a reduction of up to 67% in the flow at the top of this reach, and this is assessed as a **major** hydrological impact at any time of year.

During the winter refill period when catchment flows are generally increasing, there may be some limited flow accretion along the reach so that the percentage flow reduction is less at the lower end of the reach. However the flow reduction at the top of the reach will remain at 67% until the reservoir reaches top water level and begins to spill again.

Towards the downstream end of the reach, flow is gauged at Hollins Bridge at grid reference SK322884. The summer Q95 and Q99 flow statistics are 7.00 MI/d and 4.23 MI/d respectively, based on a daily flow record from 2001 to 2019 inclusive with some short periods of missing data (as outlined in the assessment for the Loxley 2 reach later in this report). However this gauged record includes some periods when the gauged flow is below the normal compensation release of 10.30 MI/d, possibly due to previous drought permit flow reductions. In practice the drought permit would not be expected to reduce the downstream flow to below the reduced compensation rate of 3.40 MI/d. This would represent percentage reductions of 51% and 20% in the summer Q95 and Q99 flow statistics at the gauged location and would therefore still be assessed as a major hydrological impact during the summer months of April to September inclusive. Similarly the year round Q95 and Q50 statistics for the 2001-2019 Hollins Bridge record are 8.81 MI/d and 28.39 MI/d respectively, so that the drought permit flow reduction of 6.90 MI/d (to no less than 3.40 MI/d) equates to percentage reductions of 61% and 24%, and would therefore also be assessed as a major hydrological impact during the winter months of October to March inclusive.

The hydrological impact of the drought option on Rivelin 1 is therefore assessed as **major** for both the summer/autumn period and any winter refill period while drought options remain in place.

There is one significant flow pressure influencing flow in Rivelin 1, a discharge licence leading to a significant flow addition from Rivelin Water Treatment Works, an intermittent discharge with a max daily flow of 75 MI/d. There are no significant abstractions within Rivelin 1. See Annex 1 and 2 for a full list of flow pressures considered in the assessment.

### A3.15.4 River habitats

River habitats have been characterised at a whole reach scale and with additional information for a representative 500m reach from survey information on 3 August 2018 at a reservoir outflow of 10.7MI/d.



Rivelin 1 is a fairly sinuous and steep reach which falls ~119m over 7.3km, a slope of 0.9°. The channel is heavily shaded along its length with semi-continuous to continuous tree cover. Between one to three river terraces have been recorded at the RHS sites (the most terraces towards the end of the reach). The channel was not sufficiently visible on aerial imagery to measure channel widths (with the exception of a small section towards the end of the reach at Walkley). The section at Walkley measured 8.5m, however this section was characterised by reinforced banks and due to the artificial nature of the channel the width is not representative of a natural channel at this point. Water widths recorded at the three RHS sites were between 1-4m (the narrowest width being at RHS site 3382 in the mid section of the reach). No within channel features are visible from aerial imagery, with a single unvegetated point bar and single side bar recorded at RHS site 20246. Channel substrate was noted as being predominantly cobble with a mixture of boulders and bedrock, the latter becoming common with increasing downstream distance at sites 3382 and 20786. At RHS survey 39649, boulders dominated (60%), however areas of bedrock (10%), cobble (20%) and gravel (10%). The presence of exposed bedrock and exposed boulders have been noted at all sites and subsequently noted as extensive at sites 3382 and 20786. Data from the RHS sites indicate that flow was predominantly smooth and rippled. Some chute flow was indicated at RHS sites 20246 (10%) and 3382 (30%) along with some broken standing waves (10%) and unbroken standing wave (10%) at site 3382 and 20% at site 39649. No perceptible flow was also indicated at RHS site 20246 (20%) and 20786 (20%). A total of 19 riffles and 17 pools were counted for all surveys (with the upper and lower RHS sites (20246 and 20786) having the greatest number of features. Data for all three RHS sites indicate that the left banks are composed predominantly of earth and brick or laid stone (the latter particularly at site 3382 (at 50% of spot sites)). Bedrock also forms the bank at 30% of spot sites at site 3382, and 10% at site 39649. The right banks at site 20246 and 20786 were composed predominantly earth, although boulders formed 40% of right banks at site 20786. Boulders were also observed at site 39649 within the left bank. Bedrock forms all recorded right banks at site 3382 and is also important RHS at site 20246 (30% of spot sites). Bank face vegetation of the left banks at all three sites is a mixture of uniform, simple and complex vegetation, although uniform dominates (80%) at site 3382. Right bank face vegetation is mostly bare (70%) with some complex (20%) at site 20246, becoming equally uniform and simple at sites 3382 and 20786. Left bank tops were simple (50%) and complex (40%) at site 20246, becoming predominantly simple (90%) at site 3382 and bare (80%) at site 20786. Right bank tops were mainly simple (40%) and complex (40%) at site 20246, becoming complex (90%) at site 3382. Where visible at site 20786, bank faces were mostly bare. A range of bank types were noted at all RHS sites, with steep (>45°) and reinforced banks being dominant. Vertical or undercut, gentle, composite and reinforced toes bank types were all common at site 20786. Surrounding land use at the three RHS sites was recorded as predominantly deciduous woodland with scrub and shrub and rough pasture present. Open water and wetland was also note around the left bank at sites 20246 and 3382 with rock and screen around the right bank at site 20786.

Rivelin 1 is likely to support predominantly high energy environments, indicated by the steep slope of the watercourse and relative absence of depositional features. However, the flow structure identified in the reach supports lower energy flows, so both are likely to be present. Although the substrate is dominated by cobble, boulder and bedrock, the presence of a significant number of riffles suggests suitable spawning habitat opportunities are present. The larger substrates and undercut banks, where present, provide suitable refuge/cover habitat opportunities for juvenile and adult fish and white-clawed crayfish. The semi-continuous presence of trees in the riparian habitat will provide an input of allochthonous energy and provide further refuge/cover opportunities for fish and white-clawed crayfish. White-clawed crayfish may also find habitat opportunities in the reinforced banks. Migration/movement of fish and sediment may potentially be impacted by the presence of the weirs in the reach.

The reduction in flow could lead to several potential impacts within Rivelin 1:

- Major risk of changes in the energy of the system associated with up to 67% reduction in flow for duration of drought option.
- Potentially major 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 protrusion of bed elements (such as larger particles) through the flow surface

for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.

- Potentially major risk of change in available aquatic habitat (flow velocity reduction and depth reduction) for periods of time during the duration of drought option, with changes to the range and abundance of flow types.
- Major risk to longitudinal connectivity from 19 noted weirs, for periods of time during the duration of drought option, noting the retention of an overall variable flow pattern.
- Moderate 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 land-based sources will be largely dormant during environmental drought. During winter refill periods, overland flow processes that add fine sediment to the channel during rainfall events will increase in-channel flows and increase velocities. Coarse sediment dynamics are unlikely to be affected.

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

### A3.15.5 River water quality

For this assessment the first sample in the reach, River Rivelin at Hollins Lane Bridge (NE-49301821), has been used. This was selected due to data quality over upstream sites. The average pH between 2010-2020 was 7.8 with a maximum temperature of 17.2°C for the same period. There is one frequently spilling CSO potentially presenting an environmental risk in the reach. A summary description of the potential risks to water quality in Rivelin 1 as a result of drought options is presented in **Table A4.21**.

**Table A4.21 Potential risks to water quality in Rivelin 1 as a result of drought options**

	Total ammonia	Oxygen	Phosphate
General quality	Ammonia concentrations were consistent with 'Good' WFD status (0.3 mg/l) throughout the monitoring period.	Dissolved oxygen saturation (%) values were consistent with 'Good' WFD status (75%) throughout the monitoring period. Some seasonality was apparent with saturation rising in late winter/spring and falling in late summer/autumn.	Orthophosphate concentrations were mostly consistent with 'Good' WFD status (0.04 mg/l) throughout the monitoring period with 28% of samples achieving 'Moderate' status or lower. Some seasonality was apparent with notable peaks in June/ August.
Flow sensitivity (diffuse pollution)	None apparent	None apparent	None apparent
WwTW presenting increased risk	None	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 one listed CSO during rainfall events.		None
Other point source pressures presenting risk	None	None	None
Summary	Moderate risk from drought options associated with CSO discharge	Moderate risk from drought options associated with CSO discharge	Minor risk from drought options

### A3.15.6 Summary of potential changes in the physical environment as a result of drought options

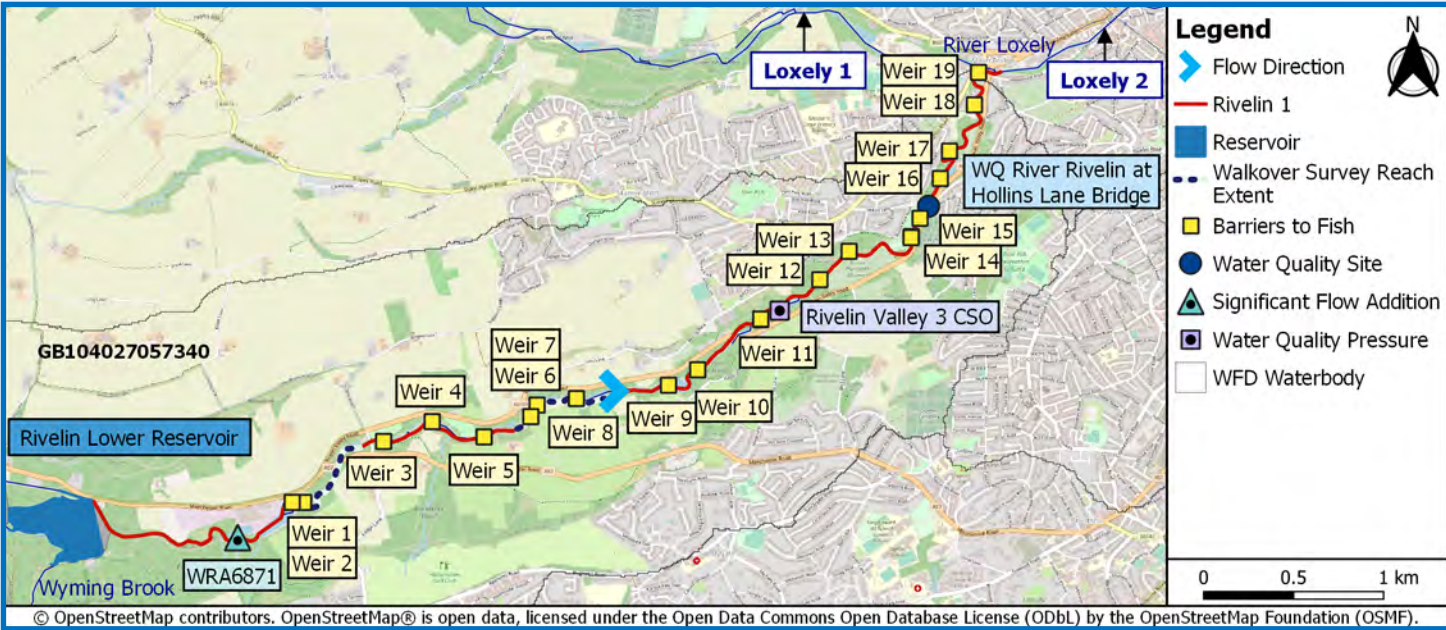
An overall summary of potential changes in the physical environment of Rivelin 1 as a result of drought options is presented in **Table A4.22**.

**Table A4.22 Summary of potential changes in the physical environment of Rivelin 1 as a result of drought options**

Physical environment aspect reviewed	Assessment of risk from implementation of drought options
<b>River flows</b> <i>Major impacts</i>	<ul style="list-style-type: none"> <li>• Reductions of up to 67% in river flows throughout the reach at any time of year that drought options implemented.</li> </ul>
<b>Flow depleted reaches</b> <i>None</i>	<ul style="list-style-type: none"> <li>• There are no flow depleted reaches within Rivelin 1.</li> </ul>
<b>River habitats</b> <i>Major risk</i>	<ul style="list-style-type: none"> <li>• The major reduction in flow will change the energy of the system</li> <li>• Potential major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting a significant variety of wetted habitats are present.</li> <li>• Major risk to longitudinal connectivity</li> <li>• Moderate risk of change in sediment dynamics.</li> </ul>
<b>Water quality</b> <i>Moderate risk</i>	<ul style="list-style-type: none"> <li>• Risk of short term acute, infrequent, temporary water quality pressures locally downstream of one listed CSO during rainfall events. There are no continuous water quality pressures identified as presenting increased risk with drought options implemented.</li> <li>• Reported water quality is predominantly consistent with 'Good' status and no apparent flow sensitivity.</li> </ul>



Reach Setting

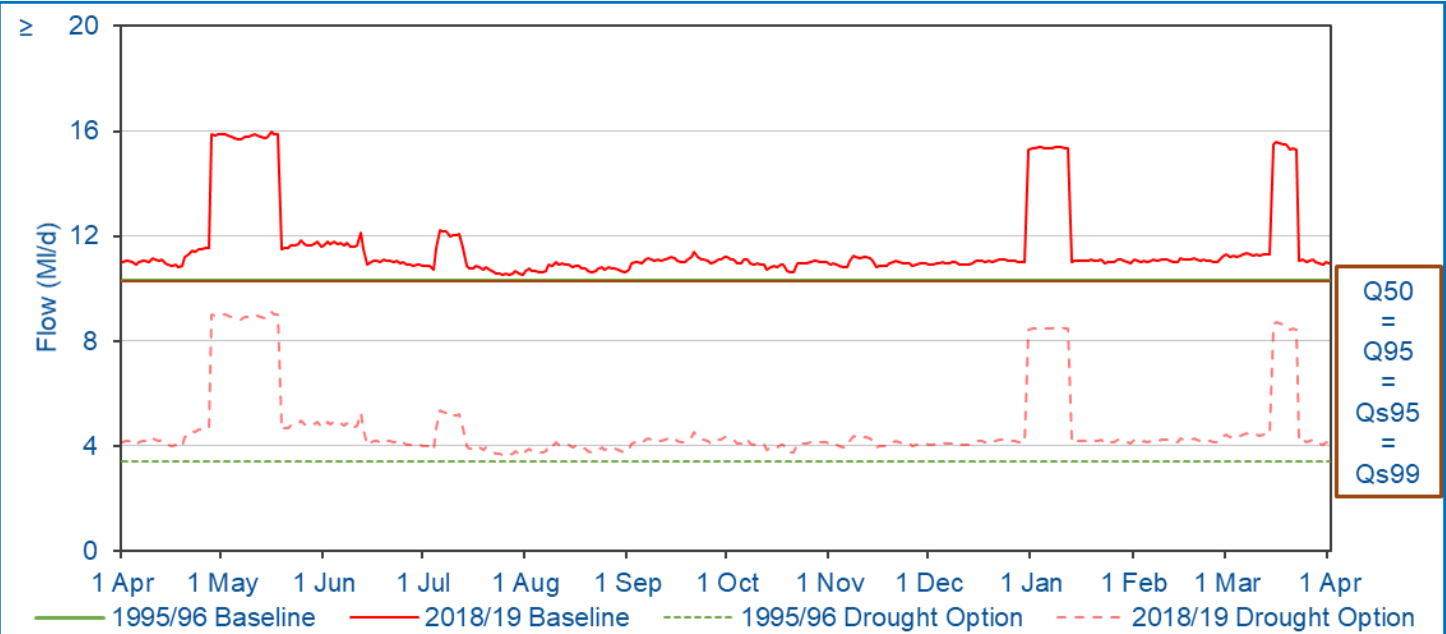


Reach Setting Information:

The bedrock geology is comprised of Carboniferous deposits of sandstone, mudstone, siltstone and coal (Millstone Grit Group and Pennine Coal Measures). The superficial geology of the reservoir catchment is limited and is predominated by peat deposits, particularly in the elevated areas of the catchment. Soils in the reservoir catchment are predominantly composed of a mixture of slowly permeable, wet, very acid upland soils, very acid, loamy upland soils and blanket bog soils. Urbanisation is relatively low in the reach until ~4.1km downstream when the river flows through the outskirts of Sheffield.

	Supplementary Information
Catchment Area at Assessment Point	18.5km <sup>2</sup>
Mean Slope Gradient	0.94 <sup>0</sup>
Length of Reach	7.3km
Additional Catchment Area	10.7km <sup>2</sup>
Upstream Reach	N/A
Downstream Reach	Loxley 2

River Flow Regime



	Reference Conditions (MI/d)	Drought Plan Conditions (MI/d)	% Reduction	Impact
Q <sub>s</sub> 95	10.30	3.40	67	Summer Major
Q <sub>s</sub> 99	10.30	3.40	67	
Q95	10.30	3.40	67	Winter Major
Q50	10.30	3.40	67	

Significant Flow Additions/Reductions	Flow Rate (MI/d)	Abstraction / Discharge
Rivelin Water Treatment Work WRA 6871	75	Discharge

River Habitats



River Water Quality

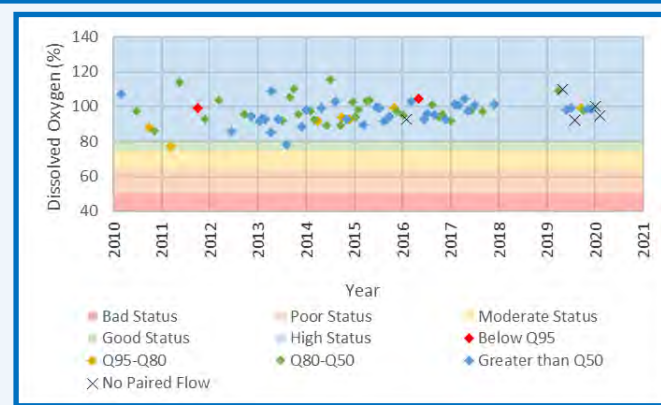
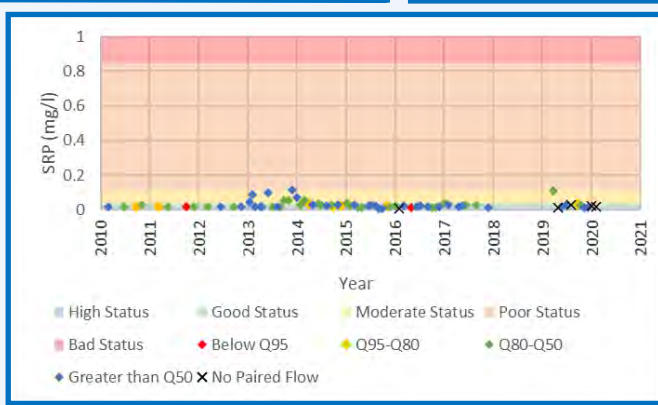
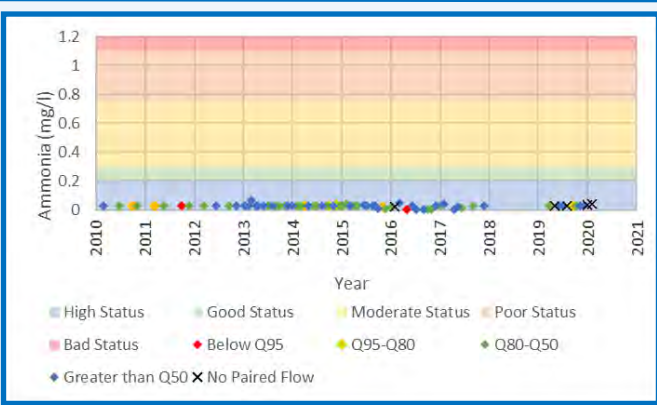
Significant Water Quality Pressures	Permit Conditions
Rivelin Valley 3/ CSO WADC1286 A1	Intermittent Discharge

In the River Rivelin at Hollins Lane Bridge (NE-49301821) the average pH between 2010-2020 was 7.8 with a maximum temperature of 17.2°C



Figure A4.11

Rivelin 1:  
Physical Environment Information





## Annex 1 – Regulated abstractions in South Area reaches

DP reach	Licence No.	Use Description	NGR 1	Max Annual Quantity (m³)	Max Daily Quantity (m³)
Don 1	NE/027/0005/008	Heat Pump	SE2119002950	15500	50
Don 1	NE/027/0005/001/R01	Pollution Remediation	SE2147202906	-	-
Don 1	NE/027/0005/007	Production of Energy	SE2090202675	12960000	51840 (Hands off flow condition of 11200)
Don 2	2/27/05/201/R01	Hydroelectric Power Generation	SE2790000626	10249200	28080
Don 4	NE/027/0005/003/R01	Fish Pass/Canoe Pass	SK3286791530	-	-
Don 5	2/27/06/006	Spray Irrigation - Direct	SK4110291676	1000000	9093
Don 5	2/27/06/006	Conveying Materials	SK4110291676	1000000	9093
Don 5	2/27/06/006	Evaporative Cooling	SK4110291676	1000000	9093
Don 5	2/27/06/006	Non-Evaporative Cooling	SK4110291676	1000000	9093
Don 5	2/27/06/006	Process Water	SK4110291676	1000000	9093
Don 5	2/27/06/026	General Cooling (Existing Licences Only) (Low Loss)	SK382896	6100000	26500
Don 5	NE/027/0006/009	Evaporative Cooling	SK4173191856	936650	3026
Don 5	NE/027/0006/013	Heat Pump	SK3871190100	150000	1200
Little Don 1	2/27/05/097	General Use Relating To Secondary Category (High Loss)	SK257991	7065455	20618
Loxley 1	NE/027/0005/020	Hydroelectric Power Generation	SK3176089625	20554560	56160
Loxley 1	NE/027/0005/020	Hydroelectric Power Generation	SK3176089625	20554560	56160

## Annex 2 – Water quality pressures considered in the assessment

Name	Permit Reference	Outfall NGR	Significant Water Quality Pressure	Intermittent/Continuous
Abbey Lane Sheffield/CSO	WRA7562 1(4)	SK 33658 83258	No	Intermittent
Abbeydale Road 46/CSO	WRA7562 1(5)	SK 33658 83258	No	Intermittent
Abbeydale Road South/CSO	WRA7562 1	SK 33658 83258	No	Intermittent
Alma Street Sheffield/CSO	EPR/DP3024GP	SK 35450 88028	No	Intermittent
Bridge End Penistone/CSO	C4960	SE 24433 03703	No	Intermittent
Bridge Street Courts/CSO	WADC752	SK 35691 87753	No	Intermittent
Broadfield Road/CSO	WRA8499 1	SK 34762 84768	No	Intermittent
Burgoyne Road/CSO	3431(SS)	SK 34229 88852	No	Intermittent
Burnaby Crescent/CSO	3430(SS)	SK 34084 89449	No	Intermittent
Catchbar Lane/CSO	WRA8504	SK 33092 90625	No	Intermittent
Claywheels Lane/CSO	WADC833	SK 32795 91656	No	Intermittent
Dudley Road/CSO	EPR/UP3128XD	SK 32973 90870	No	Intermittent
Dvisa A22 Gilpin Street/CSO	WRA7031	SK 34475 88633	No	Intermittent
Fraser Drive/CSO	WRA7482 A2	SK 34629 83151	No	Intermittent
Gibson Lane/No 2 CSO	WRA8520	SK 26992 98596	No	Intermittent
Glen Bridge/CSO	WRA7981	SK 31150 87828	No	Intermittent
Green Brook Place/CSO	EPR/EP3225XP	SE 24985 02799	No	Intermittent
Hangingwater Road/CSO	WRA6682 A1	SK 3163 8531	No	Intermittent
Hastilar Road South/CSO	218 A1	SK 39955 85004	No	Intermittent
Herries Road/No 2 CSO	WRA8261	SK 33767 90737	Yes	Intermittent
Hill Bridge/CSO	WRA9131	SK 33276 89572	No	Intermittent
Holme Lane Sheffield/CSO	WRA8509	SK3342589701	No	Intermittent
Holme Lane Sypte/CSO	WRA8514	SK 32799 89335	No	Intermittent
Holme Lane/CSO	27/24/0188	SE 6156 3264	No	Intermittent
Holme Lane/CSO	WRA8509	SK33420 89700	No	Intermittent
Hunshelf Road/No 2 CSO	WRA8524	SK 27304 98452	No	Intermittent
Langsett Road/CSO	WRA8454	SK 31514 92502	No	Intermittent
Manchester Rd Garage/CSO	WRA8521	SK 29029 97973	No	Intermittent
Manchester Road Weir/CSO	WRA8523	SK 28483 98153	Yes	Intermittent
Parkside Road/CSO	WRA9195	SK 33264 90517	No	Intermittent
Rivelin Valley 3/CSO	WADC1286	SK 31430 87987	Yes	Intermittent
Rudyard Road/CSO	WRA9134	SK 33310 89618	No	Intermittent
Sicey Avenue/CSO	WRA8166 A1	SK 36627 93759	No	Intermittent
Springvale/CSO	2002	SE2574 0321	No	Intermittent
Stannington Road/No 2 CSO	735	SK 32507 89293	No	Intermittent
Station Lane W17/No 2 CSO	WRA8155	SK 30795 93368	No	Intermittent
Stocksbridge/CSO	3300(SS)	SK 29053 97798	No	Intermittent
Thurgoland/CSO	2992	SE 2930 0010	Yes	Intermittent
Thurlstone Road/No 2 CSO	WRA8207	SE 23621 03516	No	Intermittent
Vickers Road/CSO	WRA8113 A1	SK 36777 91072	Yes	Intermittent
Waingate/CSO	WRA9130	SK 35724 87758	No	Intermittent
Watersmeet Road/No 1 CSO	318	SK 32660 89308	No	Intermittent
Whams Road/No 2 CSO	WRA8685	SE 1916 0412	No	Intermittent
Wharncliffe West/CSO	YWUCD1/107	SK 29891 94513	No	Intermittent
Wisewood Road/CSO	WRA9024	SK 32405 89402	No	Intermittent
Aldwarke WWTW	C4954	SK4507494392	No	Continuous
Beulah Road Premises	WRA7289	SK3390090300	No	Continuous
Blackburn Meadows STW	E25	SK4053491922	Yes	Continuous

Name	Permit Reference	Outfall NGR	Significant Water Quality Pressure	Intermittent/Continuous
Bullhouse Mill	WRA7530	SE2120002950	No	Continuous
Bullhouse Minewater Project	WRA7526	SE2155002910	No	Continuous
Carlecotes STW	556	SE1817502736	No	Continuous
Cheesebottom STW	2556	SE2792001270	Yes	Continuous
Crow Edge STW	1614	SE1935003980	No	Continuous
Dunford Bridge STW	E684(SS)	SE1614102461	No	Continuous
Dungworth STW	E685(SS)	SK2879290208	No	Continuous
Ewden Village STW	C5298	SK2725595929	Yes	Continuous
Ewden WwTW	EPRMB3797WP	SK2982195770	Yes	Continuous
Ingbirchworth STW	WRA7365	SE2422603763	No	Continuous
Langsett STW	3701(SS)	SE2183200378	No	Continuous
Livesey Street Premises	WRA 6752	SK3371090350	No	Continuous
Midhopestones STW	3740(SS)	SK2374699738	No	Continuous
More Hall Works	C5299	SK2909495680	No	Continuous
Private	EPRGP3129XK	SE2118302999	No	Continuous
Private	3335	SK2970099100	No	Continuous
Private	WA6494	SK3122093510	No	Continuous
Private	3181	SK3390090300	No	Continuous
Scout Dyke STW	E696(SS)	SE2370004600	Yes	Continuous
Wentworth Castle	E702(SS)	SE3206203924	No	Continuous
Wharncliffe Side STW	E704(SS)	SK2999094550	Yes	Continuous
Wortley East STW	3717(SS)	SE3272801728	No	Continuous
Wortley West STW	E757(SS)	SK2975999079	No	Continuous

## Appendix B – Environmental Features



## B1. Introduction

This appendix assesses the potential impacts on the environmental features of the South Area river catchment during the period of implementation of associated drought options.

The South area Agency Reservoirs comprise six drought options as reported in this appendix:

1. Scout Dyke Reservoir drought permit
2. Winscar/Windleden Lower Reservoir drought permit
3. Underbank Reservoir drought permit
4. More Hall Reservoir drought permit
5. Damflask Reservoir drought permit
6. Rivelin Reservoir drought permit

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<sup>1</sup>.

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 **Figures B1.1** and **B1.2**. Note that the only local wildlife sites mapped on the figures are those which were agreed with the Environment Agency in 2019 as having water dependent receptors.

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

1. Statutory designated sites
2. NERC and local wildlife sites
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 – this includes for each reach:

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

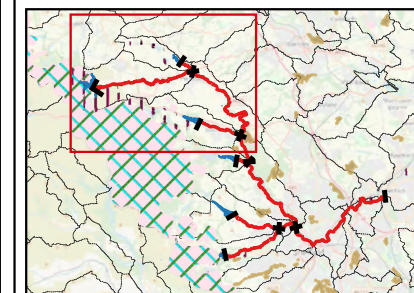
1. Features assessment
2. Summary of impacts.

