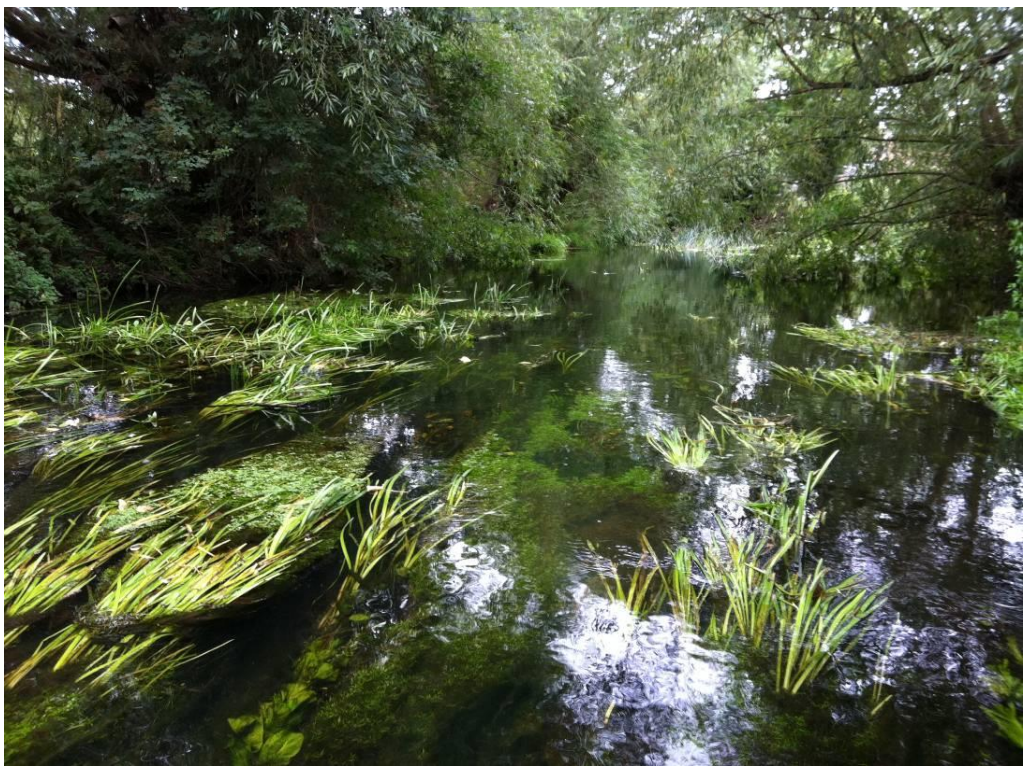
Drought Permit Environmental Assessment Report: Tittesworth and River Churnet



Drought Permit Environmental Assessment Report: Tittesworth and River Churnet

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Executive Summary

What is a drought order / drought permit?

In periods of unusually low rainfall, where water resources become scarce, powers are available to grant drought permits and ordinary and emergency drought orders under the Water Resources Act 1991 (as amended). Drought permits are granted by the Environment Agency (EA) and drought orders and emergency drought orders are granted by the Secretary of State. Drought permits can be applied for where the main change is variation of an abstraction licence condition, such as the maximum yearly abstraction allocation or to reduce a compensation flow.

The water industry is required by the Government to demonstrate that they have adequate drought contingency plans, and there is now a statutory duty for water companies to agree publicly available drought plans following consultation with the EA, the Secretary of State, the Water Services Regulation Authority (Ofwat) and other statutory bodies.

Drought permit / drought order options are identified in Severn Trent Water Ltd's (STWL's) Drought Plan (published in 2022). The Drought Plan details the range of actions that STWL will consider implementing during drought conditions in order to maintain essential water supplies to its customers and minimise environmental impact.

Background

The River Churnet rises on the Staffordshire Moorlands above the town of Leek and flows into Tittesworth Reservoir before heading southwards through Cheddleton, Froghall and Alton to its confluence with the River Dove at Rocester. The Churnet is 52 km long and has a catchment area of 232 km^2. Its main tributary is Endon Brook, which joins just below Leek. Downstream of the reservoir, the River Churnet is immediately joined by Solomon's Hollow Brook. Further downstream, Endon Brook flows into the Churnet between Leek and Cheddleton.

STWL abstracts water from Tittesworth Reservoir for the purpose of public water supply, supplying Leek, parts of Stoke-on-Trent and the surrounding area. The River Churnet is one of the potential sites for drought permits listed within STWL's Drought Plan.

Currently, compensation flow requirements are a minimum flow of 14.8 Ml/d maintained at Leek Flume gauging station (comprising Tittesworth Reservoir compensation, Tittesworth overflows and any natural flow from Solomon's Hollow Brook), with a total compensation requirement for the River Churnet of 19.32 Ml/d. Some of the total compensation requirement comes from the Deep Hayes catchment, whose natural flows can be augmented by a borehole there.

What will the drought permit entail?

Given the current period of extended dry weather and an exceptional shortage of rain, the need for a drought permit at Tittesworth and the River Churnet has been identified. STWL are applying to the EA for a drought permit covering the following scenario:

- Scenario 2: 8 Ml/d compensation release from Tittesworth, 0 Ml/d augmentation release from Abbey Green. As for Scenario 1 there would be no augmentation requirement from Deep Hayes borehole (i.e removal of combined compensation requirement for the River Churnet of 19.32 Ml/d).

STWL propose to apply on 14th October 2022 for a drought permit for a six-month period. This Environmental Assessment Report (EAR) includes an assessment of the impacts of the drought permit for the upcoming six-month period, covering October 2022 to March 2023.

What does this environmental assessment cover?

An EAR, which includes a monitoring plan and mitigation measures, is required for each supply-side management action (e.g. drought permits) included within the Drought Plan. Each EAR should provide details of baseline flow conditions, assess impacts of potential changes to the flow regime due to implementation of the drought permit, and provide an Environmental Monitoring Plan (EMP) to support the requirement for baseline, during and post drought permit monitoring.

Following a 'source-pathway-receptor' approach, this environmental assessment focuses first on examining how the drought permit (the 'source') will affect the hydrological, hydrogeological and geomorphological environment (the 'pathways'), and then considers how ecological and other features (the 'receptors') will respond to changes in those pathways.

This report forms the assessment of likely impacts of the drought permit on the pathways and receptors of interest for the River Churnet; hydrology, water quality, habitat and geomorphology and ecological and other receptors.

What are the likely impacts of the drought permit on the environment?

The predicted magnitude of impact on each pathway and significance of impact on each receptor are summarised in the dashboard summary below (Table ES.1). The significance of impact on receptors draws on the impact magnitude on relevant pathways and the sensitivity of the receptor. These two elements are combined to determine overall impact significance for each receptor. In summary, the potential for moderate impacts has been predicted as a consequence of the drought permit on the spawning and egg incubation life stages of brown trout, bullhead and rheophilic coarse fish (including the ability to complete migratory movements and access spawning grounds), and on *Lampetra* sp. ammocoetes (juvenile lampreys) in the River Churnet from Meerbrook to Leekbrook water body only. The effect of the drought permit is predicted to be minor on all other receptors in comparison with the baseline. Drought permits are granted on the basis of being in place for six months and so this assessment is made on the basis that the drought permit would be in place for up to six months from October 2022. The assessment presented considers the impacts should a permit be implemented at any time of year and therefore impacts across the whole year are summarised.

What measures will be used to mitigate significant impacts?

Where significant negative impacts (defined for this report as those of moderate significance or greater) are identified during the environmental assessment process, there is a need to identify appropriate mitigation measures in order to avoid, reduce or remedy any impacts. Such measures may be identified either to be implemented in advance or implemented during implementation of the drought permit.

Based on this assessment and given the uncertainties inherent in some of the assessments undertaken, a range of precautionary mitigation measures have been developed, if environmental monitoring during drought implementation identifies that unexpected impacts are occurring. These are detailed in Section 4 of the report.

It should be noted that not all the mitigation measures described may be required or appropriate. If unexpected impacts are found to be occurring, potential mitigation measures should be discussed and agreed with the EA as a matter of urgency proportionate to the level of risk. Mitigation measures would

be implemented to avoid, mitigate or compensate the impacts of the drought permit and not the impacts of the drought itself.

A number of additional mitigation measures could be implemented depending on feasibility, should monitoring during a drought permit indicate that significant impacts are occurring.

It may not be necessary to implement any of these mitigation measures if significant negative impacts are not observed to be occurring. Implementation of the mitigation measures will take place should monitoring during the drought permit indicate that significant impacts are being experienced.

What monitoring will be carried out?

An EMP has been developed which includes baseline, pre-drought permit implementation, during-drought permit implementation and post-drought permit implementation monitoring. This is detailed in Section 5 of the report.

Monitoring has been recommended in order to capture any changes before, during and after the drought permit implementation. This includes checking for signs of ecological stress including: potential effects on flow; potential effects of poor water quality; inhibition of movement of fish past river structures or other barriers; and habitat availability for adult and juvenile life stages (including spawning / nursery areas).

It is important to note that the level of monitoring is risk-based. The environmental assessment indicates that the drought permit presents a low to moderate risk to the environment (negligible or minor negative impacts are predicted for most receptors). Nevertheless, given the uncertainties inherent in some of the assessments undertaken, monitoring has been recommended, to check the predicted degree of impact, and identify any unexpected impacts in order to trigger mitigation measures, if needed.

Table ES.1 Dashboard summary of predicted magnitude of impacts on each pathway and receptor under the drought permit (implementation proposed between October 2022 and March 2023 inclusive only) (listed as Scenario 2 in main text)

				Churnet drought permit												
		Scenario	Sensitivity of receptor	J	F	M	A	M	J	J	A	S	O	N	D	Level of Confidence
Pathways	**Hydrology**															
	Level: Tittesworth Reservoir	1, 2	NA	N	N	N	N	N	N	N	N	N	N	N	N	Medium
	Flow: River Churnet from Meerbrook to Leekbrook	2	NA	M	M	M	M	M	M	M	M	M	M	M	M	Medium
	Flow: River Churnet from Endon Brook to Consall	1, 2	NA	M	M	M	M	M	M	M	M	M	M	M	M	Medium
	Flow: River Churnet from Consall to River Dove	1, 2	NA	L	L	L	L	L	L	L	L	L	L	L	L	Medium
	Hydromorphology															
	River Churnet from Meerbrook to Leekbrook – upstream Wall Bridge Leek	1, 2	NA	M	M	M	M	M	M	M	M	M	M	M	M	Medium
	River Churnet from Meerbrook to Leekbrook – downstream Wall Bridge Leek	1, 2	NA	L	L	L	L	L	L	L	L	L	L	L	L	Medium
	River Churnet from Endon Brook to Consall	1, 2	NA	L	L	L	L	L	L	L	L	L	L	L	L	Medium
	River Churnet from Consall to River Dove	1, 2	NA	N	N	N	N	N	N	N	N	N	N	N	N	Medium
	Water quality															
	River Churnet from Endon Brook to Consall	1, 2	NA	M	M	M	M	M	M	M	M	M	M	M	M	High
Receptors	**Macroinvertebrates**															
	Non-notable species: River Churnet from Meerbrook to Leekbrook	1, 2	Low													Medium
	Non-notable species: River Churnet from Endon Brook to Consall	1, 2	Low													Medium
	Non-notable species: River Churnet from Consall to River Dove	1, 2	Low													Medium

		Scenario	Sensitivity of receptor	Churnet drought permit												
				J	F	M	A	M	J	J	A	S	O	N	D	Level of Confidence
Receptors	**Fish**															
	River Churnet from Meerbrook to Leekbrook *Lampetra* sp. (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Meerbrook to Leekbrook *Lampetra* sp.(ammocoetes)	1, 2	High													Medium
	River Churnet from Meerbrook to Leekbrook Brown trout (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Meerbrook to Leekbrook Brown trout (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Bullhead (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Meerbrook to Leekbrook Bullhead (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Eurytopic / minor coarse fish (spawning and egg incubation)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Eurytopic / minor coarse fish (juveniles)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Eurytopic / minor coarse fish (adults)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Rheophilic coarse fish (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Meerbrook to Leekbrook Rheophilic coarse fish (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook Angling Groups	1, 2	Low													Medium
	River Churnet from Endon Brook to Consall Brook Lamprey (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Endon Brook to Consall Brook Lamprey (ammocoetes)	1, 2	High													Medium
	River Churnet from Endon Brook to Consall Brown trout (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Endon Brook to Consall Brown trout (juveniles and adults)	1, 2	Medium													Medium

				Churnet drought permit												
		Scenario	Sensitivity of receptor	J	F	M	A	M	J	J	A	S	O	N	D	Level of Confidence
Receptors	River Churnet from Endon Brook to Consall Bullhead (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Endon Brook to Consall Bullhead (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Endon Brook to Consall Eurytopic / minor coarse fish (spawning and egg incubation)	1, 2	Medium													Medium
	River Churnet from Endon Brook to Consall Eurytopic / minor coarse fish (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Endon Brook to Consall Rheophilic coarse fish (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Endon Brook to Consall Rheophilic coarse fish (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Endon Brook to Consall Angling Groups	1, 2	Low													Medium
	River Churnet from Consall to River Dove Atlantic salmon (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Consall to River Dove Atlantic salmon (juveniles)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Atlantic salmon (adults)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Brook Lamprey (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Consall to River Dove Brook Lamprey (ammocoetes)	1, 2	High													Medium
	River Churnet from Consall to River Dove Brown trout (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Consall to River Dove Brown trout (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Bullhead (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Consall to River Dove Bullhead (juveniles and adults)	1, 2	Medium													Medium

