Appendix 8

Environmental monitoring plan

Contents

1. Introduction

The following report provides a summary of our Environmental Monitoring Plan (EMP), which supports the environmental assessments that form part of our Drought Plan 2022. Monitoring and mitigation requirements have been identified through the environmental assessment of supply-side drought actions that may require a drought permit. These are summarised in **Appendix 7**.

1.1 Background

The purpose of the EMP is to provide a summary of the existing monitoring in place, and to identify where additional monitoring and / or mitigation will be required for potential drought permits to ensure they do not have a detrimental impact on the environment. The plan covers all the stages of drought planning and monitoring including baseline (pre-drought), in-drought, and post drought recovery.

It is important that a comprehensive baseline monitoring regime is in place for the drought permit sites to allow comparison with the in-drought and post-drought monitoring. This enables us to distinguish the impacts of our actions from the natural effects of drought and inform mitigation requirements during implementation of a permit. The monitoring contributes to the improvement of our Drought Plan, as it will help to inform the implementation of the drought permits.

Current Environment Agency guidance has been followed when developing the monitoring plan.[1]

The Environment Agency already collects a large amount of physio-chemical, ecological and hydrological data that is relevant to the drought permits. Standard Environment Agency methods are used throughout. It is considered that the routine data gathered by the Environment Agency, along with any additional monitoring undertaken by Anglian Water, generally allows good coverage and enables long-term trend analysis of any changes caused by a drought permit. Where there are data gaps identified, additional monitoring has been proposed.

The monitoring plan will be regularly reviewed with the Environment Agency to ensure that any changes in routine monitoring are identified, and that monitoring is continued where it is required for the drought permits. The baseline monitoring data will also be routinely reviewed to ensure that any required changes to the environmental assessments or Drought Plan actions are identified.

The following chapters give a summarised assessment of the potential effects of the proposed Drought Plan 2022 drought permits, the need for monitoring and mitigation and a high-level overview of the monitoring and mitigation plan for the predicted impacts. The full EMP is included within each Environmental Assessment Report (EAR) which have been completed for each drought permit. Further information on the proposed permits and their potential impact on the environment is available in **Appendix 7**, and the individual EARs are available on request. This work is also support by a Strategic Environmental Assessment (SEA) and Habitats Regulation Assessment (HRA).

[1] *Environment Agency (2020) Environmental Assessment for Water Company Drought Plans - supplementary guidance.*

2. River Nene intake (Pitsford Water)

2.1 Background

We abstract from the River Nene. In periods of drought, we may seek a drought permit which proposes a 50% reduction in Minimum Residual Flow (MRF) immediately downstream of the intake to help refill Pitsford Water.

The environmental assessment demonstrates that the proposed drought permit would result in minor-moderate environmental risk in winter, and a minor-major environmental risk in summer. Any adverse effects on environmental variables would be temporary, however, and the predicted changes are not thought to result in a permanent effect on WFD status, although a temporary deterioration for the duration of the drought is likely.

2.2 Description of proposed drought permit

The proposed drought permit will take the form of a winter or summer authorisation, for the duration of six months at any one time, to allow increased refilling of Pitsford Water through a 50% reduction in the MRF from the River Nene.

The assessment is based on a reduction in MRF from the current 34.1 Ml/d to 17.05 Ml/d within the period from October to March (inclusive) for a winter permit and April to September (inclusive) for a summer permit.

The permit would be required if there is a risk of compromising our ability to refill Pitsford Water. This is likely to only occur in a severe, multi-season drought. Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling us to refill the reservoir during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduced sensitivity for the majority of potential environmental receptors. However, should drought conditions continue to present a significant risk to supply, a summer drought permit may also be considered as an option.

2.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 2.1 summarises the recommended monitoring and mitigation in relation to this assessment. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

2.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 2.2.