## Section B.5      Monitoring and mitigation



## Legend

- River Reaches
- Reach Divides
- Reservoirs
- ▶ Flow Direction
-  Macroinvertebrate Site
-  Fish Site
- 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

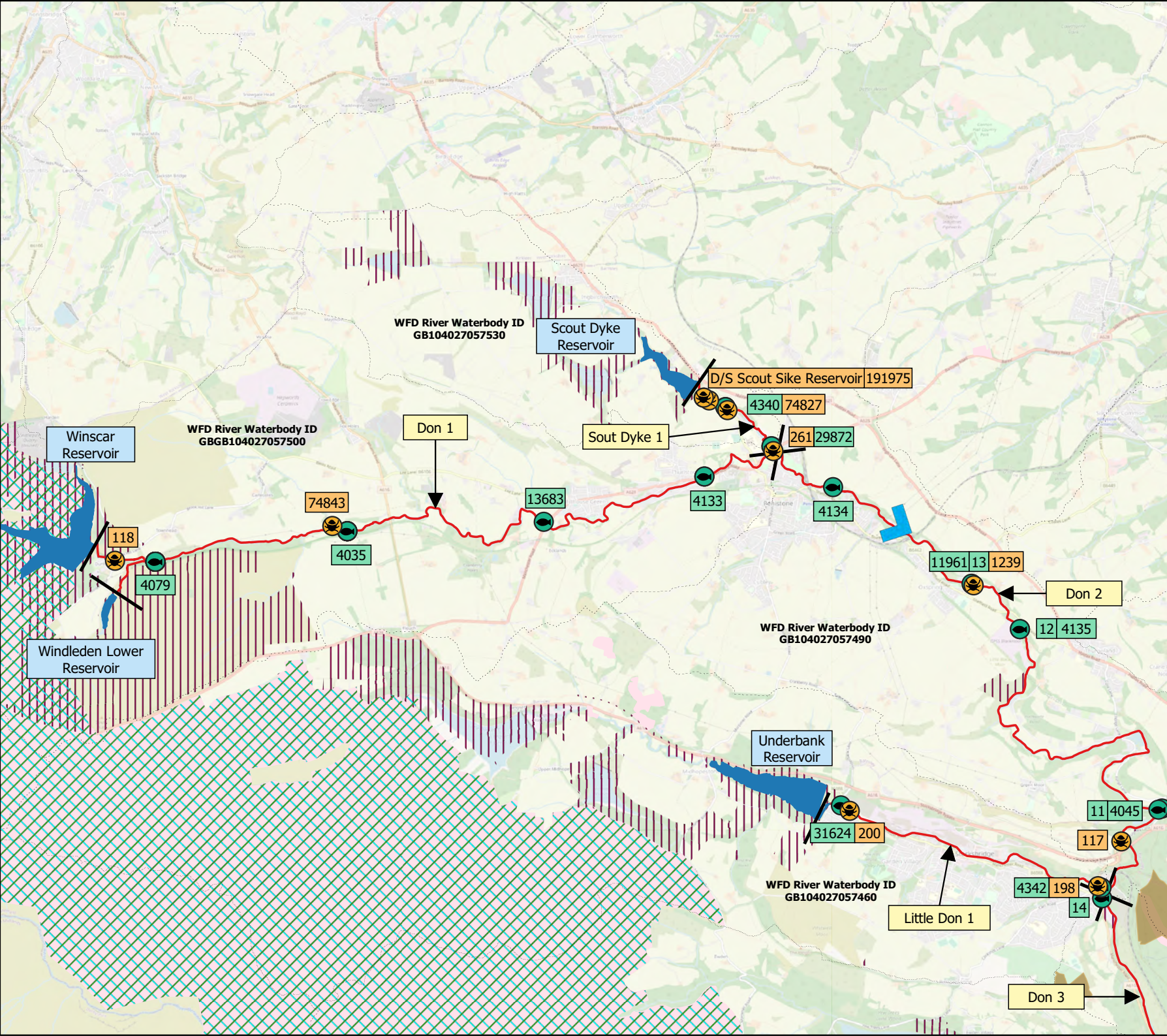
**Figure title:**  
South Ecology

Figure B1.1 **Date:** August 2020

**NGR:** SE 22678 01529 **Scale:** 1:66000


Note: All locations are approximate

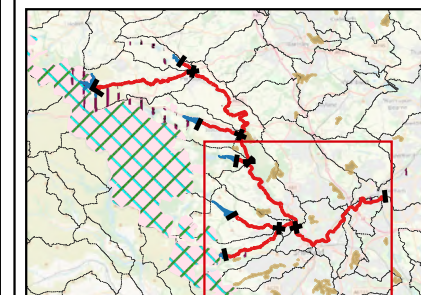
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## Legend

- River Reaches
- Reach Divides
- Reservoirs
- ▶ Flow Direction
-  Macroinvertebrate Site
-  Fish Site
- Local Nature Reserves
- |||| Local Wildlife Sites
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- ▨ Special Protection Areas
- Sites of Special Scientific Interest
- WFD Management Catchment



## Project title:

Yorkshire Water Drought Plan  
Environmental Assessment

## Figure title:

South Ecology

Figure B1.2

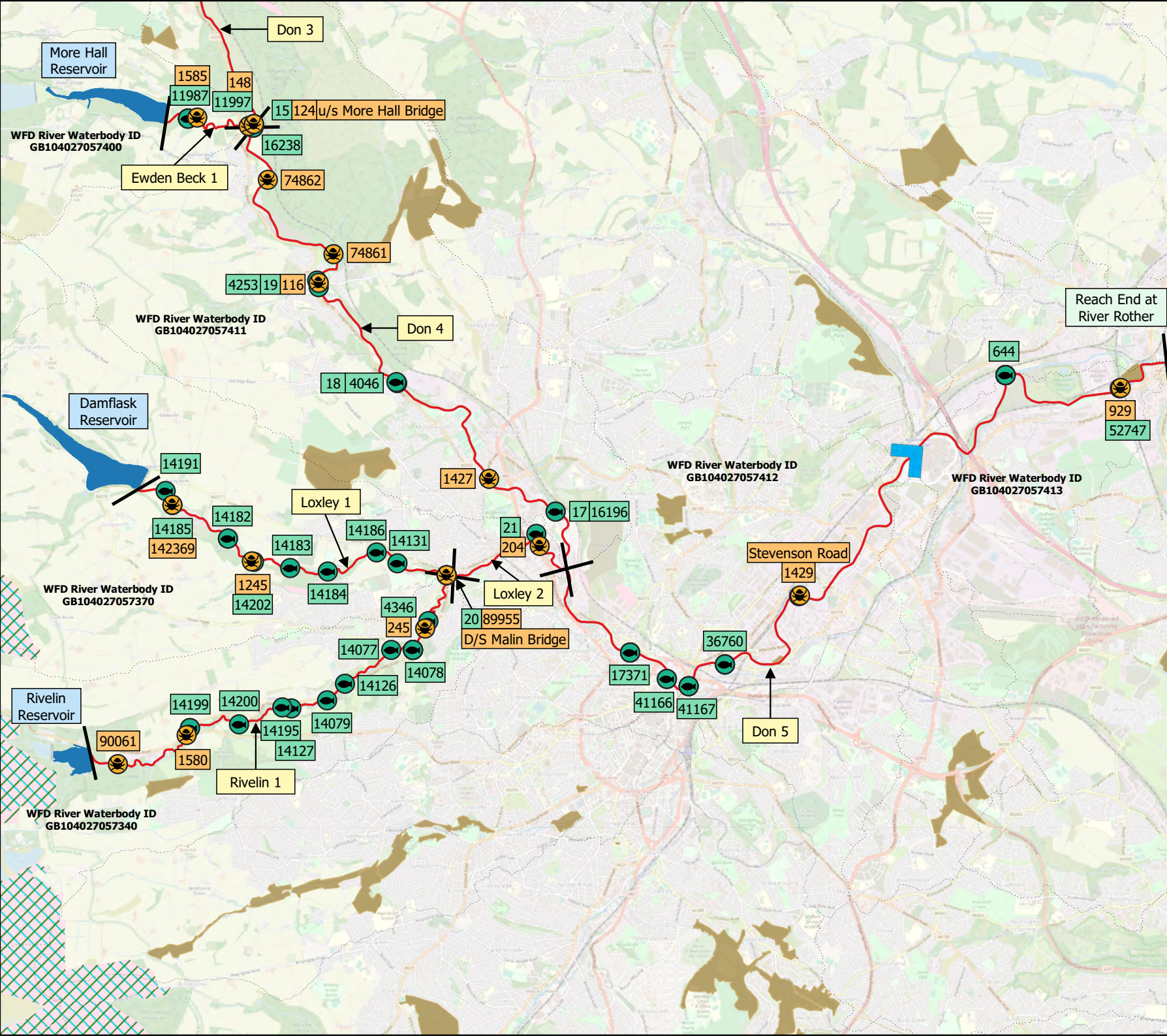
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Note: All locations are approximate

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## 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<sup>2</sup>.

### B2.1 Don 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.

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.1**).

**Table B2.1** Statutory 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)
Wharnccliffe Craggs SSSI	Major	Wharnccliffe Craggs SSSI comprises natural sandstone outcrops that are of geological interest. The crags here are the best available exposure in the Upper Carboniferous (approximately 300 million years old) sandstones of the Wharnccliffe Edge Rock Formation. The site is unlikely to be affected by hydrological changes within the zone of influence of Scout Dyke reservoir.	Not sensitive	No
Wharnccliffe Heaths LNR	Major	Situated above Wharnccliffe Craggs overlooking the Don Valley to the northwest of Sheffield. It lies in an area of outstanding local natural history and archaeological interest and protects one of the few remaining remnants of a formerly much larger heathland complex. The site is unlikely to be affected by hydrological changes within the zone of influence of Scout Dyke reservoir.	Not sensitive	No
The Dark Peak SSSI	Major	None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.	Not sensitive	No
South Pennine Moors SAC	Major	None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley	Not sensitive	No

<sup>2</sup> Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

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)
Peak District Moors (South Pennine Moors Phase 1) SPA	Major	are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.  None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.	Not sensitive	No

## B2.1.2 NERC and local wildlife sites

**Table B2.2** summarises 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)
Wogden Foot, Dunford Bridge LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors.	Not sensitive	No
Western Moors LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors.	Not sensitive	No
NERC Habitat – Blanket bog -18982 -18972	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Cotton grass moorland.	Not sensitive	No
NERC Habitat - Blanket bog -19541	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Dry bog non-heather dominant.	Not sensitive	No
NERC Habitat - Blanket bog -526337 -13952 -13951	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Blanket bog, Upland flushes, fens and swamps, Fragmented heath, Upland heath, Grass moorland and rough grazing	Not sensitive	No
NERC Habitat - Blanket bog -13991 -13993	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Blanket bog, Upland heathland, Upland flushes, fens and swamps, Fragmented heath, Upland	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)
-13992 -13959 -13961 -13960 -13976		heath, Grass moorland and rough grazing		
NERC Habitat - Deciduous woodland -315253 -315254 -315256	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Lowland heath, Lowland meadows and pastures	Not sensitive	No
NERC Habitat - Good quality semi-improved grassland -362411 -362410 -362405 -362404 -362403	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Lowland meadows and pastures; Restoration of species-rich, semi-natural grassland	Not sensitive	No
NERC Habitat - Good quality semi-improved grassland -360076 -360961 -360960 -360962	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Restoration of species-rich, semi-natural grassland	Not sensitive	No
NERC Habitat - Grass moorland -369324 -369384	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Blanket bog, Fragmented heath, Upland heath, Grass moorland and rough grazing	Not sensitive	No
NERC Habitat - Lowland heathland -414343 -414345 -414344 -414346 -414421 -414420 -414419	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors.	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)
-414261 -414259 NERC Habitat - Lowland heathland -414447	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Upland flushes, fens and swamps	Not sensitive	No
NERC Habitat - No main habitat but additional habitats present -442487 -442486	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Lowland heath.	Not sensitive	No
NERC Habitat - Upland heathland -499103	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Bilberry/crowberry moorland.	Not sensitive	No
NERC Habitat - Upland heathland -499698	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. Heather moor.	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.

White-clawed crayfish are a NERC Act Section 41 species and are sensitive to habitat modification from the management of waterbodies. Data obtained from the Environment Agency and YWSL, as well as a review of available data from NBN gateway was used inform the assessment of the feature in the impacted reach. White-clawed crayfish surveys carried out by YWSL in 2016 in Don 1 found no evidence of white-clawed crayfish. The Environment Agency reported that signal crayfish were recorded near Millhouse Green (at SE2155302908) in October 2018. Given the dense populations of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.

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 otter 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**.

Four NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout and European eel) and two notable fish species (bullhead and grayling).

The IUCN Near Threatened water beetle *Oreodytes davisii* have been identified as being present in Don 1. The species was identified in routine sampling carried out by the Environment Agency at the site D/S Windledon bridge in 2015. One specimen was present. Based on the available information this feature is not considered to be susceptible to drought permit impacts and have a **low** sensitivity to the physical environment impacts identified in **Appendix A**.

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**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 ( <i>Austropotamobius pallipes</i> )	Major	Given the presence of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present, and they are not considered further for this reach.	Not sensitive	No
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout <i>Salmo trutta</i> -European eel ( <i>Anguilla anguilla</i> )	Major	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	Major	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	High	Yes

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)
Grayling ( <i>Thymallus thymallus</i> ) Bullhead ( <i>Cottus gobio</i> )		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.		
Notable Species – Invertebrates -Water beetle ( <i>Oreodytes davisii</i> )	Major	This species is moderately tolerant/sensitive of pollution (WHPT scores of 4.5) and such water quality pressures are unlikely to impact the species.	Low	Yes
NERC and Notable species – Birds There are many bird species present across the region	Major	The following bird species to varying extents rely on water dependent habitats. However, they are not expected to be impacted severely from implementation of the drought option against a baseline of reduced flows characteristic of drought: -Little ringed plover ( <i>Charadrius dutius</i> ) - Snipe ( <i>Gallinago gallinago</i> ) - House martin ( <i>Delichon urbica</i> ) - Swallow ( <i>Hirundo rustica</i> ) - Grey wagtail ( <i>Motacilla cinerea</i> )	Not sensitive	No

## B2.1.4 WFD features

### B2.1.4.1 Macroinvertebrates

The WFD waterbody GB104027057500 Don from Source to Scout Dyke classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by three Environment Agency monitoring sites, Dunford Bridge (ID 118), U/S Scout Dyke (162382) and D/S Windledon Bridge (ID 74843). Dunford Bridge had baseline survey data for two seasonal samples for 2009, 2010, and 2012 to 2019. D/S Windledon Bridge had baseline survey data for two seasonal samples for 2012 to 2019. U/S Scout Dyke had baseline survey data for two seasonal samples for 2013 and 2014.

The WFD status of the macroinvertebrate community in Don 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 Don 1 has medium to high sensitivity to reduced flows, with the upstream site (ID118) showing medium to high sensitivity while the downstream (ID 74843) highly sensitivity (**Figure B 2.1**). 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

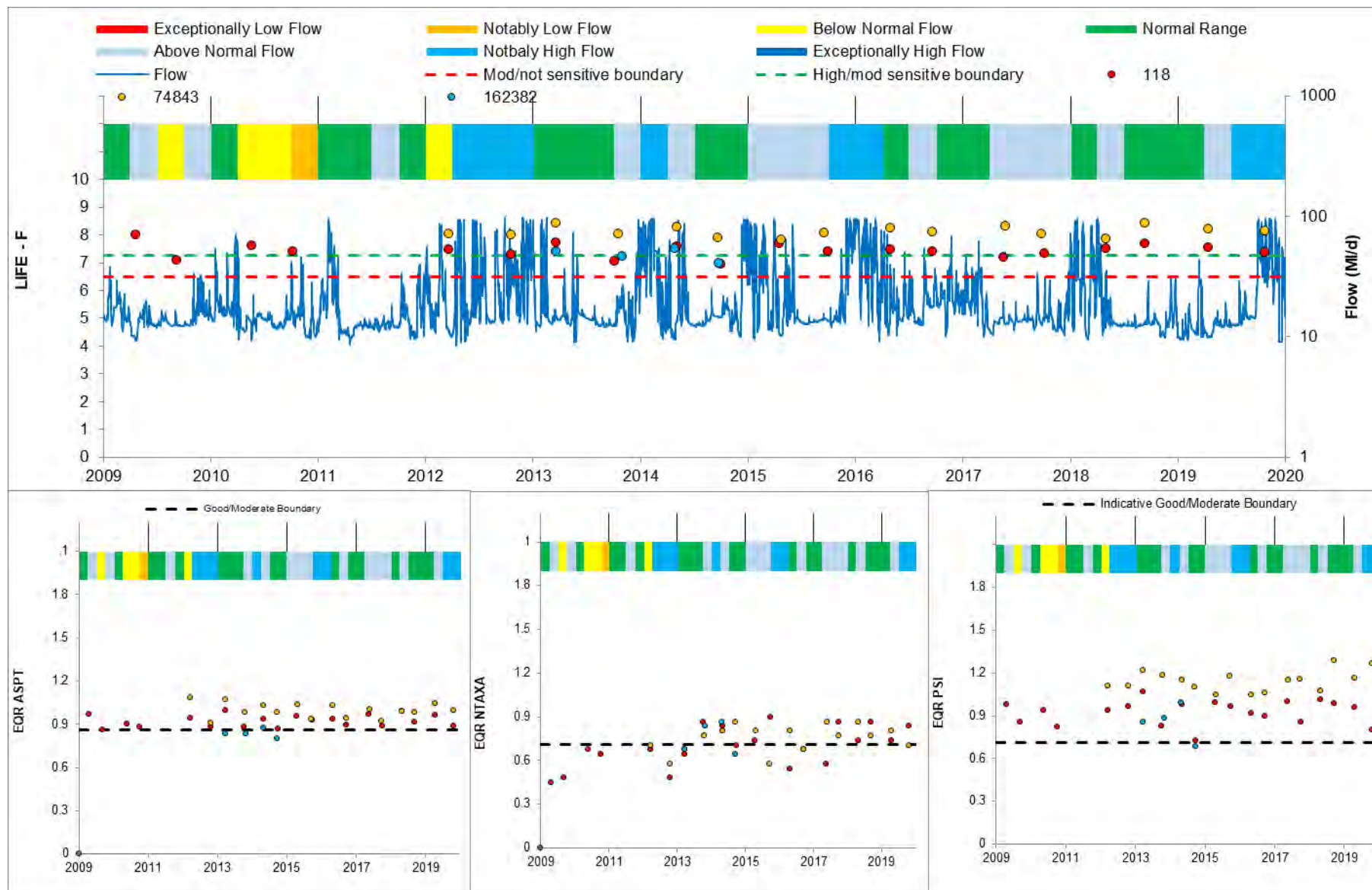
WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> scores are available for the site. WHPT and PSI EQR scores are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B 2.1**.

Data from the monitoring sites shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve good or high WFD status over the monitoring period, with only two instances at site ID 118 (autumn 2009 and 2014) and three instances at site ID 162382 (autumn 2013/14 and autumn 2014) which were indicative of moderate WFD status. WHPT<sub>ASPT</sub> 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<sub>ASPT</sub> scores ranging between 5.74 and 7.79. 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 Don 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 14 and 28. WHPT<sub>NTAXA</sub> EQR scores showed significant variance between seasonal surveys, ranging between 0.45 and 0.90, indicative of bad to high ecological status. This suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B 2.1 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

Waterbody GB104027057500 Don from Source to Scout Dyke is classified under Cycle 2 (2016) as moderate. Baseline fisheries data is informed by four sites, Dunford Bridge (Lower) (ID4079), Soughley Farm (ID 4035), Thurlstone (ID 4133), Bull House Bridge (ID 13683). Dunford Bridge (Lower) was surveyed in 2009 to 2013, 2015 and 2017 to 2019. Soughley Farm was surveyed in 2009 to 2012 and 2017 to 2019. Thurlstone and Bull House Bridge were surveyed in 201 and 2017. **Table B2.5** sets out the available fish survey data from these sites.

The WFD status of the fish community in Don 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.

The site Soughley Farm is individually classified as moderate with a site EQR of 0.2094, based on the FCS2 EQR scores from the 2018 survey. The site has a relatively poor diversity, with one species present from an expected three species. Trout are observed at the site at lower densities than expected, contributing to a poor EQR score of 0.3423. Bullhead and stone loach were expected to be observed at the site, with an expected prevalence of greater than 50%, being more likely to occur at the site than not.

The site Bull House Bridge is individually classified as moderate with a site EQR of 0.3188, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with three species present from an expected three species. Trout are observed at the site at lower densities than expected, contributing to a poor EQR score of 0.583. The EQR score for grayling was high than expected at 0.7527. 3-spined stickleback were expected to be observed at the site, with an expected prevalence of greater than 50%, being more likely to occur at the site than not. Though diversity at the site was good, with three species observed, bullhead were absent when expected with a prevalence >50%.

Baseline fish data for sites within the impacted reach showed similar species diversity with the classification site. The number of brown trout at Dunford Bridge (Lower) showed an increase from 2009 to 2013, while maintain a moderate number of individuals thereafter. Thurlstone recorded a low number of brown trout and bullhead in both 2011 and 2017, while a single grayling was also recorded in 2017. The survey data from all four sites indicate that a medium population of brown trout and bullhead are likely to be present, with a low population of grayling also present in the impacted reach.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 Don 1**

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	3-spined stickleback
4035	Soughley Farm	19/08/2009	Single Catch Sample	91			
		25/08/2010	Single Catch Sample	108			
		12/09/2011	Single Catch Sample	66			
		04/09/2012	Catch Depletion Sample	63			
		04/09/2017	Single Catch Sample	93			
		09/10/2018	Single Catch Sample	60			

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	3-spined stickleback
		19/08/2019	Single Catch Sample	69			
4079	Dunford Bridge (lower site)	19/08/2009	Catch Depletion Sample	74			
		25/08/2010	Single Catch Sample	62	1 to 9 [Survey]		
		12/09/2011	Single Catch Sample	75			
		07/08/2012	Single Catch Sample	108			
		30/08/2013	Single Catch Sample	120			
		14/09/2015	Single Catch Sample	101			
		04/09/2017	Single Catch Sample	106			
		09/10/2018	Single Catch Sample	113			
		19/08/2019	Single Catch Sample	102			
4133	Thurlstone	06/09/2011	Single Catch Sample	15	4		
		04/09/2017	Single Catch Sample	4	17	1	
13683	Bull House Bridge	12/09/2011	Single Catch Sample	36		1	
		04/09/2017	Single Catch Sample	89		1	1

#### 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 objective 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			GB104027057500 Don from Source to Scout Dyke	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment (Major, Moderate, Minor, Negligible)	Impact at Location		Major	
	Overall		Moderate	
RBMP Cycle 2 Status/ Potential	Fish		Moderate	Medium
	Macroinvertebrates		Good	Medium
Hydro-morph designation			Heavily modified	
RBMP2 Waterbody Objective	Overall		Good	
	Fish		Moderate	
	Macroinvertebrates		Good	
Waterbody Measures			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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Northern Crangonyctid ( <i>Crangonyx pseudogracilis</i> ) -Signal crayfish ( <i>Pacifastacus leniusculus</i> )	Major	The implementation of this drought option is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> )	Major	The implementation of this drought option 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)
Trans Pennine Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Barnsley Boundary Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
River Don - canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No
River Don - angling	Major	Due to length of reach affected and level of reduction combined with the angling being carried out by organised clubs on leased land, however, flows during a drought will be low such that further	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)
		reduction in flows would not be likely to further reduce the angling quality of the reach.		

## B2.2 Don 2

### B2.2.1 Statutory designated sites

**Table B2.9** 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 B2.9**).

**Table B2.9** Statutory 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)
Townend Common LNR	Major	No water dependent features	Not sensitive	No

### B2.2.2 NERC and local wildlife sites

**Table B2.10** 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 B2.10**).

**Table B2.10** 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)
Black Moor Common LWS	Major	The site contains lowland mixed deciduous woodland, lowland dry acidic grassland, lowland heathland, scrub and nearby river corridor type habitats.	Not sensitive	No
Romicle Viaduct & Thurgoland Tunnels LWS	Major	Running water, Semi-natural Woodland, Tall Ruderal, scrub. The site encompasses part of a disused railway line forming part of the Trans-Pennine Way. The site includes the River Don which runs through the site.	Medium	Yes
Glow Worm Site LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors. The site encompasses part of a disused railway line forming part of the Trans-Pennine Way. Either	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)
		Semi-natural broadleaved woodlands dominated by oak and birch or ash and sycamore, modified neutral grassland or dense/continuous scrub line the railway. Areas of tall ruderal herbs are present. Up to 150 glowing females have been recorded.		
Forge Rocher and Tin Mill Rocher LWS	Major	The River Don runs along the east side of the site and is partially encompassed by the site boundary. Most of the site is ancient or lowland mixed deciduous woodland including wet woodland. Two large ponds are present and potentially connected to the river.	Low	Yes
Wharnccliffe Chase and Wood LWS	Major	Wharnccliffe Chase and Wood is a located east of the River Don. The site contains ancient woodland, lowland mixed deciduous woodland, lowland dry acid grassland, ponds and running water habitats. The River Don is not within the site boundary and the included running water features references to small streams and brooks which flow down into the River Don.	Not sensitive	No

### B2.2.3 NERC and other protected species

**Table B2.11** summaries the NERC Act Section 41 and other protected species which are located on or within 500m of the impacted reach.

White-clawed crayfish are a NERC Act Section 41 species and are sensitive to habitat modification from the management of waterbodies. Data obtained from the Environment Agency and YWSL, as well as a review of available data from NBN gateway was used inform the assessment of the feature in the impacted reach. White-clawed crayfish surveys carried out by YWSL in 2016 in Don 2 found no evidence of white-clawed crayfish. The Environment Agency reported that signal crayfish were recorded near Millhouse Green (at SE2155302908) in October 2018 and that they are common in the River Don to Wortley. Given the dense populations of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.

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 reach, 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 otter 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**.

Four NERC act section 41 and notable fish species have been identified as present in the impacted reach, including two NERC Act Section 41 fish species (brown trout and European eel) and two notable fish species (bullhead and grayling).

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**Table B2.11 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 ( <i>Austropotamobius pallipes</i> )	Major	Given the presence of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.	Not sensitive	No
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout <i>Salmo trutta</i> -European eel ( <i>Anguilla anguilla</i> )	Major	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 ( <i>Thymallus thymallus</i> ) Bullhead ( <i>Cottus gobio</i> )	Major	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	High	Yes

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)
		change is very high over a long reach of the watercourse. Predation could occur on fish stranded in pools in high densities.		
NERC and Notable species – Birds  There are many bird species present across the region	Major	The following bird species to varying extents rely on water dependent habitats. However, they are not expected to be impacted severely from implementation of the drought option against a baseline of reduced flows characteristic of drought: - Willow tit ( <i>Parus montanus</i> ) - Lapwing ( <i>Vanellus vanellus</i> )	Not sensitive	No
Notable Species – Plant  Bluebell ( <i>Hyacinthoides non-scripta</i> )	Major	The current factors affecting this species are: - Habitat loss, particularly woodland and hedgerows - Climate change - Bulb removal for gardens - Trampling - Competition and hybridisation with Spanish bluebell  Therefore, this species is unlikely to be significantly affected by hydrological impacts.	Not sensitive	No

## B2.2.4 WFD features

### B2.2.4.1 Macroinvertebrates

The WFD waterbody GB104027057490 Don from Scout Dyke to the Little Don classifies as 'moderate' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by two Environment Agency monitoring sites, Oxspring Bridge (1239), and Soughley Bridge (117). Soughley Bridge and Oxspring Bridge had baseline survey data for two seasonal samples for 2013, 2014 and 2017.

The WFD status of the macroinvertebrate community in Don 2 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 Don 2 has medium to high sensitivity to reduced flows (**Figure B2.2**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.2**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve good or moderate WFD status over the monitoring period. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed

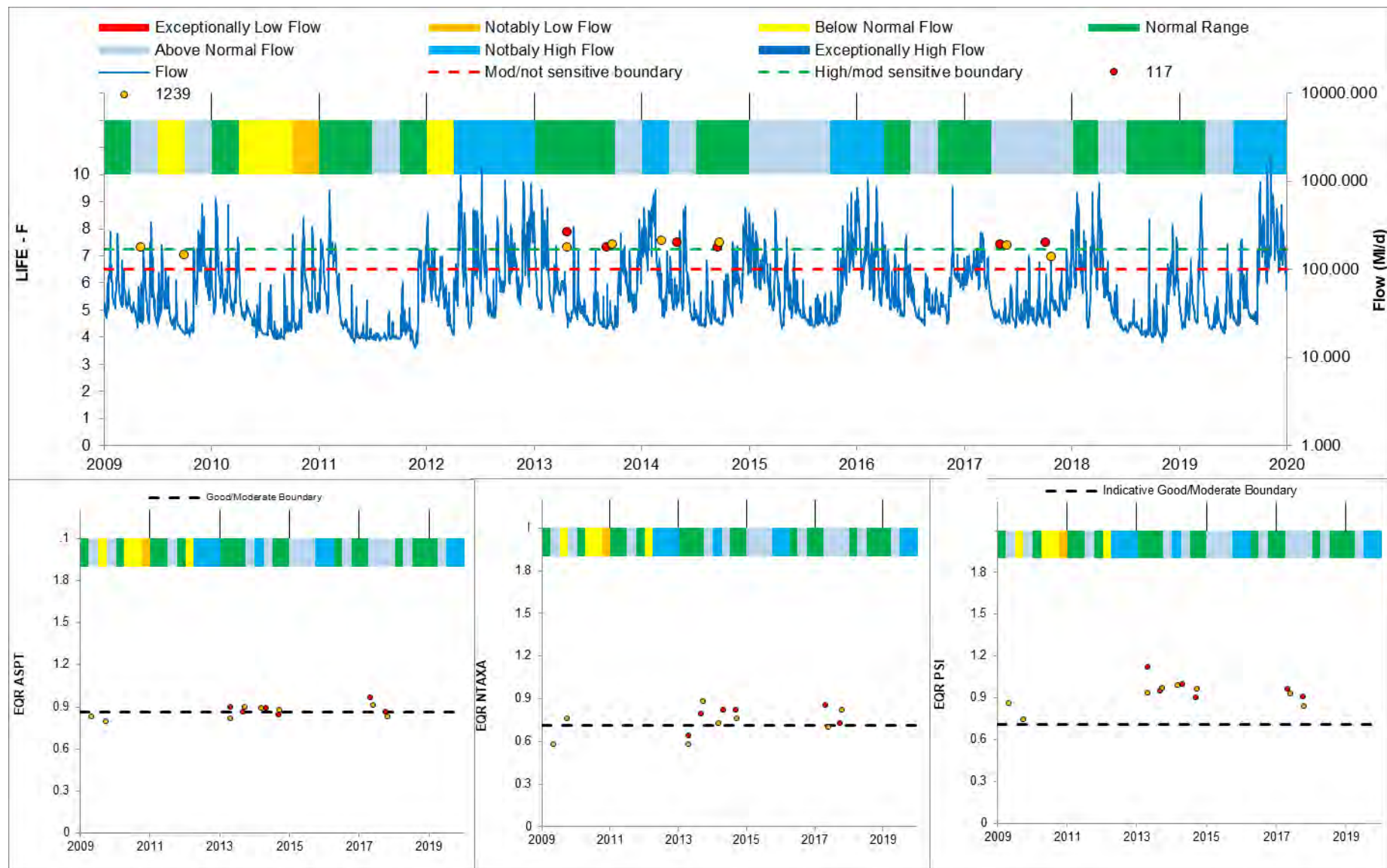
of a medium to good proportion of taxa which are sensitive to pressures including water quality. WHPT<sub>ASPT</sub> scores ranging between 5.54 and 6.72.

In Don 2 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 19 and 29. WHPT<sub>NTAXA</sub> EQR scores showed significant variance between seasonal surveys, ranging between 0.58 and 0.88, indicative of poor to moderate ecological status, with only Oxspring Bridge's 2013 autumn survey indicative of good. This suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B2.2** LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.2.4.2 Fish

Waterbody GB104027057490 Don from Scout Dyke to the Little Don is classified under Cycle 2 (2016) as good. This classification is informed by four sites, Baseline fisheries data is informed by four Environment Agency sites; Oxspring Bridge (11961), Penistone Cricket Club (4134), Cheesebottom STW (4135 and Wortley (4045). Monitoring of the fish community at this site was also undertaken from 2016 to 2018 by YWSL at the Environment Agency sites at Wortley (YW10008), Cheesebottom STW (YW10009) and Oxspring Bridge (R26). **Table B2.12** sets out the available fish survey data from these sites.

The WFD status of the fish community in Don 2 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.

The site Oxspring Bridge (WR) is individually classified as good with a site EQR of 0.436, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with all four of the four expected species present. The EQR score for trout is low at 0.2527, with an observed density below that of the expected density. Bullhead and stone loach are observed at increased numbers, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.656, though observed densities were lower than expected. The low EQR score for trout had an effect in the overall site classification, however the generally good diversity of the site positively contributed to the 'good' overall site classification.

The site Wortley is individually classified as poor with a site EQR of 0.1064, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with all four of the four expected species present. The EQR score for trout is low at 0.093, with an observed density significantly lower than the expected density. Bullhead and minnow are observed at increased numbers, with an EQR score of 1. Roach were recorded at the site with a high EQR score of 0.8227. Though grayling and stone loach are expected to be present at the site, both at a moderate prevalence of 0.6027 and 0.5102 respectively, neither species were observed. The low EQR for trout and the absence of bullhead and stone loach had a significant overall effect on the site EQR value.