				Churnet drought permit												
		Scenario	Sensitivity of receptor	J	F	M	A	M	J	J	A	S	O	N	D	Level of Confidence
Receptors	River Churnet from Consall to River Dove Eurytopic / minor coarse fish (spawning and egg incubation)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Eurytopic / minor coarse fish (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Rheophilic coarse fish (spawning and egg incubation)	1, 2	High													Medium
	River Churnet from Consall to River Dove Rheophilic coarse fish (juveniles and adults)	1, 2	Medium													Medium
	River Churnet from Consall to River Dove Angling Groups	1, 2	Low													Medium
	INNS															
	Signal crayfish (*Pacifastacus leniusculus*)	1, 2	Low													High
	Demon shrimp (*Dikerogammarus haemobaphes*)	1, 2	Low													High
	Himalayan balsam (*Impatiens glandulifera*)	1, 2	Low													High
	Japanese knotweed (*Fallopia japonica*)	1, 2	Not sensitive													High
	Protected species															
	Pied flycatcher	1, 2	Low													Low
	Marsh tit	1, 2	Medium													Low
	Willlow tit	1, 2	Medium													Low
	Wood warbler	1, 2	Medium													Low
	Dipper	1, 2	Low													Low
	Redstart	1, 2	Low													Low
	Otter – River Churnet from Meerbrook to Leekbrook and River Churnet from Endon Brook to Consall	1, 2	Low													Low
	Otter – River Churnet from Consall to River Dove	1, 2	Low													Medium
	Water vole	1, 2	Uncertain													Low
	Common toad	1, 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Great crested newt	1, 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Other abstractors															
	River Churnet from Meerbrook to Leekbrook: Portland Dyeing Company	1, 2	Uncertain													Medium

				Churnet drought permit												
		Scenario	Sensitivity of receptor	J	F	M	A	M	J	J	A	S	O	N	D	Level of Confidence
Receptors	River Churnet from Meerbrook to Leekbrook: Brindley's Mill	1, 2	Medium													Medium
	River Churnet from Meerbrook to Leekbrook: Eternis Fine Chemicals	1, 2	Uncertain													Medium
	River Churnet from Endon Brook to Consall: Cheddleton Flint Mill	1, 2	Low													Medium
	River Churnet from Endon Brook to Consall: Canal and River Trust Caldon Canal	1, 2	Not sensitive													Medium
	River Churnet from Consall to River Dove: level dependent offtakes including JCB	1, 2	Uncertain													Medium
	Designated sites															
	Brough Park Fields and Ladderedge Country Park	1, 2	Low													Medium
	Churnet Valley SSSI and Froghall Meadow and Pastures SSSI	1, 2	Moderate													Medium
	Aesthetics, recreation and navigation															
	River Churnet (all three water bodies)	1, 2	Low													Medium
	Archaeology and heritage															
	Brindley's Mill (scheduled monument)	1, 2	Medium													Medium
	Crumpwood weir (Grade II listed building)	1, 2	Medium													Medium

Key

Magnitude of impact on pathway		Significance of impact on receptor	
H	High		Major
M	Medium		Moderate
L	Low		Minor
N	Negligible		Uncertain
	Uncertain	NA	Not assessed
NA	Not assessed		

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Glossary

Term	Definition
BOD	Biochemical Oxygen Demand
CIEEM	Chartered Institute of Ecology and Environmental Management
EA	Environment Agency
EAR	Environmental Assessment Report
EMP	Environmental Monitoring Plan
EQS	Environmental Quality Standard
Froude number	The dimensionless velocity / depth ratio used to describe the different flow regimes of open channel flow
GEP	Good Ecological Potential
GES	Good Ecological Status
HMC	Habitat Modification Class
HMS	Habitat Modification Score
HMWB	Heavily Modified Water Body
HQA	Habitat Quality Assessment
INNS	Invasive Non-Native Species
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum
MEP	Moderate Ecological Potential
Ml/d	Megalitres per day
NRW	Natural Resources Wales
RHS	River Habitat Survey
SAC	Special Area of Conservation
Sonde	A probe that automatically transmits information about its surroundings
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
UIA	Un-Ionised Ammonia
UKAS	United Kingdom Accreditation Service
WFD	Water Framework Directive

1 Introduction

1.1 Background

Severn Trent Water Ltd (STWL) abstracts water from Tittesworth Reservoir for the purpose of public water supply, supplying Leek, parts of Stoke-on-Trent and the surrounding area.

The River Churnet is listed as a potential drought permit site within STWL's current Drought Plan (STWL, 2022). In total the plan identifies six locations where applications for drought permits or drought orders may be made (Table 1.1).

Table 1.1 STWL drought permit / drought order sites

Catchment	Potential STWL drought permit / drought order site
Derwent (Derbyshire)	- Derwent Valley Reservoirs; and - River Derwent at Ambergate
Leam & Avon	- River Leam and River Avon (one single drought permit)
River Churnet	- Tittesworth Reservoir; and - River Churnet
Severn	- River Severn at Site G
Dove	- Dove Reservoirs (Staunton Harold and Foremark)

1.2 Drought permits and drought orders

In periods of unusually low rainfall, where water resources become scarce, powers are available to grant drought permits, ordinary drought orders and emergency drought orders under the Water Resources Act 1991 (as amended by the Environment Act 1995 and the Water Act 2003). Drought permits and drought orders are drought 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 (EA & Defra, 2019).

In the case of drought permits, the EA must be satisfied that a serious deficiency of supplies of water in any area exists or is threatened and that the reason for the deficiency is an exceptional shortage of rain.

Drought permits can be applied for under the Water Resources Act 1991 (Section 79A) where the main change is variation of an abstraction licence condition, such as the maximum yearly allocation or a compensation flow. They are authorised by the EA which can hold a public hearing to discuss the application if it deems one is necessary.

Following the severe drought in northern England in 1995/96, the Government set out a wide range of actions to be taken by the water industry, including the need for water companies to demonstrate that they have adequate drought contingency plans. As required under Sections 39B and 39C of the Water Industry Act 1991, as amended by the Water Act 2003 and in accordance with the Drought Plan Regulations 2005 the Drought Plan Direction 2020, water companies have a duty to prepare and maintain a Drought Plan.

Prospective drought permit/drought order options are identified in STWL's current Drought Plan (STWL, 2022). The Drought Plan details the range of actions that STWL will consider implementing during drought conditions in order to maintain essential water supplies to its customers and minimise environmental impact.

The environmental assessment of drought permits/drought orders is undertaken in recognition of the guidance from the EA and Defra, as contained in:

- EA Water Company Drought Plan Guideline (April 2020);

- EA and Defra Guidance on Drought Permits and Drought Orders (May 2019); and
- EA environmental assessment for water company drought planning supplementary guidance (July 2020).

The environmental assessment of a drought permit/drought order is not a statutory Environmental Impact Assessment (EIA), as recognised, for example, within the Town & Country Planning regime and its enabling regulations. However, this environmental assessment has been undertaken in accordance with best practice guidance wherever applicable.

An EAR, which includes a monitoring plan and mitigation measures, is required for each supply-side management action (e.g. drought permits) included within the Drought Plan. Each EAR should provide details of baseline flow conditions, assess impacts of potential changes to the flow regime due to implementation of the drought permit, and provide an EMP to support the requirement for baseline, during and post drought permit implementation monitoring. STWL has prepared 'shelf-copy' EARs for each of the existing drought permit/drought order sites in support of its Drought Plan. These reports provide a template report which can be updated to support an application for a drought permit/drought order if required. The EARs also inform the Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) of STWL's Drought Plan.

This version of the Tittesworth and Churnet EAR has been updated to support an application for a drought permit in October 2022. The report considers the implementation of a drought permit at Tittesworth and the River Churnet at any time of year, noting that the six-month drought permit implementation period in STWL's drought permit application is October 2022 to March 2023.

1.3 Scope of assessment

Following a 'source-pathway-receptor' approach, this environmental assessment focuses first on examining how the drought permit (the 'source') will affect the hydrological, hydrogeological and geomorphological environment (the 'pathways'), and then considers how ecological and other features (the 'receptors') will respond to changes in those pathways.

As a preliminary screening step, the long list of pathways and receptors in Table 1.2 was reviewed to identify the environmental features of interest for inclusion in the environmental assessment. Features were excluded only if:

- the pathway or receptor is absent from the area of potential impact;
- there is no pathway by which the receptor could be impacted;
- the receptor has negligible value; or
- the receptor is not sensitive to changes in these pathways.

Table 1.2 Environmental features considered in this environmental assessment

Category	Environmental feature	Included	Justification
Pathways	Hydrogeology	No	See Appendix A
	Hydrology	Yes	
	Habitat and geomorphology	Yes	
	Water quality	Yes	

Category	Environmental feature	Included	Justification
Ecological receptors	Macrophytes and diatoms	No	Water bodies have not been designated for their macrophyte community; river does not dry out.[1]
	Macroinvertebrates	Yes	
	Fish (including angling groups)	Yes	
	Invasive non-native species	Yes	
	Protected species	Yes	
Other receptors	Other abstractors Designated sites Aesthetics, recreation and navigation Archaeology and heritage	Yes	

[1] whilst detailed assessment of macrophytes was outside the scope of the EAR, no changes in WFD status are predicted based on the pathways assessments.

1.4 This report

Figure 1.1 shows how the EA's requirements for environmental assessments of drought permits are satisfied by this report.

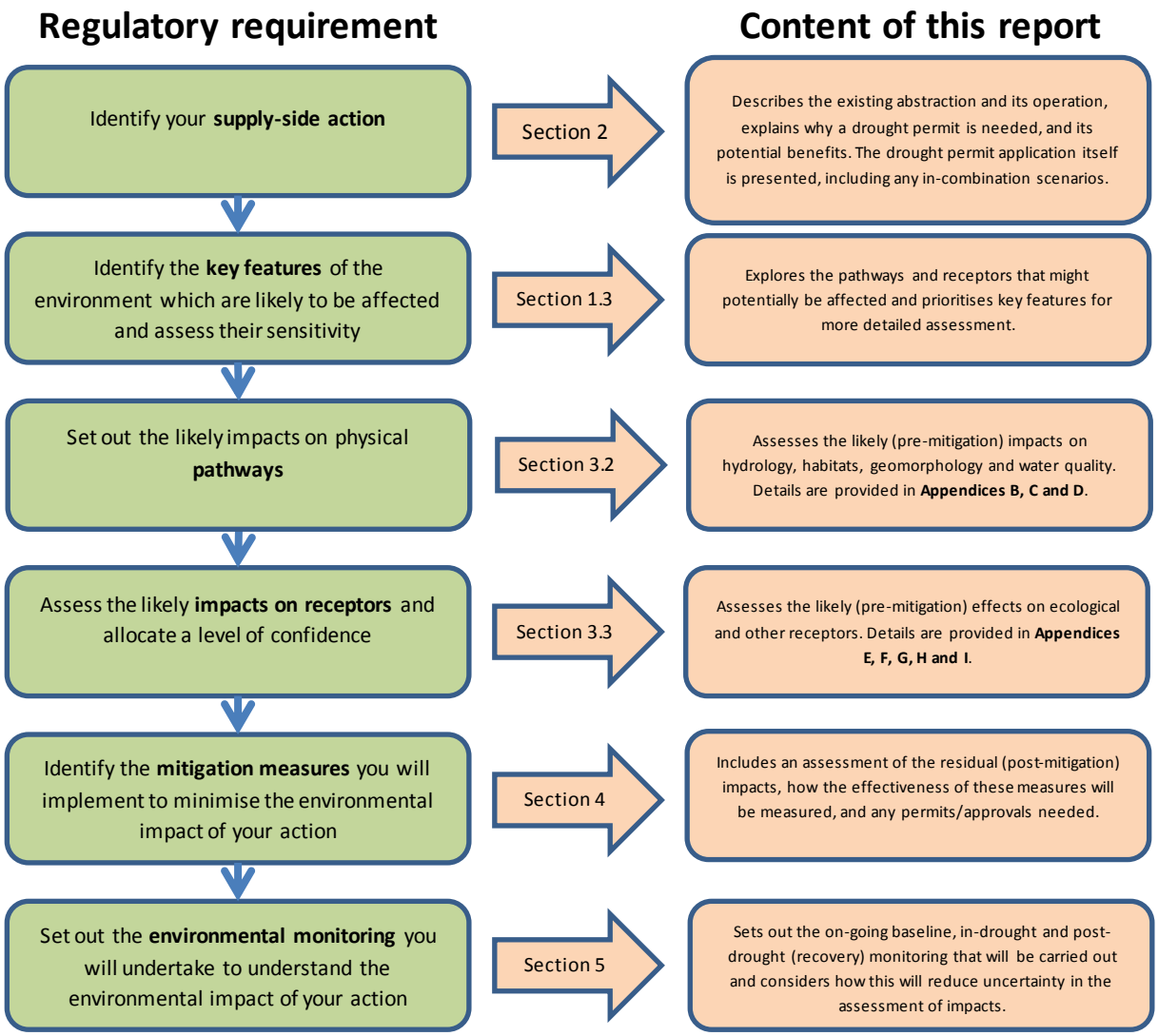

Figure 1.1 Flow chart detailing how the EA's requirements for drought permits are satisfied by this report.

This report constitutes both the 'pathways' and 'receptors' sections of the EAR for the River Churnet (Tittesworth and River Churnet) drought permit site. 'Pathways' is the term used to describe the routes by which the ecology ('receptors') might be affected by a potential stressor, in this case the application of the proposed drought permit. The pathways assessments included here comprise of hydrology, hydromorphology and water quality. A draft document focusing only on the pathways assessments was consulted upon with the EA and STWL and agreed in advance of the dependent ecological assessments.

This report updates the existing 'shelf-copy' EAR that dates from 2022 (Stantec and APEM, 2022) to support an application for a drought permit in October 2022.

For ease of reading, the report presents a technical summary of the more detailed assessments that are subsequently presented as a series of Appendices.