Table 2.1: Summary of monitoring recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions, including continuous water quality monitoring at Duston Mill. • Identification of relevant stakeholders.
Pre-drought (commence in potential drought)	• Frequent monitoring of flow data during periods of low flow to identify the trigger for initiating a drought permit application. • Additional biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to supplement baseline monitoring, where required. • Contact all licensed abstractors within the potentially affected area and initiate engagement with key stakeholders. • Regular liaison with the Environment Agency.
During drought (commence in drought period)	• Frequently monitor flow against temporary drought permit licence and cease abstraction at Duston Mill if flows drop too low. • Enhanced monitoring of water quality and biological communities to quantify the immediate impact of the drought. • Water quality monitoring upstream of Duston Mill, and downstream of Broadholme and Great Billing Water Recycling Centres (WRC). • Continuous monitoring of water levels at South Bridge and Bedford Road Sluice to ensure minimum navigable depth is maintained.
Post drought (commence after drought permit has been lifted)	• Continued flow monitoring in the River Nene to ensure that drought permit actions are no longer required. • Continued water quality and biological community monitoring to assess the need for continuation of mitigation measures.

Table 2.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Navigation	Water levels controlled by locks, tilting gates and weirs. Navigation peaks in summer months, lock operations and demand for water will be higher. Algal blooms and weed choking may impact navigation.	Monitoring of level data in comparison to the minimum navigable depth. Dialogue with the navigation authority.	Reduce abstraction during busy navigation periods. Also consider dredging, de-silting or weed clearing at know problem locations on the main navigation channel.
Recreation	Recreational activities such as angling, walking and cycling may be affected by a decrease in the visual appearance of the river, with the risk of algal blooms and reduced flows.	Dialogue with local angling groups in order to address any concerns.	See fish and navigation measures.
Other abstractors	Spray irrigators could be affected by reduced water levels in summer months.	Consult other abstractors to determine potential impact and evaluate need for mitigation.	Variable MRF to ensure affected licence holders are not significantly impacted. Note that abstraction would automatically be stopped or reduced if flows would otherwise drop below the temporary MRF.
Water quality: orthophosphate	Excess orthophosphate associated with reduced dilution has the potential to cause a decrease in water quality	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Temporary orthophosphate removal. Ensure storm flows return to Great Billing and Broadholme WRCs as soon as possible to prevent untreated sewage entering the Nene. Increase maintenance of the CSOs at Becketts Park to prevent spill during a drought. Additional orthophosphate stripping at WRCs may be required if water quality drops below agreed concentration with the Environment Agency. Cessation rules if water quality parameters fall below pre-agreed levels.
Fish (main river)	Deterioration in water quality and increased algal activity may impact fish communities. Effects are more pronounced in summer.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Cessation of abstraction if water quality levels fall below a critical value for fish health or if levels are impacted more than predicted.
Fish spawning (backchannels)	Flow and levels in backchannels should not be affected by the drought permit, due to the structural controls on the main river that control flow into these channels. If flow does decrease in the backchannels, this could affect sediment deposition and hence gravel spawners. The risks are greater in summer as most fish species in the Nene spawn from March to April.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Supplementing flows to isolated backchannels, with the possibility to “pump over” water into stranded backchannels at lower flows. Ensure structural controls maintain flow into backchannels.

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Fish passage	Reductions in 'trigger' flows that initiate eel and trout migration from the estuary may cause mortalities. Restricted migration in summer due to higher temperatures and lower DO levels resulting in increased risk of algal blooms, stagnation or choking of river sections. It is likely that, even at low flows, fish species would be able to swim over the fish passes at in-channel structures between Duston Mill and Peterborough.	Monitoring of flow data in comparison to the migration 'trigger' flows.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.
Macro-invertebrates	Reduction in water quality may impact communities. Impacts on water quality more significant in summer. Risk of sedimentation and reduced flows already stressors for community.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.
Macrophytes	Reduction in water quality may affect macrophyte communities. Impacts on water quality more significant in summer as an increase in temperature and sunlight increases the risk of algal blooms and consequential DO sags.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.

3. River Nene intake (Rutland Water)

3.1 Background

We abstract from the River Nene and may seek a drought permit which proposes a 50% reduction in MRF immediately downstream of the intake on the River Nene in both summer and winter, for the duration of six months at any one time, to help refill Rutland Water during drought conditions.

The environmental assessment demonstrates that the proposed drought permit would result in major environmental risk in winter and summer. Any adverse effects on environmental variables would be non-permanent, however, and the predicted changes are not thought to result in a permanent effect on WFD status, although a temporary deterioration for the duration of the drought is likely.

3.2 Description of proposed drought permit

The drought permit may take the form of a winter or summer authorisation to allow increased refilling of Rutland Water through a 50% reduction in the MRF from 125 Ml/d to 62.5 Ml/d for December to April and 150 Ml/d to 75 Ml/d for May to November.