Sites within the impacted reach (Don 2) showed fish populations similar to the classification sites, with a moderate abundance of trout and bullhead throughout the reach. A low abundance of grayling, stone loach, minnow, 3-spined stickleback, perch and roach were intermittently recorded through the sites, with Penistone Cricket Club only recording stone loach from the previously mentioned species. at Burney Road in 2010.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.12 Fish survey data from Don 2**

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	Stone loach	Minnow	3-spined stickleback	Perch	Roach
4045	Wortley	08/09/2011	Single Catch Sample	37	10	4	1				
		28/09/2017	Single Catch Sample	6	1			6			1
4134	Penistone Cricket Club	07/09/2011	Single Catch Sample	25	2		2				
		07/09/2017	Single Catch Sample	64	52		3				
4135	Cheesebottom STW	07/09/2011	Catch Depletion Sample	37	35						
		28/09/2017	Single Catch Sample	24	21	4	1	2	1		
11961	Oxspring Bridge (WR)	07/09/2011	Single Catch Sample	64	8	3	3	6		1	
R26	Oxspring	03/09/2015	Catch Depletion Sample	53	39	1	8	1		1	
		31/08/2016	Catch Depletion Sample	23							
		08/08/2018	Catch Depletion Sample	67	113	5	49	16	1	1	
		24/08/2017	Catch Depletion Sample	28	70	1	9	1		1	
11	Wortley	08/09/2015	Single Catch Sample	6	9		1	6		1	
		08/09/2016	Single Catch Sample	12	39	3	12	1			
		28/09/2017	Single Catch Sample	39	12	5	2			2	
		08/08/2018	Single Catch Sample	7	5			3	1	2	1
12	Cheesebottom STW	08/09/2015	Single Catch Sample	48	14	6	1				
		08/09/2016	Single Catch Sample	18	15	1					
		28/09/2017	Catch Depletion Sample	6	1			6			1
		08/08/2018	Single Catch Sample	24	21	4	1	2	1		

#### B2.2.4.3 WFD waterbody status

**Table B2.13** summarises the WFD classification of waterbody which contain the impacted reach. **Table B.13** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.13 WFD classifications**

Waterbody ID & Name		GB104027057490 Don from Scout Dyke to the Little Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
	Overall	Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Good	Medium
	Macroinvertebrates	Moderate	Medium
Hydro-morph designation		Heavily modified	
	Overall	Moderate	
RBMP2 Waterbody Objective	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

## B2.2.5 Invasive non-native species (INNS)

**Table B2.14** 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 B2.14**).

**Table B2.14 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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Northern Crangonyctid ( <i>Crangonyx pseudogracilis</i> ) -Signal crayfish ( <i>Pacifastacus leniusculus</i> ) -Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought option is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> ) -Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought option is not anticipated to increase the spread of Invasive non-native species.	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)
Invasive non-native species – fish -Rainbow trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought option is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.2.6 Landscape, navigation, recreation and heritage

**Table B2.15** 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 B2.15**).

**Table B2.15 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)
Trans Pennine Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Stocksbridge and District Golf Course	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Barnsley Boundary Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Wortly Top Forge – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Water powered bloomery, Iron Forge and Rolling Mill at Low Forge – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Romano-British settlement at Finkle Street – Scheduled Ancient Monument	Major	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)
Iron Age and Roman Quern workings on Wharncliffe Rocks – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
River Don - canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No
River Don - angling	Major	Due to length of reach affected and level of reduction combined with the angling being carried out by organised clubs on leased land, however, 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

## B2.3 Don 3

### B2.3.1 Statutory designated sites

**Table B2.16** 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 B2.16**).

**Table B2.16** Statutory 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)
Townend Common LNR	Major	No water dependent features	Not sensitive	No
Wharnccliffe Craggs SSSI	Major	This site lies in extensive woodlands overlooking the River Don valley. Areas of birch/oak woodland, down-slope from the cliff face and dry heathland, on flat ground at the top of the hill, occur within the site. It is the geological features displayed in the cliff face that are of special interest. No water dependent features	Not sensitive	No
Wharnccliffe Heath LNR	Major	Site is situated above Wharnccliffe Craggs overlooking Don Valley. No water dependent features	Not sensitive	No
Wheata Woods LNR	Major	Wheata Woods is a semi-natural ancient woodland supporting several UK Biodiversity Action plan priority species and habitats such as wet woodland.  Wheata Woods has limited aquatic habitat present with semi-natural ancient woodland the predominant feature. Some minor watercourse feed into Sough Dike before joining the River Don. The site is some distance (approximately 500m) away and at a higher elevation and will likely not be in connectivity with the impacted reach.	Not sensitive	No

### B2.3.2 NERC and local wildlife sites

**Table B2.17** 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.

Three 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 B2.17**).

**Table B2.17 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)
Wharnccliffe Chase and Wood LWS	Major	Unlikely to be in connectivity with impacted reach. Wharnccliffe Chase and Wood is located east of the River Don. The site contains ancient woodland, lowland mixed deciduous woodland, lowland dry acid grassland, ponds and running water habitats. The River Don is not within the site boundary and the included running water features references to small streams and brooks which flow down into the River Don.	Not sensitive	No
Lower Ewden Beck LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors.  The site is segmented with several areas surrounding the River Don above its confluence with the Little Don. Aerial imagery shows woodland, grassland, pasture and heathland in the upper segments. The southern areas of the site follow Lower Ewden Beck from More Hall Reservoir to its confluence with the Don. Areas of ancient upland oak woodland are present around the river. Some wet woodland is also present and are present.	Low	Yes
Upper River Don: Deepcar to Hillsborough LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  Although the site encompasses the river as it passes through urban areas, the river corridor is very species rich. The river passes close to three major ancient woodlands and the corridor is significant for dispersal and maintenance of a wide range of species. Semi-natural woodland, scrub, other tall herb, flush/spring, marsh and marginal aquatic vegetation habitats are also present.	Low	Yes
Upper River Don: Station Road, Deepcar LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site is an unmanaged field on a River Don flood plain hosting springs feeding into a shallow wetland /marsh/ wet grassland. Grassland becomes wetter southwards. The woodland along the banks of the river is ancient.	Low	Yes



### B2.3.3 NERC and other protected species

**Table B2.18** summaries the NERC Act Section 41 and other protected species which are located on or within 500m of the impacted reach.

White-clawed crayfish are a NERC Act Section 41 species and are sensitive to habitat modification from the management of waterbodies. Data obtained from the Environment Agency and YWSL, as well as a review of available data from NBN gateway was used inform the assessment of the feature in the impacted reach. No information from survey findings was available for white-clawed crayfish, therefore it was not possible to conclusively rule out their presence. However, the Environment Agency reported that signal crayfish are common in the River Don. Given the dense populations of signal crayfish in proximity to this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.

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. 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. 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 reach, 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 otter 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**.

Five NERC act section 41 and notable fish species have been identified as present in the impacted reach, including two NERC Act Section 41 fish species (brown trout and European eel) and three notable fish species (bullhead, barbel and grayling).

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**Table B2.18 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 ( <i>Austropotamobius pallipes</i> )	Major	Given the presence of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.	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 Species – mammals Otter ( <i>Lutra lutra</i> )	Major	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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout <i>Salmo trutta</i> -European eel ( <i>Anguilla anguilla</i> )	Major	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 ( <i>Thymallus thymallus</i> ) Bullhead ( <i>Cottus gobio</i> ) Barbel ( <i>Barbus barbus</i> ) <sup>3</sup>	Major	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
NERC and Notable species – Birds There are many bird species present across the region	Major	The following bird species to varying extents rely on water dependent habitats. However, they are not expected to be impacted severely from implementation of the drought option against a baseline of reduced flows characteristic of drought: - Willow tit ( <i>Parus montanus</i> ) - Lapwing ( <i>Vanellus vanellus</i> )	Not sensitive	No

<sup>3</sup> Barbel is listed in Annex V of the Habitats Directive as a species of Community interest whose taking in the wild and exploitation may be the subject of management measures.

## B2.3.4 WFD features

### B2.3.4.1 Macroinvertebrates

The WFD waterbody GB104027057411 Don from the Little Don to River Loxley confluence classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by one Environment Agency monitoring site within the impacted reach, u/s More Hall Bridge (ID 124). u/s More Hall Bridge only had baseline survey data for two seasonal samples for 2009, with additional monitoring was undertaken by YWSL in 2015 and 2016.

The WFD status of the macroinvertebrate community in Don 3 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 Don 3 has a medium to high sensitivity to reduced flows (**Figure B2.3**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.3**.

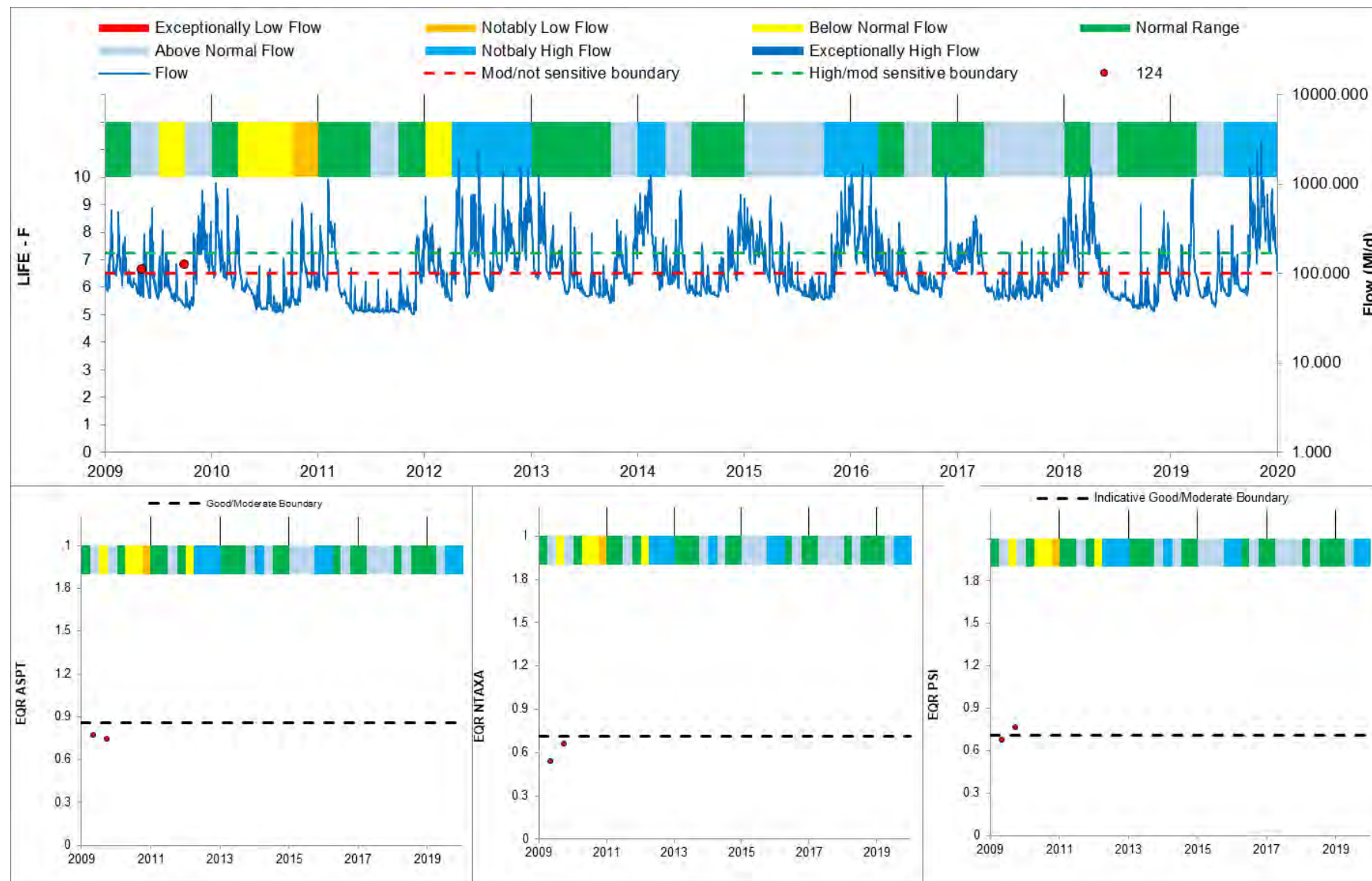
Data from the monitoring site is temporally limited and shows little variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve moderate WFD status over the monitoring period. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a good proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 6.64 and 6.83.

In Don 3 data from the site identifies macroinvertebrate communities which shows a good level of diversity, with WHPT<sub>NTAXA</sub> ranging between 18 and 22. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.54 and 0.66, indicative of poor ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that these pressures are not likely present in the reach.

YWSL 2015 and 2016 spring and autumn data from the site u/s More Hall Bridge describes a macroinvertebrate community which is also highly sensitive to flow reductions (LIFE score 7.11 to 7.45) and also show a high level of both diversity (BMWP<sub>NTAXA</sub> scores 13 and 24) and proportion of pollution sensitive taxa, BMWP<sub>ASPT</sub> scores of 5.46 and 5.87. This is consistent with the Environment Agency's baseline data and provides further evidence of the sensitivity of the community to drought permit impacts.

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 B2.3** LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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



#### B2.3.4.2 Fish

Waterbody GB104027057411 Don from the Little Don to River Loxley confluence is classified under Cycle 2 (2016) as moderate. Baseline fisheries data is informed by one Environment Agency site, U/S Ewden Beck (ID 16238) which was surveyed in 2011 and 2017. No FCS2 data was available for the Environment Agency monitoring site within the impacted reach, FCS2 data was provided by Beeley Wood d/s weir (ID 4046) and Livesey Street - Owlerton, Sheffield (ID 16196), located downstream of the impacted reach (Don 4). Additional monitoring within the Don 3 was undertaken by YWSL at u/s More Hall Bridge (YW15) and Bitholmes (YW16) from 2015 to 2018. **Table B2.19** sets out the available fish survey data from these sites.

The WFD status of the fish community in Don 3 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.

Waterbody GB104027057411 Don from the Little Don to River Loxley confluence classified as moderate overall and informed by two fisheries sites (Beeley Wood, d/s weir and Livesey Street - Owlerton, Sheffield), with both of these sites located downstream of the impacted reach, in Don 4.

The site Beeley Wood d/s weir is individually classified as poor with a site EQR of 0.1738, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively low diversity, with three species present from an expected seven species. Trout had a slightly lower observed density than expected, with a good EQR score of 0.4643. Bullhead are present at a level that meets/exceeds expectations, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.5363, though observed densities were lower than expected. Stone loach, perch, minnow, chub and gudgeon were expected at varying degrees of prevalence at the site but were not observed. Although trout and grayling both had good EQR scores and bullhead were present in increased numbers the overall low diversity of the site had a significant effect on the overall classification of 'poor' for the site.

The site Livesey Street - Owlerton, Sheffield is individually classified as good with a site EQR of 0.6374, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with six species present from an expected eight species. Trout had a slightly higher observed density than expected, with a good EQR score of 0.7153. Bullhead, stone loach, minnow and 3-spined stickleback are all present at a level that meets/exceeds expectations, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.5633, with observed densities were much higher than expected. Gudgeon, chub and dace were expected at varying degrees of prevalence at the site but were not observed.

From the data identified in the FCS2, a moderate abundance of brown trout is likely to be present in the downstream reach (Don 4), which is an increased number of trout when compared to the impacted reach (Don3). With both Beeley Wood, d/s weir and Livesey Street - Owlerton, Sheffield being located downstream of the impacted reach in Don 4, the fish community at both sites is significantly different to that of the sites surveyed in the impacted reach, and therefore not representative of sensitivity of the fish community in the impacted reach.

Environment Agency and YWSL sites within the impacted reach show a low to moderate abundance of brown trout and bullhead across all sites throughout the monitoring period, with a low abundance of grayling recorded intermittently. Individual minnow, stone loach and 3-spined stickleback were recorded during surveys at U/s More Hall Bridge and Bitholmes U/S Ewden Beck, with a low abundance of each thought to be present.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.19 Fish survey data from Don 3**

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	Gudgeon	Rainbow trout	Stone loach	Minnow	3-spined stickleback	Perch	Rudd	Dace
16196	Livesey Street - Owlerton, Sheffield	16/09/2011	Single Catch Sample	53	5	8	3		29	12 5	4	1	1	1
		02/10/2017	Catch Depletion Sample	46	31	10			6	3	2			
4046	Beeley Wood, d/s weir	16/09/2011	Single Catch Sample	82	38	16			52	80	2		3	
		02/10/2017	Single Catch Sample	8	7	6			29	12 5	4			
16238	U/S Ewden Beck	12/09/2011	Single Catch Sample	34	17	10								
		02/10/2017	Single Catch Sample	21	13	7					1			
15	u/s More Hall Bridge	11/09/2015	Single Catch Sample	13	7									
		15/09/2016	Single Catch Sample	10	21	5		2		1				
		02/10/2017	Single Catch Sample	21	13	7					1			
		09/08/2018	Catch Depletion Sample	23	22									
16	Bitholmes	11/09/2015	Single Catch Sample	29	9	1				1				
		15/09/2016	Single Catch Sample	27	12	1								
		02/10/2017	Single Catch Sample	15	2									
		09/08/2018	Single Catch Sample	14	13				1					

### B2.3.4.3 WFD waterbody status

**Table B2.20** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.20** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.20 WFD classifications**

Waterbody ID & Name		GB104027057411 Don from the Little Don to River Loxley confluence	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Moderate	
Overall		Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Moderate	Medium
	Macroinvertebrates	Good	Medium
Hydro-morph designation		Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	
	Fish	Moderate	
	Macroinvertebrates	Good	
Waterbody Measures		None	

### B2.3.5 Invasive non-native species (INNS)

**Table B2.21** 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 B2.21**).

**Table B2.21 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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> ) -Signal crayfish ( <i>Pacifastacus leniusculus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	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)
-Japanese knotweed ( <i>Fallopia japonica</i> )				
Invasive non-native species – fish - Rainbow trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

### B2.3.6 Landscape, navigation, recreation and heritage

**Table B2.22** 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 B2.22**).

**Table B2.22 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)
Trans Pennine Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Stocksbridge and District Golf Course	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Barnsley Boundary Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Romano-British settlement at Finkle Street – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Iron Age and Roman Quern workings on Wharnccliffe Rocks – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
River Don - canoeing	Major	Drought conditions would not be conducive to canoeing 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	Not sensitive	No
River Don - angling	Major		Low	No



## B2.4 Don 4

### B2.4.1 Statutory designated sites

**Table B2.23** 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.

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.23**).

**Table B2.23 Statutory 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)
Wharnccliffe Craggs SSSI	Major	Wharnccliffe Craggs SSSI comprises natural sandstone outcrops that are of geological interest. The crags here are the best available exposure in the Upper Carboniferous (approximately 300 million years old) sandstones of the Wharnccliffe Edge Rock Formation. The site is unlikely to be affected by hydrological changes within the zone of influence.	Not sensitive	No
Wharnccliffe Heaths LNR	Major	Situated above Wharnccliffe Craggs overlooking the Don Valley to the northwest of Sheffield. It lies in an area of outstanding local natural history and archaeological interest and protects one of the few remaining remnants of a formerly much larger heathland complex. The site is unlikely to be affected by hydrological changes within the zone of influence.	Not sensitive	No
Town End Common LNR	Major	No water dependent features	Not sensitive	No

### B2.4.2 NERC and local wildlife sites

**Table B2.24** 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.

Two 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 B2.24**).

**Table B2.24 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)
Lower Ewden Beck LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site is segmented with several areas surrounding the River Don above its confluence with the Little Don. Aerial imagery shows	Low	Yes

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)
		woodland grassland, pasture and heathland in the upper segments. The southern segments of the site follow Lower Ewden Beck from More Hall Reservoir to its confluence with the Don. Areas of ancient upland oak woodland are present around the river. Some wet woodland is also present and are present.		
Upper River Don: Deepcar to Hillsborough LWS	Major	<p>Likely to be in connectivity with impacted reach and support aquatic receptors</p> <p>Although the site encompasses the river as it passes through urban areas, the river corridor is very species rich. The river in the site passes close to three major ancient woodland and the corridor is significant for dispersal and maintenance of a wide range of species. Semi-natural woodland, scrub, other tall herb, flush/spring, marsh and marginal aquatic vegetation habitats are also present.</p>	Low	Yes
Middle River Don: Hillsborough to City Centre LWS	Major	<p>Likely to be in connectivity with impacted reach and support aquatic receptors</p> <p>The banks of the river corridor were previously industrial but are now becoming residential. The woodland on the banks are ancient, containing indicator species such as pendulous sedge, wood anemone and dog's mercury. Island within the river are very species rich with vegetation and wildlife including birds and invertebrates. The islands also host ancient woodland indicator species. Bankside habitats include broad-leaved woodland, scrub, tall and short herbs, built (walls and disused buildings). The river has strong marginal aquatic vegetation and a rich aquatic fauna.</p>	Low	Yes
Wharcliffe Chase and Wood LWS	Major	<p>Wharcliffe Chase and Wood is a located on the east bank of the River Don. The site contains ancient woodland, lowland mixed deciduous woodland, lowland dry acid grassland, ponds and river habitats.</p>	Not sensitive	No
Glen Howe Park LWS	Major	<p>Unlikely to be in connectivity with impacted reach or support aquatic receptors</p> <p>Large woodland crossed by Tinker Brook.</p>	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)
Usher Wood LWS	Major	The site is a long strip of woodland on a north/north east facing slope. Ancient woodland indicator species are present. A small seasonal watercourse is present in a field to the east.	Not sensitive	No
Beeley and Great Hollins Wood LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  A large woodland and fields on the bank on the River Don.	Not sensitive	No
Birks Wood LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Predominantly oak woodland with holly shrub. Ancient woodland indicator species are present.	Not sensitive	No
Wardsend Cemetery LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  A cemetery, grassland and woodland areas surrounding allotments	Not sensitive	No

### B2.4.3 NERC and other protected species

**Table B2.25** 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 surveys were completed historically by YWSL and the Environment Agency, no records have been recorded in the impacted reach, although suitable habitat has been identified as 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of Environment Agency records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit 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 reach, 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 otter 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**.

Four NERC act section 41 and notable fish species have been identified as present in the impacted reach, including two NERC Act Section 41 fish species (brown trout and European eel) and two notable fish species (bullhead and grayling).

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**Table B2.25 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 ( <i>Austropotamobius pallipes</i> )	Major	White-clawed crayfish are sensitive to habitat modification from the management of waterbodies. Therefore, they are considered to be sensitive to hydrological impacts, particularly low flows.	Medium	Yes
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout ( <i>Salmo trutta</i> ) -European eel ( <i>Anguilla anguilla</i> )	Major	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	Major	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	High	Yes



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)
Grayling ( <i>Thymallus thymallus</i> ) Bullhead ( <i>Cottus gobio</i> )		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.		
NERC and Notable species – Birds There are many bird species present across the region	Major	The following bird species to varying extents rely on water dependent habitats. However, they are not expected to be impacted severely from implementation of the drought option against a baseline of reduced flows characteristic of drought: - Willow tit ( <i>Parus montanus</i> ) - Lapwing ( <i>Vanellus vanellus</i> )	Not sensitive	No

## B2.4.4 WFD features

### B2.4.4.1 Macroinvertebrates

The WFD waterbody GB104027057411 Don from the Little Don to River Loxley confluence classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by four Environment Agency monitoring sites, U/S Georgia Pacific (ID 74862), Oughtibridge (ID 116), D/S Georgia Pacific (ID 74861) and Leppings Lane (ID 1427). U/S Georgia Pacific and D/S Georgia Pacific had baseline survey data for two seasonal samples for 2010 to 2013, with U/S Georgia Pacific also surveyed in 2009, 2015 and 2018. Leppings Lane had baseline survey data for two seasonal samples for 2010, 2013, 2015 and 2018. Oughtibridge had baseline survey data for two seasonal samples for only 2009.

The WFD status of the macroinvertebrate community in Don 4 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 Don 4 has a medium to high sensitivity to reduced flows (**Figure B2.4**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

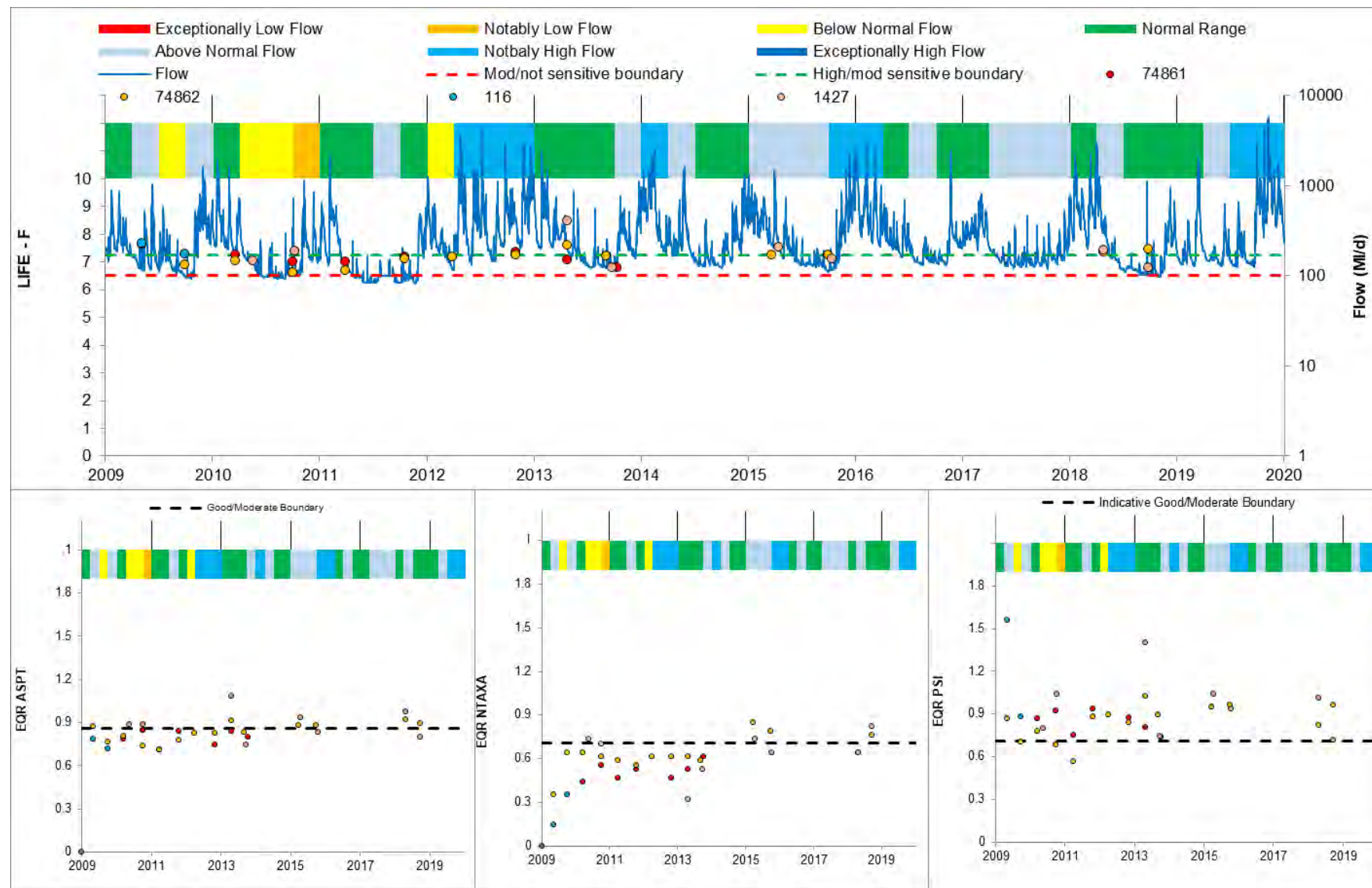
WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> scores are available for the site. WHPT and PSI EQR scores are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.4**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve good or high WFD status over the monitoring period, with D/S Georgia Pacific and U/S Georgia Pacific samples in spring 2011 and Oughtibridge in autumn 2009. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a poor to moderate proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 4.76 and 7.27. There are instances of deterioration to this standard during the monitoring period as such the community has possibly been impaired by water quality pressures historically.

In Don 4 data from the monitoring sites identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 5 and 29. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.15 and 0.85, indicative of poor to moderate ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B2.4** LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.4.4.2 Fish

Waterbody GB104027057411 Don from the Little Don to River Loxley confluence is classified under Cycle 2 (2016) as moderate. Baseline fisheries data is informed by four Environment Agency sites, U/S Ewden Beck (ID 16238), Oughtibridge (ID 4253), Beeley Wood d/s weir (ID 4046) and Livesey Street - Owlerton, Sheffield (ID 16196). Additional monitoring within the Don 4 was undertaken by YWSL at Oughtibridge (YW19), Beeley Wood d/s weir (YW18) and Livesey Street - Owlerton, Sheffield (YW17) from 2015 to 2018. **Table B2.26** sets out the available fish survey data from these sites.

The WFD status of the fish community in Don 4 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.

Waterbody GB104027057411 Don from the Little Don to River Loxley confluence classified as moderate overall and informed by two fisheries sites (Beeley Wood, d/s weir and Livesey Street - Owlerton, Sheffield).

The site Beeley Wood d/s weir is individually classified as poor with a site EQR of 0.1738, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively low diversity, with three species present from an expected seven species. Trout had a slightly lower observed density than expected, with a good EQR score of 0.4643. Bullhead are present at a level that meets/exceeds expectations, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.5363, though observed densities were lower than expected. Stone loach, perch, minnow, chub and gudgeon were expected at varying degrees of prevalence at the site but were not observed. Although trout and grayling both had good EQR scores and bullhead were present in increased numbers the overall low diversity of the site had a significant effect on the overall classification of 'poor' for the site.

The site Livesey Street - Owlerton, Sheffield is individually classified as good with a site EQR of 0.6374, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with six species present from an expected eight species. Trout had a slightly higher observed density than expected, with a good EQR score of 0.7153. Bullhead, stone loach, minnow and 3-spined stickleback are all present at a level that meets/exceeds expectations, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.5633, with observed densities were much higher than expected. Gudgeon, chub and dace were expected at varying degrees of prevalence at the site but were not observed.

Sites within the impacted reach (Don 4) showed fish populations similar to the classification sites. Livesey Street showed a decrease in the number of trout recorded in 2017 compared to 2011, additionally the latest YWSL survey at the site in 2018 showed a further significant decrease in the number of individuals. Similarly, Beeley Wood, d/s weir showed a significant decrease in the number of trout recorded in 2017 compared to 2011 and an overall reduced diversity at the site. Oughtibridge and U/S Ewden Beck were comparable to the other sites in the reach, with the most recent surveys recording a moderate abundance of trout and bullhead abundance, with a low abundance of grayling recorded.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.26 Fish survey data from Don 4**

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	Gudgeon	Minnow	Perch	Stone loach	3-spined stickleback	Rudd	Dace
17	Livesey Street	09/08/2018	Catch Depletion Sample	16	44	5		29		11	7		
		25/08/2015	Catch Depletion Sample	68	6	15		8	1	9			
		30/08/2016	Catch Depletion Sample	17	31	2	1	6		6			
		02/10/2017	Catch Depletion Sample	46	31	10		3		6	2		
16196	Livesey Street - Owlerton, Sheffield	16/09/2011	Single Catch Sample	53	5	8	3	125	1	29	4	1	1
		02/10/2017	Catch Depletion Sample	46	31	10		3		6	2		
18	Beeley Wood, d/s weir	24/09/2018	Catch Depletion Sample	20	30	12		22		1			
		25/08/2015	Single Catch Sample	49	47	9				4			
		30/08/2016	Single Catch Sample	2	29	1				1			
		02/10/2017	Single Catch Sample	8	7	6							
4046	Beeley Wood, d/s weir	16/09/2011	Single Catch Sample	82	38	16		80		52	2	3	
		02/10/2017	Single Catch Sample	8	7	6							
19	Oughtibridge	09/08/2018	Single Catch Sample	20	81					1	1		
		11/09/2015	Single Catch Sample	42	16	4				2			

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	Gudgeon	Minnow	Perch	Stone loach	3-spined stickleback	Rudd	Dace
4253	Oughtibridge	08/09/2016	Single Catch Sample	20	40								
		02/10/2017	Single Catch Sample	37	40					2			
		11/09/2015	Single Catch Sample	42	16	4				2			
16238	U/S Ewden Beck	12/09/2011	Single Catch Sample	34	17	10							
		02/10/2017	Single Catch Sample	21	13	7					1		

#### B2.4.4.3 WFD waterbody status

**Table B 2.27** summarises the WFD classification of waterbody which contain the impacted reach. **Table B 2.27** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B 2.27 WFD classifications**

Waterbody ID & Name			GB104027057411 Don from Little Don to River Loxley confluence	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment (Major, Moderate, Minor, Negligible)	Impact at Location		Major	
	Overall		Moderate	
RBMP Cycle 2 Status/ Potential	Fish		Good	Medium
	Macroinvertebrates		Good	Medium
Hydro-morph designation			Heavily modified	
RBMP2 Waterbody Objective	Overall		Moderate	
	Fish		Good	
	Macroinvertebrates		Good	
Waterbody Measures			None	

## B2.4.5 Invasive non-native species (INNS)

**Table B2.28** 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 B2.28**).

**Table B2.28 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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Freshwater Shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> ) -Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – fish - Rainbow Trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.4.6 Landscape, navigation, recreation and heritage

**Table B2.29** 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 B2.29**).

**Table B2.29 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)
Trans Pennine Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
River Don – Angling	Major	Reaches are fished by organised clubs on leased land. However, hydrological impacts against a baseline of severe drought are not expected to result in more than minor impact to the angling resource.	Low	No
River Don – Canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No
Romano-British settlement at Finkle Street – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Iron Age and Roman Quern workings on Wharnccliffe Rocks – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Cementation furnace, Hoyle Street – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Bower Spring cementation furnace – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Stocksbridge and District Golf Course	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No



## B2.5 Don 5

### B2.5.1 Statutory designated sites

**Table B2.30** 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.

Two statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.30**).