2 The Tittesworth and River Churnet drought permit

This Chapter:

- provides details of the supply side action to maintain water supply (Section 2.2);
- sets out the evidence to justify the action* (Section 2.1);
- where there is a change to an abstraction or a discharge, explains where it is from/to and which sites, water bodies and other abstractions will be affected (Section 2.3); and
- describes the Water Framework Directive status of the water bodies of interest (Section 2.4), and designated sites therein (Section 2.5).

* Further evidence is included in the application.

2.1 Site setting and background

2.1.1 Water sources and abstraction licences

The River Churnet rises on the Staffordshire Moorlands above the town of Leek and flows into Tittesworth Reservoir before heading southwards through Cheddleton, Froghall and Alton to its confluence with the River Dove at Rocester. The Churnet is 52 km long and has a catchment area of 232 km^2. Its main tributary is Endon Brook, which joins just below Leek. Downstream of the reservoir, the River Churnet is immediately joined by Solomon's Hollow Brook. Further downstream, Endon Brook flows into the Churnet between Leek and Cheddleton.

There are three impounding reservoirs at the top of the catchment: Tittesworth Reservoir (owned by STWL), Rudyard Reservoir and Stanley Reservoir (managed by the Canal and River Trust). Water (for public water supply) is also abstracted from four boreholes near Leek (the Leek Group). Tittesworth Reservoir is an impounding reservoir that lies within the catchment of the River Churnet. Along with the Leek Group boreholes it is a source of local importance to public water supply in Staffordshire supplying Leek, parts of Stoke-on-Trent and the surrounding area. The Tittesworth Reservoir abstraction licence (03/28/30/124) permits up to 16,000 Ml/a (average 43.8 Ml/d) to be abstracted, however there is no daily maximum abstraction restriction.

There has been a reservoir at Tittesworth since 1858 (STWL, 2013), originally constructed to support mill owners downstream on the rivers Churnet and Dove. The reservoir was then modified between 1959 and 1963 to its current condition to provide for increasing demand for public water supply in the area. In the mid-1990s a new treatment plant was commissioned to supply up to 45 Ml/d.

Downstream of Tittesworth Reservoir, parts of the River Churnet catchment are underlain by the Leek Groundwater Management Unit (GWMU). This consists of an outlier of Triassic Sherwood Sandstone (Chester Pebble Beds Formation) underlain and surrounded by folded and faulted Carboniferous Strata (Millstone Grit and Bowland Shale/Craven Groups). The River Churnet flows westwards onto the Sherwood Sandstone outcrop north of Leek and meanders its way southwards (both on and off the outcrop) before leaving the GWMU just upstream of Basford Bridge.

The Tittesworth abstraction licence previously specified various downstream compensation requirements. A minimum flow of 14.8 Ml/d was to be maintained at Leek Flume gauging station, comprising Tittesworth

Reservoir compensation, Tittesworth overflows and any natural flow from Solomon's Hollow Brook. The total compensation requirement for the River Churnet was 19.32 Ml/d and the remainder of this (up to 4.5 Ml/d) was supplied from Tittesworth Reservoir when flows from the Deep Hayes catchment were insufficient. Following an investigation in AMP6, the licence was updated (EA, 2020c) to reduce the total compensation requirement in the Churnet to 14.8Ml/d, as it removes the Deep Hayes compensation requirement for the licence variation[2]. However, as the licence change has not yet come into effect, the baseline used for this assessment is as set out above: a minimum flow of 14.8 Ml/d maintained at Leek Flume gauging station, with a total compensation requirement for the River Churnet of 19.32 Ml/d. Once the licence changes come into effect, the baseline will be reviewed as part of a future update to the drought permit EAR alongside the next update of the Drought Plan.

There are a number of anthropogenic factors that have been identified in the study area. These are summarised below:

- Abstractions from Tittesworth Reservoir.
- The compensation flow released from Tittesworth Reservoir and Deep Hayes borehole.
- Compensation from Rudyard Reservoir.
- STWL operates four licensed PWS groundwater abstractions[3] from the Leek Sandstone aquifer.
- STWL operates one significant effluent discharge to the River Churnet, at Leek STW (11.9 Ml/d consented DWF4).
- Mains leakage.
- The Leek branch of the Caldon Canal receives water from the Canal and River Trust Rudyard Reservoir through the Rudyard Feeder. There are several other locations where the Caldon Canal interacts with the River Churnet. The canal also receives water from unlicensed abstractions in the Endon Brook tributary of the Churnet and from Stanley Reservoir. The canal joins the River Churnet at Oakmeadow Ford to the south-west of Cheddleton.
- Leakage from the Rudyard Reservoir to Leek aquifer via Roaches Grit. It has been assumed that there is no significant leakage from Tittesworth Reservoir as this is separated from the Permo-Triassic Sandstone by the less permeable Morridge Formation.
- There are two non-PWS surface water abstractions on the Churnet upstream of the Rudyard tributaries confluence. There are also several (non-consumptive) abstraction licences near Leek.
- There are also pollutant sources, including poor water quality (elevated suspended solids, ammonia, BOD and phosphate: sources unknown) upstream of Leek STW and excessive diffuse inputs of fine sediment (e.g. bank poaching by cattle).
- Channel morphology is also altered in places, with barriers to fish passage.

2.1.2 Previous drought permits / drought orders

Previously, Severn Trent Water applied for the following drought permits/drought orders:

[2] The 2020 licence change is time-limited with monitoring; there will still be natural flows from the Deep Hayes catchment but no augmentation from the borehole and no requirement to release more than 14.8Ml/d from Tittesworth Reservoir.
[3] The Abbey Green PWS has not been used for public water supply consistently since the 1980's.
[4] The discharge from Leek STW is approximately 5 Ml/d (dry summer) and 7.5 Ml/d (wet summer) (ESI & APEM, 2017).

- Severn Trent Water was granted a drought order for the Churnet Valley (Tittesworth Reservoir and associated groundwater sources) from 8 September 1989 to 7 March 1990 (6 months). This reduced the compensation discharge from the reservoir to 5 Ml/d, whilst augmenting flows upstream of Leek by pumping between 7.5 Ml/d and 9.5 Ml/d to the Churnet from Abbey Green borehole, and up to 2 Ml/d from Wakefield Well at Wallgrange, into the Endon Brook. The combined compensation was no less than 14.5 Ml/d. Additionally, an unlicensed source, a borehole at Deep Hayes, was pumped to supplement run-off in the valley so that discharge to the Endon Brook was maintained at a minimum 4.5 Ml/d.

- Severn Trent Water was granted a drought order for the Churnet Valley in December 1995 until June 1996 (7 months). The drought order was granted to aid winter refilling of the reservoir following the exceptionally dry summer and autumn of 1995. The effects were to reduce the compensation into the River Churnet from 14.8 Ml/d to 5 Ml/d, and to pump up to 10 Ml/d from Abbey Green borehole to compensate the Churnet. Additionally, up to 4.5 Ml/d could be pumped from Deep Hayes borehole into the Endon Brook and hence the Churnet, with a further 2 Ml/d from Wakefield Well, to provide a revised minimum required compensation to the Churnet of 18 Ml/d, rather than the 19.3 Ml/d required under normal licence conditions.

- Severn Trent Water applied for a drought permit for Churnet Valley in late summer/autumn 2003. The permit was prepared but rain alleviated the situation before it became effective, and it was not required.

2.2 Proposed drought permit

Given the current period of extended dry weather and an exceptional shortage of rain, the need for a drought permit at Tittesworth and the River Churnet has been identified. STWL are applying to the EA for a drought permit covering the second scenario listed below (STWL included two potential scenarios in their drought plan, so scenario 1 has been retained within this report for information purposes only):

- Scenario 1: 8 Ml/d compensation release from Tittesworth Reservoir, 3.3 Ml/d augmentation release from Abbey Green borehole. Under this scenario there would be no augmentation requirement from Deep Hayes borehole[5] (i.e removal of combined compensation requirement for the River Churnet of 19.32 Ml/d).

- **Scenario 2: 8 Ml/d compensation release from Tittesworth, 0 Ml/d augmentation release from Abbey Green. As for Scenario 1 there would be no augmentation requirement from Deep Hayes borehole** (i.e removal of combined compensation requirement for the River Churnet of 19.32 Ml/d).

STWL propose to apply on 14th October 2022 for a Scenario 2 drought permit for a six-month period. This Environmental Assessment Report (EAR) includes an assessment of the impacts of the drought permit for the upcoming six-month period, covering October 2022 to March 2023.

2.2.1 Cumulative and in-combination effects

This EAR only considers the impacts of a single drought permit application for a six-month period, and not the cumulative effects if a second drought permit were needed directly afterwards. If this situation were to arise, cumulative impacts would need to be considered in further detail at the time of the second application and a separate environmental assessment prepared.

[5] This is a new scenario which has not been considered in previous versions of the Tittesworth and Churnet EAR (ESI, 2015). This larger discharge from Tittesworth Reservoir is in line with the findings of AMP6 RSA investigations (Stantec & APEM, 2020a; Stantec & APEM, 2020b) and the smaller augmentation from Abbey Green is in line with capabilities of current infrastructure at the site, and in line with the discharge rate during a trial release from the borehole in November 2020 (Stantec & APEM, 2021).

There are no other drought permits or orders affecting the River Churnet catchment and therefore no risk of any in-combination effects has been identified.

2.2.2 Requirement for a drought permit

The required criteria for an application for a drought permit are set out in Section 1.2 and ultimately depend on an exceptional shortage of rain. STWL's Drought Plan identifies a series of triggers specific to each strategic reservoir system and water resource zone, where consideration is given to which drought management actions are required to address the current situation at any given time.

The justification for the drought permit at the River Churnet and consideration of alternatives is set out in the drought permit application.

2.2.3 Benefit to water supply and environmental considerations

The Tittesworth and River Churnet drought permit will result in reduced flow to the River Churnet with more water being retained within the reservoir system for abstraction. This will result in a decreased rate of drawdown during the drought and thus benefit aquatic and riparian species and habitats within the reservoir. It will also delay the run-dry date; the event that there is insufficient water to continue to supply a compensation flow from Tittesworth Reservoir. Furthermore, at the end of a drought period this reduced drawdown level resulting from the drought permit will expedite a return to typical water levels in the reservoir and thus flows within the river, benefiting both the reservoir and river environments. However, it should be noted that the drought permit is expected to have negative as well as positive effects. Such potential impacts are analysed in this environmental assessment. It should be noted that although the drought permit proposes an overall reduction in the compensation flow, these actions also maintain a guaranteed minimum flow.

2.3 Geographical extent of study

The geographical extent of the study area was determined by comparing the drought permit compensation flow changes to statistics based on long term gauged flow data from EA gauging stations. The geographical extent of the study was defined as the point at which the drought permit change in compensation flow was small in comparison with total river flows. Even during periods of low flow, downstream of the confluence between the River Churnet and the River Dove, the drought permit reductions are small in comparison with total river flows. The geographical extent of the Environmental Assessment was therefore defined as the River Churnet at the confluence with the River Dove. As a result, the assessment covered Tittesworth Reservoir (GB30433790) plus a total of four WFD surface water bodies:

- Churnet from Source to Meerbrook (GB104028052800) upstream river water body
- Churnet from Meerbrook to Leekbrook (GB104028052770) potentially affected river water body
- Churnet from Endon Brook to Consall (GB104028052651) potentially affected river water body
- Churnet from Consall to River Dove (GB104028052652) potentially affected river water body

The Tittesworth and River Churnet area of interest is shown in Figure 2.1.

Ten Assessment Points (APs) have been selected to characterise these reaches, as detailed in Table 2.1 below. The selection of APs was originally made in consultation with STWL, the EA and APEM during consultation for the previous drought permit EAR (ESI, 2015). APs were selected to coincide with existing EA monitoring sites which were suitable for identifying potential low flow impacts and at which historical datasets were available. Additional new sites were also identified where necessary (e.g. upstream of Leek STW, to allow direct comparison with the results from the existing site downstream of Leek STW).