The permit would be required if there is a risk of compromising our ability to refill Rutland Water. This is likely to only occur in a severe, multi-season drought. Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling Anglian Water to refill Rutland Water during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduced sensitivity for the majority of potential receptors. However, should drought conditions continue to present a significant risk to supply, a summer drought permit may also be considered as an option.

3.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 3.1 summarises the recommended monitoring in relation to this assessment and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

3.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 3.2.

Table 3.1: Summary of monitoring recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders.
Pre-drought (commence in potential drought)	• Frequent monitoring of flow data during periods of low flow to identify the trigger for initiating a drought permit application. • Additional biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to supplement baseline monitoring, where required. • Contact all licensed abstractors within the potentially affected area and initiate engagement with key stakeholders. • Regular liaison with the Environment Agency.
During drought (commence in drought period)	• Frequently monitor flow against temporary drought permit licence and cease abstraction at Wansford if flows drop too low. • Enhanced monitoring of water quality and biological communities to quantify the immediate impact of the drought. • Abstraction to be halted if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts. • Records of daily abstraction quantities and flow submitted weekly to the Environment Agency.
Post drought (commence after drought permit has been lifted)	• Continued flow monitoring in the River Nene to ensure that drought permit actions are no longer required. • Continued water quality and biological community monitoring to assess the need for continuation of mitigation measures.

Table 3.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Navigation	Water levels controlled by locks, tilting gates and weirs. Navigation peaks in summer months, lock operations and demand for water will be higher. Algal blooms and weed choking may impact navigation.	Monitoring of level data in comparison to the minimum navigable depth. Dialogue with the navigation authority.	Reduce abstraction during busy navigation periods. Also consider dredging, de-silting or weed clearing at know problem locations on the main navigation channel. Agreed with Environment Agency that it is unlikely mitigation measures for diatoms (e.g. algal blooms) would be required.
Recreation	Recreational activities such as angling, walking and cycling may be affected by a decrease in the visual appearance of the river, with the risk of algal blooms and reduced flows.	Dialogue with local angling groups in order to address any concerns.	See fish and navigation measures.
Other abstractors	Spray irrigators could be affected by reduced water levels in summer months.	Consult other abstractors to determine potential impact and evaluate need for compensation.	Variable MRF to ensure affected licence holders are not significantly impacted. Note that abstraction would automatically be stopped or reduced if flows would otherwise drop below the temporary MRF.
Water quality: orthophosphate	Excess orthophosphate associated with reduced dilution has the potential to cause a decrease in water quality.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Cessation rules should be in place to halt abstraction if water quality deteriorates below acceptable levels, or if water levels are affected more than currently predicted. Temporary phosphate stripping at WRCs, for example Wittering and Stibbington.
Fish (main river)	Deterioration in water quality and increased algal activity may impact fish communities. Effects are more pronounced in summer.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Cessation of abstraction if water quality levels fall below a critical value for fish health or if levels are impacted more than predicted.
Fish passage	Reductions in 'trigger' flows that initiate eel and trout migration from the estuary may cause mortalities. Restricted migration in summer due to higher temperatures and lower DO levels resulting in increased risk of algal blooms, stagnation or choking of river sections.	Monitoring of flow data in comparison to the migration 'trigger' flows.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.
Macro-invertebrates	Reduction in water quality may impact communities. Impacts on water quality more significant in summer. Risk of sedimentation and reduced flows already stressors for community.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.
Macrophytes	Reduction in water quality may affect macrophyte communities. Impacts on water quality more significant in summer as an increase in temperature and sunlight increases the risk of algal blooms and consequential DO sags.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated. Levels need to be defined.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Cessation rules if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts.

4. River Great Ouse intake (Grafham Water)

4.1 Background

Anglian Water abstract from the River Great Ouse to fill Grafham Water. During drought conditions we may seek a drought permit in two stages (see **Section 4.2** for further detail).

The environmental assessment concluded that the proposed Stage 1 drought permit would result in minor-moderate environmental risk in winter and minor environmental risk in summer. The proposed Stage 2 drought permit would likely result in moderate environmental risk in winter and major environmental risk in summer. It is not considered likely that implementation of the drought permit would result in permanent changes to the WFD status of the impacted waterbodies, however a temporary deterioration for the duration of the drought is likely.