**Table B2.30 Statutory 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)
Salmon Pastures LNR	Major	The site has been taken over by a range of opportunist plants that moved in when industry moved out. The new plant community supports several types of butterfly and other invertebrates such as dragonflies. The site is situated next to the River Don and therefore is likely to be have water dependant features.	Uncertain	Yes
Centenary Riverside LNR	Major	An urban reserve, part of the pioneering flood alleviation scheme on the banks of the River Don. The habitats are a mixture of wet and dry woodland, wet grassland, meadow, reed bed, marshland and a small pillwort pond. The marshland lagoon contains 3 islands formed by retained slag piles, the islands provide habitat for nesting birds. The site has a number of water dependant features and as such will require further assessment to determine the impact of the cumulative effect of the drought options.	Uncertain	Yes

### B2.5.2 NERC and local wildlife sites

**Table B2.31** 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.

Six 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 B2.31**).

**Table B2.31 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)
Kelham Island LWS	Major	Kelham Island is situated close to the City Centre alongside the River Don and at the heart of the Don Valley. The site is in the relatively low lying flood plain of the River Don. The site hosts a good example of biodiversity along the	Low	Yes

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, including fresh water fish and variety of bird life such as heron, geese and kingfisher		
Lower River Don: River Don (City Centre to Blackburn Meadows) LWS	Major	The site encompasses the river and its banks and immediate area. The banks contain areas of semi-natural woodland with ancient woodland indicator species, tall herbs. Sections of the river are canalised.	Low	Yes
Sandersons Mill Race LWS	Major	The Site encompasses the River Don, its banks, a large weir, lowland mixed deciduous woodland and semi-natural woodland, scrub areas, a mosaic habitat and open mosaic habitats on previously developed land. The site hosts aquatic vegetation, including marginal vegetation. A vast amount of in-channel vegetation is present downstream of the weir.	Medium	Yes
Lower Don Valley: Sheffield and Tinsley Canal LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site encompasses the canal and banks from the River Don Navigation near Tinsley to Park Hill. The canal banks have a range of habitat from woodland, grassland, scrub, tall herbs and urban common. There is much aquatic vegetation on the canal including submerged, floating-leaved, emergent and marginal aquatic plants. Fresh water jellyfish have been recorded on site.	Low	Yes
Blackburn Meadows LWS	Major	The site boundary encompasses a section of the River Don and its banks, an old disused sewage treatment works, areas of woodland, wet woodland, scrub, grassland, heathland, marsh, urban common, standing water, marginal aquatic vegetation and wet woodland.	Low	Yes
Sheffield & South Yorkshire Navigation LWS	Major	Likely to support aquatic receptors, However the canal is not likely to be in connectivity with the impacted reach and water levels and flow should remain within typical range.  The site covers the river and its banks from Jordan Dam to Don Island. The site hosts acid woodland, neutral woodland,	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)
Centenary Riverside LWS	Major	neutral grassland and standing water habitats  Likely to be in connectivity with impacted reach and support aquatic receptors  A flooded wetland / wet woodland side adjacent to the river	Low	Yes
Salmon Pastures LWS	Major	Area of acid heathland, woodland and scrub.	Low	Yes
Middle River Don: Hillsborough to City Centre LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The banks of the river corridor were previously industrial but are now becoming residential. The woodland on the banks are ancient, containing indicator species such as pendulous sedge, wood anemone and dog's mercury. Island within the river are very species rich with vegetation and wildlife including birds and invertebrates. The islands also host ancient woodland indicator species. Bankside habitats include broad-leaved woodland, scrub, tall and short herbs, built (walls and disused buildings). The river has strong marginal aquatic vegetation and a rich aquatic fauna.	Low	Yes
Deciduous woodland NERC habitat -316929	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Reedbeds	Not sensitive	No
NERC habitat No main habitat but additional habitats present -452749	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  Reedbeds, Deciduous woodland	Low	Yes
NERC habitat No main habitat but additional habitats present -447335	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  Reedbeds	Low	Yes

### B2.5.3 NERC and other protected species

**Table B2.32** 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

surveys were completed historically by YWSL and the Environment Agency, no records have been recorded in the impacted reach, although suitable habitat has been identified as 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of Environment Agency records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit impacts and have a **low** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of water vole in the impacted reach. The data showed historical records of the feature in the impacted reach. Additionally, the data identifies that suitable habitat is present in the impacted reach. However, the distribution of information and survey data for the species was considered to be limited. Based on the available information these species are considered to be susceptible to drought order impacts and have a **medium** sensitivity to the physical environment impacts identified in **Appendix A**.

One NERC act section 41 species of water beetle, *Bembidion testaceum* has been identified as being present with the zone of influence of Don 5, near Salmon Pastures. Based on the limited available information this feature is considered to be potentially susceptible to drought option impacts and has an **uncertain** 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 three NERC Act Section 41 fish species (brown trout, river lamprey and European eel) and four notable fish species (bullhead, brook lamprey, barbel and grayling).

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**Table B2.32 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 – Invertebrate Pale Pin-palp ( <i>Bembidion testaceum</i> )	Major	Limited data is available for the impacted reach. A specialist beetle of exposed riverine sediments in catchments with hard rock geology that erodes to produce coarse sandy sediments, though occasionally also occurring in analogous artificial habitats such as a gravel pit and a newly created river. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Uncertain	Yes



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 ( <i>Austropotamobius pallipes</i> )	Major	Limited data is available for the impacted reach. White-clawed crayfish are not likely to be present in the impacted reach as identified by an assessment of habitat during an Environment Agency walkover survey.	Medium/High	Yes
NERC Species – mammals  Otter ( <i>Lutra lutra</i> )	Major	Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	Water vole could potentially to use 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 permit may reduce habitat availability and alter the species food supply.	Medium	Yes
NERC Species – Fish  - Atlantic salmon ( <i>Salmo salar</i> ) - Brown trout ( <i>Salmo trutta</i> ) -European eel ( <i>Anguilla anguilla</i> )	Major	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 ( <i>Thymallus thymallus</i> ) -Bullhead ( <i>Cottus gobio</i> ) -Barbel ( <i>Barbus barbus</i> ) <sup>4</sup>	Major	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.	Medium	Yes
NERC and Notable species – Birds  There are many birds species	Major	The following bird species to varying extents rely on water dependent habitats. However they are not expected to be impacted severely from implementation of the drought option against a baseline of reduced flows characteristic of drought:  - Grey wagtail ( <i>Motacilla cinerea</i> )	Not sensitive	No

<sup>4</sup> Barbel is listed in Annex V of the Habitats Directive as a species of Community interest whose taking in the wild and exploitation may be the subject of management measures.

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)
present across the region		<ul style="list-style-type: none"> <li>- House martin (<i>Delichon urbica</i>)</li> <li>- Swallow (<i>Hirundo rustica</i>)</li> <li>- Eurasian curlew (<i>Numenius arquata</i>)</li> </ul>		

## B2.5.4 WFD features

### B2.5.4.1 Macroinvertebrates

The WFD waterbody GB104027057412 Don from River Loxley confluence to River Don Works classifies as 'good' and GB104027057413 Don from River Don Works to River Rother classifies as 'poor' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by two Environment Agency monitoring sites, Stevenson Road (ID 1429) and D/S Blackburn Meadows (ID 929). D/S Blackburn Meadows had baseline survey data for two seasonal samples, 2013, 2014 and 2017, with a single seasonal sample for 2010. Stevenson Road had baseline survey data for two seasonal samples, 2013, 2014 and 2018.

The WFD status of the macroinvertebrate community in Don 5 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 Don 5 has a medium to high sensitivity to reduced flows (**Figure B2.5**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

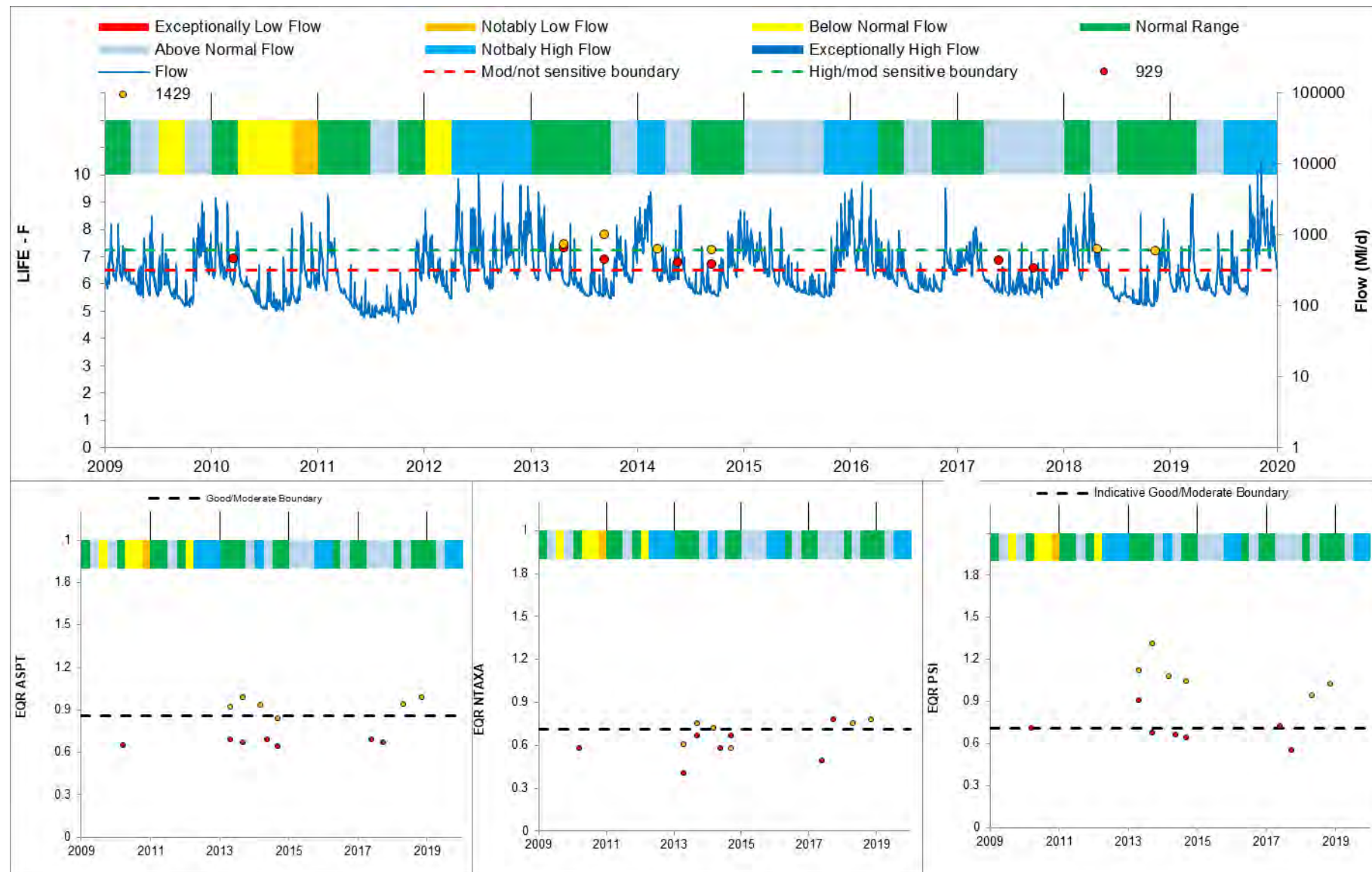
WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> scores are available for the site. WHPT and PSI EQR scores are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.5**.

Data from the monitoring site, D/S Blackburn Meadows shows consistency in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 with the standard to achieve poor WFD status, while Stevenson Road remained consistent to achieve good to high WFD status (with the exception of autumn 2014). WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a poor to good proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 4.13 and 6.37. There are instances of deterioration to this standard during the monitoring period as such the community has possibly been impaired by water quality pressures historically.

In Don 5 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 14 and 27. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.40 and 0.78, indicative of poor to moderate ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B2.5** LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.5.4.2 Fish

Waterbody GB104027057412 Don from River Loxley confl to River Don Works and GB104027057413 Don from River Don Works to River Rother are both classified under Cycle 2 (2016) as good. Baseline fisheries data is informed by seven Environment Agency sites, Blackburn Meadows (ID 644), Attercliffe Road (ID 174310, Kelham Island (Channel 2) (ID 38246), Nursery Street Sheffield (ID 41166), Blonk Street Sheffield (ID 41167), Effingham Street Sheffield (ID 36760) and Firth Rixon (ID 52747) **Table B2.33** sets out the available fish survey data from these sites.

The WFD status of the fish community in Don 5 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.

Waterbody GB104027057412 Don from River Loxley confl to River Don Works classified as good overall and informed by one fisheries site, Effingham Street, Sheffield. Waterbody GB104027057413 Don from River Don Works to River Rother classified as good overall and informed by one fisheries site, Blackburn Meadows d/s weir.

The site Effingham Street, Sheffield is individually classified as good with a site EQR of 0.5952, based on the FCS2 EQR scores from the 2014 survey. The site has a relatively good diversity, with nine species present from an expected ten species. Trout had a slightly higher observed density than expected, with a good EQR score of 0.6713. Bullhead, stone loach and minnow are observed at increased numbers, with an EQR score of 1. Grayling were recorded at the site with a good EQR score of 0.731, though observed densities were slightly lower than expected. Gudgeon, chub, dace and perch were also recorded at the site though observed densities were slightly lower than expected.

The site Blackburn Meadows d/s weir is individually classified as good with a site EQR of 0.6374, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with ten species present from an expected eleven species. Trout had a slightly lower observed density than expected, with a good EQR score of 0.411. Bullhead, stone loach, 3-spined stickleback and minnow are observed at increased numbers, with an EQR score of 1. Grayling were recorded at the site with an EQR score of 0.4033, with barbel, gudgeon, dace and perch also recorded at the site though observed densities were slightly lower than expected. Roach were recorded at the site with an EQR score of 0.4803, observed densities were higher than expected.

Sites within the impacted reach (Don 5) showed fish populations similar to the classification sites. Kelham Island (Channel 2) and Nursery Street, Sheffield were limited to surveys in 2011 and 2012 only, with a moderate abundance of trout and grayling, and a high abundance of bullhead recorded. Stone loach and minnow were recorded in a high abundance, while low numbers of gudgeon and perch were also recorded at Kelham Island (Channel 2). Nursery Street, Sheffield recorded a single lamprey in 2012. Blonk Street, Sheffield and Effingham Street, Sheffield had an extended number of surveys, with surveys from 2011 to 2014. Both sites had comparable fish populations, with a moderate number of trout and bullhead, though grayling were recorded at moderate to high abundances. Firth Rixon was only surveyed in 2013 and showed a decrease in the number of trout, bullhead and grayling recorded when compared to the above-mentioned sites.

Although Atlantic Salmon have not been identified, information provided by Dan Smallwood (Environment Agency) suggests that there is increasing evidence from angling community of salmon being present with some evidence of natural recruitment too. Therefore, a low abundance of this species has been assumed.

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 B2.33 Fish survey data from Don 5**

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	European eel	Lamprey sp.	Barbel	Rainbow trout	Stone loach	Minnow	Chub	Dace	Gudgeon	Ruffe	3-spined stickleback	Perch	Pike	Common bream	Orfe / Ide
644	Blackburn Meadows d/s weir	22/07/2009	Single Catch Sample	1		6			2				19		6	1		12	3		
		07/07/2010	Single Catch Sample	12	10 to 99*	10			12	1	100 to 999*	100 to 999*	19	14	36	2	100 to 999*	4	3		
		12/07/2011	Single Catch Sample	5	10 to 99**	4			7		1000 to 9999**	1000 to 9999**		5	18	1	100 to 999**	3			
		03/07/2012	Single Catch Sample	16	10 to 99**		1		12		10 to 99**	100 to 999**	9	11	9	6	10 to 99**	10	1		
		09/07/2013	Single Catch Sample	14	10 to 99**	22	1 to 9**		21		100 to 999**	100 to 999**	4	1	15	3	1 to 9**	3			

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	European eel	Lamprey sp.	Barbel	Rainbow trout	Stone loach	Minnow	Chub	Dace	Gudgeon	Ruffe	3-spined stickleback	Perch	Pike	Common bream	Orfe / Ide
		24/07/2014	Single Catch Sample	10		12			3				3	14	10	6		13			
		20/07/2015	Single Catch Sample	17	7	8			3		9	40	2	15	7		27				
		14/07/2016	Single Catch Sample	18	14	2			5		19	51			9	4	5		3		
		07/07/2017	Single Catch Sample	9	196	5			1		41	60		6	17		4	3			
17371	Kelham Museum Island	22/07/2009	Single Catch Sample	20	10 to 99**	5					1 to 9**	10 to 99**	to 2				1 to 9**	1			
		15/07/2011	Single Catch Sample	36	10 to 99**	33					10 to 99**	100 to 999**	to								
		02/08/2012	Single Catch Sample	30	10 to 99*	45					10 to 99*	100 to 999*	to						1		

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	European eel	Lamprey sp.	Barbel	Rainbow trout	Stone loach	Minnow	Chub	Dace	Gudgeon	Ruffe	3-spined stickleback	Perch	Pike	Common bream	Orfe / Ide
36760	Effingham Street, Sheffield	26/07/2011	Single Catch Sample	74	20	125					100 to 999**	31	12	12	10		10 to 99**	3			
		29/07/2012	Single Catch Sample	72	10	119			2		10	28	7	26	1	1		1	1		
		19/08/2013	Single Catch Sample	63	38	66					10 to 99*	10 to 99*	11	15	1	1		3			
		05/09/2014	Single Catch Sample	79	1 to 9*	369					10 to 99*	10 to 99*	2	37	10 to 99*			1			
38246	Kelham (Channel 2) Island	15/07/2011	Single Catch Sample	22	10 to 99**	12					100 to 999**	100 to 999**			8			2			
		02/08/2012	Single Catch Sample	36	100 to 999*	13					100 to 999*	1000 to 9999*						1			
41166	Nursery Street, Sheffield	30/07/2011	Single Catch Sample	21	3	32					10 to 99**	14		4	22	2	10 to 99**	5			
		02/08/2012	Single Catch Sample	30	5	41		1	2		5	42	1	1	25	1		7			1
41167	Blonk Street, Sheffield	30/07/2011	Single Catch Sample	57	22	108					10 to 99**	16		53		1		2		7	

Site ID	Site name	Event date	Method	Brown / sea trout	Bullhead	Grayling	European eel	Lamprey sp.	Barbel	Rainbow trout	Stone loach	Minnow	Chub	Dace	Gudgeon	Ruffe	3-spined stickleback	Perch	Pike	Common bream	Orfe / Ide
52747	Firth Rixon	28/07/2012	Single Catch Sample	70	40	86			1		3	81	3	22	6	2		3		1	
		21/08/2013	Single Catch Sample	95	42	193	1		2		1	3		8	13	2		14	1		
		02/10/2014	Single Catch Sample	24	18	78					3	9				1		5	1		
		08/07/2013	Single Catch Sample	10	1	2			2		9	10 to 99*	2		14			4	1		



### B2.5.4.3 WFD waterbody status

**Table B2.34** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.34** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.34 WFD classifications**

Waterbody ID & Name		GB104027057412 Don from River Loxley confluence to River Don Works	GB104027057413 Don from River Works to River Rother	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	Major	
RBMP Cycle 2 Status/ Potential	Overall	Poor	Poor	
	Fish	Good	Good	Medium
	Macroinvertebrates	Good	Poor	Medium
Hydro-morph designation		Heavily modified	Heavily modified	
RBMP2 Waterbody Objective	Overall	Moderate	Moderate	
	Fish	Good	Good	
	Macroinvertebrates	Good	Good	
Waterbody Measures		None	None	

### B2.5.5 Invasive non-native species (INNS)

**Table B2.35** 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 B2.35**).

**Table B2.35 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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Freshwater Shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> ) -Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	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)
Invasive non-native species – fish - Rainbow Trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.5.6 Landscape, navigation, recreation and heritage

**Table B2.36** 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 B2.36**). In addition it is noted that the River Don Navigation commences at Victoria Quays, in this reach. The River Don Navigation is managed by the Canal and River Trust and Yorkshire Water are liaising with them, as abstractors.

**Table B2.36 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)
River Don – Angling	Major	Organised club fishing and informal fishing such that hydrological impacts could cause impact to angling resource.	Moderate	Yes
River Don – Canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No
Cementation furnace, Hoyle Street – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Bower Spring cementation furnace – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No

## B2.6 Scout Dyke 1

### B2.6.1 Statutory designated sites

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment.

### B2.6.2 NERC and local wildlife sites

**Table B2.37** 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 B2.37**).

**Table B2.37** 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)
Scout Dyke Reservoir LWS	Major	The site contains the reservoir, lowland heathland, purple moor grass and rush pasture and river habitats.	Not sensitive	No
Black Moor Common LWS	Major	The site contains lowland mixed deciduous woodland, lowland dry acidic grassland, lowland heathland, scrub and nearby river corridor type habitats.	Not sensitive	No

### B2.6.3 NERC and other protected species

**Table B2.38** summaries the NERC Act Section 41 and other protected species which are located on or within 500m of the impacted reach.

White-clawed crayfish are a NERC Act Section 41 species and are sensitive to habitat modification from the management of waterbodies. Data obtained from the Environment Agency and YWSL, as well as a review of available data from NBN gateway was used inform the assessment of the feature in the impacted reach. No information from survey findings was available for white-clawed crayfish, therefore it was not possible to conclusively rule out their presence. However, the Environment Agency reported that signal crayfish are present in the Scout Dyke. Given population of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of Environment Agency records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit 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 suitable habitat has been identified as 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 otter 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**.

Two NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout and European eel) and one notable fish species (bullhead).

**Table B2.38 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 ( <i>Austropotamobius pallipes</i> )	Major	Given the presence of signal crayfish in this reach the Environment Agency considers it unlikely that white-clawed crayfish are present and they are not considered further for this reach.	Not sensitive	No
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	Limited data is available for the impacted reach. Water vole could potentially to use 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 permit may reduce habitat availability and alter the species food supply.	Medium	Yes
NERC Species – Fish - Brown trout ( <i>Salmo trutta</i> ) -European eel ( <i>Anguilla anguilla</i> )	Major	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 -Bullhead ( <i>Cottus gobio</i> )	Major	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.	Medium	Yes

## B2.6.4 WFD features

### B2.6.4.1 Macroinvertebrates

The WFD waterbody GB104027057530 Scout Dyke from Source to River Don classifies as 'moderate' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by four Environment Agency monitoring sites, D/S Scout Dyke Reservoir (ID 191975), Scout Dyke Reservoir



(ID 157414), U/S Scout Bridge (ID74827) and U/S River Don (261). U/S River Don had baseline survey data for two seasonal samples for 2012 to 2014 and 2017 to 2019. U/S Scout Bridge had baseline survey data for two seasonal samples for 2009 and 2019. Scout Dyke Reservoir had baseline survey data for two seasonal samples for 2010, 2012, to 2014 and 2018 to 2019, with additional monitoring was undertaken by YWSL in 2015. D/S Scout Dyke Reservoir had baseline survey data for two seasonal samples for only 2019.

The WFD status of the macroinvertebrate community in Scout Dyke 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 Scout Dyke 1 has medium to high sensitivity to reduced flows (**Figure B2.6**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.6**.

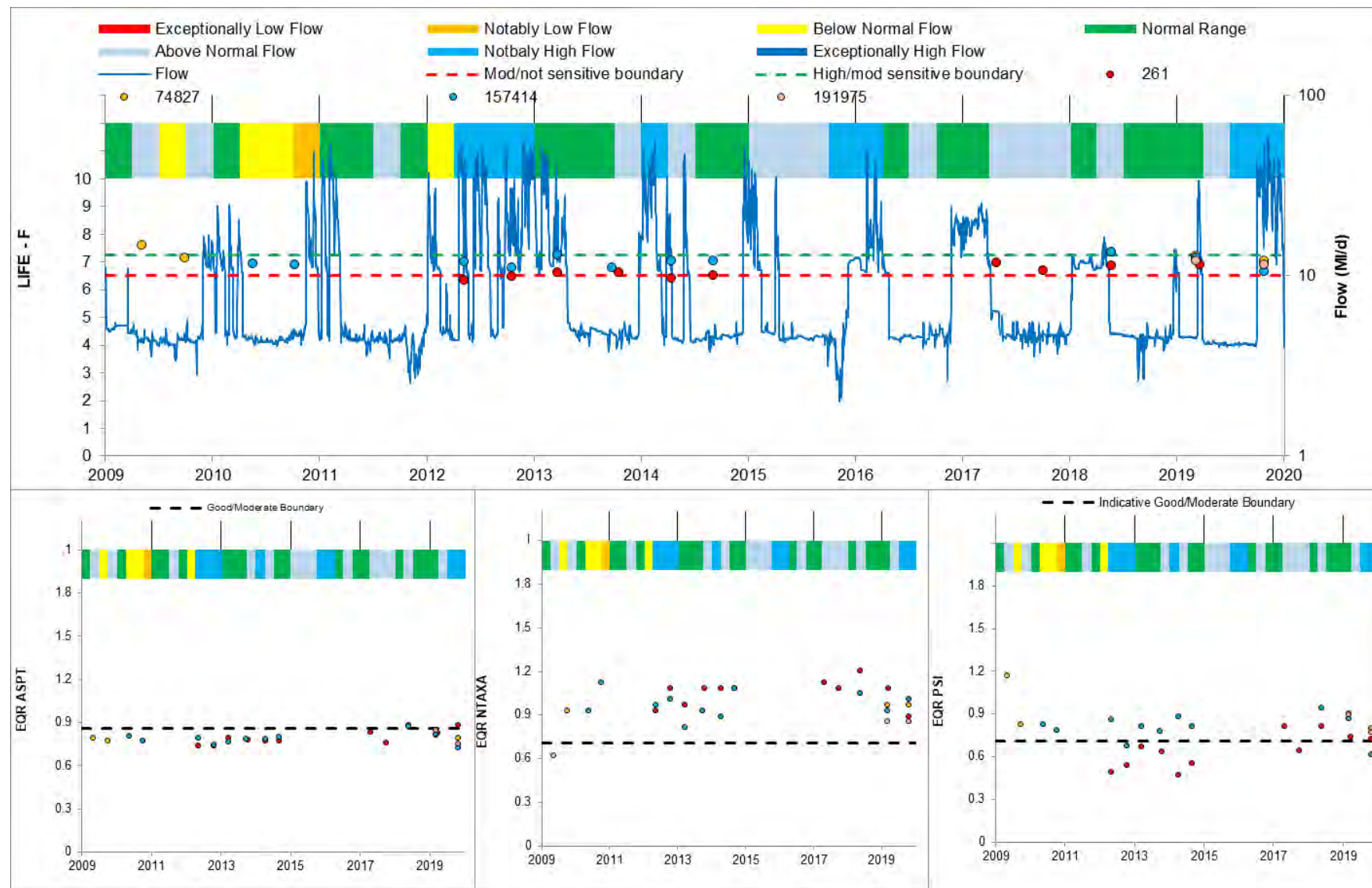
Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve moderate or good WFD status over the monitoring period. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a moderate proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 4.92 and 5.99. 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 Scout Dyke 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 16 and 31. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.62 and 1.20, indicative of moderate to high ecological status, with only U/S Scout Bridge in spring 2009 indicative of ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows may influence the baseline community.

YWSL 2015 spring and autumn data from the site Scout Dyke Reservoir describes a macroinvertebrate community which is also highly sensitive to flow reductions (LIFE score 7.0 and 6.88) and also show a high level of both diversity (BMWP<sub>NTAXA</sub> scores 20 and 24) and proportion of pollution sensitive taxa, BMWP<sub>ASPT</sub> scores of 5.35 and 5.25. This is consistent with the Environment Agency's baseline data and provides further evidence of the sensitivity of the community to drought permit impacts.

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 B2.6 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

## B2.6.4.2 Fish

Waterbody GB104027057530 Scout Dyke from Source to River Don is classified under Cycle 2 (2016) as moderate. This classification is informed by two sites, D/S B6462 (ID 4340) and Nether Mill Fishery (ID 29872) which were surveyed in 2011 and 2017, with D/S B6462 also surveyed in 2009. **Table B2.39** sets out the available fish survey data from these sites.

The WFD status of the fish community in Scout Dyke 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.

The site D/S B6462 is individually classified as bad with a site EQR of 0.005, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with three species present from an expected three species, though this includes a non-native species (Golden orfe0 which likely escaped from the upstream pond. Trout were not observed in this reach, although they are expected to be present, resulting in a low EQR score of 0.022. Additionally, bullhead are not observed in this reach, although they are expected to be present, resulting in a low EQR score of 0.4796. Chub, perch and roach were also recorded at the site with higher than expected densities. Though chub, perch and roach were observed at the site, the absence of trout and bullhead had an effect in the overall site classification, with the moderate diversity also contributing to the overall 'bad' classification of the site.