Table 2.1 River Churnet Assessment Points

Assessment Point	Name
1	Middle Hulme C1
2	Leek Flume C2
3	Abbey Green Roadbridge C3
4	Wall Bridge C4
5	US Leek STW C5
6	DS Leek STW C6
7	Basford Bridge C7
8	Consall C8
9	Rocester C9
10	Endon Brook (Denford) C10

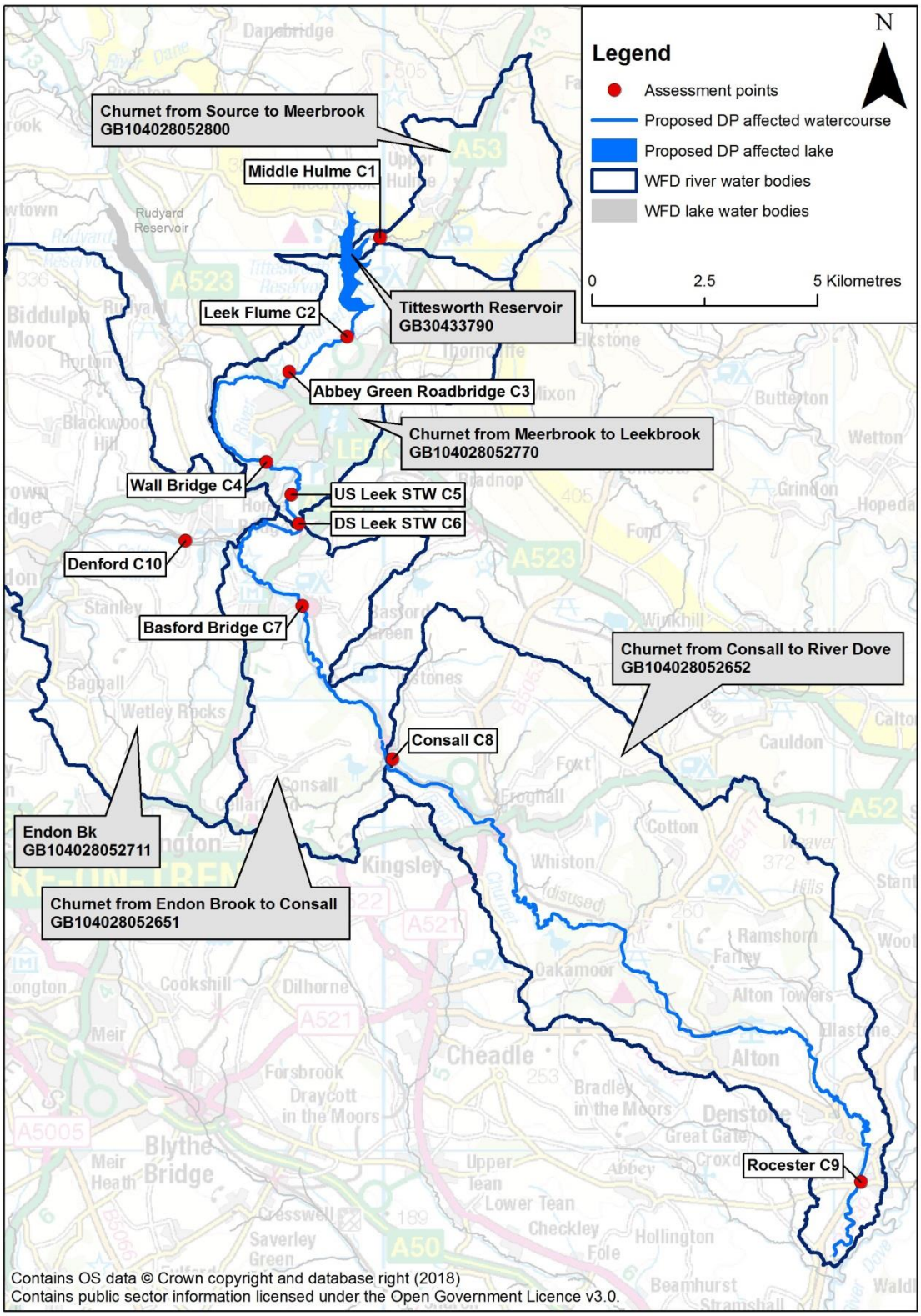

Figure 2.1 EAR study area, showing WFD water bodies and Assessment Point (AP) locations

2.4 Water Framework Directive status

A key requirement of the WFD is to ensure 'no deterioration' in the ecological status of water bodies. Extreme natural events such as drought are recognised within the WFD, with temporary deterioration allowances covered by Article 4.6. This allows for temporary deterioration as a 'result of circumstances of natural cause which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged droughts.' This applies to situations where it is necessary to make use of the water environment in ways that result in a temporary deterioration of status (e.g. supplying the public with drinking water during prolonged drought).

When assessing impacts on WFD elements, it is necessary to consider whether the impacts are temporary, whether the water body will recover quickly and without the need for restoration measures and the extent to which the impact is a result of natural causes versus anthropogenic management practices.

2.4.1 Groundwater WFD status

The Dove – PT Sandstone Leek groundwater body (GB40401G302000) has a Poor overall status as it fails the quantitative resource balance test (as the abstraction exceeds the Available Groundwater Resource) (Table 2.2). As the groundwater body is already at Poor status, any increase in long term average abstraction from the groundwater body above the recent actual rates will result in a decline in the WFD status. As the long-term average groundwater abstraction from the Leek Permo-Triassic Sandstone Aquifer will not increase as a result of the Churnet drought permit implementation, this will not result in a decline in WFD quantitative status of the Dove – PT Sandstone Leek groundwater body.

Table 2.2 Groundwater body WFD status (Cycle 2, 2019)

GWB	Quantitative resource balance	Surface Waters	Wetlands	Saline Intrusion	Overall Quantitative Status
Dove - PT Sandstone Leek	Poor	Poor	Good	Good	Poor

2.4.2 Surface water WFD status

Summaries of current WFD classification status for Tittesworth Reservoir and the four River Churnet water bodies are shown in Table 2.3 to Table 2.7, based on data from the EA's Catchment Data Explorer (accessed 11/02/2021). The 2019 interim WFD classifications are the most recently published by the EA, and 2015 classifications are also presented as these represent those used in the most recent River Basin Management Plans.

Tittesworth Reservoir was classified as MEP in 2015, remaining at MEP according to the 2019 classification updates. The 2015 Cycle 2 classification data for Tittesworth Reservoir demonstrated High status for salinity, but Bad status for total phosphorus. The only classified ecological element was phytoplankton, assessed at Moderate status. The inclusion of priority hazardous substances data in 2019 resulted in a deterioration in Chemical status, with other parameters remaining unchanged. Total nitrogen has additionally been assessed in 2019 and was assessed as at Moderate status (Table 2.3).

Table 2.3 Summary of Cycle 2 WFD classification status and objectives for the Tittesworth Reservoir water body (GB30433790)

Classification	Ecological Potential	Phytoplankton	Phytobenthos and Macrophytes	Ammonia	Dissolved Oxygen	Total Nitrogen	Total Phosphorus	Salinity	Chemical	Polybrominated diphenyl ethers	Mercury and Its Compounds
2015 (Cycle 2)	MEP	M	-	-	-	-	B	H	G	-	-
2019 (Cycle 2)	MEP	M	-	-	-	M	B	H	F	F	F
Objectives	MEP 2015	G 2027	-	-	-	-	M 2027	G 2015	G 2015	-	-

NB H=High, G=Good, M=Moderate, P=Poor, B=Bad, F=Failure to achieve Good status MEP=Moderate Ecological Potential.

All four river water bodies were at Moderate status in 2015 and the River Churnet from Meerbrook to Leekbrook was the only water body to change in 2019: it showed a deterioration to Bad status due to a deterioration in the classification for Fish from Moderate to Bad status. The 2015 Cycle 2 classification data indicated at least Good status for all physio-chemical elements within all four river water bodies with the following exceptions. Phosphate was indicated as being of Bad status in the Churnet from Meerbrook to Leekbrook and Moderate status in the two most downstream Churnet water bodies; ammonia was indicated as being of Moderate status in the River Churnet from Endon Brook to Consall. Chemical status was Good in all four water bodies.

The 2015 classification for macroinvertebrates was Good for all four water bodies. Fish were at Moderate status in the two most upstream water bodies, High in the River Churnet from Endon Brook to Consall and Good in the River Churnet from Consall to the River Dove. Combined phytobenthos and macrophytes status was Moderate in all four water bodies.

Comparison of the 2015 and 2019 classification data indicates recent improvement in macroinvertebrate status from Good to High and in fish status from Moderate to Good in the Churnet from Source to Meerbrook water body. In the River Churnet from Meerbrook to Leekbrook the fish status deteriorated from Moderate to Bad; whilst a specific cause and effect relationship for this deterioration has not been established, it could theoretically be linked to the accompanying deterioration in chemical status from Good to Fail, however the chemical status deterioration is unlikely to reflect an actual recent environmental change, rather it will reflect addition of new parameters to the WFD water quality monitoring / assessment programme. The Environment Agency's reasons for not achieving good (RNAG) database lists 'barriers-ecological discontinuity' and 'Regulating Reservoir Flow Regime' as the pressures influencing the Fish classification element. Ammonia and phosphate status showed improvement from Good to High and from Bad to Moderate respectively for this waterbody. A deterioration in fish status from High to Moderate was shown in the River Churnet from Endon Brook to Consall, while dissolved oxygen improved from Good to High. In the River Churnet from Consall to River Dove water body the invertebrates classification improved from Good to High status and phosphate improved from Poor to Moderate status, while a deterioration was shown in dissolved oxygen from High to Moderate. In all four river water bodies the Chemical status changed from Good to Fail, due to polybrominated diphenyl ethers, mercury and its compounds, and perfluorooctane sulphonate.

Table 2.4 Summary of Cycle 2 WFD classification status and objectives for the River Churnet from Source to Meerbrook (GB104028052800)

Classification	Ecological Status	Invertebrates	Fish	Phytobenthos and Macrophyte *	Ammonia	Dissolved Oxygen	pH	Phosphate	Temp	Chemical	Polybrominated diphenyl ethers	Mercury and Its Compounds
2015 (Cycle 2)	M	G	M	M	H	H	H	G	H	G	-	-
2019 (Cycle 2)	M	H	G	M	H	H	H	G	H	F	F	F
Objectives	G 2027	G 2015	G 2027	G 2027	G 2015	G 2015	G 2015	G 2027	G 2015	G 2015	-	-

NB H=High, G=Good, M=Moderate, P=Poor, B=Bad, F=Failure to achieve Good status

Table 2.5 Summary of Cycle 2 WFD classification status and objectives for the River Churnet from Meerbrook to Leekbrook (GB104028052770)

Classification	Ecological Status	Invertebrates	Fish	Phytobenthos and Macrophyte *	Ammonia	Dissolved Oxygen	pH	Phosphate	Temp	Chemical	Polybrominated diphenyl ethers	Perfluorooctane sulphonate (PFOS)	Mercury and its compounds
2015 (Cycle 2)	M	G	M	M	G	H	H	B	H	G	-	-	-
2019 (Cycle 2)	B	G	B	M	H	H	H	M	H	F	F	F	F
Objectives	G 2027	G 2015	G 2027	G 2027	G 2015	G 2015	G 2015	G 2027	G 2015	G 2015	-	-	-

NB H=High, G=Good, M=Moderate, P=Poor, B=Bad, F=Failure to achieve Good status

Table 2.6 Summary of Cycle 2 WFD classification status and objectives for the River Churnet from Endon Brook to Consall (GB104028052651)

Classification	Ecological Status	Invertebrates	Fish	Phytobenthos and Macrophyte *	Ammonia	Dissolved Oxygen	pH	Phosphate	Temp	Chemical	Polybrominated diphenyl ethers	Perfluorooctane sulphonate (PFOS)	Mercury and its compounds
2015 (Cycle 2)	M	G	H	M	M	G	H	M	H	G	-	-	-
2019 (Cycle 2)	M	G	M	M	M	H	H	M	H	F	F	F	F
Objectives	G 2027	G 2015	G 2015	G 2027	G 2027	G 2015	G 2015	G 2027	G 2015	G 2015	-	-	-

NB H=High, G=Good, M=Moderate, P=Poor, B=Bad, F=Failure to achieve Good status

Table 2.7 Summary of Cycle 2 WFD classification status and objectives for the River Churnet from Consall to River Dove (GB104028052652)

Classification	Ecological Status	Invertebrates	Fish	Phytobenthos and Macrophyte *	Ammonia	Dissolved Oxygen	pH	Phosphate	Temp	Chemical	Polybrominated diphenyl ethers	Mercury and Its Compounds
2015 (Cycle 2)	M	G	G	M	H	H	H	P	H	G	-	-
2019 (Cycle 2)	M	H	G	M	H	M	H	M	H	F	F	F
Objectives	G 2027	G 2015	G 2015	G 2027	G 2015	G 2015	G 2015	G 2027	G 2015	G 2015	-	-

NB H=High, G=Good, M=Moderate, P=Poor, B=Bad, F=Failure to achieve Good status

2.5 Designated sites

A search for environmentally designated sites within the Churnet study area (e.g. SPA, SAC, ancient monuments, national nature reserves, local nature reserves, SSSIs and local wildlife sites) has been carried out.

The Churnet from Source to Meerbrook water body is located within the Peak District National Park and the source of the Churnet is located within the South Pennine Moors SAC/SPA.

The Churnet Valley SSSI spans the River Churnet for several kilometres, starting in the Churnet from Endon Brook to Consall water body and ending in the Churnet from Consall to River Dove water body. The western part of the SSSI is overlain by the Consall local nature reserve. A short distance downstream of the Churnet Valley SSSI is the Froghall Meadow and Pastures SSSI.

The Churnet Valley SSSI (SK 006484) includes the steep-sided main valley of the River Churnet and several tributary valleys. These valleys retain the largest remaining concentration of semi-natural ancient woodland in Staffordshire, intermixed with scrub, unimproved neutral and acid grassland and large areas of mire, marsh and carr.

The Froghall Meadow and Pastures SSSI (SK 023469) consists of a series of unimproved, species-rich fields, showing a range of grassland types which are locally flushed, and areas of scrub.

Two local nature reserves are located within the Churnet Meerbrook to Leekbrook water body: Brough Park Fields and Ladderedge Country Park.

A scheduled monument, Brindley's Mill, is located on the Churnet in the north west of Leek.

Further details of the designated sites are provided in Appendix I as part of the assessment of impacts on other receptors.

3 Assessment of pre-mitigation impacts

This Chapter:

- explains the methodology used to complete this environmental assessment;
- demonstrates how assessment of the proposed drought permit is in line with expectations set out in relevant legislation (Appendices B, C, D, E, F, G, H and I);
- describes the baseline environmental conditions (Appendices B, C, D, E, F, G, H and I);
- summarises the hydrological impacts of drought permit implementation (Section 3.2 and Appendix B);
- summarises the sensitivity of environmental features to this action (Section 3.3 and Appendices E, F, G, H and I);
- assesses the likely impacts on: ecological and other receptors, designated sites; the likelihood of the impacts being temporary or permanent; (Section 3.3 and Appendices E, F, G, H and I);
- considers the likely impact on water body status or potential and risk of deterioration (Sections 3.2 and 3.3 and Appendices D, E and F);
- allocates a level of confidence to the environmental assessments (Sections 3.2 and 3.3 and Appendices B, C, D, E, F, G, H and I), and;
- identifies sources of uncertainty in the assessment and sets out plans to reduce these (Sections 3.2 and 3.3 and Appendices B, C, D, E, F, G, H and I).