4.2 Description of proposed drought permit

The drought permit on the River Great Ouse may take the form of a winter or summer permit. The current licence allows abstraction of 75% of flow in excess of the MRF, subject to licence and pump capacity constraints. It is proposed that a drought permit would be considered in two stages:

- Stage 1: Existing MRF, abstraction at up to 100% of the flow in excess of the MRF
- Stage 2: Reduced MRF, abstraction at up to 75% of the flow in excess of the MRF

Stage 2 allows greater abstraction than Stage 1 when the flow is below 340 Ml/d, so would be likely to be applied for in the later stages of a drought. Usage would be expected to revert to Stage 1 when sufficient flow recovery has occurred.

The permit would be required if there is a risk of compromising our ability to refill Grafham Water. This is likely to only occur in a severe, multi-season drought. Under the most likely scenario, a winter drought permit would be sought after a dry winter and summer, enabling us to refill Grafham Water during the following winter. This typically corresponds to a natural increase in flows (and hence water available for abstraction) and a reduction in the sensitivity of physio-chemical and biological receptors to impact. However, should drought conditions continue to present a significant risk to supply, a summer drought permit may also be considered as an option. Note that summer is defined as April to September (inclusive) and winter as October to March (inclusive).

4.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 4.1 summarises the recommended monitoring in relation to this assessment and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

4.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 4.2.

Table 4.1: Summary of monitoring recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders.
Pre-drought (commence in potential drought)	• Frequent monitoring of flow data during periods of low flow to identify the trigger for initiating a drought permit application, including spot flow gauging at key sites along the River Great Ouse. • Additional biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to supplement baseline monitoring, where required. • Contact all licensed abstractors within the potentially affected area, and initiate engagement with key stakeholders including navigational and recreational users. • Regular liaison with the Environment Agency.
During drought (commence in drought period)	• Frequently monitor flow against temporary drought permit licence and cease abstraction at Offord if flows drop too low. • Enhanced monitoring of water quality and biological communities to quantify the immediate impact of the drought.
Post drought (commence after drought permit has been lifted)	• Continued flow monitoring in the River Great Ouse to ensure that drought permit actions are no longer required. • Continued water quality and biological community monitoring to evaluate recovery and to assess the need for continuation of mitigation measures.

Table 4.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Water quality: orthophosphate	Excess phosphate associated with reduced dilution has the potential to cause a decrease in water quality.	If phosphate concentrations were exceeding 0.53 mg/l in summer and 0.45 mg/l in winter.	Cessation if water quality parameters fall below acceptable levels. Temporary phosphate removal at Anglian Water WRCs, for example Huntingdon and Cotton Valley WRCs, where phosphate removal would be expected to ensure that concentrations would not exceed 0.53 mg/l in summer and 0.45 mg/l in winter. Ammonia removal at storm tanks, CSOs and WRCs so that they are below the target concentrations, if required. Variable abstraction to allow occasional pulses of water throughout the system to aid in the flushing of pollutants and prevent stagnation.
Navigation	If navigation usage in the River Great Ouse starts to exceed river flow capacity, then levels could start to fall. This is a particular concern in summer, when navigation usage is higher than in winter. Changes to river levels can also affect stationary boats along the River Great Ouse, many of which are focussed in two marinas between Godmanchester and Houghton. Boats are prone to tipping when river levels change, causing appliances and services to stop working correctly.	Evaluation of need for remedial work on lock structures between Offord and Hermitage Lock: pre-drought. An indicative draught of 1.0 m is proposed. If water levels fall below the navigation retention level threshold of 11.12 mAOD.	Coordination with Environment Agency team with regard to their mitigation measures for residential and navigational users (signage, navigation notices) Dredging or weed clearance at known problem locations on the main navigation channel if required - e.g. around locks. Remedial work to any of the lock structures between Offord and Hermitage Lock which cannot provide adequate draught to be evaluated. Water to be abstracted gradually over a 24-hour period and reduce abstraction during busy navigation times Take steps to reduce lock usage. Abstraction to cease immediately if water levels drop below 11.12 mAOD or below the temporary reduced MRF.
Recreation	The predicted negative impact on fish health and migration has the potential to affect anglers. There is also a predicted reduction in other recreational activities such as walking and cycling. Recreational usage of the river is reduced in winter. The occurrence of algal blooms may degrade the aesthetic quality of the River Great Ouse, which has the potential to impact walkers and cyclists.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Cessation rules to halt abstraction if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts. Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation.
Fish passage	Limited impacts on winter migration. For a summer permit, a lack of attraction flow and water quality deterioration may affect migration regardless of drought permit implementation, but a drought permit will increase this risk.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Between March and June: pulsing flow with alternating weeks on and off. Cessation rules to halt abstraction if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts, or if flow drop below the temporary MRF.