The site Nether Mill Fishery is individually classified as good with a site EQR of 0.4596, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with four species present from an expected three species. Trout had a significantly lower observed density than expected, with an EQR score of 0.2057. Bullhead, stone loach and minnow are observed at increased numbers, with an EQR score of 1.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.39 Fish survey data from Scout Dyke 1**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Rainbow trout	Stone loach	Minnow	Chub	3-spined stickleback	Perch	Golden orfe
4340	D/S B6462	18/08/2009	Single Catch Sample	1	2	1					6	
		06/09/2011	Single Catch Sample		2				3	4	16	1
		07/09/2017	Single Catch Sample						2		28	2
29872	Nether Mill Fishery	06/09/2011	Single Catch Sample	27	24		2	20		5	2	
		07/09/2017	Single Catch Sample	12	4		5	47				

## B2.6.4.3 WFD waterbody status

**Table B2.40** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.40** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.40 WFD classifications**

Waterbody ID & Name		GB104027057530 Scout Dyke from Source to River Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
	Overall	Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Moderate	Medium
	Macroinvertebrates	Moderate	Medium
Hydro-morph designation		Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	
	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

## B2.6.5 Invasive non-native species (INNS)

**Table B2.41** 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 B2.41**).

**Table B2.41 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)
Invasive non-native species – macroinvertebrates - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> ) -Signal crayfish ( <i>Pacifastacus leniusculus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants - Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Fish - Rainbow trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No



## B2.6.6 Landscape, navigation, recreation and heritage

**Table B2.42** 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 B2.42**).

**Table B2.42 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)
Trans Pennine Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Scout Dyke Reservoir Walk/Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Scout Dyke – Angling, including in on-line pond	Major	Minor impact as flows will already be low at time of implementation	Low	No
Scout Dyke - Canoeing	Major	Drought conditions would not be conducive to canoeing, so implementation of the drought option will not impact the baseline	Not sensitive	No
Nether Mill Fishery	Major	Online Stillwater on Scout Dyke takes water from stream	Uncertain	Yes

## B2.7 Little Don 1

### B2.7.1 Statutory designated sites

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment.

### B2.7.2 NERC and local wildlife sites

**Table B2.43** 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.

Four 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 B2.43**).

**Table B2.43 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)
Underbank Reservoir LWS	Major	The site encompasses some of Underbank Reservoir, its slipway, the Little Don River and the surrounding area.  The south bank of the reservoir is host to plantation woodland, reed canary grass and a rocky drawdown zone. The northern bank of the reservoir hosts a mixture of woodland types.	Not sensitive	No
Lower Little Don, Stocksbridge LWS	Major	Contains the Lower Little Don River and fringing surrounding areas. As well as the river habitats, the site includes areas of semi-natural woodland, ancient woodland, unimproved grassland neutral grassland, lowland heath and improved grassland on regenerating brownfield sites. The river corridor has been altered by industry and has been culverted in other sections.	Low	Yes
New Hall Wood and Brook LWS	Major	Predominantly oak/ash woodland (semi natural and ancient). Habitats present include ancient woodland, unimproved grassland and rivers/running water, scrub, other tall herbs, dry dwarf scrub heath, flush/spring and hedgerows habitats are also present.	Not sensitive	No
Knoll Top LWS	Major	Unlikely to be in connectivity with impacted reach. Contains a variety of habitats including lowland mixed deciduous woodland, running water, scrub, springs and dry stone walls. A beck runs north toward the river and is added to by two small springs in the site.	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)
Old Haywoods LWS	Major	Old Haywoods is an agricultural site with a variety of habitats including species rich unimproved acidic and neutral grassland, scrubland and semi-natural woodland. The site forms a woodland corridor linking other LWS and woodland.	Not Sensitive	No
Upper River Don: Deepcar to Hillsborough LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  Although the site encompasses the river as it passes through urban areas, the river corridor is very species rich. The river in the site passes close to three major ancient woodland and the corridor is significant for dispersal and maintenance of a wide range of species. Semi-natural woodland, scrub, other tall herb, flush/spring, marsh and marginal aquatic vegetation habitats are also present.	Low	Yes
Upper River Don: Station Road, Deepcar LWS	Major	The site is located downstream of the impacted reach on the eastern bank of the River Don. The site does support aquatic features but doesn't include the impacted reach.  The site is an unmanaged field on a River Don flood plain hosting springs feeding into a shallow wetland /marsh/ wet grassland. Grassland becomes wetter southwards. The woodland along the banks of the river is ancient.	Not Sensitive	No

### B2.7.3 NERC and other protected species

**Table B2.44** 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 surveys were completed historically by YWSL and the Environment Agency, no records have been recorded in the impacted, although suitable habitat has been identified as 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** 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 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 reach, although suitable habitat has been identified as 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 otter 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**.

Two NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and three notable fish species (bullhead, grayling and barbel).

**Table B2.44 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 ( <i>Austropotamobius pallipes</i> )	Major	Limited data is available for the impacted reach. White-clawed crayfish could potentially to use the impacted reach. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Medium/High	Yes
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	Limited data is available for the impacted reach. Water vole could potentially to use 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 permit may reduce habitat availability and alter the species food supply.	Medium	Yes
NERC Species – Fish - Brown trout ( <i>Salmo trutta</i> )	Major	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



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)
Notable Species – Fish  Grayling ( <i>Thymallus thymallus</i> )  Bullhead ( <i>Cottus gobio</i> ) Barbel ( <i>Barbus barbus</i> ) <sup>5</sup>	Major	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.	Medium	Yes

## B2.7.4 WFD features

### B2.7.4.1 Macroinvertebrates

The WFD waterbody GB104027057460 Little Don from Source to River Don classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by two Environment Agency monitoring sites, Deepcar (ID 198) and D/S Underbank Reservoir (ID 200) Deepcar had baseline survey data for two seasonal samples for 2012 to 2015. D/S Underbank Reservoir had baseline survey data for two seasonal samples for 2009, 2010, 2015 to 2019.

The WFD status of the macroinvertebrate community in Little Don 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 Little Don 1 is highly sensitive to reduced flows (**Figure B2.7**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.7**.

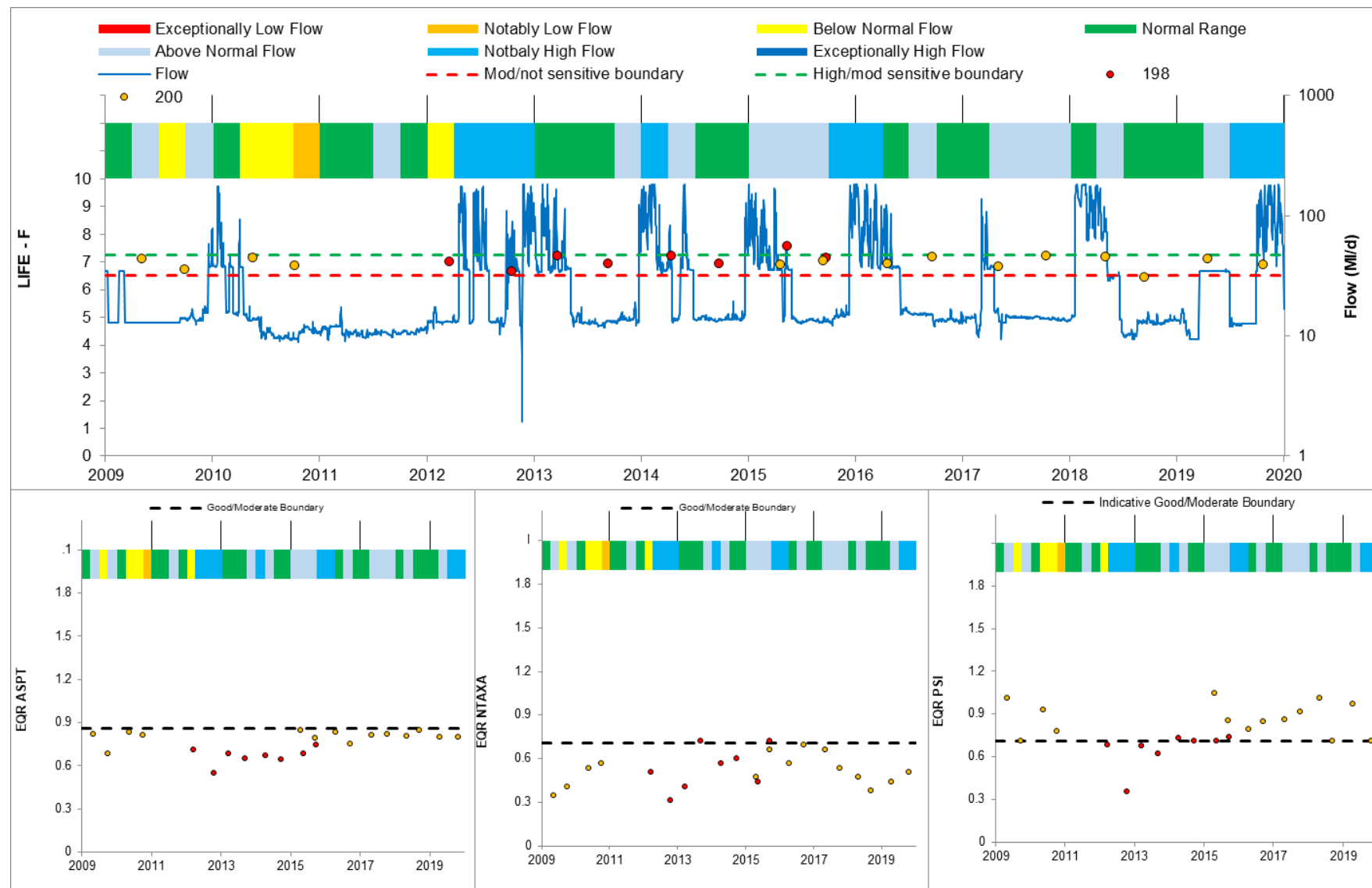
Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve poor or moderate WFD status over the monitoring period, WHPT<sub>ASPT</sub> scores ranging between 3.96 and 6.08. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a poor to moderate proportion of taxa which are sensitive to pressures including water quality.

In Little Don 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 22 and 33. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.31 and 0.72, indicative of poor to moderate ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows may influence the baseline community.

<sup>5</sup> Barbel is listed in Annex V of the Habitats Directive as a species of Community interest whose taking in the wild and exploitation may be the subject of management measures.

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 B2.7 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

## B2.7.4.2 Fish

Waterbody GB104027057460 Little Don from Source to River Don is classified under Cycle 2 (2016) as poor. Baseline fisheries data is informed by two sites, Downstream Underbank (ID 31624) and Deepcar (formerly Stocksbridge WWTW US) (ID 4342), which were surveyed in 2011, with Downstream Underbank also surveyed in 2017. Monitoring of the fish community at Deepcar (formerly Stocksbridge WWTW US) was also undertaken in 2015 to 2018 by YWSL. **Table B2.45** sets out the available fish survey data from these sites.

The WFD status of the fish community in Little Don 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.

Waterbody GB104027057460 Little Don from Source to River Don classified as poor overall and informed by one fisheries site, Downstream Underbank.

The site Downstream Underbank is individually classified as poor with a site EQR of 0.1142, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with three species present from an expected four species. Trout had a lower observed density than expected, with a low EQR score of 0.09667. Bullhead are observed at increased numbers, with an EQR score of 1. Roach had a higher observed density than expected, with a high EQR score of 0.9453. The low EQR score of trout had an effect in the overall site classification, contributing to the overall 'poor' classification of the site.

Additional baseline fish data for little Don 1, Deepcar (formerly Stocksbridge STW US), showed an increased species diversity when compared to the site further upstream, Downstream Underbank. Deepcar (formerly Stocksbridge STW US) observed a moderate abundance of trout and Bullhead, and a low abundance of grayling recorded. Additional YWSL monitoring at Deepcar (formerly Stocksbridge STW US) showed increased species diversity when compared to the survey in 2011 by the Environment Agency, though the survey methodology differed (Catch Depletion Sample) in 2015 to 2017. A single barbel was recorded at the site in 2017, therefore a low abundance is thought to be present.

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 B2.45 Fish survey data from Little Don 1**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Grayling	Minnow	3-spined stickleback	Stone loach	Barbel	Roach
4342	Deepcar (formerly Stocksbridge STW US)	08/09/2011	Single Catch Sample	56	28	2	33	11			
YW14	Deepcar (formerly Stocksbridge STW US)	11/09/2015	Catch Depletion Sample	50	81	32	3	1	3		
		08/09/2016	Catch Depletion Sample	10	47	1			1		
		28/09/2017	Catch Depletion Sample	17	80	1	3		1	1	
		08/08/2018	Single Catch Sample	10	42	3	1		1		
31624	Downstream Underbank Reservoir	08/09/2011	Single Catch Sample	17	41						
		05/09/2017	Single Catch Sample	4	108						4



### B2.7.4.3 WFD waterbody status

**Table B2.46** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.46** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.46 WFD classifications**

Waterbody ID & Name		GB104027057460 Little Don from Source to River Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
Overall		Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Poor	Medium
	Macroinvertebrates	Good	Medium
Hydro-morph designation		Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	
	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

### B2.7.5 Invasive non-native species (INNS)

**Table B2.47** 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 B2.47**).

**Table B2.47 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)
Invasive non-native species – macroinvertebrates -New Zealand mud snail ( <i>Potamopyrgus antipodarum</i> ) - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants - Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – fish - Ide ( <i>Leuciscus idus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.7.6 Landscape, navigation, recreation and heritage

**Table B2.48** 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 B2.48**).

**Table B2.48 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)
Stocksbridge and District Golf Course	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Barnsley Boundary Walk – National Trail	Major	The route of the trail runs in close proximity to the Little Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Little Don River - Angling	Major	Minor impact as flows will already be low at time of implementation	Low	No
Little Don River – Canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No

## B2.8 Ewden Beck 1

### B2.8.1 Statutory designated sites

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment.

#### Table B2.49 Statutory designated sites

### B2.8.2 NERC and local wildlife sites

**Table B2.50** 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.

Two 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 B2.50**).

**Table B2.50 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)
More Hall Reservoir LWS	Major	The site compasses the large standing water expanse of More Hall reservoir, its surrounding areas including the slipway, offtake and section of the Little Don River immediately downstream. Present are wooded areas, possibly wet woodland. Areas of grassland are present of the reservoir slopes. The upstream end shows uncovered sediment, likely hosting inundation vegetation. The banks of the reservoir are wooded. There is some vegetation within the water.	Not sensitive	No
Lower Ewden Beck LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site is segmented with several areas surrounding the River Don above its confluence with the Little Don. Aerial imagery shows woodland grassland, pasture and heathland in the upper segments. The southern segments of the site follow Lower Ewden Beck from More Hall Reservoir to its confluence with the Don. Areas of ancient upland oak woodland are present around the river. Some wet woodland is also present and are present.	Low	Yes
Upper River Don: Deepcar to Hillsborough LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  Although the site encompasses the river as it passes through urban areas, the river corridor is very species rich. The river in the site passes close to three major ancient woodland and the corridor is significant for dispersal and	Low	Yes

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)
		maintenance of a wide range of species. Semi-natural woodland, scrub, other tall herb, flush/spring, marsh and marginal aquatic vegetation habitats are also present.		
Good quality semi-improved grassland NERC habitat -365508 -365511	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors	Not sensitive	No
No main habitat but additional habitats present- Good quality semi-improved grassland NERC habitat -454463	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors	Not sensitive	No

### B2.8.3 NERC and other protected species

**Table B2.51** summaries the NERC Act Section 41 and other protected species which are located on or within 500m of the impacted reach.

White-clawed crayfish are a NERC Act Section 41 species and are sensitive to habitat modification from the management of waterbodies. Data obtained from the Environment Agency and YWSL, as well as a review of available data from NBN gateway was used inform the assessment of the feature in the impacted reach. However, no information from survey findings was available for white-clawed crayfish, therefore it was not possible to conclusively rule out their presence. Based on the available information this feature is considered to be susceptible to drought option impacts and has an **uncertain** 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 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 otter 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 nationally scarce species of riffle beetle, *Riolus subviolaceus* has been identified as being present in Ewden Beck 1. The species was identified in routine sampling carried out by the Environment Agency at the site D/S Dam in 2014. Three specimens were present. Based on the available information this



feature is not considered to be susceptible to drought permit impacts and have a **low** sensitivity to the physical environment impacts identified in **Appendix A**.

Two NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and one notable fish species (bullhead).

**Table B2.51 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 ( <i>Austropotamobius pallipes</i> )	Major	White-clawed crayfish are sensitive to habitat modification from the management of waterbodies. Therefore, they are considered to be sensitive to hydrological impacts, particularly low flows.	Uncertain	Yes
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout ( <i>Salmo trutta</i> )	Major	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 -Bullhead ( <i>Cottus gobio</i> )	Major	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.	Medium	Yes
Notable Species – Invertebrates -Riffle beetle	Major	This species is moderately tolerant/sensitive of pollution (WHPT scores of 6.4) and such	Low	Yes

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)
( <i>Riolus subviolaceus</i> )		water quality pressures are unlikely to impact the species.		

## B2.8.4 WFD features

### B2.8.4.1 Macroinvertebrates

The WFD waterbody GB104027057400 Ewden Beck from Source to River Don classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by three Environment Agency monitoring sites, D/S Dam (1585) and U/S River Don (148). U/S River Don had baseline survey data for two seasonal samples for 2009, 2010, and 2012 to 2019. D/S Dam had baseline survey data for two seasonal samples for 2009, 2010, 2012 to 2015 and 2018.

The WFD status of the macroinvertebrate community in Ewden Beck 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 Ewden Beck 1 is highly sensitive to reduced flows (**Figure B2.8**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.8**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve moderate to high WFD status over the monitoring period. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a good to high proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 5.75 and 8.04.

In Ewden Beck 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 11 and 33, WHPT<sub>NTAXA</sub> EQR scores ranged between 0.35 and 1.05, indicative of bad to high ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B2.8** LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.8.4.2 Fish

Waterbody GB104027057400 Ewden Beck from Source to River Don is classified under Cycle 2 (2016) as moderate. Baseline fisheries data is informed by two sites, D/S Dupont Abstraction (ID 11997) and D/S More Hall Reservoir (ID 11987) which were surveyed in 2010 to 2012 and 2015. **Table B2.52** sets out the available fish survey data from these sites.

The WFD status of the fish community in Ewden Beck 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.

Waterbody GB104027057400 Ewden Beck from Source to River Don classified as moderate overall and informed by one fisheries site, D/S Dupont Abstraction.

The site D/S Dupont Abstraction is individually classified as good with a site EQR of 0.5014, based on the FCS2 EQR scores from the 2017 survey. The site has a relatively good diversity, with four species present from an expected five species. Trout had a higher observed density than expected, with a good EQR score of 0.6793. Bullhead are observed at increased numbers, with an EQR score of 1. Grayling and perch were recorded, with good EQR scores of 0.552 and 0.7677 respectively. Stone loach are not observed in this reach, although they are expected to be present.

Additional baseline fish data for Ewden Beck 1, D/S More Hall Res (WR), showed an increased abundance when compared to the site further downstream, D/S Dupont Abstraction. D/S More Hall Res (WR) observed a moderate to high abundance of trout, though bullhead were absent through all surveys. A low abundance of perch was recorded from 2010 to 2012 with an increased number of perch in 2015. Two rainbow trout were recorded in 2012 and a single Orfe / Ide in 2015.

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 B2.52 Fish survey data from Ewden Beck 1**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Grayling	Perch	Roach	Rainbow trout	Orfe / Ide	Bullhead
11987	D/S More Hall Res (WR)	02/09/2010	Catch Depletion Sample	91		3	2			
		13/09/2011	Catch Depletion Sample	142		3	4			
		28/08/2012	Catch Depletion Sample	105		6	7	2		
		14/09/2015	Catch Depletion Sample	53		34	8		1	
11997	D/S Dupont Abstraction	02/09/2010	Catch Depletion Sample	60						19
		12/09/2011	Catch Depletion Sample	54		1				43
		28/08/2012	Catch Depletion Sample	53		5				81
		14/09/2015	Catch Depletion Sample	28		4				19
		01/09/2017	Catch Depletion Sample	27	1	1				33

#### B2.8.4.3 WFD waterbody status

**Table B2.53** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.53** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.53 WFD classifications**

Waterbody ID & Name		GB104027057400 Ewden Beck from Source to River Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
	Overall	Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Moderate	Medium
	Macroinvertebrates	Good	Medium
Hydro-morph designation		Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	
	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

### B2.8.5 Invasive non-native species (INNS)

**Table B2.54** 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 B2.54**).

**Table B2.54 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)
Invasive non-native species – macroinvertebrates - Freshwater shrimp (Crangonys pseudogracilis)	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants - Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Fish -Rainbow trout ( <i>Oncorhynchus mykiss</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.8.6 Landscape, navigation, recreation and heritage

**Table B2.55** 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 B2.55**).

**Table B2.55 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)
Sheffield Country Walk – National Trail	Major	The route of the trail runs in close proximity to the River Don. The river forms part of the landscape setting of the trail.	Not sensitive	No
Ewden Beck – Angling	Major	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

## B2.9 Loxley 1

### B2.9.1 Statutory designated sites

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment

### B2.9.2 NERC and local wildlife sites

**Table B2.56** 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.

Four 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 B2.56**).

**Table B2.56 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)
Dam Flask to Rowel Bridge LWS	Major	<p>Likely to be in connectivity with impacted reach and support aquatic receptors</p> <p>The site includes the slipway of the Damflask reservoir, the River Loxley immediately downstream, areas of fields, broadleaved woodland (mature, wet, semi-natural) and agricultural grassland (unimproved, semi-improved, improved, acid, neutral) around the Rover Loxley and Storrs Brook. Also present are areas of standing water, marsh, health/grassland mosaic, western gorse shrub, bracken, tall herbs, springs and hedgerows. A silted-up mill/dam has been colonised by alder and willow carr</p>	Low	Yes
Acorn Hill and Little Matlock Wood LWS	Major	<p>Likely to be in connectivity with impacted reach and support aquatic receptors</p> <p>Contains the Loxley River, areas of standing water (mill ponds) and ancient woodland and associated woodland species, lowland dry acid grassland (UKBAP habitat), unimproved grassland, semi-improved grassland and neutral grassland. Some areas of grassland are grazed, others have become overgrown and are now covered in scrub. Other habitats present include semi-natural woodland, flush/spring, cliff/rock face/outcrop and quarry</p>	Low	Yes
Broadhead Dam to Malin Bridge LWS	Major	<p>Likely to be in connectivity with impacted reach and support aquatic receptors</p> <p>The site covers a former mill pond on the River Loxley and Broadhead Dam. The dam hosts sensitive wetland habitats. Wet woodlands are present. The riparian zone hosts</p>	Low	Yes

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)
		large alders. Areas of scrub, springs and tall herbs are also present as well as areas of marginal aquatic vegetation.		
Lower Rivelin Valley LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site encompasses the River Rivelin and immediate areas until its confluence with the River Loxley. The area is used for recreation, flood control and nature conservation. Areas wet woodland/alder carr are present, typically at the sites of silted mill ponds. Along with the carr areas, the bankside vegetation among the trees supports ancient woodland indicator species	Low	Yes
Deciduous woodland NERC habitat -322455 -322454 -322457 -322456	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Good quality semi-improved grassland	Not sensitive	No
Deciduous woodland NERC habitat -322461	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Good quality semi-improved grassland, Lowland meadows and pastures	Not sensitive	No
Good quality semi-improved grassland NERC habitat -365514	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Lowland meadows and pastures, Restoration of species-rich, semi-natural grassland	Not sensitive	No
Good quality semi-improved grassland NERC habitat -365515	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Lowland meadows and pastures; Restoration of species-rich, semi-natural grassland  Deciduous woodland	Not sensitive	No
Good quality semi-improved grassland NERC habitat -365513	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  Restoration of species-rich, semi-natural grassland	Not sensitive	No
Good quality semi-improved	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors	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)
grassland NERC habitat -364115		Lowland meadows and pastures; Restoration of species-rich, semi-natural grassland		

### B2.9.3 NERC and other protected species

Two NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and one notable fish species (bullhead).

Table B2.57 summarises 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, 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of YWSL records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit 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. Therefore, absence cannot be confirmed. It was 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 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**.

Two NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and one notable fish species (bullhead).

**Table B2.57 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	Major	Limited data is available for the impacted reach. White-clawed crayfish could potentially to use the impacted reach.	Medium/High	Yes

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)
Freshwater white – clawed crayfish ( <i>Austropotamobius pallipes</i> )		Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.		
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout ( <i>Salmo trutta</i> )	Major	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 -Bullhead ( <i>Cottus gobio</i> )	Major	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.	Medium	Yes

## B2.9.4 WFD features

### B2.9.4.1 Macroinvertebrates

The WFD waterbody GB104027057370 Loxley from Strines Dyke to River Don classifies as ‘moderate’ for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by three Environment Agency monitoring sites, Rowell Lane (ID 1245), D/S Weir (ID 142369) and D/S Malin Bridge (ID 89955). Rowell Lane had baseline survey data for two seasonal samples for 2010, and 2012 to 2018, with only one seasonal sample in 2019. D/S Weir had baseline survey data for two seasonal samples for 2009, 2010, and 2012 to 2019. D/S Malin Bridge only had baseline survey data for two seasonal samples for 2009, with additional monitoring was undertaken by YWSL in 2015 and 2016.

The WFD status of the macroinvertebrate community in Loxley 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 Loxley 1 is medium to high sensitivity to reduced flows (**Figure B2.9**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.9**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> scores over the period 2009 to 2019 but remain consistent with the standard to achieve moderate or good WFD status over the monitoring period. WHPT<sub>ASPT</sub> scores from the site identifies macroinvertebrate communities which are composed of a moderate to good proportion of taxa which are sensitive to pressures including water quality, WHPT<sub>ASPT</sub> scores ranging between 5.52 and 6.56. 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 Loxley 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 11 and 29. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.35 and 0.92, indicative of bad to moderate ecological status, with only D/S Weir in spring 2018 indicative of good ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows may influence the baseline community.

YWSL 2015 and 2016 spring and autumn data from the site D/S Malin Bridge describes a macroinvertebrate community which is also highly sensitive to flow reductions (LIFE score 7.35 to 7.79) and also show a high level of diversity (BMWP<sub>NTAXA</sub> scores 21 to 29) and good proportion of pollution sensitive taxa, <sub>ASPT</sub> scores of 6.17 to 6.44. This is consistent with the Environment Agency's baseline data and provides further evidence of the sensitivity of the community to drought permit impacts.

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 B2.9 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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



## B2.9.4.2 Fish

Waterbody GB104027057370 Loxley from Strines Dyke to River Don is classified under Cycle 2 (2016) as good. Baseline fisheries data is informed by eight Environment Agency sites, Pinegrove Country Club (ID 14131), Old Wheel Farm (ID 14182), Olive Cottage (ID 14183), Proroll (ID 14184), Loxley Fisheries (ID 14185), Fiat Garage (ID 14186), Stacey Lane (ID 14191) and Rowell Lane, 25m d/s old bridge (ID 14202). Additional monitoring within the Loxley 1 was undertaken by YWSL from 2015 to 2018 at D/S Malin Bridge (ID YW20). **Table B2.58** sets out the available fish survey data from these sites.

The WFD status of the fish community in Loxley 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.

Waterbody GB104027057370 Loxley from Strines Dyke to River Don classified as good overall and informed by one fisheries site, Old Wheel Farm.

The site Old Wheel Farm is individually classified as good with a site EQR of 0.4468, based on the FCS2 EQR scores from the 2017 survey. The site has a moderate diversity, with two species present from an expected four species. Trout had a slightly lower observed density than expected, with a good EQR score of 0.5677. Bullhead are observed at increased numbers, with an EQR score of 1. Stone loach are not observed in this reach, although they are expected to be present.

Sites within the impacted reach (Loxley 1) showed fish populations similar to the classification sites, with a moderate to high abundance of trout and low to moderate abundance of bullhead. Chub, perch and pike were intermittently recorded at Olive Cottage and Proroll, with a single pike recorded at Old Wheel Farm.

Additional baseline fish data for Loxley1 from YWSL at D/S Malin Bridge. The number of brown trout and bullhead present were comparable to those observed within the reach by the Environment Agency. A low abundance of perch were observed at each survey, with minnow, stone loach and three-spined stickleback observed intermittently.

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 B2.58 Fish survey data from Loxley 1**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Chub	Perch	Pike	Minnow	Stone loach	Three-spined stickleback
14131	Pinegrove Country Club	12/08/2009	Single Catch Sample	100	86						
14182	Old Wheel Farm	05/08/2009	Single Catch Sample	65	36		1				
		14/09/2011	Single Catch Sample	16	8						
		30/08/2017	Single Catch Sample	34	9						
14183	Olive Cottage	05/08/2009	Single Catch Sample	79	53		5	2			
14184	Proroll	12/08/2009	Single Catch Sample	78	60		2				
		14/08/2011	Single Catch Sample	74	31		1	1			
		14/09/2017	Single Catch Sample	27	10						
14185	Loxley Fisheries	06/08/2009	Single Catch Sample	72	2	4					
14186	Fiat Garage	11/08/2009	Single Catch Sample	46	8						

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Chub	Perch	Pike	Minnow	Stone loach	Three-spined stickleback
14191	Stacey Lane	12/08/2009	Single Catch Sample	49	2	2					
14202	Rowell Lane, 25m d/s old bridge	05/08/2009	Single Catch Sample	75	42						
20	D/S Malin Bridge	10/08/2018	Catch Depletion Sample	46	61		3			2	1
		22/09/2015	Single Catch Sample	42	50		1			1	
		12/09/2016	Catch Depletion Sample	42	40		1		5		
		24/08/2017	Catch Depletion Sample	45	58		1		1	2	

#### B2.9.4.3 WFD waterbody status

**Table B2.59** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.59** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.59 WFD classifications**

Waterbody ID & Name			GB104027057370 Loxley from Strines Dyke to River Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment (Major, Moderate, Minor, Negligible)	Impact at Location		Major	
	Overall		Moderate	
RBMP Cycle 2 Status/ Potential	Fish		Good	Medium
	Macroinvertebrates		Moderate	Medium
Hydro-morph designation			Heavily modified	
RBMP2 Waterbody Objective	Overall		Good	
	Fish		Good	
	Macroinvertebrates		Good	
Waterbody Measures			None	

#### B2.9.5 Invasive non-native species (INNS)

**Table B2.60** 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 B2.60**).

**Table B2.60 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)
Invasive non-native species – macroinvertebrates - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Fish - Goldfish ( <i>Carassius auratus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.9.6 Landscape, navigation, recreation and heritage

**Table B2.61** 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 B2.61**).

**Table B2.61 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)
Little Matlock Rolling Mill immediately south and east of olive terrace – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Mousehole Forge, Malin Bridge – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
River Loxley - Angling	Major	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
River Loxley - Canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No

## B2.10 Loxley 2

### B2.10.1 Statutory designated sites

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment.

### B2.10.2 NERC and local wildlife sites

**Table B2.62** 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.

One 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 B2.62**).

**Table B2.62** 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)
Malin Bridge to River Don LWS	Major	Likely to be in connectivity with impacted reach and support aquatic receptors  The site covers the River Loxley to its confluence with the Don, and the surrounding margins and woodland habitat. The woodlands are semi-natural. Tall herb habitats also exist, as well as marginal aquatic vegetation.	Low	Yes

### B2.10.3 NERC and other protected species

Three NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and two notable fish species (bullhead and grayling).

Table B2.63 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 surveys were completed historically by YWSL and the Environment Agency, no records have been recorded in the impacted reach, although suitable habitat has been identified as 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of Environment Agency records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit 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. Therefore, absence cannot be confirmed. It was 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 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**.

Three NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout) and two notable fish species (bullhead and grayling).

**Table B2.63 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 ( <i>Austropotamobius pallipes</i> )	Major	Limited data is available for the impacted reach. White-clawed crayfish could potentially to use the impacted reach. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Medium/High	Yes
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	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 – Fish - Brown trout ( <i>Salmo trutta</i> ) --European eel ( <i>Anguilla Anguilla</i> )	Major	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 -Bullhead ( <i>Cottus gobio</i> )	Major	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	Medium	Yes



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)
-Grayling ( <i>Thymallus thymallus</i> )		watercourse. Predation could occur on fish stranded in pools in high densities.		