Full details of the environmental assessment are provided in Appendices B (hydrology), C (hydromorphology receptors), D (water quality), E (macroinvertebrates), F (fish), G (INNS), H (protected species) and I (other receptors).

3.1 Environmental assessment methodology

Figure 3.1 summarises the process used to describe and categorise the impact of the drought permit on each receptor. The process is consistent with the latest EA guidance on Environmental Assessment for Water Company Drought Planning (EA, 2020b) and draws on industry good practice for undertaking ecological impact assessments (CIEEM, 2018) and on NRW technical guidance for Water Company Drought Plans (NRW, 2017).

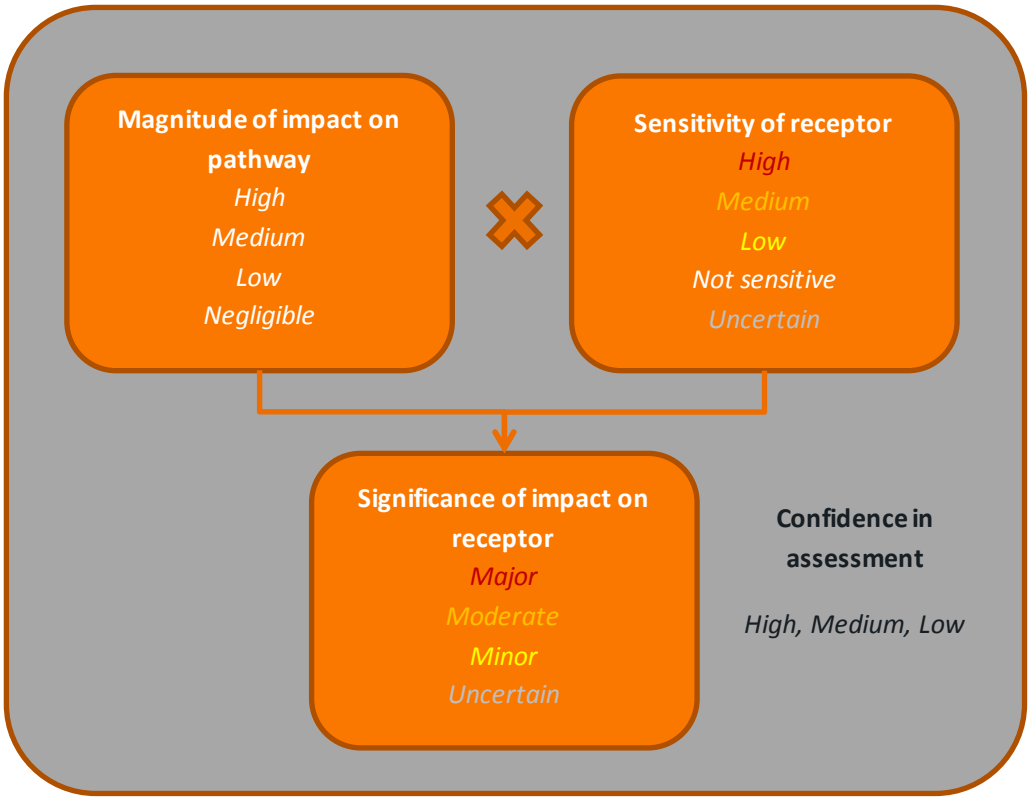

Figure 3.1 Flow chart outlining the environmental assessment process

The first step is to assess **magnitude of impact on each pathway**. We have chosen to categorise these impacts on a five-point scale similar to that advocated by the EA for assessing the sensitivity of receptors (EA, 2020b): High, Medium, Low, Negligible, or Uncertain. These categories and associated definitions are provided in Table 3.1.

Table 3.1 Magnitude categories

Category	Definition
High	A large, extensive, long-term and/or very frequent change.
Medium	A medium-sized, substantial, medium-term and/or frequent change.
Low	A small, localised, short-term and/or infrequent change.
Negligible	A change unlikely to be noticeable / measurable.
Uncertain	Insufficient information is available to judge the magnitude of impact.

Following NRW (2017) and CIEEM (2018) guidance, the assessment of magnitude considers some or all of the following factors (as necessary to understand the resulting impact on receptors):

- Severity – the degree of change, relative to the baseline (large, medium, small);
- Extent – the area over which the impact occurs (extensive, substantial, localised);
- Duration – the time for which the impact occurs (short-, medium-, long-term); and
- Frequency – how often the impact may occur (very frequent, frequent, infrequent).

Where relevant, the specific location and timing of any impacts is also described. Impacts on pathways may translate into positive or negative impacts on receptors, so whilst the direction of change is important (e.g. increase of decrease), impacts on pathways are not described as being positive or negative.

Next, the **sensitivity of each receptor** is categorised as High, Medium, Low, Not Sensitive, or Uncertain, in accordance with EA guidance (EA, 2020b). Definitions are provided in Table 3.2.

Table 3.2 Sensitivity categories

Category	Definition
High	Receptor is highly sensitive to changing environments due to inability to tolerate and recover from changes.
Medium	Receptor is sensitive to changing environments due to limited ability to tolerate and/or recover slowly from the environmental change.
Low	Receptor is relatively insensitive to changing environments due to ability to tolerate and/or recover quickly from the environmental change.
Not sensitive	Receptor is not sensitive due to high tolerance to environmental change and/or ability to recover rapidly.
Uncertain	Insufficient information is available to judge the sensitivity of the receptor.

Sensitivity is a function of the receptor's capacity to accommodate change and its ability to recover if it is affected. A receptor may be more sensitive to changes in certain pathways than others. The assessment of sensitivity takes into account some or all of the following factors (adapted from NRW, 2017):

- Adaptability – the degree to which a receptor can avoid or adapt to an impact;
- Tolerance – the ability of a receptor to accommodate change without a significant adverse impact; and
- Recoverability – the temporal scale over and extent to which a receptor will recover following an impact.

The magnitude of impact is combined with the sensitivity of receptor to assess the significance of impact on each receptor, as shown in Table 3.3 (adapted from NRW 2017). In accordance with EA guidance (EA, 2020b), impacts on receptors are categorised as: Major, Moderate, Minor, or Uncertain. Impacts on receptors can be positive as well as negative, however, so we have included a fifth category – Beneficial – to identify any positive impacts. Definitions, adapted from NRW (2017), are provided in Table 3.4.

Table 3.3 Determining the significance of impacts on receptors

Magnitude of impact on pathway	Sensitivity of receptor				
	High	Medium	Low	Not sensitive	Uncertain
High	Major	Major	Moderate	Minor	Uncertain
Medium	Major	Moderate	Minor	Minor	Uncertain
Low	Moderate	Minor	Minor	Minor	Uncertain
Negligible	Minor	Minor	Minor	Minor	Uncertain
Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain

Table 3.4 Significance categories

Category	Definition
Major	Very large or large change in environmental or socio-economic conditions, which, if lost, cannot be replaced or relocated. The impacts are generally, but not exclusively associated with features and sites of national to regional importance because they contribute to achieving national / regional objectives. The impacts are likely to result in exceedance of statutory objectives and/or breaches of legislation (e.g. Likely Significant Effects or deterioration of WFD status).
Moderate	Intermediate change in environmental or socio-economic conditions. The impacts are likely to affect important considerations at a regional and local level. The impacts are unlikely to affect key decision-making processes (e.g. statutory objectives). Nevertheless, the cumulative effect of such impacts may lead to an increase of overall effect on a particular area or on a particular feature.
Minor	Small or negligible change in environmental or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision-making process.
Uncertain	Insufficient information is available to judge the impact significance.

Impact significance provides a consistent means of expressing impacts which, in turn, informs the need for mitigation measures to offset the impacts. The determination of impact significance, both pre and post mitigation, also provides a transparent means for regulators to understand the impacts of a drought permit/drought order.

In practice, determining the significance of impact carries a degree of subjectivity and requires expert judgement. This may be because of limited evidence/data on the sensitivity of the receptors and/or the complexity of interactions that require assessment to determine the magnitude of change. For example, receptors may experience direct impacts as a result of changes in pathways, but also indirect impacts as a secondary response to changes in other receptors. If a receptor is subject to different impacts via different pathways, then the combined effect of the different pathways is integrated to assess the overall significance of impact.

Finally, in accordance with EA guidance (EA, 2020b), the **degree of confidence** in the assessment of impact significance is categorised as **High**, **Medium** or **Low**. Definitions are provided in Table 3.5. Key sources of uncertainty are identified and used to inform the design of the EMP.

Table 3.5 Confidence categories

Category	Definition
High	Judgments based on high-quality, robust information, and/or the nature of the impact makes it possible to render a solid judgement.
Medium	Credibly sourced and plausible information, but not of sufficient quality or corroboration to warrant a higher level of confidence.
Low	The information available is too fragmented or poorly corroborated to make solid analytic inferences, or significant concerns or problems with information sources exist.

The assessment has also considered the legislative requirements of:

- Conservation of Habitats and Species Regulations 2017;
- Fisheries legislation: Salmon and Freshwater Fisheries Act 1975 and The Eels (England and Wales) Regulations 2009;
- Water Environment (Water Framework Directive) Regulations 2017 including the objectives set out in river basin management plans;
- Section 40 of the Natural Environment and Rural Communities Act 2006 (NERC);
- Legislation covering INNS;
- Other non-statutory requirements (local wildlife sites etc.);
- Protected areas designated under international agreements (incl. Ramsar & Natura 2000 sites); and
- Protected areas designated under national legislation (SSSIs), nationally protected species and habitats - Wildlife and Countryside Act 1981 and other locally important sites.

3.2 Impact on pathways

Table 3.6 and Table 3.7 summarise the likely impacts of the proposed drought permit on hydrology, hydromorphology and water quality. Table 3.6 is presented for information purposes only. Full details of the assessment are provided in Appendices B, C and D.

Table 3.6 Summary of impacts on physical pathways: drought permit Scenario 1 (for information purposes only)

Pathway	Water body	Description	Magnitude of impact	Confidence level
Hydrogeology	Dove - PT Sandstone Leek (GB40401G302000)	The GWB is at Poor status, failing the GW balance test at RA and FL.[6] There would be a new 3.3 Ml/d abstraction from Abbey Green during drought period, however no change in long-term average abstraction expected as a result of the drought permit.	Negligible	Medium
Hydrology	Tittesworth Reservoir (GB30433790)	Reservoir levels are anticipated to benefit from implementation of the drought permit scenario.	None	Medium
	River Churnet from Meerbrook to Leekbrook (GB104028052770)	River flows predicted to reduce by up to 46% between Tittesworth and Abbey Green, reducing to a 24% flow reduction downstream of the augmentation at Abbey Green. Potential in-combination effect with 2 downstream abstractions (see page 38).	Upstream of discharge from Abbey Green Borehole: Medium Downstream of discharge from Abbey Green Borehole: Low	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	River flows predicted to reduce by 36%.	Medium	Medium

[6] Deficit against available licence of 11.7 Ml/d and 17.2 Ml/d at RA and FL respectively (2019 WRGIS data)

Pathway	Water body	Description	Magnitude of impact	Confidence level
	River Churnet from Consall to River Dove (GB104028052651)	River flows predicted to reduce by 11%.	Low	Medium
Habitat and geomorphology	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Wetted perimeter (used as an indicator of overall aquatic habitat space) reduced by up to 17%	Upstream of Wall Bridge Leek – Medium Downstream of Wall Bridge Leek - Low	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	Wetted perimeter (used as an indicator of overall aquatic habitat space) reduced by up to 4.5%	Low	Medium
	River Churnet from Consall to River Dove (GB104028052651)	Negligible change in all hydraulic parameters	Negligible	Medium
Water quality	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Negligible change in heavy metal concentrations d/s Abbey Green borehole	Negligible	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	Significant (>10%) increase in total ammonia d/s Leek STW, also >10% change in some chemicals	Medium	High

Table 3.7 Summary of impacts on physical pathways: drought order Scenario 2

Pathway	Water body	Description	Magnitude of impact	Confidence level
Hydrology	Tittesworth Reservoir (GB30433790)	Reservoir levels are anticipated to increase under the drought permit scenario.	None	Medium
	River Churnet from Meerbrook to Leekbrook (GB104028052770)	River flows predicted to reduce by up to 46% between Tittesworth and Abbey Green, increasing to a 50% flow reduction upstream of the Endon Brook confluence. Potential in-combination effect with 2 downstream abstractors (see page 38).	Medium	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	River flows predicted to reduce by 50%.	Medium	Medium
	River Churnet from Consall to River Dove (GB104028052651)	River flows predicted to reduce by 16%.	Low	Medium

Pathway	Water body	Description	Magnitude of impact	Confidence level
Habitat and geomorphology	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Wetted perimeter (used as an indicator of overall aquatic habitat space) reduced by up to 23%	Upstream of Wall Bridge Leek – Medium Downstream of Wall Bridge Leek - Low	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	Wetted perimeter (used as an indicator of overall aquatic habitat space) reduced by up to 6%	Low	Medium
	River Churnet from Consall to River Dove (GB104028052651)	Negligible change in all hydraulic parameters	Negligible	Medium
Water quality	River Churnet from Endon Brook to Consall (GB104028052651)	Significant increase (>10%) in total ammonia d/s Leek STW, also >10% change in some chemicals	Medium	High

3.3 Impact on receptors

Table 3.8 and Table 3.9 summarise the likely impacts of the proposed drought permit on invertebrates, fish, INNS, protected species and other receptors, as part of the receptors assessment. Table 3.8 is presented for information purposes only. Full details of the assessment are provided in Appendices E, F, G, H and I.