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Fish (main channel)	Increased BOD and algal activity may affect fish communities. Effects are more pronounced in summer with increased ammonia and temperature induced deterioration. Risk of stagnation and DO sags, which may have a significant impact on fish health during Stage 2 summer permit. Early and summer spawners potentially affected by reduction in MRF; gravel spawners most likely to be impacted.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Cessation rules to halt abstraction if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts, or if water levels drop below the temporary MRF. Aerators on standby if DO levels drop below an agreed threshold. This is considered a last resort.
Fish (backchannels)	There is potential for fish to become stranded in backchannels under lower flows.	Commence on implementation of drought permit.	Cessation rules to halt abstraction if water levels are affected by greater than expected amounts. Possibility of 'pump over' water into stranded backchannels at lower flows. Should fish becomes stranded, an action plan could be implemented setting out the logistics and timing of relocation.
Macroinvertebrates	Reduced flows and increase in orthophosphates may cause increased algal growth and eutrophication, which in turn may increase the risk of DO sags, thus affecting macroinvertebrate communities. Diurnal DO sags in the backchannels connected to the Great Ouse, could impact on macroinvertebrate species with a high oxygen demand.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Aerators on standby if DO levels drop below an agreed threshold. This is considered a last resort. Flows to isolated backchannels to be supplemented if necessary, with the possibility of “pump over” water into stranded backchannels at lower flows.
Macrophytes and phytobenthos	Predicted increases in orthophosphate concentrations and decreases in flow have the potential to change the community structure of macrophytes and algae. Increased risk of eutrophication potentially impacting on rare species.	Trigger mitigation if water quality deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Cessation rules to halt abstraction if water quality deteriorates below acceptable levels, or if water levels are affected by greater than expected amounts. Variable abstraction to be employed to allow occasional pulses of water to aid in flushing of pollutants and prevent stagnation. Aerators on standby if DO levels drop below an agreed threshold. This is considered a last resort. Flows to isolated backchannels to be supplemented if necessary, with the possibility of “pump over” water into stranded backchannels at lower flows.

5. River Colne augmentation (Ardleigh Reservoir)

5.1 Background

We abstract from the River Colne in order to fill Ardleigh Reservoir. At times of low flow, the river flow (and hence the abstraction) can be supported by an augmentation scheme using water abstracted from nearby groundwater sources. During drought conditions we may seek a drought permit that would allow an increased rate of augmentation.

The environmental assessment demonstrates that the augmentation between Cook's Mill (the point of augmentation) and East Mills is predicted to have a minor positive effect on this reach of the River Colne, including water quality due to increased dilution capacity. It is deemed unlikely that the temporary flow augmentation and water quality improvement would result in changes to fish, macroinvertebrate, macrophyte or algal communities of the augmented reach.

It was determined that there are no mechanisms whereby potential impacts from the proposed drought action on the River Colne (e.g. impacts on flow, water level, flooding, water chemistry or habitat loss) could have a likely significant effect on any of the European sites (SAC / SPA / Ramsar sites) or nationally designated sites (e.g. SSSIs) identified within the study area, or on the WFD status of the affected waterbodies. However, other abstractors within a 3 km vicinity may be impacted by a drawdown in groundwater levels.

5.2 Description of proposed drought permit

The water abstracted from four groundwater sources is used for the purposes of public water supply and / or augmenting the River Colne at two specified augmentation points near Cook's Mill and near Balkerne to increase the yield of the intake for Ardleigh Reservoir. A total combined quantity of 10,000 Ml of water can be abstracted from the groundwater sources over a five-year period. In addition, there are also conditions on the maximum quantity that can be abstracted in any 24-hour period. The abstraction licence also contains water quality conditions to restrict discharge into the River Colne when quality is poor (based on concentrations of chloride, sodium and iron and temperature) and aeration of the abstracted water is required prior to discharge.