## B2.10.4 WFD features

### B2.10.4.1 Macroinvertebrates

The WFD waterbody GB104027057370 Loxley from Strines Dyke to River Don classifies as ‘moderate’ for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by two Environment Agency monitoring sites, D/S Malin Bridge (ID 89955) and A61 (Sheffield) (ID204). D/S Malin Bridge only had baseline survey data for two seasonal samples for 2009, with additional monitoring was undertaken by YWSL in 2015 and 2016. A61 (Sheffield) had baseline survey data for two seasonal samples for 2013, and 9, 2010, with only one seasonal sample 2015. Additional monitoring was undertaken by YWSL in the impacted reach at Park and Ride d/s Rivelin Confluence in 2017 and 2018.

The WFD status of the macroinvertebrate community in Loxley 2 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 Loxley 2 is highly sensitive to reduced flows (**Figure B2.10**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> 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<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.10**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> 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<sub>ASPT</sub> 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<sub>ASPT</sub> scores ranging between 5.55 and 6.81. 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.

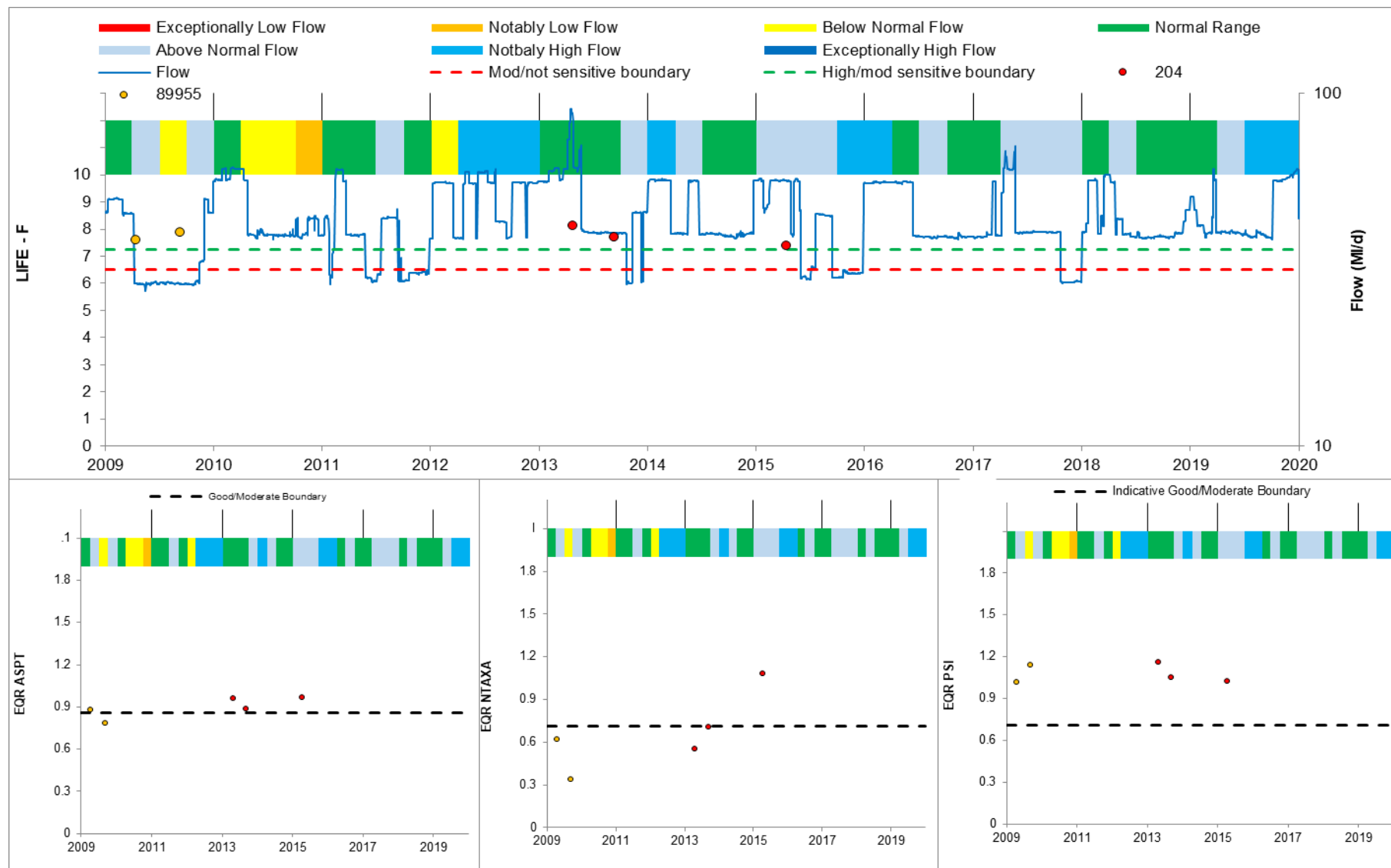
In Loxley 2 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 11 and 35. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.34 and 1.08, indicative of bad to high ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows may influence the baseline community.

YWSL 2015 and 2016 spring and autumn data from the site D/S Malin Bridge describes a macroinvertebrate community which is also highly sensitive to flow reductions (LIFE score 7.35 to 7.79) and also show a high level of diversity (BMWP<sub>NTAXA</sub> scores 21 to 29) and good proportion of pollution sensitive taxa, ASPT scores of 6.17 to 6.44. This is consistent with the Environment Agency’s baseline data and provides further evidence of the sensitivity of the community to drought permit impacts.

YWSL 2015 and 2016 spring and autumn data from the site at Park and Ride d/s Rivelin Confluence describes a macroinvertebrate community which is also highly sensitive to flow reductions (LIFE score 7.39 to 7.45) and also show a high level of diversity (BMWP<sub>NTAXA</sub> scores 21 to 25) and good proportion of pollution sensitive taxa, ASPT scores of 6.11 to 6.50. This is consistent with the Environment Agency's baseline data and provides further evidence of the sensitivity of the community to drought permit impacts.

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 B2.10 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.10.4.2 Fish

Waterbody GB104027057370 Loxley from Strines Dyke to River Don is classified under Cycle 2 (2016) as good. Baseline fisheries data is informed by three YWSL monitoring sites, D/S Malin Bridge (YW20), Livesey Street (YW21) and Owlerton (YW22). All YWSL monitoring sites in the impacted reach were surveyed from 2015 to 2018. No Environment Agency fisheries monitoring sites were present in the impacted reach, FCS2 data was provided by Old Wheel Farm. (ID 14182), located upstream of the impacted reach (Loxley 1).

This classification is informed by one site, Leighton Beck / Pott Beck (ID 26601) which was surveyed in 2010 and 2013. Monitoring of the fish community at this site was also undertaken in October 2015 by YWSL. Additional monitoring within the Pott Beck 1 was undertaken by YWSL in October 2017 and 2018 at Six sites (Pott Beck 1 to 6). **Table B2.64** sets out the available fish survey data from these sites.

The WFD status of the fish community in Loxley 2 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.

The site Old Wheel Farm is individually classified as good with a site EQR of 0.4468, based on the FCS2 EQR scores from the 2017 survey. The site has a moderate diversity, with two species present from an expected four species. Trout had a slightly lower observed density than expected, with a good EQR score of 0.5677. Bullhead are observed at increased numbers, with an EQR score of 1. Stone loach are not observed in this reach, although they are expected to be present.

Baseline fish data for Loxley from YWSL sites within the impacted reach (Loxley 2) showed an increased diversity to the Environment Agency site in the upstream reach (Loxley 1). All three YWSL sites observed a low to moderate abundance of trout and bullhead. While grayling were recorded regularly at a low abundance at Livesey Street and Owlerton, they were only recorded at a low abundance once at D/S Malin Bridge. A low abundance of perch were observed at each survey, with minnow, stone loach and three-spined stickleback observed intermittently.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.64 Fish survey data from Loxley 2**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Grayling	Stone loach	Minnow	3-spined stickleback	Perch
14182	Old Wheel Farm	05/08/2009	Single Catch Sample	65	36					1
		14/09/2011	Single Catch Sample	16	8					
		30/08/2017	Single Catch Sample	34	9					
YW20	D/S Malin Bridge	10/08/2018	Catch Depletion Sample	46	61		2		1	3
		22/09/2015	Single Catch Sample	42	50	4	1			1
		12/09/2016	Catch Depletion Sample	42	40			5		1
		24/08/2017	Catch Depletion Sample	45	58		2	1		1
YW21	Livesey Street	10/08/2018	Single Catch Sample	12	21	3				
		25/08/2015	Single Catch Sample	29	14	1				
		30/08/2016	Single Catch Sample	9	5	1				
		03/10/2017	Single Catch Sample	14	8	2				
YW22	Owlerton	10/08/2018	Single Catch Sample	8	11	2				
		08/09/2015	Single Catch Sample	6	36	2				

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Grayling	Stone loach	Minnow	3-spined stickleback	Perch
		30/08/2016	Single Catch Sample	4	15					
		03/10/2017	Single Catch Sample	3	3	2				

#### B2.10.4.3 WFD waterbody status

**Table B2.65** summarises the WFD classification of waterbody which contain the impacted reach. **Table B2.65** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.65 WFD classifications**

Waterbody ID & Name		GB104027057370 Loxley from Strines Dyke to River Don	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
	Overall	Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Good	Medium
	Macroinvertebrates	Moderate	Medium
Hydro-morph designation		Heavily modified	
	Overall	Good	
RBMP2 Waterbody Objective	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

#### B2.10.5 Invasive non-native species (INNS)

**Table B2.66** 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 B2.66**).



**Table B2.66 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)
Invasive non-native species – macroinvertebrates - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> ) - Japanese knotweed ( <i>Fallopia japonica</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Fish -Rainbow trout ( <i>Oncorhynchus mykiss</i> ) -Ide ( <i>Leuciscus idus</i> ) -Goldfish ( <i>Carassius auratus</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.10.6 Landscape, navigation, recreation and heritage

**Table B2.67** 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 B2.67**).

**Table B2.67 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)
Little Matlock Rolling Mill immediately south and east of olive terrace – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
Mousehole Forge, Malin Bridge – Scheduled	Major	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)
Ancient Monument				
River Loxley - Angling	Major	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

## B2.11 Rivelin 1

### B2.11.1 Statutory designated sites

**Table B2.68** 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.

No statutory designated sites that are sensitive or susceptible to drought permit impacts have been identified for detailed assessment (see **Table B2.68**).

**Table B2.68** Statutory 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)
Eastern Peak District Moors SSSI	Major	None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.	Not sensitive	No
South Pennine Moors SAC	Major	None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.	Not sensitive	No
Peak District Moors (South Pennine Moors Phase 1) SPA	Major	None. The Moors are upstream of the impacted reach. The gradients between the moor and the valley are sufficiently steep that there would be no hydrodynamic connectivity between channel and the moor, particularly during dry conditions.	Not sensitive	No
Fox Hagg LNR	Major	No water dependent features	Not sensitive	No

### B2.11.2 NERC and local wildlife sites

**Table B2.69** 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.

Three 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 B2.69**).

**Table B2.69** 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)
Fox Hagg LWS	Major	The site covers the River Rivelin immediately downstream of the Rivelin Dams as it flows through a large expanse of woodland. Areas	Medium	Yes

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)
		of grassland area also present. Bracken, heather, birch, scrub, woodland and moorland habitats are also present, as well as a pond. Allen Sike stream runs through the site to connect with the River Rivelin.		
Middle Rivelin Valley LWS	Major	Is in connectivity with impacted reach and support aquatic receptors  Encompasses a long stretch of the River Rivelin and adjacent habitats. The adjacent habitats are predominately woodland (wet alder, semi-natural, ancient, plantation). Area of grassland are present (unimproved, semi-improved, acid, improved) as well as bracken, tall herb, marsh, flush/spring, marginal aquatic vegetation and hedgerows. There are many areas of standing water from working mill ponds and areas were former mill ponds have silted up.	Medium	Yes
Millstone Edge Rough and Fields LWS	Major	Unlikely to be in connectivity with impacted reach or support aquatic receptors  The site has a wide variety of habitats, including upland heathland mosaic, secondary and semi-natural woodland, plantation woodland, grassland (unimproved, semi-improved, acid, neutral, grazed), bracken, tall herb, spring, and cliff/rock face/outcrop).	Not sensitive	No
The Reaps LWS	Major	The sites contain 3 areas of mature oak dominated woodland with several ancient woodland indicator species, a large grassland area which is gradually turning into scrub, springs and flushes within the grassland with stands of tall herbs and a stream feeding into a pond. Also present are amenity grass and ornamental planting around 3 burial grounds	Not sensitive	No
Walkley Bank Plantation LWS	Major	An area of plantation woodland of predominately mature even-aged beech with sections of coppiced oak. There are two flushes within the site.	Not sensitive	No
Roscoe Plantation LWS		A stream runs through the large mill dam, now silted up and overgrown with mature woodland including Alder, Beech, Sycamore	Medium	Yes

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)
		and Willow. The site borders the impacted reach.		
Lower Rivelin Valley LWS	Major	Is in connectivity with impacted reach and support aquatic receptors  The site encompasses the River Rivelin and immediate areas until its confluence with the River Loxley. The area is used for recreation, flood control and nature conservation. Areas wet woodland/alder carr are present, typically at the sites of silted mill ponds. Along with the carr areas, the bankside vegetation among the trees supports ancient woodland indicator species	Medium	Yes

### B2.11.3 NERC and other protected species

**Table B2.70** 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 surveys were completed historically by YWSL and the Environment Agency, with the species recorded in the impacted, and suitable habitat has been identified as 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 white-clawed crayfish likely to be present in the reach at the time of the implementation of a drought permit. Based on the available information this species is considered to be susceptible to drought permit impacts and have a **medium/high** sensitivity to the physical environment impacts identified in **Appendix A**.

Data obtained from the Environment Agency, YWSL and a review of available data from NBN gateway was used inform the assessment of otter in the impacted reach. Review of YWSL records indicate the presence of otter within impacted reach. The data identifies that suitable habitat is present in the impacted reach. 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 otters likely to be present in the reach at the time of the implementation of a drought permit. Based on the limited available information otters considered to be susceptible to drought permit 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 reach. Therefore, absence cannot be confirmed. It was 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 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**.



Three NERC act section 41 and notable fish species have been identified as present in the impacted reach, including one NERC Act Section 41 fish species (brown trout and European eel) and one notable fish species (bullhead).

The nationally scarce species of spongefly, *Sisyra terminalis* has been identified as being present in Rivelin 1. The species was identified in routine sampling carried out by the Environment Agency at the site Rivelin Mill in 2015. One specimen was present. Based on the available information this feature is not considered to be susceptible to drought permit impacts and have a **low** sensitivity to the physical environment impacts identified in **Appendix A**.

One NERC act section 41 species of herb, *Teucrium Scordium* has been identified as being present in Rivelin 1. The species was identified by the Sheffield Biological Records Centre. Based on the limited available information this feature is considered to be potentially susceptible to drought permit impacts and have **uncertain** sensitivity to the physical environment impacts identified in **Appendix A**.

Several NERC act section 41 and notable bird species have been identified as present in water dependent habitats which rely on the impacted reach. Based on the available information these species are considered not to be susceptible to drought order impacts and **not sensitive** to the physical environment impacts identified in **Appendix A**.

**Table B2.70 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 – Plant - Water germander ( <i>Teucrium scordium</i> )	Major	Limited data is available for the impacted reach. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Uncertain	Yes
NERC Species – Crustacea Freshwater white – clawed crayfish ( <i>Austropotamobius pallipes</i> )	Major	Limited data is available for the impacted reach. White-clawed crayfish could potentially to use the impacted reach. Further consideration would be necessary to determine to what extent or how they may be impacted by reduced flows caused by the drought option.	Medium/High	Yes
NERC Species – mammals Otter ( <i>Lutra lutra</i> )	Major	Limited data is available for the impacted reach. Otters could potentially to use the impacted reach. 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 ( <i>Arvicola amphibious</i> )	Major	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	Uncertain	Yes

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)
		habitat availability and alter the species food supply.		
NERC Species – Fish - Brown trout ( <i>Salmo trutta</i> ) -European eel ( <i>Anguilla anguilla</i> )	Major	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 -Bullhead ( <i>Cottus gobio</i> ) -Brook lamprey ( <i>Lampetra planeri</i> )	Major	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.	Medium	Yes
Notable Species – Invertebrates -Spongefly ( <i>Sisyra terminalis</i> )	Major	This species is moderately tolerant/sensitive of pollution (WHPT scores of 5.7) and such water quality pressures are unlikely to impact the species.	Low	Yes

## B2.11.4 WFD features

### B2.11.4.1 Macroinvertebrates

The WFD waterbody GB104027057340 Rivelin from Source to River Loxley classifies as 'good' for macroinvertebrates in 2016, Cycle 2. Baseline macroinvertebrate data is provided by four Environment Agency monitoring sites, Hollins Bridge (ID 245), Rivelin Mill (ID 1580), U/S WTW (ID 90061) and U/S Roscoe Bridge (ID 142368). Hollins Bridge had baseline survey data for two seasonal samples for 2013, with only a single seasonal sample in 2009. Rivelin Mill had baseline survey data for two seasonal samples for 2012 to 2019, with only a single seasonal sample in 2009. U/S Roscoe Bridge only had baseline survey data for two seasonal samples for 2009. U/S WTW only had baseline survey data for two seasonal samples for 2009 and 2010.

The WFD status of the macroinvertebrate community in Rivelin 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 Rivelin 1 is highly sensitive to reduced flows (**Figure B2.11**). See **Table B2.4** for guidance in interpreting raw LIFE scores.

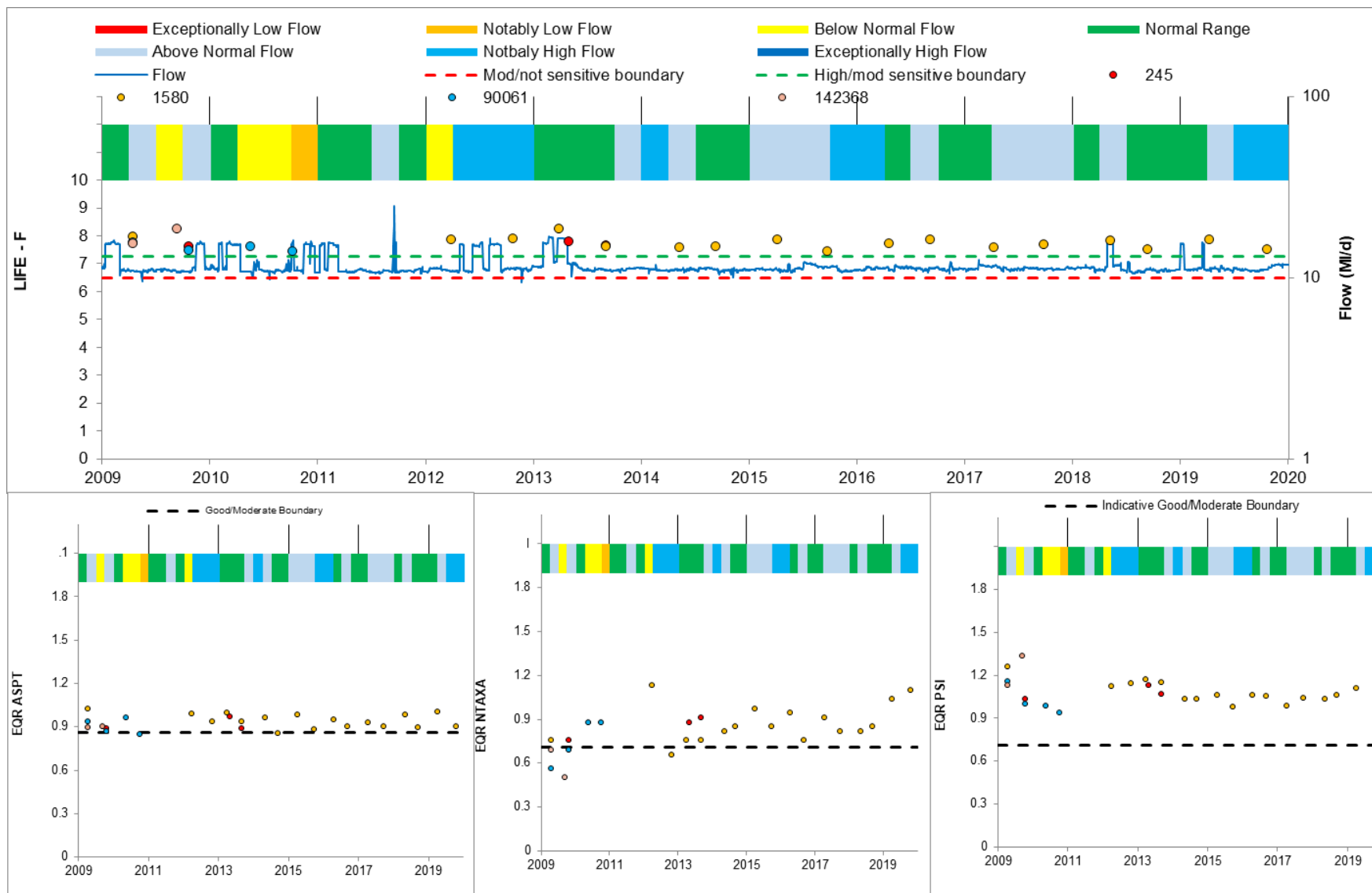
WHPT<sub>ASPT</sub> and WHPT<sub>NTAXA</sub> scores are available for the site. WHPT and PSI EQR scores are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT<sub>NTAXA</sub> and WHPT<sub>ASPT</sub>, see **Figure B2.11**.

Data from the monitoring site shows variation in WHPT<sub>ASPT</sub> 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<sub>ASPT</sub> 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<sub>ASPT</sub> scores ranging between 6.33 and 7.66. 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 Rivelin 1 data from the site identifies macroinvertebrate communities which significantly varies in terms of diversity, with WHPT<sub>NTAXA</sub> ranging between 16 and 36. WHPT<sub>NTAXA</sub> EQR scores ranged between 0.5 and 1.13, indicative of poor to high ecological status. Impaired WHPT<sub>NTAXA</sub> can be indicative of pressures including denuded habitat quality, siltation or reduced water quality, this data suggests that pressures which impair macroinvertebrate diversity such as habitat loss or/and low or high flows 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 B2.11 LIFE score sensitivities, EQR values for WHPT<sub>NTAXA</sub>, WHPT<sub>ASPT</sub> 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

#### B2.11.4.2 Fish

Waterbody GB104027057340 Rivelin from Source to River Loxley is classified under Cycle 2 (2016) as good. Baseline fisheries data is informed by nine Environment Agency sites, Pinegrove Rivelin Mill (14199), Allotments Bridge (ID 14078), Coppice Cottage (ID 14127), U/S Coppice Cottages (ID 14195), D/S Mill Dam (ID 14079), Glen Bridge (ID 14126), U/S Roscoe Bridge (ID 14077), Hospital (ID 14200) and Havelock Dam (ID 4346). **Table B2.71** sets out the available fish survey data from these sites.

The WFD status of the fish community in Rivelin 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.

Waterbody GB104027057340 Rivelin from Source to River Loxley classified as good overall and informed by two fisheries sites, Rivelin Mill and Allotments Bridge.

The site Allotments Bridge is individually classified as good with a site EQR of 0.692, based on the FCS2 EQR scores from the 2018 survey. The site has a good diversity, with four species present from an expected five species. Trout had a higher observed density than expected, with a good EQR score of 0.8307. Bullhead and stone loach are observed at increased numbers, with an EQR score of 1. Stone loach are not observed in this reach, although they are expected to be present. Lamprey were observed at the site, though not expected due to the low prevalence, resulting in a high EQR score of 0.9903. Grayling are expected to be present at the site, at a low prevalence of 0.4657, though were not observed.

The site Rivelin Mill is individually classified as good with a site EQR of 0.5286, based on the FCS2 EQR scores from the 2017 survey. The site has a good diversity, with three species present from an expected three species. Trout had a lower observed density than expected, with a EQR score of 0.2897. Bullhead and stone loach are observed at increased numbers, with an EQR score of 1. Stone loach are not observed in this reach, although they are expected to be present.

The sites within the impacted reach (Rivelin 1) show a moderate to high abundance of brown trout. Havelock Dam, U/S Roscoe Bridge, D/S Mill Dam, Glen Bridge, Coppice Cottage, U/S Coppice Cottages and Hospital were only surveyed in 2009, therefore no temporal change can be identified. The number of brown trout observed varies between surveys, but a general trend showed a decrease in the abundance in later years at Rivelin Mill and Allotments Bridge. A moderate to high abundance of bullhead was observed at in the reach, although a low abundance was recorded at U/S Coppice Cottages, Rivelin Mill and Hospital. A single minnow was present at D/S Mill Dam and hospital, with 4 individuals recorded at Havelock Dam. A low abundance of stone loach were intermittently observed throughout the reach, with the exception of D/S Mill Dam and Glen Bridge.

Although European eel have not been identified, an absence from the impacted reach is not considered likely as previous historical data obtained from the EA suggested their presence. Therefore, a low abundance of this species has been assumed.

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 B2.71 Fish survey data from Rivelin 1**

Site ID	Site Name	Event Date	Method	Brown / sea trout	Bullhead	Stone loach	Minnow	Perch	Three-spined	Brook lamprey
4346	Havelock Dam	10/08/2009	Catch Sample Depletion	66	99		4	5		2
14077	U/S Roscoe Bridge	11/08/2009	Catch Sample Depletion	43	59					
14078	Allotments Bridge	11/08/2009	Catch Sample Depletion	87	205	5				1
		10/09/2010	Single Sample Catch	59	100 to 999 [Survey]	1 to 9 [Survey]				1 to 9 [Survey]
		14/09/2011	Single Sample Catch	62	81	2				
		07/08/2012	Single Sample Catch	40	92	1				
		14/09/2015	Single Sample Catch	33	53					
		30/08/2017	Single Sample Catch	44	60					
		09/10/2018	Single Sample Catch	47	31	1				3
		20/08/2019	Single Sample Catch	45	89					
14079	D/S Mill Dam	10/08/2009	Catch Sample Depletion	88	22		1			
14126	Glen Bridge	10/08/2009	Catch Sample Depletion	63	41					
14127	Coppice Cottages	04/08/2009	Catch Sample Depletion	61	42	8				2
14195	U/S Coppice Cottages	04/08/2009	Catch Sample Depletion	116	9	12				4
14199	Rivelin Mill	06/08/2009	Catch Sample Depletion	84	1	64				1
		14/09/2011	Single Sample Catch	68	7	16				
		30/08/2017	Single Sample Catch	23	29	3				
14200	Hospital	04/08/2009	Catch Sample Depletion	192	1	34	1			15

#### B2.11.4.3 WFD waterbody status

**Table B2.72** summarises the WFD classification of waterbody which contain the impacted reach.

**Table B2.72** also displays the objective status for 2016 (Cycle 2) or the predicted status in 2021 where objective 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 B2.72 WFD classifications**

Waterbody ID & Name		GB104027057340 Rivelin Source to River Loxley	Sensitivity (Uncertain, High, Medium, Low, Not Sensitive)
Physical Environment Impact at Location (Major, Moderate, Minor, Negligible)		Major	
	Overall	Moderate	
RBMP Cycle 2 Status/ Potential	Fish	Good	Medium
	Macroinvertebrates	Good	Medium
Hydro-morph designation		Heavily modified	
RBMP2 Waterbody Objective	Overall	Good	
	Fish	Good	
	Macroinvertebrates	Good	
Waterbody Measures		None	

### B2.11.5 Invasive non-native species (INNS)

**Table B2.73** 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 B2.73**).

**Table B2.73 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)
Invasive non-native species – macroinvertebrates - Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No
Invasive non-native species – Terrestrial plants -Himalayan balsam ( <i>Impatiens glandulifera</i> )	Major	The implementation of this drought permit is not anticipated to increase the spread of Invasive non-native species.	Not sensitive	No

## B2.11.6 Landscape, navigation, recreation and heritage

**Table B2.74** 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 B2.74**).

**Table B2.74 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)
Camp/Caravan Site, Rivelin Mill	Major	Unlikely to be impacted over the duration of the drought options implementation.	Not sensitive	No
Mousehole Forge, Malin Bridge – Scheduled Ancient Monument	Major	Unlikely to be impacted over the duration of the drought options implementation	Not sensitive	No
River Rivelin - Angling	Major	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
River Rivelin - Canoeing	Major	Drought conditions would not be conducive to canoeing	Not sensitive	No



## B3. Environmental features screening summary

**Table B3.1** Environmental features summary of the South Area

Reach	Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
<b>Associated Drought Options</b>	Winscar/Windleden Lower Reservoirs	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir	Winscar/Windleden Lower Reservoirs / Scout Dyke Reservoir / Underbank Reservoir / More Hall Reservoir / Damflask Reservoir / Rivelin Reservoir	Scout Dyke Reservoir	Underbank Reservoir	More Hall Reservoir	Damflask Reservoir	Damflask Reservoir / Rivelin Reservoir	Rivelin Reservoir
<b>WFD Waterbody</b>	GB104027057500 Don from Source to Scout Dyke	GB104027057490 Don from Scout Dyke to the Little Don	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057411 Don from the Little Don to River Loxley confluence	GB104027057412 Don from River Loxley conf to River Don Works; GB104027057413 Don from River Don Works to River Rother	GB104027057530 Scout Dyke from Source to River Don	GB104027057460 Little Don from Source to River Don	GB104027057400 Ewden Beck from Source to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057370 Loxley from Strines Dyke to River Don	GB104027057340 Rivelin from Source to River Loxley
<b>NERC and Notable Species Receptors</b>											
White-clawed crayfish				✓	✓		✓	✓	✓	✓	✓
<i>Sisyr terminalis</i>											✓
<i>Teucrium scordium</i>											✓
<i>Riolus subviolaceus</i>								✓			
<i>Oreodytes davisii</i>	✓										
Otter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water vole	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Atlantic salmon					✓						
Barbel			✓		✓		✓				
Brook lamprey					✓						✓
Brown trout	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bullhead	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
European eel	✓	✓	✓	✓	✓	✓				✓	✓
Grayling	✓	✓	✓	✓	✓		✓			✓	
River lamprey					✓						
<b>WFD Waterbody WFD Status Receptors</b>											
Fish	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Invertebrates	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>Local Wildlife Sites / Local Nature Reserve</b>											
Romticle Viaduct & Thurgoland Tunnels LWS		✓									
Forge Rocher and Tin Mill Rocher LWS		✓									
Lower Ewden Beck LWS			✓	✓				✓			
Upper River Don: Deepcar to Hillsborough LWS			✓	✓			✓	✓			

Reach	Don 1	Don 2	Don 3	Don 4	Don 5	Scout Dyke 1	Little Don 1	Ewden Beck 1	Loxley 1	Loxley 2	Rivelin 1
Upper River Don: Station Road, Deepcar LWS			✓								
Middle River Don: Hillsborough to City Centre LWS				✓	✓						
Centenary Riverside LNR/LWS					✓						
Salmon Pastures LNR/LWS					✓						
Kalham Island LWS					✓						
Lower River Don: River Don (City Centre to Blackburn Meadows) LWS					✓						
Sandersons Mill Race LWS					✓						
Lower Don Valley: Sheffield and Tinsley Canal LWS					✓						
Blackburn Meadows LWS					✓						
NERC Habitats - 452749/447335 Reedbeds					✓						
Lower Little Don, Stocksbridge LWS							✓				
Dam Flask to Rowel Bridge LWS									✓		
Acorn Hill and Little Matlock Wood LWS									✓		
Broadhead Dam to Malin Bridge LWS									✓		
Malin Bridge to River Don LWS										✓	
Fox Hagg LWS											✓
Middle Rivelin Valley LWS											✓
Lower Rivelin Valley LWS									✓		✓
Roscoe Plantation LWS											
Landscape, navigation, recreation and heritage											
Angling					✓	✓					

Further assessment required = ✓ No further assessment required = x

## B4. Features assessment

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<sup>6</sup>. The potential changes to the physical environment as a result of drought option implementation are described in **Appendix A**.