Table 3.8 Summary of impacts on ecological and other receptors: drought permit Scenario 1 (for information purposes only)

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Macroinvertebrates	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	Low sensitivity macroinvertebrate community; community demonstrates resilience to environmental change.	Minor	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	Low	Low sensitivity macroinvertebrate community; data for only one monitoring location were available for this water body.	Minor	Medium
	River Churnet from Consall to River Dove (GB104028052652)	Low	Low sensitivity macroinvertebrate community; data for only one monitoring location were available for this water body.	Minor	Medium
Fish (brown trout, bullhead and rheophilic coarse fish: spawning & egg incubation)	River Churnet (Meerbrook to Leekbrook)	High	Reductions in wetted width and marginal habitat may cause significant reductions in available spawning habitat for these species. Egg incubation life stages are also at risk due to their reduced mobility.	Moderate	Medium
Fish (brown trout, bullhead and rheophilic coarse fish: juvenile and adults)	River Churnet (Meerbrook to Leekbrook)	Medium	Hydromorphological impacts are not anticipated to significantly reduce available habitat for these species and life stages.	Minor	Medium
Fish (*Lampetra* sp.: spawning & egg incubation)	River Churnet (Meerbrook to Leekbrook)	High	Baseline conditions do not support suitable habitat for lamprey spawning & egg incubation life stages.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Fish (*Lampetra* sp.: ammocoetes)	River Churnet (Meerbrook to Leekbrook)	High	Reductions in wetted width and marginal habitat pose a risk for ammocoetes, due to their reduced mobility.	Moderate	Medium
Fish (eurytopic coarse fish: spawning & egg incubation and adults)	River Churnet (Meerbrook to Leekbrook)	Medium	Baseline conditions do not support suitable habitat for adult or spawning & egg incubation life stages of eurytopic coarse fish.	Minor	Medium
Fish (eurytopic coarse fish: juvenile)	River Churnet (Meerbrook to Leekbrook)	Medium	Predicted hydromorphological changes may lead to reduction of suitable habitat for juvenile eurytopic coarse fish.	Minor	Medium
Fish (all species and life stages)	River Churnet (Endon Brook to Consall) and River Churnet (Consall to River Dove)	Medium - High	Significant impacts are not anticipated for any species or life stages, due to negligible impacts on hydromorphology.	Minor	Medium
Fish (angling groups)	River Churnet (Meerbrook to Leekbrook) and River Churnet (Endon Brook to Consall)	Low	Modelled hydrological changes may result in shifts in habitat use for species of interest to anglers.	Minor	Medium
Fish (angling groups)	River Churnet (Consall to River Dove)	Low	No impacts on angling are anticipated in this reach due to negligible changes to hydromorphology.	Minor	Medium
INNS (Signal crayfish (*Pacifastacus leniusculus*))	All	Low	Changes in water quality may alter habitat suitability	Minor	High

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
INNS (Demon shrimp (*Dikerogammarus haemobaphes*))	All	Low	Changes in water quality may alter habitat suitability	Minor	High
INNS (Himalayan balsam (*Impatiens glandulifera*))	All	Low	Reduced flows could result in a decrease in the spread of seeds, however a reduction in water levels could increase the area available for colonisation by riparian plants	Minor	High
INNS (Japanese knotweed (*Fallopia japonica*))	All	Not sensitive	Reduced flows could result in a decrease in the spread of seeds, however a reduction in water levels could increase the area available for colonisation by riparian plants	Minor	High
Protected species (Pied flycatcher)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Marsh tit)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Willlow tit)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Wood warbler)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Protected species (Dipper)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Redstart)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Otter)	River Churnet from Meerbrook to Leekbrook and River Churnet from Endon Brook to Consall	Low	Sensitive to changes in water levels and quality but presence in these water bodies is unconfirmed.	Minor	Low
Protected species (Otter)	River Churnet from Consall to River Dove	Low	Sensitive to changes in water levels and quality.	Minor	Medium
Protected species (Water vole)	All	Uncertain	Sensitive to changes in water levels or flow but presence in the River Churnet is unconfirmed.	Uncertain	Low
Other abstractors (level dependent: Portland Dyeing Company)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Uncertain	Modelled changes in river level range between 4-7 cm. Unlikely to affect level dependent intake but sensitivity unknown.	Uncertain	Medium
Other abstractors (level dependent: Brindley's Mill)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Medium	Modelled changes in river level range between 4-7 cm. May affect time to refill mill pond.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Other abstractors (level dependent: Cheddleton Flint Mill)	River Churnet from Endon Brook to Consall (GB104028052651)	Low	Modelled changes in river level predicted to be 3cm. No historical problems with low flows; sensitivity therefore likely to be low.	Minor	Medium
Other abstractors (level dependent: JCB and others)	River Churnet from Consall to River Dove (GB104028052651)	Uncertain	Modelled changes in river level <2cm. Sensitivity to such changes is unknown.	Uncertain	Medium
Other abstractors (HoF restricted: Eternis Fine Chemicals)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Uncertain	HoF is above the baseline Q95 flow so abstraction operating at reduced daily volume of 0.682 Ml/d under baseline conditions and therefore given this very small abstraction volume compared with predicted river flows, no further impacts of either drought permit scenario are predicted. Theoretically higher flows that would allow abstraction may also be impacted by the drought permit; this could reduce the percentage of time the abstraction could be operated though such effects would be expected to be short lived.	Uncertain	Medium
Other abstractors (HoF restricted: Canal and River Trust Caldon Canal)	River Churnet from Endon Brook to Consall (GB104028052651)	Not sensitive	HoFs related to abstractions in this water body are above the baseline Q95 flow and are therefore not expected to be operating under baseline conditions and would therefore not be derogated by the drought permit.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Designated sites (local nature reserves)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	Sites associated with this water body have little or no sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area.	Minor	Medium
Designated sites (SSSIs)	River Churnet from Endon Brook to Consall (GB104028052651) River Churnet from Consall to River Dove (GB104028052651)	Moderate	Sites associated with these water bodies have some sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area.	Minor	Medium
Aesthetics, recreation and navigation	All	Low	Little or no sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area. Angling covered separately.	Minor	Medium
Archaeology and heritage (Brindley's Mill (scheduled monument))	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	May have some sensitivity to changes in flow.	Minor	Medium
Archaeology and heritage (Crumpwood weir and fish pass (Grade II listed building))	River Churnet from Consall to River Dove (GB104028052651)	Low	May have some sensitivity to changes in flow.	Minor	Medium

Table 3.9 Summary of impacts on ecological and other receptors: drought permit Scenario 2

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Macroinvertebrates	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	Low sensitivity macroinvertebrate community; community demonstrates resilience to environmental change.	Minor	Medium
	River Churnet from Endon Brook to Consall (GB104028052651)	Low	Low sensitivity macroinvertebrate community; data for only one monitoring location were available for this water body.	Minor	Medium
	River Churnet from Consall to River Dove (GB104028052652)	Low	Low sensitivity macroinvertebrate community; data for only one monitoring location were available for this water body.	Minor	Medium
Fish (brown trout, bullhead and rheophilic coarse fish: spawning & egg incubation)	River Churnet (Meerbrook to Leekbrook)	High	Reductions in wetted width and marginal habitat may cause significant reductions in available spawning habitat for these species. Egg incubation life stages are also at risk due to their reduced mobility.	Moderate	Medium
Fish (brown trout, bullhead and rheophilic coarse fish: juvenile and adults)	River Churnet (Meerbrook to Leekbrook)	Medium	Hydromorphological impacts are not anticipated to significantly reduce available habitat for these species and life stages.	Minor	Medium
Fish (*Lampetra* sp.: spawning & egg incubation)	River Churnet (Meerbrook to Leekbrook)	High	Baseline conditions do not support suitable habitat for lamprey spawning & egg incubation life stages.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Fish (*Lampetra* sp.: ammocoetes)	River Churnet (Meerbrook to Leekbrook)	High	Reductions in wetted width and marginal habitat pose a risk for ammocoetes due to their reduced mobility.	Moderate	Medium
Fish (eurytopic coarse fish: spawning & egg incubation and adults)	River Churnet (Meerbrook to Leekbrook)	Medium	Baseline conditions do not support suitable habitat for adult or spawning & egg incubation life stages of eurytopic coarse fish.	Minor	Medium
Fish (eurytopic coarse fish: juvenile)	River Churnet (Meerbrook to Leekbrook)	Medium	Predicted hydromorphological changes may lead to reduction of suitable habitat for juvenile eurytopic coarse fish.	Minor	Medium
Fish (all species and life stages)	River Churnet (Endon Brook to Consall) and River Churnet (Consall to River Dove)	Medium - High	Significant impacts are not anticipated for any species or life stages, due to negligible impacts on hydromorphology.	Minor	Medium
Fish (angling groups)	River Churnet (Meerbrook to Leekbrook) and River Churnet (Endon Brook to Consall)	Low	Modelled hydrological changes may result in shifts in habitat use for species of interest to anglers.	Minor	Medium
Fish (angling groups)	River Churnet (Consall to River Dove)	Low	No impacts on angling are anticipated in this reach due to negligible changes to hydromorphology.	Minor	Medium
INNS (Signal crayfish (*Pacifastacus leniusculus*))	All	Low	Changes in water quality may alter habitat suitability	Minor	High

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
INNS (Demon shrimp (*Dikerogammarus haemobaphes*))	All	Low	Changes in water quality may alter habitat suitability	Minor	High
INNS (Himalayan balsam (*Impatiens glandulifera*))	All	Low	Reduced flows could result in a decrease in the spread of seeds, however a reduction in water levels could increase the area available for colonisation by riparian plants	Minor	High
INNS (Japanese knotweed (*Fallopia japonica*))	All	Not sensitive	Reduced flows could result in a decrease in the spread of seeds, however a reduction in water levels could increase the area available for colonisation by riparian plants	Minor	High
Protected species (Pied flycatcher)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Marsh tit)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Willlow tit)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Wood warbler)	All	Medium	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Protected species (Dipper)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Redstart)	All	Low	May be indirectly impacted by any change to the abundance of aquatic insects.	Minor	Low
Protected species (Otter)	River Churnet from Meerbrook to Leekbrook and River Churnet from Endon Brook to Consall	Low	Sensitive to changes in water levels and quality but presence in these water bodies is unconfirmed.	Minor	Low
Protected species (Otter)	River Churnet from Consall to River Dove	Low	Sensitive to changes in water levels and quality.	Minor	Medium
Protected species (Water vole)	All	Uncertain	Sensitive to changes in water levels or flow but presence in the River Churnet is unconfirmed.	Uncertain	Low
Other abstractors (level dependent: Portland Dyeing Company)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Uncertain	Modelled changes in river level range between 4-9 cm. Unlikely to affect level dependent intake but sensitivity unknown.	Uncertain	Medium
Other abstractors (level dependent: Brindley's Mill)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Medium	Modelled changes in river level predicted to be 4-5cm. May affect time to refill mill pond.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Other abstractors (level dependent: Cheddleton Flint Mill)	River Churnet from Endon Brook to Consall (GB104028052651)	Low	Modelled changes in river level 2cm. No historical problems with low flows; sensitivity therefore likely to be low.	Minor	Medium
Other abstractors (level dependent: JCB and others)	River Churnet from Consall to River Dove (GB104028052651)	Uncertain	Modelled changes in river level 2cm. Sensitivity to such changes is unknown.	Uncertain	Medium
Other abstractors (HoF restricted: Eternis Fine Chemicals)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Uncertain	HoF is above the baseline Q95 flow so abstraction operating at reduced daily volume of 0.682 Ml/d under baseline conditions and therefore given this very small abstraction volume compared with predicted river flows, no further impacts of either drought permit scenario are predicted. Higher flows that would allow abstraction may also be impacted by the drought permit; this could reduce the percentage of time the abstraction could be operated.	Uncertain	Medium
Other abstractors (HoF restricted: Canal and River Trust Caldon Canal)	River Churnet from Endon Brook to Consall (GB104028052651)	Not sensitive	HoFs related to abstractions in this water body are above the baseline Q95 flow and are therefore not expected to be operating under baseline conditions and would therefore not be derogated by the drought permit.	Minor	Medium
Designated sites (local nature reserves)	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	Sites associated with this water body have little or no sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area.	Minor	Medium

Receptor	Water body	Sensitivity	Description	Significance of impact	Confidence level
Designated sites (SSSIs)	River Churnet from Endon Brook to Consall (GB104028052651) River Churnet from Consall to River Dove (GB104028052651)	Moderate	Sites associated with these water bodies show some sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area.	Minor	Medium
Aesthetics, recreation and navigation	All	Low	Little or no sensitivity to changes in water level, average velocity, depth, wetted width and/ or wetted area. Angling covered separately.	Minor	Medium
Archaeology and heritage (Brindley's Mill (scheduled monument))	River Churnet from Meerbrook to Leekbrook (GB104028052770)	Low	May have some sensitivity to changes in flow.	Minor	Medium
Archaeology and heritage (Crumpwood weir and fish pass (Grade II listed building))	River Churnet from Consall to River Dove (GB104028052651)	Low	May have some sensitivity to changes in flow.	Minor	Medium

4 Mitigation measures

This Chapter sets out how we will:

- minimise the environmental impact of our actions;
- mitigate the impacts and assess the effectiveness of these mitigation measures; and
- where legally required, compensate for the impacts where it's not possible to minimise or mitigate for them.

Where significant negative impacts (defined for this report as those of moderate significance or greater) are identified during the environmental assessment process, there is a need to identify appropriate mitigation measures in order to avoid, reduce or remedy any impacts. Such measures may be identified either to be implemented in advance or implemented during implementation of a drought permit.

The potential for moderate impacts has been predicted because of drought permit Scenarios 1 and 2 on certain species and life stages of fish in the River Churnet from Meerbrook to Leekbrook water body. The effect of the drought permit is predicted to be minor on all other receptors and in all other water bodies in comparison with the baseline. Based on this assessment and given the uncertainties inherent in some of the assessments undertaken, a range of precautionary mitigation measures have been developed, if environmental monitoring during drought implementation identifies that unexpected impacts are occurring.