### B4.1 Don 1

#### B4.1.1 Feature assessment

##### B4.1.1.1 NERC and other protected species

###### Water Beetle, *Oreodytes davisii*

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.1**.

**Table B4.1** Impacts on *Oreodytes davisii* in Don 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
<i>Oreodytes davisii</i>	<ul style="list-style-type: none"><li>• Reductions in wetted width and depth will reduce habitat availability for the species</li><li>• Reduced water quality in the reach</li></ul>	Regional	Low	Minor

###### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Don 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 B4.2**. 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.

<sup>6</sup> Ricardo Energy & Environment (2020). Yorkshire Water Drought Plan 2022. Environmental Assessment Methodology. Report for Yorkshire Water Services Ltd. June 2020.

**Table B4.2 Impacts on water vole in Don 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as minor and will not impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>7</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>8</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

#### Otter

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 otter in Don 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	Negligible	Negligible

<sup>7</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>8</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

## 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 Don 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Potential reduction in effectiveness of Bullhouse Mill Weir fish pass to brown trout movement (noting there a significant barrier at Millhouse Weir downstream in this reach).</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is unlikely as the risk to longitudinal connectivity is moderate.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>9</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	National	Medium	Moderate
Bullhead		Regional	Low	Minor
Grayling		Regional	Medium	Moderate
European eel		International	Low	Moderate

### B4.1.1.2 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<sub>NTAXA</sub> 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 medium to 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 good WHPT<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a minor risk. Furthermore, there are no significant flow pressures, either abstractions or discharges, influencing flow in Don 1, as indicated 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 major risk to the macroinvertebrate component of the WFD GB104027057500 Don from Source to Scout Dyke (associated with Don 1).

<sup>9</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.



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<sup>10,11</sup>. There is uncertainty associated with the dilution of iron in the discharge from the Bullhouse Minewater Project in Don 1 and how this may change with drought options as to date no data are available. 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 GB104027057500 Don from Source to Scout Dyke (associated with Don 1). The duration of impacts could be up to 6 months. There is uncertainty associated with the dilution of iron in the discharge from the Bullhouse Minewater Project in Don 1 and how this may change with drought options as to date no data are available.

### 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 Don 1's environmental features assessment**

Reach	Don 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>NERC and Notable Species Receptors</b>		
Otter	Negligible	No
Water vole	Moderate	Yes
<i>Oreodytes davisii</i>	Minor	No
Brown trout	Moderate	Yes
Bullhead	Minor	No
European eel	Moderate	Yes
Grayling	Moderate	Yes
<b>WFD Status Receptors</b>		
<b>WFD Waterbody</b>	GB104027057500 Don from Source to Scout Dyke	
Fish	Moderate	Yes
Invertebrates	Moderate	No

<sup>10</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>11</sup> 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.

## B4.2 Don 2

### B4.2.1 Feature assessment

#### B4.2.1.1 Statutory designated sites/Local wildlife sites

##### Romticle Viaduct & Thurgoland Tunnels LWS

The site includes the Thurgoland Tunnel, which is a double-bore abandoned railway tunnel between Penistone and Wortley and the Romticle viaduct which now carries the Upper Don trail over the River Don near Thurgoland. These feature of the Romticle Viaduct & Thurgoland Tunnels LWS will not be impacted by the implementation of the drought option and is not considered further. The site also includes the section of the River Don below the viaduct. The River Don flow through Romticle Viaduct & Thurgoland Tunnels LWS with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to the Romticle Viaduct & Thurgoland Tunnels LWS is deemed to be **minor**.

##### Forge Rocher and Tin Mill Rocher LWS

The River Don runs along the east side of the site and is partially encompasses by the site boundary. Most of the site is ancient or lowland mixed deciduous woodland including wet woodland. Wet woodland occurs on poorly drained or seasonally wet soils, usually with alder, birch and willows as the predominant tree species, but sometimes including ash, oak, pine and beech on the drier riparian areas. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. Two large former ponds are present. Disused millponds are often standing water with limited inflow from adjacent waterbodies. These ponds may now be offline but some connectivity of these ponds to the river cannot be ruled out, and a precautionary approach has been adopted. Based on the available information these ponds may potentially be hydrologically connected via a man-made stream/leat. A reduction in flows within the River Don may result in a disconnection of the ponds with the impacted reach, but given the assumed hydrological regime the risk from the implementation of the drought option to Forge Rocher and Tin Mill Rocher LWS is deemed to be **minor**.

#### B4.2.1.2 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 Don 2 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 potential reduction in flow may impact water vole, as burrow located along the banks on the potentially depleted reaches without mitigation within Don 2.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.6**. 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 B4.6** Impacts on water vole in Don 2

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> </ul>	National	Medium	Moderate

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
	<ul style="list-style-type: none"> <li>Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>12</sup>.</li> <li>Increased predation as a result of decreased water width and exposure of burrows.</li> <li>The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>Impacts could occur throughout the breeding season for this species.</li> <li>Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>13</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>			

### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.7**

**Table B4.7 Impacts on otter in Don 2**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>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.</li> <li>Species could remain within the reach for longer.</li> <li>Otter likely to move to unaffected reaches.</li> </ul>	International	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 B 4.8**. **Appendix A** also details the potential impact of the implementation of the associated drought option on the depleted reaches with potential for zero flow without mitigation within Don 2.

<sup>12</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>13</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

**Table B 4.8 Impacts on NERC and notable fish species in Don 2**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>It is noted that, fish are known to show a behavioural response to drought conditions and will potentially relocate downstream where suitable habitat is present.</li> <li>However, the risk of depleted reaches and the major risk to flow reduction and loss of longitudinal connectivity could result in impacts/delay in migration of salmonids.</li> </ul>	National	High	Major
Bullhead	<ul style="list-style-type: none"> <li>This would impact on the downstream migration of smolt, the upstream migration of adults and the movement of juveniles from spawning grounds to nursery habitats and feeding areas.</li> <li>Exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> </ul>	Regional	Medium	Moderate
Grayling	<ul style="list-style-type: none"> <li>Decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals as a result of a reduction in velocity, depth and/or wetted width</li> <li>Increased mortality (density dependant) as a result of increased predation</li> </ul>	Regional	High	Major
European eel	<ul style="list-style-type: none"> <li>Mortality as a result of water quality deterioration (oxygen stress, gill clogging) – <i>Salmonids only</i></li> <li>Fragmentation of habitats and increased significance of obstacles/barriers</li> <li>It is noted that depth of water is not critical to bullhead<sup>14</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	International	High	Major

#### B4.2.1.3 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<sub>NTAXA</sub> 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 medium to 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 moderate to good WHPT<sub>ASPT</sub> 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 one listed CSO during rainfall events. Additionally, water quality modelling identifies one continuous discharge, YWSL Cheesebottom WwTW, presenting a significant risk to both dissolved oxygen and total ammonia in Don 2.

<sup>14</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

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 major risk to the macroinvertebrate component of the WFD GB104027057490 Don from Scout Dyke to the Little Don (associated with Don 2). 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<sup>15 16</sup>. 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 major risk to the fish component of the WFD GB104027057490 Don from Scout Dyke to the Little Don (associated with Don 2). 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 **Major**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Cheesebottom WwTW, as identified in **Appendix A**. Furthermore, there is the potential for two flow depleted reaches (with potential for zero flow without mitigation) within Don 2, there is a risk of a reduction in the water quality needed to maintain the current WFD status for fisheries and macroinvertebrates without mitigation.

### B4.2.2 Summary of impacts

**Table B4.9** 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 B4.9 Summary of impacts identified in Don 2's environmental features assessment**

Reach	Don 2	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Romticle Viaduct & Thurgoland Tunnels LWS	Minor	No
Forge Rocher and Tin Mill Rocher LWS	Minor	No
<b>NERC and Notable Species Receptors</b>		
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Major	Yes
Bullhead	Moderate	Yes
European eel	Major	Yes
Grayling	Major	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057490 Don from Scout Dyke to the Little Don	
Fish	Major	Yes
Invertebrates	Moderate	Yes

<sup>15</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>16</sup> 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.



## B4.3 Don 3

### B4.3.1 Feature assessment

#### B4.3.1.1 Statutory designated sites/Local wildlife sites

##### Lower Ewden Beck LWS

Lower Ewden Beck LWS comprises woodland, grassland, pasture and heathland. Areas of ancient upland oak woodland are present around the river, with some wet woodland also present. Upland oak woods are characterised by a predominance of oak (most commonly sessile, but locally pedunculate) and birch in the canopy, with varying amounts of holly, rowan and hazel as the main understorey species. The implementation of the drought option will not significantly affect oak woodlands, against a baseline of reduced flows characteristic of drought, as oak woodlands are known to have a high tolerance to prolonged dry periods. Ewden Beck flows through the Lower Ewden Beck LWS, though the impacted reach is upstream of the confluence with Ewden Beck and therefore is unlikely to result in further reduction in flows. As such, the risk from the implementation of the drought option to Lower Ewden Beck is deemed to be **negligible**.

##### Upper River Don LWS's

Both Upper River Don LWS's comprise wetland habitats, with the wetlands providing a wealth of habitats for a vast array of animals and plants. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wet woodland and wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>17</sup>. The River Don flow through both the Upper River Don: Deepcar to Hillsborough and Upper River Don: Station Road, Deepcar LWS's, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a Potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to the Upper River Don LWS's is deemed to be **minor**.

#### B4.3.1.2 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 Don 3 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 B4.10**.

<sup>17</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews Volume 140, January 2015, Pages 203-214.

**Table B4.10 Impacts on water vole in Don 3**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>18</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>19</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

#### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.11**.

**Table B4.11 Impacts on otter in Don 3**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.12**.

<sup>18</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>19</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

**Table B4.12 Impacts on NERC and notable fish species in Don 3**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is unlikely as longitudinal connectivity will not be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>20</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	National	Medium	Moderate
Bullhead		Regional	Low	Minor
Grayling		Regional	Medium	Moderate
Barbel		County	Low	Minor
European eel		International	Low	Moderate

### B4.3.1.3 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<sub>NTAXA</sub> EQRs, the macroinvertebrate community shows a good 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 medium to 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 good WHPT<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a moderate risk. Additionally, water quality modelling identifies two continuous discharge, YWSL Ewden WwTW and Cheesebottom WwTW, presenting a significant risk to both dissolved oxygen and total ammonia in Don 3.

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 major risk to the macroinvertebrate component of the WFD GB104027057411 Don from the Little Don to River Loxley confluence (associated with Don 3). 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

<sup>20</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

strategies in macroinvertebrates<sup>21,22</sup>. 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 GB104027057411 Don from the Little Don to River Loxley confluence (associated with Don 3). 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 **Moderate**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of each of Ewden WwTW and Cheesebottom WwTW, as identified in **Appendix A**.

### B4.3.2 Summary of impacts

**Table B4.13** 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 B4.13 Summary of impacts identified in Don 3's environmental features assessment**

Reach	Don 3	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Lower Ewden Beck LWS	Negligible	No
Upper River Don: Deepcar to Hillsborough LWS	Minor	No
Upper River Don: Station Road, Deepcar LWS	Minor	No
<b>NERC and Notable Species Receptors</b>		
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Moderate	Yes
Bullhead	Minor	No
European eel	Moderate	Yes
Grayling	Moderate	Yes
Barbel	Minor	No
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057411 Don from the Little Don to River Loxley confluence	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes

<sup>21</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>22</sup> 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.

## B4.4 Don 4

### B4.4.1 Feature assessment

#### B4.4.1.1 Statutory designated sites/Local wildlife sites

##### Lower Ewden Beck LWS

Lower Ewden Beck LWS comprises woodland, grassland, pasture and heathland. Areas of ancient upland oak woodland are present around the river, with some wet woodland also present. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. Upland oak woods are characterised by a predominance of oak (most commonly sessile, but locally pedunculate) and birch in the canopy, with varying amounts of holly, rowan and hazel as the main understorey species. The implementation of the drought option will not significantly affect oak woodlands, against a baseline of reduced flows characteristic of drought, as oak woodlands are known to have a high tolerance to prolonged dry periods. Ewden Beck flow through the Lower Ewden Beck LWS, though the impacted reach is upstream of the confluence with Ewden Beck and therefore is unlikely to result in further reduction in flows. As such, the risk from the implementation of the drought option to Lower Ewden Beck is deemed to be **negligible**.

##### Middle River Don: Hillsborough to City Centre LWS

The banks of the river corridor were previously industrial but are now becoming residential. The woodland on the banks are ancient, containing indicator species such as pendulous sedge, wood anemone and dog's mercury. Island within the river are very species rich with vegetation and wildlife including birds and invertebrates. The islands also host ancient woodland indicator species. Bankside habitats include broad-leaved woodland, scrub, tall and short herbs, built (walls and disused buildings). The river has strong marginal aquatic vegetation and a rich aquatic fauna. The River Don flows through the Middle River Don: Hillsborough to City Centre LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a 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. As such, the risk from the implementation of the drought option to Middle River Don: Hillsborough to City Centre LWS is deemed to be **moderate**.

##### Upper River Don LWS

Upper River Don: Deepcar to Hillsborough LWS comprises wetland habitats, with the wetlands providing a wealth of habitats for a vast array of animals and plants. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>23</sup>. The River Don flows through the Upper River Don: Deepcar to Hillsborough LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a 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. As such,

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<sup>23</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews Volume 140, January 2015, Pages 203-214.



the risk from the implementation of the drought option to Upper River Don: Deepcar to Hillsborough LWS is deemed to be **moderate**.

#### B4.4.1.2 NERC and other protected species

##### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Don 4 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.14**. 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 B4.14 Impacts on white-clawed crayfish in Don 4**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature.</li> </ul>	National	Low	Moderate

##### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Don 4 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 B4.15**. 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 B4.15 Impacts on water vole in Don 4**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>Species has a preference for waterbodies that do not have extreme</li> </ul>	National	Medium	Moderate

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
	<p>fluctuations in water level<sup>24</sup>.</p> <ul style="list-style-type: none"> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>25</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>			

## Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.16**

<sup>24</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>25</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

**Table B4.16 Impacts on otter in Don 4**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>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.</li> <li>Species could remain within the reach for longer.</li> <li>Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.17**.

**Table B4.17 Impacts on NERC and notable fish species in Don 4**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered moderate</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Potential reduction in effectiveness of fish passes to salmonids movement.</li> </ul>	National	Medium	Moderate
Bullhead	<ul style="list-style-type: none"> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> </ul>	Regional	Low	Minor
Grayling	<ul style="list-style-type: none"> <li>Stranding of individuals is likely as risk to longitudinal connectivity is moderate.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>26</sup></li> </ul>	Regional	Medium	Moderate
European eel	<ul style="list-style-type: none"> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	International	Low	Moderate

### B4.4.1.3 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<sub>NTAXA</sub> EQRs, the macroinvertebrate community shows a poor to high level of diversity, and consequently, loss of habitat may reduce the diversity of the

<sup>26</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

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 medium to 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 poor to moderate WHPT<sub>ASPT</sub> 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 one listed CSO during rainfall events. Additionally, water quality modelling identifies one continuous discharge, YWSL Wharncliffe Side WwTW and Ewden WwTW, presenting a significant risk to dissolved oxygen in Don 4.

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 major risk to the macroinvertebrate component of the WFD GB104027057411 Don from the Little Don to River Loxley confluence (associated with Don 4). 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<sup>27/28</sup>. 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 GB104027057411 Don from the Little Don to River Loxley confluence (associated with Don 4). 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 **moderate**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of each of Wharncliffe Side WwTW and Ewden WwTW, as identified in **Appendix A**.

#### B4.4.2 Summary of impacts

**Table B4.19** 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.

<sup>27</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>28</sup> 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.

**Table B4.18 Summary of impacts identified in Don 4's environmental features assessment**

Reach	Don 4	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Lower Ewden Beck LWS	Negligible	No
Upper River Don: Deepcar to Hillsborough LWS	Moderate	Yes
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Moderate	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Moderate	Yes
Bullhead	Minor	No
Grayling	Moderate	Yes
European eel	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057411 Don from the Little Don to River Loxley confluence	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes



## B4.5 Don 5

### B4.5.1 Feature assessment

#### B4.5.1.1 Statutory designated sites/Local wildlife sites

##### Centenary Riverside LNR/LWS

Centenary Riverside LNR/LWS is a 4.5 hectare wetland reserve alongside the River Don. The site consists of a wildflower meadow bank with a high density of butterflies and insects, and a series of ponds and wetlands that attract a large variety of birds, mammals and insects. The site is excellent for butterflies with 23 different species having been recorded and is also home to a variety of damselfly and dragonflies. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>29</sup>. The site serves as a natural floodplain for the River Don as the site periodically floods with increased flows in the river. The variation in flows during flood and drought conditions exerts a strong influence on river and riparian ecosystem function, with floodplain habitats and the sustainability of the high biodiversity observed along river systems. Wetlands are ecosystems characterised by periods of saturation or inundation. Because they are not all constantly wet, the species occurring in wetlands are adapted to periods of dryness. River-fed wetland ecosystems are more resilient to drought than rain-fed wetlands. The implementation of the drought option will not significantly affect the hydrological functioning of the meadow habitat, against a baseline of reduced flows characteristic of drought. As such, the risk from the implementation of the drought option to Centenary Riverside LNR/LWS is deemed to be **negligible**.

##### Salmon Pastures LNR/LWS

Salmon Pastures LNR/LWS hosts a unique mix of habitats that support myriad of birds and invertebrates, this reserve plays a vital role in Sheffield's green corridor. 22 species of hoverfly that have been recorded at the reserve. There are also dragonflies, moths and butterflies, including gatekeeper and orange tip. Birds such as mistle thrush, bullfinch, goldfinch and long tailed tit nest and feed in the local area, while kingfishers, little grebe, moorhens and mallards all live nearby on the banks of the River Don. Salmon Pastures has limited aquatic habitat present with woodland and grassland the predominant features. The site is not thought to be within connectivity with the impact impacted reach in a way which will impact the habitat during implementation of the drought option. Therefore, the implementation of the drought option will not significantly affect the hydrological regime of the grassland habitat, against a baseline of reduced flows characteristic of drought. As such, the risk from the implementation of the drought option to Salmon Pastures LNR/LWS is deemed to be **negligible**.

##### Kelham Island LWS

Kelham Island is one of Sheffield's oldest manufacturing sites, with the manmade island forming in the 1100s, when a stream was diverted to power a nearby mill. The wetland/floodplain habitat is found surround the edge of the ex-industry hub. The River don flow past the island, which is located in a low-lying flood plain of the River Don. The site forms part of the natural floodplain and wetland habitat for the River Don. The variation is flows during flood and drought conditions exerts a strong influence on river and riparian ecosystem function, with floodplain habitats and the sustainability of the high biodiversity observed along river systems. Wetlands are ecosystems characterised by periods of saturation or inundation. Because they are not all constantly wet, the species occurring in wetlands are adapted to periods of dryness. River-fed wetland ecosystems are more resilient to drought than rain-fed wetlands. The implementation of the drought option will not significantly affect the hydrological functioning of the meadow habitat, against a baseline of reduced flows characteristic of drought. However, the River Don flows through the Kelham Island LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk

<sup>29</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews Volume 140, January 2015, Pages 203-214.

of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Kelham Island LWS is deemed to be **minor**.

#### **Sandersons Mill Race LWS**

Sandersons Goit (mill race) branches off from the River Don opposite Sandersons Weir, running east between the railway and Stevenson Road; where the water is culverted under Sanderson Kayser Steelworks and back into the river. The mill race contains diverse aquatic vegetation and supports breeding wildfowl and dragonflies. The grassland is rich in wildflowers, including orchids. The River Don flows through the Sandersons Mill Race LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Sandersons Mill Race LWS is deemed to be **minor**.

#### **Lower River Don: River Don (City Centre to Blackburn Meadows) LWS**

The site encompasses the river and its banks and immediate area. The banks contain areas of semi-natural woodland with ancient woodland indicator species, tall herbs. Sections of the river are canalised with access to the banks in various locations. The River Don flows through the Lower River Don: River Don (City Centre to Blackburn Meadows) LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Lower River Don LWS is deemed to be **minor**.

#### **Lower Don Valley: Sheffield and Tinsley Canal LWS**

The site encompasses the canal and banks from the River Don Navigation near Tinsley to Park Hill. The canal banks have a range of habitat from woodland, grassland, scrub, tall herbs and urban common. There is much aquatic vegetation on the canal including submerged, floating-leaved, emergent and marginal aquatic plants. Fresh water jellyfish have been recorded on site. The site includes the confluence of Sheffield and Tinsley Canal and River Don, however the implementation of the drought option will not significantly affect the connectivity of the canal with the impacted reach, against a baseline of reduced flows characteristic of drought. As such, the risk from the implementation of the drought option to Lower Don Valley LWS is deemed to be **minor**.

#### **Blackburn Meadows LWS**

Sheffield City Council and Yorkshire Water leased an unused part of the former sewage works, to turn into a nature reserve which provides habitat for migrating birds. A water meadow created on vacant land promotes ecological biodiversity and flood water attenuation. The site boundary encompasses a section of the River Don and its banks, an old disused sewage treatment works, areas of woodland, wet woodland, scrub, grassland, heathland, marsh, urban common, standing water, marginal aquatic vegetation and wet woodland. Blackburn Meadows offers a mix of open water, grassland and scrub attractive to a range of species, including water birds, warblers and finches. There is a lake and wader flash although, as water levels are not controlled on the reserve itself, there may only be sufficient water for wildfowl and other water birds after recent wet weather. The River Don flows through the Blackburn Meadows LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Blackburn Meadows LWS is deemed to be **minor**.

#### **Middle River Don: Hillsborough to City Centre LWS**

The banks of the river corridor were previously industrial but are now becoming residential. The woodland on the banks are ancient, containing indicator species such as pendulous sedge, wood anemone and dog's mercury. Island within the river are very species rich with vegetation and wildlife including birds and invertebrates. The islands also host ancient woodland indicator species. Bankside

habitats include broad-leaved woodland, scrub, tall and short herbs, built (walls and disused buildings). The river has strong marginal aquatic vegetation and a rich aquatic fauna. The implementation of the drought option will not significantly affect the connectivity of the marginal aquatic vegetation with the main river channel within the impacted reach, against a baseline of reduced flows characteristic of drought. However, the River Don flows through the Middle River Don: Hillsborough to City Centre LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a potential minor risk of reduction in total wetted aquatic habitat in the reach, and minor risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Middle River Don: Hillsborough to City Centre LWS is deemed to be **moderate**.

## NERC Habitat

The likely impacts on NERC habitats, and their magnitude are identified in **Table B4.1**.

**Table B4.1 Impacts on NERC habitats in Don 5**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
NERC Habitats Reedbeds -452749 -447335	<ul style="list-style-type: none"> <li>Habitat degradation as a result of decreased river flows in the impacted reach</li> <li>Habitat degradation potentially linked to effects on connectivity.</li> <li>Detailed information on connectivity within the reach is lacking.</li> <li>However, loss of connectivity with the impacted reach, are not expected to be significantly increased by implementation of the drought option against a baseline of reduced flows characteristic of drought</li> </ul>	County	Negligible	Negligible

### B4.5.1.2 NERC and other protected species

#### Pale Pin-palp *Bembidion testaceum*

In the absence of quantitative data on population of Pale Pin-palp a detailed assessment of the impact in Don 5 as a result of the implementation of the drought option is not feasible. 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 species appears to be tied to catchments with hard rock geology that erodes to produce coarse sandy sediments. The species can be found in a range of sedimentary or morphology units on UK rivers, and even anthropogenic habitats such as gravel pits and newly created rivers<sup>30</sup>. However, the species shows strong microhabitat and sedimentary affinities to unconsolidated, unvegetated sediment of varying sizes ranging from pebbles to cobbles overlying coarse and clean sands.

The species has a clear affinity to unshaded, gravelly-sandy edges of waters in the lowlands to foothills and are suggested to be a true riverbank specialist associated with running water and cobbles, pebbles and gravel overlying sands. As rivers dry because of natural drought conditions, microclimate gradients may begin to diminish, as may the extent of riparian plant communities<sup>31</sup>. Dry riverbeds can be novel

<sup>30</sup> J.P.Sadler, D.Bell & P.M.Hammond (2005) Assessment of the distribution of *Bembidion Testaceum* and reasons for its decline. Environment Agency.

<sup>31</sup> Maddison D, Will K, Crews S, LaBonte J (2018) *Bembidion ambiguum* (Coleoptera: Carabidae) is established in California. Biodiversity Data Journal 6: e30763.

habitat to riparian species, such as the Pale Pin-palp beetle which are exposed riverine sediment specialists<sup>32</sup>. The species are also one of the first to recolonize recently flooded habitat.

**Table B4.19 Impacts on *Bembidion testaceum* in Don 5**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
<i>Bembidion testaceum</i>	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reductions in wetted width and depth will increase habitat availability for the species during the implementation of the option</li> </ul>	National	Low	Minor

### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Don 5 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.20**. 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 B4.20 Impacts on white-clawed crayfish in Don 5**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature.</li> </ul>	National	Low	Moderate

### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Don 5 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 potential reduction in flow may impact water vole, as burrow located along the banks on the two potentially depleted reaches without mitigation within Don 5.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.21**. 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.

<sup>32</sup> Tonya L. Ramey, John S. Richardson, Terrestrial Invertebrates in the Riparian Zone: Mechanisms Underlying Their Unique Diversity, *BioScience*, Volume 67, Issue 9, September 2017, Pages 808–819

**Table B4.21 Impacts on water vole in Don 5**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>33</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>34</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

#### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.22**

**Table B4.22 Impacts on otter in Don 5**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.23**. **Appendix A** also details the potential impact of the implementation of the associated drought option on the two potentially flow depleted reaches with potential for zero flow without mitigation within Don 5.

<sup>33</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>34</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.



**Table B4.23 Impacts on NERC and notable fish species in Don 5**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Potential reduction in effectiveness of fish passes to salmonids movement</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is unlikely as longitudinal connectivity will not be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>35</sup></li> <li>Exposure/loss of important habitats for juveniles and adult eel</li> </ul>	National	High	Major
Atlantic salmon		National	High	Major
River lamprey		Regional	Medium	Moderate
Bullhead		Regional	Medium	Moderate
Brook lamprey		National	High	Major
Grayling		Regional	Medium	Moderate
Barbel		County	Medium	Moderate
European eel		International	High	Major

#### B4.5.1.3 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<sub>NTAXA</sub> 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 medium to 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 poor to good WHPT<sub>ASPT</sub> 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 two listed CSO during rainfall events. **Appendix A** also details the potential impact of the implementation of the associated drought option on the two potentially flow depleted reaches with potential for zero flow without mitigation within Don 5. Additionally, water quality modelling identifies one continuous discharge, YWSL Blackburn Meadows WwTW, presenting a significant risk to total ammonia in Don 5.

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 major risk to the macroinvertebrate component of the WFD GB104027057412 Don from River Loxley conf to River Don Works and GB104027057413 Don from River Don Works to River Rother (associated with Don 5). The duration of impacts could be up to 6 months. However, the macroinvertebrate community recovery is expected to

<sup>35</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

be relatively quick due to effective re-colonisation strategies in macroinvertebrates<sup>36,37</sup>. 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 Major risk to the fish component of the WFD GB104027057412 Don from River Loxley conf to River Don Works and GB104027057413 Don from River Don Works to River Rother (associated with Don 5). 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 **Major**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of each of Wharnccliffe Side WwTW and Ewden WwTW, as identified in **Appendix A**. Furthermore, there is the potential for one flow depleted reach with potential for periods of time with flow reduced by 10.5% without mitigation within Don 5, there is a risk of a reduction in the water quality needed to maintain the current WFD status for fisheries and macroinvertebrates without mitigation.

### B4.5.1.4 Landscape, navigation, recreation and heritage features

#### Angling

The assessment of impacts on angling is based on changes to water flow/levels, water quality summarised in **Appendix A** and fish communities summarised above.

As a result of the implementation of the drought option, the impacts to anglers will involve a required geographical shift in location to target specific areas as fish may avoid impacted areas during the implementation of the drought permit. Despite the potential reduction in abundance and species diversity in the impacted reach, angling would be able to continue during drought permit implementation. Similar impacts on angling will be presented during a natural drought and therefore impacts on angling resulting from the implementation of the drought permit are considered to be **negligible** in Don 5.

### B4.5.2 Summary of impacts

**Table B4.24** 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 B4.24 Summary of impacts identified in Don 5's environmental features assessment**

Reach	Don 5	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Kelham Island LWS	Minor	No
Centenary Riverside LNR/LWS	Negligible	No
Sandersons Mill Race LWS	Minor	No
Salmon Pastures LNR/LWS	Negligible	No
Lower River Don: River Don (City Centre to Blackburn Meadows) LWS	Minor	No
Lower Don Valley: Sheffield and Tinsley Canal LWS	Minor	No

<sup>36</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>37</sup> 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		Don 5	
Middle River Don: Hillsborough to City Centre LWS	Moderate		Yes
Blackburn Meadows LWS	Minor		No
NERC Habitats Reedbeds -452749 -447335	Negligible		No
NERC and Notable Species Receptors			
White-clawed crayfish	Moderate		Yes
Otter	Negligible		No
Water vole	Moderate		Yes
Atlantic salmon	Major		Yes
Barbel	Moderate		Yes
Brook lamprey	Major		Yes
Brown trout	Major		Yes
Bullhead	Moderate		Yes
European eel	Major		Yes
Grayling	Moderate		Yes
River lamprey	Moderate		Yes
WFD Status Receptors		Risk of Deterioration	
WFD Waterbody	GB104027057412 Don from River Loxley conf to River Don Works	GB104027057413 Don from River Don Works to River Rother	Yes
	Major	Major	
	Moderate	Moderate	
Landscape, navigation, recreation and heritage features		Risk of Deterioration	
Angling	Negligible		No

## B4.6 Scout Dyke 1

### B4.6.1 Feature assessment

#### B4.6.1.1 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 Scout Dyke 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 B4.26.

**Table B4.25 Impacts on water vole in Scout Dyke 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>38</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>39</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

<sup>38</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>39</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

## Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.26**

**Table B4.26 Impacts on otter in Scout Dyke 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>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.</li> <li>Species could remain within the reach for longer.</li> <li>Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.27**.

**Table B4.27 Impacts on NERC and notable fish species in Scout Dyke 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> </ul>	National	Medium	Moderate
Bullhead	<ul style="list-style-type: none"> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> </ul>	Regional	Low	Minor
European eel	<ul style="list-style-type: none"> <li>Stranding of individuals is unlikely as longitudinal connectivity will not be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>40</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	International	Low	Moderate

### B4.6.1.2 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<sub>NTAXA</sub> 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

<sup>40</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.



flow and channel bed may reduce flow velocity, as the macroinvertebrate community is sensitive to flow velocity reductions, as indicated by medium to 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 good WHPT<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a moderate risk. Additionally, water quality modelling identifies one continuous discharge, YWSL Scout Dyke WwTW, presenting a significant risk to total ammonia in Scout Dyke 1.

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 major risk to the macroinvertebrate component of the WFD GB104027057530 Scout Dyke from Source to River Don (associated with Scout Dyke 1). 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<sup>41/42</sup>. 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 GB104027057530 Scout Dyke from Source to River Don (associated with Scout Dyke 1). 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 **moderate**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Scout Dyke WwTW, as identified in **Appendix A**.