Analysis of the potential impacts of the drought permit on third party abstractors has identified potential in-combination risks of the drought permit in combination with operation of the Portland Dyeing Company abstraction. If the Portland Dyeing Company abstraction were to be operated beyond recent actual to their maximum daily abstraction during drought permit implementation there is a risk that downstream flows on the River Churnet could decrease by a further 3.58 Ml/d under both scenarios compared to recent actual as modelled within the water balance. STWL have contacted the company prior to application who has confirmed that they do not intend to take their full licenced volume for the life of the permit and plan to continue to abstract at recent actual levels. More generally, impacts on other abstractors have been found to be uncertain, largely as a result of a lack of understanding of the mechanisms of impacts on abstraction infrastructure on a site by site basis. STWL has contacted licence holders ahead of and, if necessary, will maintain contact, during implementation of the drought permit.

Monitoring has been recommended in order to capture any changes before, during and after the drought permit implementation (see Section 5). This includes checking for signs of ecological stress including: potential effects on flow and water quality; inhibition of movement of fish past river structures or other barriers; habitat availability for adult and juvenile life stages (including spawning/nursery areas); and concentration of fish in restricted areas/pools which could increase susceptibility to predation.

It should be noted that not all of the mitigation measures described may be required or appropriate. If unexpected impacts are found to be occurring, potential mitigation measures should be discussed and agreed with the EA. This could include working with catchment partners to assist with control of invasive species, should monitoring indicate that an ecological receptor may be more sensitive to the impact of invasive species than assessed through the EAR process. Mitigation measures would be implemented to reduce the impacts of the drought permit and not the impacts of the drought itself. A method document setting out trigger levels and procedures to follow in order to identify and implement appropriate mitigation measures will be prepared.

4.1 Fish

Moderate impacts are anticipated on the River Churnet between Meerbrook and Leekbrook under both drought permit scenarios for the spawning and egg incubation life stages of brown trout, bullhead and rheophilic coarse fish, and for the ammocoete life stage of lamprey. Given the barriers to upstream migration further downstream at Cheddleton and Leek, brown trout spawning is likely limited to resident (as opposed to diadromous) populations and is therefore not thought to be augmented by migratory sea trout. Given that suitable salmonid spawning, fry and parr habitat have been identified through walkover surveys in this reach, it would be necessary to monitor changes in the availability of these habitats during the implementation of either drought permit scenario. It is recommended that habitat walkover assessments be carried out prior to the trout spawning seasonal window (i.e. from September through to January, to account for early and late spawning fish). In addition to monitoring impacts on trout spawning, it would also be necessary to carry out visual assessments of wetted channel width, in order to identify areas at which marginal habitat may be lost for lamprey ammocoetes. Walkovers before, during and immediately after this window are recommended, to pre-emptively identify any potential loss of habitat, and to monitor changes in habitat availability during spawning activities.

A number of mitigation measures could be implemented depending on feasibility, should monitoring during the drought permit indicate that significant impacts are occurring:

- Provision to release additional flows from the reservoir in the event of a pollution incident, if there is evidence of ecological distress, and/or if reduced flows are considered to be having serious detrimental environmental consequences on downstream waterbodies.
- Provision to release additional flows from the reservoir during the salmonid spawning season if the pre-implementation walkover survey identifies the presence of salmonid redds potentially at risk of exposure. Such releases should be preventative as opposed to restorative to avoid the loss of spawning gravels and / or desiccation of eggs.
- Provision to release additional flows from the reservoir to facilitate movement of fish past river structures or other barriers, excluding barriers which are already known to be largely impassible to upstream and downstream movements of migratory fish. Additional flows would only be required should the passability of the two structures for which passage is currently unknown be impacted during a drought permit. It is likely that the release of additional flows would only be required during implementation of the drought permit; this requirement could be visually assessed concurrently with the walkover surveys planned during this period.
- Provision to mobilise a fish rescue team should significant numbers of migratory fish become trapped/stranded in between obstacles during periods of low flow. Whilst barriers to movements of migratory fish are known to be present throughout the watercourse, it is likely that a fish rescue would only be required should these fish be considered at high risk of mortality as a result of stranding during periods of low flow (e.g. due to elevated risk of predation or a significant reduction in oxygen concentration).

It may not be necessary to implement any of these mitigation measures if (in line with the assessment in this report) significant negative impacts are not observed to be occurring. Implementation of the mitigation measures will take place should monitoring during the drought permit indicate that significant impacts are being experienced. Funding of appropriate reasonable measures (e.g. habitat restoration) could be considered to remedy any impacts that are observed to have occurred.

4.2 Water quality

4.2.1 Downstream of Leek STW

The drought permit scenarios are predicted to increase the concentrations of total ammonia downstream of Leek STW by 10% or more and therefore mitigation measures are recommended to reduce this impact. There is an ammonia improvement scheme listed in the WINEP at Leek STW (for completion Dec 2024, proposed permit limit 1 mg/l) and so implementation of a drought permit after this date is expected to have a reduced impact in terms of ammonia concentrations downstream of Leek STW. However, ahead of the completion of this scheme, STWL should investigate how additional treatment of ammonia could be provided temporarily at Leek STW during implementation of the drought permit if required.

4.2.2 Downstream of Abbey Green discharge (Scenario 1 only)

Based on the findings of the 2020 trial at Abbey Green (Stantec & APEM, 2021), it is recommended that under implementation of drought permit Scenario 1, measures are put in place to minimise the risks of the following:

- increased suspended solids concentrations due to the accumulation of sediment in the Abbey Green borehole during periods of disuse;
- a potential reduction in the concentration of dissolved oxygen; and
- a possible increase in the concentration of dissolved cadmium.

The accumulation of sediment during periods of disuse would have the potential to increase suspended solids concentrations downstream of the Abbey Green borehole discharge for a short duration immediately following the switching on of the discharge. Mitigation measures to be implemented by STWL are as follows:

- Run the Abbey Green borehole discharge through a highly vegetated overflow channel which will hold back any suspended solids present in the borehole. This will be done for one hour at first start up prior to operation (i.e. prior to discharging into the River Churnet).
- Operate the Abbey Green borehole for a short duration, at regular intervals (e.g. 30 minutes per month) in order to minimise the accumulation of sediment.
- Operate the Abbey Green discharge through a diffuser to increase the concentration of dissolved oxygen in the borehole water as it discharges to the river.
- Section 5 includes a recommendation for weekly monitoring for dissolved cadmium downstream of the Abbey Green discharge while it is operational (Scenario 1 only). If a sample is found to exceed the MAC EQS for dissolved cadmium (0.45 µg/l) the discharge from Abbey Green should be stopped. Similarly, if analysis of the weekly data indicate the AA EQS for dissolved cadmium (0.08 µg/l) is at risk of being breached (in the event, for example, that the drought permit lasts for the entire six month period), the discharge from Abbey Green should be stopped.

5 Environmental Monitoring Plan

This Chapter:

- Sets out an environmental monitoring plan (EMP) covering the baseline, in-drought and post-drought (recovery) monitoring that will be carried out to:
- understand the actual environmental impact of implementing the side-supply actions;
- improve the confidence of the environmental assessment; and
- assess the effectiveness of the mitigation measures detailed in Section 4.

5.1 Introduction

An EMP has been developed which includes baseline, pre-drought permit implementation, during-drought permit implementation and post-drought permit implementation monitoring. The receptors to be monitored are detailed in Table 5.1, together with the agreed monitoring locations.

It is important to note that the level of monitoring is risk-based. The environmental assessment indicates that the drought permit presents a low risk to the environment (negligible or minor negative impacts are predicted for most receptors) with the exception of some fish life-stages in the River Churnet from Meerbrook to Leekbrook, where moderate negative impacts are possible, season dependent. Given the latter moderate effects, and furthermore uncertainties inherent in some of the assessments undertaken, monitoring has been recommended, to check the predicted degree of impact, and identify any unexpected impacts in order to trigger mitigation measures, if needed.

Baseline monitoring

Baseline monitoring is required to formulate a description of the existing ecological conditions, from which the impacts of drought permit operations over and above the effects of other pressures, such as natural drought, can be identified. Baseline monitoring can also help to establish the sensitivity of the environment to changes in flow and improve the level of confidence in the assessment of likely impacts. Significant baseline monitoring associated with previous versions of the EMP has already been carried out on the River Churnet. This EMP therefore considers if additional baseline monitoring is required beyond what has already been done.

Pre-drought permit monitoring

Pre-implementation monitoring should be triggered by STWL drought permit preparations and undertaken prior to implementation of the Churnet drought permit. Pre-implementation data can be important to demonstrate the precise baseline conditions ahead of the changes to the compensation flow regime.

During-drought permit monitoring

In-drought monitoring is required to assess any impacts from the implementation of the drought management action and for the management of mitigation measures during a drought.

It is recommended that during drought permit monitoring continues as per the pre-implementation period, except where, in consultation with the regulator, it is deemed that such monitoring may be environmentally damaging.

Post-drought permit monitoring

Post-drought permit monitoring aims to assess a site's recovery and to check that there are no long-term effects on any environmental features. This is important as results are needed to assess the success of mitigation measures. It can also feed back into the assessment of sensitivity and likely impact and inform the management of future drought actions.

The duration of post drought permit monitoring will depend upon the severity of the natural drought but will cover the period of recovery and will be carried out in consultation with the regulator.

5.2 River Churnet Environmental Monitoring Plan

A summary of the EMP for the River Churnet is provided in Table 5.1.

5.2.1 Groundwater levels

Groundwater level monitoring is currently undertaken by the EA at Highgate Farm, High Up Farm and St Edwards, and by STWL at Rudyard Green Lane. Loggers could be installed by STWL in one of these boreholes (for example, High Up Farm) in order to maintain a continuous data record, should the EA be unable to carry out their regular monthly monitoring during the periods of interest. Groundwater levels were monitored by the EA at Abbey Green Farm until 2012 but the borehole at this location is no longer used for monitoring.

Groundwater monitoring would only be required under implementation of Scenario 1 and recommendations are as follows:

- installation of a logger to monitor groundwater levels at High Up Farm OBH (STWL);
- continuation of existing groundwater level monitoring at Rudyard Green Lane (STWL);
- continuation of existing groundwater level monitoring at Highgate Farm OBH (EA).

5.2.2 Hydrology

Spot flow gauging is recommended immediately prior to implementation, and during implementation of a drought permit. It is recommended that weekly[7] or fortnightly spot flow gauging be carried out within the upper reaches of the Churnet, between Leek Flume and Leek STW, and immediately up and downstream of Endon Brook. If the drought permit progresses from Scenario 1 to Scenario 2, an additional spot gauging survey should be carried out immediately prior to the change. Post implementation monitoring is recommended if issues at Leek gauging station are still present when the drought permit application is made.

5.2.3 Water quality

Based on the findings of the 2020 trial at Abbey Green (Stantec & APEM, 2021), it is recommended that STWL puts in place continuous monitoring of conductivity, temperature, pH and DO upstream and downstream of the Abbey Green discharge whilst it is operational (Scenario 1 only), in order to closely monitor any potential impacts arising from the Abbey Green discharge. Although the risk of such impacts is thought to be relatively low, the continuous monitoring is recommended as a precautionary measure. It is also recommended that STWL monitors dissolved cadmium at the same locations used in the 2020 Abbey Green trial, as well as upstream and downstream of Leek STW, while the discharge is operational (Scenario 1 only). The samples should be analysed for hardness and filtered on site before being sent to a laboratory. The risk of EQS exceedance for dissolved cadmium downstream of Abbey Green during the drought permit is considered low, and in-combination effects downstream of Leek STW are considered lower-risk, however weekly monitoring is recommended as a precautionary measure. Analysis of the weekly data will be required primarily to check for breaches of the MAC EQS for dissolved cadmium (0.45 µg/l), however additional assessment will be

[7] Weekly spot flow gauging is recommended if issues at Leek gauging station are still present when the drought permit application is made; if the issues have been resolved then fortnightly spot flow gauging should be carried out.

required, drawing together baseline data and during-drought permit data to assess the risk of breaching the AA EQS for dissolved cadmium (0.08 µg/l).

In addition to the above described monitoring for Scenario 1 only, it is recommended that STWL takes weekly samples upstream and downstream of Leek STW, to be analysed for ammonia, orthophosphate, fluoranthene and benzo(a)pyrene during both Scenarios 1 and 2. This is recommended due to a predicted increase in concentrations of total ammonia downstream of Leek STW by 10% or more, and due to exceedances of the EQS indicated in the baseline data for orthophosphate, fluoranthene and benzo(a)pyrene (it is noted that the EQS is exceeded both up and downstream of Leek STW but monitoring is recommended as a precautionary measure). Temperature, pH and salinity should also be measured *in situ* at the time of sampling, in order that unionised ammonia concentrations may be calculated.

As the drought permit is to be implemented before completion of the ammonia improvement scheme listed in the WINEP at Leek STW (for completion Dec 2024, proposed permit limit 1 mg/l), it is recommended that continuous monitoring of ammonia is installed upstream and downstream of Leek STW. Probes measuring ammonia, pH, temperature and salinity should be installed upstream and downstream of Leek STW for the first month of implementation of the drought permit and then need their need will be reviewed. If the continuous monitoring is removed, weekly sampling will continue throughout drought permit implementation, to monitor for any unexpected changes. It is noted that care must be taken in siting the downstream monitoring location, as it must be positioned downstream of the Leek STW final effluent discharge mixing zone.

5.2.4 Macroinvertebrates

Given that any impact to the macroinvertebrate communities of the River Churnet water bodies, as a result of both drought permit Scenario 1 and Scenario 2, was considered to be minor and of relatively low risk, additional monitoring of macroinvertebrate communities for the purposes of baseline drought assessment is not recommended at this time. The current available data (as presented in Appendix E) is considered a suitable baseline for assessment of future impacts. It is assumed that monitoring will continue on the River Churnet at the current frequency and suite of locations, as per the requirements of the abstraction licence; this data will be suitable for use under future baseline assessment, if required.

For this drought permit, it is recommended that both in-drought and post-drought monitoring be continued as per the suite of monitoring used to inform baseline assessment of the River Churnet from Meerbrook to Leekbrook and River Churnet from Endon Brook to Consall water bodies (see Table 5.1). This will allow for suitable assessment of the macroinvertebrate communities under in-drought and post-drought conditions, relative to the baseline.

5.2.5 Fish

Prior to implementation of the drought permit, it is necessary to carry out a habitat walkover of the River Churnet between Meerbrook and Leekbrook, in order to identify the areas of spawning habitat for species and life stages predicted to receive Moderate impacts (brown trout, bullhead, rheophilic coarse fish and lamprey). At the same time a check of conditions at Crumpwood Weir and fish pass would also be undertaken to identify any evidence of fish in distress or being unable to pass up or downstream. This is in order to provide a baseline to which monitoring efforts during implementation of the drought permit may be compared.

It is recommended that habitat walkover assessments be carried out before and during implementation of the drought permit, in order to pre-emptively identify any potential loss of habitat, and to monitor changes in habitat availability during spawning activities. Habitat walkovers are particularly important should as the implementation of the drought permit will coincide with key periods of sensitivity for spawning species (September to January for brown / sea trout, March to June for bullhead, and March to July for rheophilic coarse species and lamprey). These walkovers should also assess potential reductions in wetted width, to identify potential loss of habitat for (and subsequent dewatering of) lamprey ammocoetes.

As well as the habitat walkover surveys, it is recommended that weekly walkover surveys to identify signs of environmental stress (fish in distress, dry channel, etc.) are undertaken in the River Churnet between Meerbrook and Leekbrook, and at Crumpwood Weir and fish pass during implementation of the drought permit. This first survey should be timed to coincide with day one of implementation of the drought permit, i.e. the day the compensation flows are reduced/Abbey Green borehole discharge is turned on. These walkover surveys should be undertaken at least three times before their need is reviewed.

In addition to the seven barriers assessed during the fish passage assessment carried out in 2015 (ESI & APEM, 2016), two further potential barriers to fish migration have been highlighted by the EA. These are a small weir just downstream of Cheddleton Flint Mill (site 8; SJ 976 524), and another small weir further downstream near Basford Bridge (site 9; SJ 982 519).

Consulting the AMBER barrier tracker[8], the weir at site 8 is not currently registered as a barrier, and therefore it is not possible to assess the passability of this barrier to migratory fish at this stage.

The weir at site 9 is approximately 1.6 m in height and spans the width of the river. For comparison, the obstacle at site 7 is approximately 2.6 m in height, and is considered to be impassable to all migratory fish moving upstream, and all migratory fish moving downstream, with the exception of juvenile lamprey (baseline and low flow) and silver eels (baseline flow only). Given that the weir at site 9 represents a smaller obstacle to traverse, it is likely that it too will be passable to juvenile lamprey and silver eels moving downstream. However, the passability of this structure to migratory fish moving upstream is currently unknown.

It is recommended that passability assessments are conducted at both site 8 and site 9 during baseline and low flows, in order to assess the passability of both structures to migratory fish undertaking upstream and downstream movements. Depending on the findings of these passability assessments, it may be recommended to do a visual assessment of these barriers as part of the walkover surveys that will take place during the drought permit. Should this assessment find that passability is reduced under either drought permit scenario, mitigatory measures may be required.

As impacts of the drought order are likely to be localised and temporary in nature, it is not anticipated that any post-drought permit monitoring will be necessary.

5.2.6 Other receptors

An additional water vole survey is recommended at the pre-drought permit implementation stage between Tittesworth Reservoir and Abbey Green. The survey should follow the latest guidelines relating to water vole surveys.

[8] https://portal.amber.international/

Table 5.1 River Churnet EMP

Parameter	Location	By whom	Brief scope	Baseline Timing/ Frequency	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
Groundwater levels – only required under Scenario 1	High Up Farm	EA/STWL	EA monitoring network. STWL to install loggers	Logger with dip/download once every 2 months		Logger with monthly dip/download	None
	Rudyard Green Lane	STWL	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring
	Highgate Farm OBH	EA	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring	Continuation of existing groundwater level monitoring
Flow	Between Leek Flume and Leek STW (C2-05, C2-05b, C2-06, C2-06b, C2-07, C2-07b) and immediately upstream and downstream of the	STWL	Spot flow gauging	Not required	Once immediately prior to drought permit implementation	Weekly[9] or fortnightly	None

[9] recommended if issues at Leek gauging station are still present when the drought permit application is made. No post implementation spot flow gauging is recommended if issues at Leek gauging station have been resolved when the drought permit application is made.

Parameter	Location	By whom	Brief scope	Baseline Timing/ Frequency	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
	confluence with Endon Brook.						
Water quality: conductivity, temperature, pH and DO	Upstream and downstream of the Abbey Green borehole discharge	STWL	Continuous monitoring during operation of the Abbey Green borehole discharge (only required under Scenario 1)	Not required	Not required	Continuous monitoring	Not required
Water quality: dissolved cadmium and hardness	Upstream and downstream of the Abbey Green borehole discharge (C2-05B, C2-05C and C2-06B), and upstream and downstream of Leek STW (C2-07 and C2-08)	STWL	Weekly spot sampling during operation of the Abbey Green borehole discharge (only required under Scenario 1)	Not required	Once immediately prior to drought permit implementation	Weekly	Not required

Parameter	Location	By whom	Brief scope	Baseline Timing/ Frequency	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
Water quality: temperature, salinity, pH, ammonia, orthophosphate, fluoranthene and benzo(a)pyrene	Upstream and downstream of Leek STW (C2-07 and C2-08)	STWL	Weekly spot sampling, required under both scenarios	Not required	Once immediately prior to drought permit implementation	Weekly	Not required
Water quality: ammonia, pH, temperature and salinity	Upstream and downstream of Leek STW (C2-07 and C2-08)	STWL	Continuous monitoring	Not required	Install one week ahead of drought permit implementation	Keep in place for at least one month before need reviewed.	Not required
Fish	River Churnet between Meerbrook and Leekbrook	STWL	Habitat walkover surveys to identify spawning habitats	Not required	One habitat walkover survey (to be conducted at any time of year)	Seasonal habitat walkover surveys (one survey in Sept to Jan (trout) and one in Mar to July (other species) if these periods coincide with implementation of the drought permit).	Not required
	River Churnet between Meerbrook	STWL	Walkover surveys to identify signs of environmental stress (fish in	Not required	Not required	First survey on day one of drought permit implementation	Not required

Parameter	Location	By whom	Brief scope	Baseline Timing/ Frequency	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
	and Leekbrook		distress, dry channel etc.)			and weekly thereafter. To be undertaken at least three times before need reviewed.	
	Crumpwood Weir and fish pass (SK 09312 42537)	STWL	Visual check, photos and site notes to identify any signs of fish in distress or being able to pass upstream or downstream.	Not required	One survey immediately prior to implementation.	First survey on day one of drought permit implementation and weekly thereafter. To be undertaken at least three times before need reviewed.	Not required
	Weirs just downstream of Cheddleton Flint Mill (site 8) and downstream near Basford Bridge	STWL	Passability assessments	Two assessments: one during baseline flows and one during low flows	Not required	Not required	Not required
Macroinvertebrates	C2-05, C2-06, C2-07, C2-07b, C2-08, C2-10	STWL	Seasonal macroinvertebrate sampling.	Not required, existing baseline data is available.	Not required.	Seasonal sampling (spring, summer & autumn) for the duration of the drought permit.	Seasonal sampling (spring, summer & autumn) for a minimum of three years post-drought permit.

Parameter	Location	By whom	Brief scope	Baseline Timing/ Frequency	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
Water voles	Between Tittesworth Reservoir and Abbey Green	STWL	Water vole survey	n/a	One survey	n/a	n/a

6 Conclusions and recommendations

Both Churnet drought permit scenarios are predicted to have moderate impacts on the spawning and egg incubation life stages of brown trout, bullhead and rheophilic coarse fish, and on *Lampetra* sp. ammocoetes in the River Churnet from Meerbrook to Leekbrook water body only. The effect of the drought permit scenarios is predicted to be minor on all other receptors in comparison with the baseline.

The pre-mitigation potential impacts are summarised in Table 6.1 and Table 6.2.

Table 6.1 Pre-mitigation potential impacts of the Churnet drought permit Scenario 1

Water body	Impact significance	Receptors
River Churnet from Meerbrook to Leekbrook	Moderate impact	Fish (brown trout, bullhead and rheophilic coarse fish: spawning & egg incubation; *Lampetra* sp.: ammocoetes)
	Minor impact	Macroinvertebrates Fish (brown trout, bullhead and rheophilic coarse fish: juvenile and adults; *Lampetra* sp.: spawning & egg incubation; eurytopic coarse fish: spawning & egg incubation and adults; eurytopic coarse fish: juvenile; Angling groups) Other abstractors (level dependent: Brindley's Mill) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Designated sites (local nature reserves) Aesthetics, recreation, navigation Archaeology and heritage
	Uncertain impact	Protected species (water vole) Other abstractors (level dependent: Portland Dyeing Company; HoF restricted (requires reduction in abstraction below HoF): Eternis Fine Chemicals)
River Churnet from Endon Brook to Consall	Minor impact	Macroinvertebrates Fish (all species and life stages; Angling groups) Other abstractors (level dependent: Cheddleton Flint Mill; HoF restricted: Canal and River Trust Caldon Canal) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Designated sites (SSSIs) Aesthetics, recreation, navigation
	Uncertain impact	Protected species (water vole)
River Churnet from Consall to River Dove	Minor impact	Macroinvertebrates Fish (all species and life stages; Angling groups) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Aesthetics, recreation, navigation Archaeology and heritage
	Uncertain impact	Protected species (water vole) Other abstractors (level dependent: JCB and others)

Table 6.2 Pre-mitigation potential impacts of the Churnet drought permit Scenario 2

Water body	Impact significance	Receptors
River Churnet from Meerbrook to Leekbrook	Moderate	Fish (brown trout, bullhead and rheophilic coarse fish: spawning & egg incubation; *Lampetra* sp.: ammocoetes)
	Minor	Macroinvertebrates Fish (brown trout, bullhead and rheophilic coarse fish: juvenile and adults; *Lampetra* sp.: spawning & egg incubation; eurytopic coarse fish: spawning & egg incubation and adults; eurytopic coarse fish: juvenile; Angling groups) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Other abstractors (level dependent: Brindley's Mill) Designated sites (local nature reserves) Aesthetics, recreation, navigation Archaeology and heritage
	Uncertain impact	Protected species (water vole)
River Churnet from Endon Brook to Consall	Minor	Macroinvertebrates Fish (all species and life stages; Angling groups) Other abstractors (level dependent: Cheddleton Flint Mill; HoF restricted: Canal and River Trust Caldon Canal) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Designated sites (SSSIs) Aesthetics, recreation, navigation
	Uncertain impact	Protected species (water vole)
River Churnet from Consall to River Dove	Minor	Macroinvertebrates Fish (all species and life stages; Angling groups) INNS Protected species (pied flycatcher, marsh tit, willow tit, wood warbler, dipper, redstart, otter) Other abstractors (level dependent) Aesthetics, recreation, navigation Archaeology and heritage
	Uncertain impact	Protected species (water vole) Other abstractors (level dependent: JCB and others)

In addition to the impacts described above, there is a potential risk of the drought permit in combination with operation of the Portland Dyeing Company and Eternis Fine Chemicals abstractions. If these third party abstractions were to be operated beyond recent actual to their maximum daily abstraction during drought permit implementation there is a risk that downstream flows on the River Churnet could decrease by a further under both scenarios compared to recent actual as modelled within the water balance. STWL has contacted the licence holders prior to application, to discuss keeping to recent actual levels to minimise the risk of in-

combination impacts on the river. Portland Dyeing Company and Eternis Fine Chemicals have confirmed that they do not plan to take their full licenced volume for the life of the permit and will continue to abstract at recent actual levels. STWL should also share the results of the water quality assessment (included in this EAR) with the licence holders to ensure that the predicted changes in water quality would not have unacceptable impacts on the licence holders' use of the abstracted water.

More generally, impacts on other abstractors have been found to be uncertain, largely as a result of a lack of understanding of the mechanisms of impacts on abstraction infrastructure on a site by site basis. STWL has contacted the licence holders ahead of and, if necessary, will maintain contact, during implementation of the drought permit.

Where significant negative impacts are identified during the environmental assessment process, there is a need to identify appropriate mitigation measures in order to avoid, reduce or remedy any impacts.

Based on the assessment and given the uncertainties inherent in some of the assessments undertaken, a range of precautionary mitigation measures have been developed, in the event that environmental monitoring during drought permit implementation identifies that unexpected impacts are occurring (Section 4).

Monitoring has been recommended in order to capture any changes before, during and after the drought permit implementation (see Section 5). This includes checking for signs of ecological stress including: potential effects on flow; potential effects of poor water quality; inhibition of movement of fish past river structures or other barriers; and habitat availability for adult and juvenile life stages (including spawning / nursery areas).

It should be noted that not all of the mitigation measures described may be required or appropriate. If unexpected impacts are found to be occurring, potential mitigation measures will be discussed and agreed with the EA. Mitigation measures will be implemented to reduce the impacts of the drought permit and not the impacts of the drought itself.

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