#### B4.6.1.3 Landscape, navigation, recreation and heritage features

##### Nether Mill Fishery

Nether Mill Fishery is a purpose built fishing lake which covers nearly 2 acres and provides 32 pegs for anglers of all ages, interests and abilities. The lake contains 3 purpose-built islands and lake depth varies slightly between 130 and 150cm. The margins and the islands are planted with a wide variety of plants to provide cover and spawning grounds for the fish. The lake is fed by Scout Dyke Beck, which ensures a constant flow through the fishery. Based on the available information, the pond may be hydrologically connected via a man-made stream / leat. A reduction in flows within the River Scout Dyke 1 may result in a disconnection of the ponds with the impacted reach, however given the large size of the pond the risk from the implementation of the drought option to Nether Mill Fishery is deemed to be **negligible**.

#### B4.6.2 Summary of impacts

**Table B4.28** 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.

<sup>41</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>42</sup> 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.

**Table B4.28 Summary of impacts identified in Scout Dyke 1's environmental features assessment**

Reach	Scout Dyke 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>NERC and Notable Species Receptors</b>		
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Moderate	Yes
Bullhead	Minor	No
European eel	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057530 Scout Dyke from Source to River Don	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes
<b>Landscape, navigation, recreation and heritage features</b>	<b>Risk of Deterioration</b>	
Nether Mill Fishery	Negligible	No

## B4.7 Little Don 1

### B4.7.1 Feature assessment

#### B4.7.1.1 Statutory designated sites/Local wildlife sites

##### Upper River Don: Deepcar to Hillsborough LWS

Upper River Don: Deepcar to Hillsborough LWS comprises wetland habitats, with the wetlands providing a wealth of habitats for a vast array of animals and plants. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>43</sup>. The Little Don flows through a small northern section of the Upper River Don: Deepcar to Hillsborough LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a 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. As such, the risk from the implementation of the drought option to Upper River Don: Deepcar to Hillsborough LWS is deemed to be **moderate**.

##### Lower Little Don, Stocksbridge LWS

Lower Little Don, Stocksbridge contains the Lower Little Don River and fringing surrounding areas. As well as the river habitats) the site includes areas of semi-natural woodland, ancient woodland, unimproved grassland neutral grassland, lowland heath and improved grassland on regenerating brownfield sites. The river corridor has been altered by industry and has been culverted in other sections. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>44</sup>. Riparian wetlands are resilient ecosystems that can adapt to extreme periodic drought–flood episodes<sup>45</sup>. The Little Don flow through Lower Little Don, Stocksbridge LWS with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a 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. At the numerous sections the channel and banks of the little Don have been resectioned and reinforced and some areas have been the channel had been realigned and overdeepened. As such, the risk from the implementation of the drought option to Upper River Don: Lower Little Don, Stocksbridge LWS is deemed to be **minor**.

#### B4.7.1.2 NERC and other protected species

##### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Little Don 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

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<sup>43</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews  
Volume 140, January 2015, Pages 203-214.

<sup>44</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews  
Volume 140, January 2015, Pages 203-214.

<sup>45</sup> Sandi, S.G., Rodriguez, J.F., Saintilan, N. *et al.* Resilience to drought of dryland wetlands threatened by climate change. Sci Rep 10, 13232 (2020).

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.29**. 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 B4.29 Impacts on white-clawed crayfish in Little Don 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature.</li> </ul>	National	Low	Moderate

### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Little Don 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 potential reduction in flow may impact water vole, as burrow located along the banks on the potentially depleted reach without mitigation within Little Don 1.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.30**. 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 B4.30 Impacts on water vole in Little Don 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>46</sup>.</li> <li>Increased predation as a result of decreased water width and exposure of burrows.</li> <li>The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>Impacts could occur throughout the breeding season for this species.</li> <li>Alteration to food supply could occur although the species has been known to feed upon crayfish at</li> </ul>	National	Medium	Moderate

<sup>46</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
	<p>times<sup>47</sup> and the potentially increased density of this species could lead to increased predation efficiency</p> <ul style="list-style-type: none"> <li>Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>			

### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.31**

**Table B4.31 Impacts on otter in Little Don 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>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.</li> <li>Species could remain within the reach for longer.</li> <li>Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.32**. **Appendix A** also details the potential impact of the implementation of the associated drought option on the depleted reach with potential for zero flow without mitigation within Little Don 1.

**Table B4.32 Impacts on NERC and notable fish species in Little Don 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> </ul>	National	Medium	Moderate
Barbel		County	Low	Minor
Bullhead		Regional	Low	Minor

<sup>47</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.



NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Grayling	<ul style="list-style-type: none"> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is likely as longitudinal connectivity may be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>48</sup></li> </ul>	Regional	Medium	Moderate

### B4.7.1.3 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<sub>NTAXA</sub> 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 poor to moderate WHPT<sub>ASPT</sub> 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 one listed CSO during rainfall events.

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 major risk to the macroinvertebrate component of the WFD GB104027057460 Little Don from Source to River Don (associated with Little Don 1). 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<sup>49/50</sup>. 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 GB104027057460 Little Don from Source to River Don (associated with Little Don 1). 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 **Moderate**. Furthermore, there is the potential for one flow depleted reaches (with potential for zero flow without mitigation) within little Don 1, there is a risk of a reduction in the water quality needed to maintain the current WFD status for fisheries and macroinvertebrates without mitigation.

<sup>48</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

<sup>49</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>50</sup> 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.

## B4.7.2 Summary of impacts

**Table B4.33** 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 B4.33 Summary of impacts identified in Little Don 1's environmental features assessment**

Reach	Little Don 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Upper River Don: Deepcar to Hillsborough LWS	Moderate	Yes
Lower Little Don, Stocksbridge LWS	Minor	No
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Moderate	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
Barbel	Minor	No
Brown trout	Moderate	Yes
Bullhead	Minor	No
Grayling	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057460 Little Don from Source to River Don	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes

## B4.8 Ewden Beck 1

### B4.8.1 Feature assessment

#### B4.8.1.1 Statutory designated sites/Local wildlife sites

##### Lower Ewden Beck LWS

Lower Ewden Beck LWS comprises woodland, grassland, pasture and heathland. Areas of ancient upland oak woodland are present around the river, with some wet woodland also present. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. Upland oak woods are characterised by a predominance of oak (most commonly sessile, but locally pedunculate) and birch in the canopy, with varying amounts of holly, rowan and hazel as the main understorey species. The implementation of the drought option will not significantly affect oak woodlands, against a baseline of reduced flows characteristic of drought, as oak woodlands are known to have a high tolerance to prolonged dry periods. Ewden Beck flows through the Lower Ewden Beck LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Lower Ewden Beck is deemed to be **moderate**.

##### Upper River Don: Deepcar to Hillsborough LWS

Upper River Don: Deepcar to Hillsborough LWS comprises wetland habitats, with the wetlands providing a wealth of habitats for a vast array of animals and plants. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. A reduction in water quality may lead to changes in the composition of the ground flora and invertebrate communities in wetland habitats. The implementation of the drought option will not significantly affect the water quality outside that of a natural drought, which have been shown to result in significant changes in water quality<sup>51</sup>. Ewden beck is upstream of the Upper River Don: Deepcar to Hillsborough LWS, with potential changes to the physical environment presented in **Appendix A**. As such, the risk from the implementation of the drought option to Upper River Don: Deepcar to Hillsborough LWS is deemed to be **minor**.

#### B4.8.1.2 NERC and other protected species

##### Riffle Beetle, *Riolus subviolaceus*

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.34**.

**Table B4.34** Impacts on *R. subviolaceus* in Ewden Beck 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
<i>Riolus subviolaceus</i>	<ul style="list-style-type: none"> <li>Species has a moderate sensitivity to organic pollution, but water quality impacts are minor. There will be no likely impacts on the species as a result of water quality pressures.</li> </ul>	County	Low	Minor

<sup>51</sup> Mosley, L. M, Drought impacts on the water quality of freshwater systems; review and integration. Earth-Science Reviews Volume 140, January 2015, Pages 203-214.

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
	<ul style="list-style-type: none"> <li>Although dominant flow types could remain, the species is less mobile compared to fish and the reductions in wetted width and depth could reduce habitat availability for the species.</li> </ul>			

### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Ewden Beck 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.35**. 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 B4.35 Impacts on white-clawed crayfish in Ewden Beck 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Water quality risks are considered minor and water quality related impacts are considered unlikely.</li> </ul>	National	Low	Moderate

### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Ewden Beck 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 B4.37**. 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 B4.36 Impacts on water vole in Ewden Beck 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as minor and will not impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>52</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>53</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

#### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.37**

**Table B4.37 Impacts on otter in Ewden Beck 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.38**.

<sup>52</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>53</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.



**Table B4.38 Impacts on NERC and notable fish species in Ewden Beck 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered moderate</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> </ul>	National	High	Major
Bullhead	<ul style="list-style-type: none"> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is likely as longitudinal connectivity could be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>54</sup></li> </ul>	Regional	Medium	Moderate

### B4.8.1.3 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<sub>NTAXA</sub> 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<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a minor risk. Additionally, water quality modelling identifies one continuous discharge, YWSL Ewden Village WwTW, presenting a significant risk to total ammonia in Ewden Beck 1.

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 major risk to the macroinvertebrate component of the WFD GB104027057400 Ewden Beck from Source to River Don (associated with Ewden Beck 1). 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<sup>55/56</sup>. Therefore, the risk to deterioration of the WFD status of the waterbody is considered to be **moderate**.

<sup>54</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

<sup>55</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>56</sup> 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.

## 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 GB104027057400 Ewden Beck from Source to River Don (associated with Ewden Beck 1). 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 **Moderate**. The risk of medium-term chronic, regular, temporary water quality pressures (acute toxicity of ammonia) downstream of Ewden Village WwTW, as identified in **Appendix A**.

### B4.8.2 Summary of impacts

**Table B4.39** 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 B4.39 Summary of impacts identified in Ewden Beck 1's environmental features assessment**

Reach	Ewden Beck 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Lower Ewden Beck LWS	Moderate	Yes
Upper River Don: Deepcar to Hillsborough LWS	Minor	No
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Moderate	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
<i>Riolus subviolaceus</i>	Minor	No
Brown trout	Major	Yes
Bullhead	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057400 Ewden Beck from Source to River Don	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes

## B4.9 Loxley 1

### B4.9.1 Feature assessment

#### B4.9.1.1 Statutory designated sites/Local wildlife sites

##### Dam Flask to Rowel Bridge LWS

Dam Flask to Rowel Bridge LWS comprises the slipway of the Damflask reservoir, the River Loxley immediately downstream, areas of fields, broadleaved woodland (mature, wet, semi-natural) and agricultural grassland (unimproved, semi-improved, improved, acid, neutral) around the River Loxley and Storrs Brook. Grassland habitats are expected to be relatively robust to the direct threats posed by natural drought conditions, with drier conditions favouring stress-tolerant (e.g. deep rooted) and ruderal species due to the increased gaps/bare ground in swards. However, species which are intermediate between stress tolerant and competitive will be retarded by drier summers. Summer drought may favour annual species over perennials, potentially leading to community change<sup>57</sup>. Broadleaved woodland is characterised by trees which do not have needles. Broadleaved woodlands response to drought conditions will differ because the landscapes and type of woodland. However, even within a single landscape, the critical factors may vary: changes in winter rainfall might be important for valley bottoms, whereas summer drought could be critical on adjacent south-facing slopes. Mixed deciduous woodland are thought to have a low sensitivity to climate change related stress, such as droughts. The implementation of the drought option will not significantly affect the hydrological regime of the woodland and grassland habitats against a baseline of reduced flows characteristic of drought. A large pond is known to be present and given the proximity to the river, connectivity to the river is assumed on a precautionary basis. Based on the available information the pond may be hydrologically connected and a reduction in flows within the River Loxley may result in a disconnection of the ponds with the impacted reach, however given the large size of the pond the risk from the implementation of the drought option to Dam Flask to Rowel Bridge LWS is deemed to be **minor**.

##### Acorn Hill and Little Matlock Wood LWS

Acorn Hill and Little Matlock Wood LWS comprises Contains the Loxley River, areas of standing water (mill ponds) and ancient woodland and associated woodland species, lowland dry acid grassland (UKBAP habitat), unimproved grassland, semi-improved grassland and neutral grassland. has limited aquatic habitat present with woodland and grassland the predominant features. The implementation of the drought option will not significantly affect the hydrological regime of the grassland habitat, against a baseline of reduced flows characteristic of drought. Loxley 1 flows through the Acorn Hill and Little Matlock Wood LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Acorn Hill and Little Matlock Wood LWS is deemed to be **moderate**.

##### Broadhead Dam to Malin Bridge LWS

The site covers a former mill pond on the River Loxley and Broadhead Dam. The dam hosts sensitive wetland habitats. Wet woodlands are present. The riparian zone hosts large alders. Areas of scrub, springs and tall herbs are also present as well as areas of marginal aquatic vegetation. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. A large pond is known to be present and given the proximity to the river connectivity to the river is assumed on a precautionary basis. Based on the available information the pond may be hydrologically connected via a man-made stream / leat. A reduction in flows within the River Loxley may result in a disconnection of the ponds

<sup>57</sup> Crofts, A. & Jefferson, R.G. 1999 The Lowland Grassland Management Handbook. English Nature & The Wildlife Trusts, Peterborough.

with the impacted reach, however given the large size of the pond the risk from the implementation of the drought option to Broadhead Dam to Malin Bridge LWS is deemed to be **minor**.

### Lower Rivelin Valley LWS

The site encompasses the River Rivelin and immediate areas until its confluence with the River Loxley. The area is used for recreation, flood control and nature conservation. Areas wet woodland/alder carr are present, typically at the sites of silted mill ponds. Along with the carr areas, the bankside vegetation among the trees supports ancient woodland indicator species. Wet woodland are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. River Rivelin flow through the Lower Rivelin Valley LWS, though the impacted reach (Loxley 1) is upstream of the confluence with River Rivelin and therefore is unlikely to result in further reduction in flows. As such, the risk from the implementation of the drought option to Lower Rivelin Valley LWS is deemed to be **negligible**.

### B4.9.1.2 NERC and other protected species

#### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Loxley 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.40**. 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 B4.40** Impacts on white-clawed crayfish in Loxley 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Water quality risks are considered minor and water quality related impacts are considered unlikely.</li> </ul>	National	Medium	Major

#### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Loxley 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 potential reduction in flow may impact water vole, as burrow located along the banks on the potentially depleted reach without mitigation within Loxley 1.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.42**. 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 B4.41 Impacts on water vole in Loxley 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as minor and will not impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>58</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>59</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

#### Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.42**

**Table B4.42 Impacts on otter in Loxley 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.43**. **Appendix A** also details the potential impact of the implementation of the associated drought option on depleted reach with potential for zero flow without mitigation within Loxley 1.

<sup>58</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>59</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.



**Table B4.43 Impacts on NERC and notable fish species in Loxley 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>It is noted that, fish are known to show a behavioural response to drought conditions and will potentially relocate downstream where suitable habitat is present.</li> <li>However, the risk of a depleted reach and the major risk to flow reduction and loss of longitudinal connectivity could result in impacts/delay in migration of salmonids.</li> </ul>	National	High	Major
Bullhead	<ul style="list-style-type: none"> <li>This would impact on the downstream migration of smolt, the upstream migration of adults and the movement of juveniles from spawning grounds to nursery habitats and feeding areas.</li> <li>Exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals as a result of a reduction in velocity, depth and/or wetted width</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>Mortality as a result of water quality deterioration (oxygen stress, gill clogging) – <i>Salmonids only</i></li> <li>Fragmentation of habitats and increased significance of obstacles/barriers</li> <li>It is noted that depth of water is not critical to bullhead<sup>60</sup></li> </ul>	Regional	Medium	Moderate

### B4.9.1.3 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<sub>NTAXA</sub> 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 medium to 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 bad to moderate WHPT<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a minor risk. Furthermore, there are no significant flow pressures, either abstractions or discharges, influencing flow in Loxley 1, as indicated 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 major risk to the macroinvertebrate component of the WFD GB104027057370 Loxley from Strines Dyke to River Don (associated with Loxley 1). 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

<sup>60</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

macroinvertebrates<sup>61/62</sup>. 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 major risk to the fish component of the WFD GB104027057370 Loxley from Strines Dyke to River Don (associated with Loxley 1). 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 **major**.

## B4.9.2 Summary of impacts

**Table B4.44** 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 B4.44 Summary of impacts identified in Loxley 1's environmental features assessment**

Reach	Loxley 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Dam Flask to Rowel Bridge LWS	Minor	No
Acorn Hill and Little Matlock Wood LWS	Moderate	Yes
Lower Rivelin Valley LWS	Negligible	No
Broadhead Dam to Malin Bridge LWS	Minor	No
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Major	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Major	Yes
Bullhead	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057370 Loxley from Strines Dyke to River Don	
Fish	Major	Yes
Invertebrates	Moderate	Yes

<sup>61</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>62</sup> 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.

## B4.10 Loxley 2

### B4.10.1 Feature assessment

#### B4.10.1.1 Statutory designated sites/Local wildlife sites

##### Malin Bridge to River Don LWS

Malin Bridge to River Don LWS comprises the River Loxley to its confluence with the Don, and the surround margins and woodland habitat. The woodlands are semi-natural. Tall herb habitats also exist, as well as marginal aquatic vegetation. Broadleaved woodland is characterised by trees which do not have needles. Broadleaved woodlands response to drought conditions will differ because the landscapes and type of woodland. However, even within a single landscape, the critical factors may vary: changes in winter rainfall might be important for valley bottoms, whereas summer drought could be critical on adjacent south-facing slopes. Mixed deciduous woodlands are thought to have a low sensitivity to climate change related stress, such as droughts. Therefore, the implementation of the drought option will not significantly affect the hydrological regime of the woodland habitat, against a baseline of reduced flows characteristic of drought. Riparian plant communities and marginal aquatic vegetation along lowland streams are characterised by high species richness due to their system-specific environmental gradients. As these streams and their hydrological gradients are mainly rain-fed, they are sensitive to precipitation changes<sup>63</sup>. Loxley 2 flows through the Malin Bridge to River Don LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Malin Bridge to River Don LWS is deemed to be **moderate**.

#### B4.10.1.2 NERC and other protected species

##### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Loxley 2 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.45**. 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 B4.45 Impacts on white-clawed crayfish in Loxley 2**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>Increased mortality (density dependant) as a result of increased predation.</li> <li>Increased competition for resources as habitat availability reduces.</li> <li>Water quality risks are considered minor and water quality related impacts are considered unlikely.</li> </ul>	National	Low	Moderate

<sup>63</sup> Garssen, Annemarie G et al. "Effects of climate-induced increases in summer drought on riparian plant species: a meta-analysis." *Freshwater biology* vol. 59,5 (2014): 1052-1063.

## Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Loxley 2 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 B4.46**. 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 B4.46 Impacts on water vole in Loxley 2**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as minor and will not impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>64</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>65</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

## Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.48**.

<sup>64</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>65</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.

**Table B4.47 Impacts on otter in Loxley 2**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>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.</li> <li>Species could remain within the reach for longer.</li> <li>Otter likely to move to unaffected reaches.</li> </ul>	International	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 B4.48**.

**Table B4.48 Impacts on NERC and notable fish species in Loxley 2**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered minor</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> <li>Stranding of individuals is unlikely as longitudinal connectivity will not be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>66</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	National	High	Major
Bullhead		Regional	Medium	Moderate
Grayling		Regional	Medium	Moderate
European eel		International	High	Major

### B4.10.1.3 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<sub>NTAXA</sub> EQRs, the macroinvertebrate community shows a moderate 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

<sup>66</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.



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 good WHPT<sub>ASPT</sub> EQRs, however the water quality changes as a result of the implementation of the drought option are predicted to present a minor risk. Furthermore, there are no significant flow pressures, either abstractions or discharges, influencing flow in Loxley 2, as indicated 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 major risk to the macroinvertebrate component of the WFD GB104027057370 Loxley from Strines Dyke to River Don (associated with Loxley 2). 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<sup>67/68</sup>. 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 GB104027057370 Loxley from Strines Dyke to River Don (associated with Loxley 2). 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 **moderate**.

## B4.10.2 Summary of impacts

**Table B4.50** 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.

<sup>67</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>68</sup> 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.

**Table B4.49 Summary of impacts identified in Loxley 2's environmental features assessment**

Reach	Loxley 2	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Malin Bridge to River Don LWS	Moderate	Yes
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Moderate	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
Brown trout	Major	Yes
Bullhead	Moderate	Yes
European eel	Major	Yes
Grayling	Moderate	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057370 Loxley from Strines Dyke to River Don	
Fish	Moderate	Yes
Invertebrates	Moderate	Yes

## B4.11 Rivelin 1

### B4.11.1 Feature assessment

#### B4.11.1.1 Statutory designated sites/Local wildlife sites

##### Fox Hagg LWS

Fox Hagg nature reserve comprises 33.25 ha of woodland, grassland and heathland lying within the Rivelin Valley. A stream – Allen Sike - runs south-north through Fox Hagg nature reserve, meeting the River Rivelin which then runs east-west through Fox Hagg extension. Large parts of the reserve are free-draining, but seasonal springs and flushes wet flushes occur where impermeable shales impede drainage. The River Rivelin flows through the Fox Hagg LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Fox Hagg LWS is deemed to be **moderate**.

##### Lower/Middle Rivelin Valley LWS

The main habitats of the Lower/Middle Rivelin Valley LWS comprise woodland, with trees such as Alder, Ash, Beech, Holly and Oak. Spring flowers include Bluebell, Cow Parsley, Dog's Mercury, Stitchwort and Wood Sorrel. Birds such as Blackbird, Great tit, Long-tailed tit, Robin and Wren are regularly seen amongst the trees. Others such as Dipper, Grey Heron, Grey Wagtail, Kingfisher and Mallard can be found along the river or at the water-filled mill dams. Areas of wet woodland/alder carr are present, typically at the sites of silted mill ponds. Along with the carr areas, the bankside vegetation among the trees supports ancient woodland indicator species. Wet woodlands are known to be effected by the lowering of water-tables through drainage or water abstraction, resulting in change to drier woodland types, however groundwater during a drought will be low such that any further reduction in groundwater levels or slight delays in recharge rates would not be likely to further reduce the quality of wet woodland outside of normal drought conditions. The River Rivelin flows through the Lower/Middle Rivelin Valley LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Lower/Middle Rivelin Valley LWS is deemed to be **moderate**.

##### Roscoe Plantation LWS

The main habitats of the site is patches of acid grassland (on the dry slopes with bilberry and heath bedstraw), a silted mill pond (with developing willow & alder carr), old plantation woodland (possibly formed part of the larger ancient Stannington Wood), and overgrown allotments form the diversity of this site. The River Rivelin flows along the southern boundary. The River Rivelin flows through the Roscoe Plantation LWS, with potential changes to the physical environment presented in **Appendix A**. **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, and major risk of changes in available habitat for different species requirements – noting that dominant flow types will be retained. As such, the risk from the implementation of the drought option to Roscoe Plantation LWS is deemed to be **moderate**.

#### B4.11.1.2 NERC and other protected species

##### *Teucrium scordium*

*T. scordium* is a stoloniferous perennial herb which is present a variety of wetland habitats with fluctuating water levels, including the margins of dune-slack pools, reed-fen, clay-pits and the banks of rivers, ponds and ditches. The genus *Teucrium* are perennial shrubs able to withstands drought and poor sandy soil with minimal damage. Optimal conditions for establishment are sparsely vegetated water margins exposed by summer draw-down. Although **Appendix A** highlights the potential for a major risk of reduction in total wetted aquatic habitat in the reach, these potential changes in wetted width may be beneficial to the establishment and colonisation of new habitats for *T. scordium*. As such, the risk from the implementation of the drought option to *T. scordium* is deemed to be **negligible**.

### *Sisyr terminalis*

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.50**.

**Table B4.50** Impacts on *Sisyr terminalis* in Rivelin 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
<i>Sisyr terminalis</i>	<ul style="list-style-type: none"> <li>• Reductions in wetted width and depth will reduce habitat availability for the species</li> <li>• Reduced water quality in the reach</li> </ul>	Regional	Low	Minor

### White-clawed crayfish

In the absence of quantitative data on populations of white-clawed crayfish a detailed assessment of impact in Rivelin 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, it is possible that individuals will become stranded as river levels reduce and habitats become exposed.

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.52**. 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 B4.51** Impacts on white-clawed crayfish in Rivelin 1

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
White-clawed crayfish	<ul style="list-style-type: none"> <li>• Stranding and mortality as a result of a reduction in velocity, depth and/or wetted width.</li> <li>• Increased mortality (density dependant) as a result of increased predation.</li> <li>• Increased competition for resources as habitat availability reduces.</li> <li>• Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> </ul>	National	High	Major

### Water vole

In the absence of quantitative data on populations of water vole a detailed assessment of the impact in Rivelin 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 B4.52**. 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 B4.52 Impacts on water vole in Rivelin 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Water vole	<ul style="list-style-type: none"> <li>• Risk of deterioration in water quality has been identified as moderate and may impact on this feature</li> <li>• Species has a preference for waterbodies that do not have extreme fluctuations in water level<sup>69</sup>.</li> <li>• Increased predation as a result of decreased water width and exposure of burrows.</li> <li>• The reduction in wetted width could result in an increased distance between water vole food source and the burrows.</li> <li>• Impacts could occur throughout the breeding season for this species.</li> <li>• Alteration to food supply could occur although the species has been known to feed upon crayfish at times<sup>70</sup> and the potentially increased density of this species could lead to increased predation efficiency</li> <li>• Although the impacts are restricted to the reach, the effects of increased predation upon the species could have long-term impacts.</li> <li>• There are uncertainties relating to the presence of this species with the impacted reach.</li> </ul>	National	Medium	Moderate

## Otter

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B 4.53**

**Table B 4.53 Impacts on otter in Rivelin 1**

Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Otter	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Species could remain within the reach for longer.</li> <li>• Otter likely to move to unaffected reaches.</li> </ul>	International	Negligible	Negligible

<sup>69</sup> English Nature, the Environment Agency and the 1998 Wildlife Conservation Research Unit Water vole Conservation Handbook. George Street Press Ltd.

<sup>70</sup> Strachan, R. and Moorhouse, T. (2006) Water Vole Conservation Handbook. 2nd Edition. Wildlife Conservation Research Unit, Oxford.



## Fish

The likely impacts arising from the hydrological changes as a result of the implementation of the drought option are identified in **Table B4.54**.

**Table B4.54 Impacts on NERC and notable fish species in Rivelin 1**

NERC/ notable Feature	Impact	Ecological Value of Feature	Impact Magnitude	Significance of Impact
Brown trout	<ul style="list-style-type: none"> <li>The risk to siltation of spawning gravels is considered Moderate</li> <li>Reduced flow and wetted width could result in exposure/loss of important habitats (spawning gravels, nursery habitat, resting pools)</li> </ul>	National	High	Major
Bullhead	<ul style="list-style-type: none"> <li>Reduced flow during downstream and upstream migration of brown trout and movement from spawning to nursery areas could be impeded due to lower flows.</li> </ul>	Regional	Medium	Moderate
Brook lamprey	<ul style="list-style-type: none"> <li>Increased stress and competition could result in decreased growth, morphological change and/or alteration to feeding and migration</li> </ul>	National	High	Major
European eel	<ul style="list-style-type: none"> <li>Stranding of individuals is likely as longitudinal connectivity will be impacted.</li> <li>Increased mortality (density dependant) as a result of increased predation</li> <li>It is noted that depth of water is not critical to bullhead<sup>71</sup></li> <li>Exposure/loss of important habitats (wetland habitats for juveniles and adults) eel</li> </ul>	International	High	Major

### B4.11.1.3 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<sub>NTAXA</sub> 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<sub>ASPT</sub> 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

<sup>71</sup> Tomlinson, M. L. and Perrow, M. R. (2003) Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.

invertebrate community, associated with additional temporary water quality pressures locally downstream of one listed CSO during rainfall events.

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 major risk to the macroinvertebrate component of the WFD GB104027057340 Rivelin from Source to River Loxley (associated with Holme T2). 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<sup>7273</sup>. 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 Major risk to the fish component of the WFD GB104027057340 Rivelin from Source to River Loxley (associated with Rivelin 1). 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 **Major**.

## B4.11.2 Summary of impacts

**Table B4.55** 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 B4.55 Summary of impacts identified in Rivelin 1's environmental features assessment**

Reach	Rivelin 1	
	Significance of Impact	Mitigation Required (Y/N)
<b>Statutory designated sites/Local wildlife sites</b>		
Middle Rivelin Valley LWS	Moderate	Yes
Lower Rivelin Valley LWS	Moderate	Yes
Fox Hagg LWS	Moderate	Yes
Roscoe Plantation LWS	Moderate	Yes
<b>NERC and Notable Species Receptors</b>		
White-clawed crayfish	Major	Yes
Otter	Negligible	No
Water vole	Moderate	Yes
<i>Sisyr terminalis</i>	Minor	No
Brown trout	Major	Yes
Brook Lamprey	Major	Yes
Bullhead	Moderate	Yes
European eel	Major	Yes
<b>WFD Status Receptors</b>	<b>Risk of Deterioration</b>	
<b>WFD Waterbody</b>	GB104027057340 Rivelin from Source to River Loxley	
Fish	Major	Yes
Invertebrates	Moderate	Yes

<sup>72</sup> Williams, D. D. (1977) Movements of benthos during the re-colonisation of temporary streams. *Oikos* 29, pp 306 – 312.

<sup>73</sup> 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.

## 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 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.4 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.4 for significant water quality pressures related to YWSL WwTWs. In addition to specific surveillance monitoring the following is specified:

- **Don 2:** the assessment has identified a significant water quality pressure in the reach associated with Cheesebottom WwTW.
- **Don 3:** the assessment has identified a significant water quality pressure in the reach associated with Ewden WwTW and continued risk from Cheesebottom WwTW (which discharges in Don 2).
- **Don 4:** the assessment has identified a significant water quality pressure in the reach associated with Wharnccliffe Side WwTW and continued risk from Ewden WwTW (which discharges in Don 3).
- **Don 5:** the assessment has identified a significant water quality pressure in the reach associated with Blackburn Meadows WwTW.
- **Scout Dyke 1:** the assessment has identified a significant water quality pressure in the reach associated with Scout Dyke WwTW.
- **Ewden Beck:** the assessment has identified a significant water quality pressure in the reach associated with Ewden Village 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<sup>74</sup> 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.

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<sup>74</sup> YWSL (2018) Wastewater Treatment Works Optimisation and Maintenance for Drought Plan.

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<sup>75</sup> and includes all significant intermittent water quality pressures identified in this EAR.

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<sup>75</sup> YWSL (2022) Combined Sewer Overflows (CSOs) Optimisation and Maintenance for Drought Plan.

## Appendix C Monitoring and ecological mitigation measures



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

<b>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</b>	
<b>Routine baseline monitoring</b>	
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.
<b>Targeted baseline monitoring</b>	
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
<b>On-set of Environmental drought – monitoring leading to selection and implementation of appropriate mitigation measures</b>	
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.
<b>In-Drought (during drought option implementation) – monitoring leading to selection and implementation of appropriate mitigation measures</b>	
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
<b>In-Drought (During Drought Option Implementation) – Mitigation</b>	
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
<b>Post-Drought (Drought Options Removed) – Monitoring</b>	
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
<b>Post-Drought (Drought Options Removed) – Mitigation</b>	
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



T: +44 (0) 1235 753000

E: [enquiry@ricardo.com](mailto:enquiry@ricardo.com)

W: [ee.ricardo.com](http://ee.ricardo.com)