The purpose of the proposed drought permit would be to temporarily increase the licensed abstraction at two groundwater sources by 3 Ml/d each to provide additional augmentation to the River Colne. The groundwater abstracted would be piped to Cook's Mill, where it would be discharged to the River Colne. This would increase the peak daily abstraction from groundwater from 16 Ml/d to 22 Ml/d. However, 4 Ml/d goes directly to public water supply, so the peak river augmentation would increase from 12 Ml/d to 18 Ml/d. There would be no change in the total quantity of water that can be abstracted in a five year period.

It is assumed that augmentation would cease when flows are higher than the maximum abstraction at the intake. Therefore, when flows are higher than 36 Ml/d, baseline augmentation and thus drought permit abstraction would not be implemented.

5.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 5.1 summarises the recommended monitoring in relation to this assessment and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

5.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 5.2.

Table 5.1: Summary of monitoring recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders.
Pre-drought (commence in potential drought)	• Frequent monitoring of flow data during periods of low flow to identify the trigger for initiating a drought permit application. • Additional biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to supplement baseline monitoring, where required. • Contact all licensed abstractors within the potentially affected area and initiate engagement with key stakeholders. • Regular liaison with the Environment Agency.
During drought (commence in drought period)	• Frequently monitor flow against temporary drought permit licence and cease abstraction at East Mills if flows drop too low. • Enhanced monitoring of water quality and biological communities to quantify the immediate impact of the drought.
Post drought (commence after drought permit has been lifted)	• Continued flow monitoring in the River Colne to ensure that drought permit actions are no longer required. • Continued water quality and biological community monitoring to assess the need for continuation of mitigation measures.

Table 5.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Other licenced abstractors	Reduced groundwater levels means there may be insufficient water available for other licenced abstractors (groundwater only).	If levels drop below minimum abstraction level (to be agreed). Consult other abstractors to determine potential impact and evaluate need for mitigation.	Cessation rules if water levels parameters fall below pre-agreed levels. Rectify any potential impact upon other groundwater abstractors, if required slow start and slow stop of augmentation discharge if possible.
Fish (main channel)	Availability of sub-optimal habitats may change as a result of increased flows.	Trigger mitigation if water quality or fish populations deteriorates below acceptable levels, or if the impact on water levels is worse than anticipated.	Cessation of augmentation to the River Colne if fish populations are impacted.

6. Wellington Wellfield (Marham)

6.1 Background

We abstract from Wellington Wellfield to substitute for abstraction from the River Wissey during periods when flows are high and water quality is reduced. This can operate at any time of the year. Water is abstracted for Stoke Ferry Water Treatment Works (WTW) where it is combined with water from the Wissey and goes into the public water supply. We may seek a drought permit which increases the annual license quantity from Wellington Wellfield and nearby Denton Lodge to support Stoke Ferry WTW. The permit will be used when drought conditions require topping up of existing water resources due to reduced availability of water at the Marham groundwater source.

The environmental assessment demonstrates that the proposed drought permit would have negligible environmental risk on surface water receptors but a minor-moderate risk to groundwater receptors. Any adverse effects on environmental variables would be non-permanent and the predicted changes are not anticipated to result in any deterioration in WFD status. However, there is a possibility that other groundwater abstractors may be impacted through additional drawdown as a result of the permit.

6.2 Description of proposed drought permit

The proposed drought permit would be to increase peak abstraction from the Wellington Wellfield OR Denton Lodge sources by 2.76 Ml/d in the form of:

- Wellington Wellfield licence increase from 15 Ml/d to 17.76 Ml/d, or
- Denton Lodge licence increase from 7.24 Ml/d to 10 Ml/d

The application would also propose an annual licence quality to 4575 Ml (an additional 2747.5 Ml) for the six months of the permit.

Once abstracted, the water would be blended with surface water from the River Wissey for public water supply.

6.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 6.1 summarises the recommended monitoring in relation to this assessment and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

6.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 6.2.

Table 6.1: Summary of monitoring and mitigation recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders. • Encourage business as usual water saving behaviour.
Pre-drought (commence in potential drought)	• Continuation of baseline monitoring. • Infill monitoring by AWS if required. • Establish most appropriate stakeholder engagement methods. • Demand management campaigns.
During drought (commence in drought period)	• NVC surveys within wetland habitat units of statutory designated sites. • Continuation of baseline monitoring for hydrology sites. Regularly track results and if baseline monitoring identifies any impacts, additional ecological monitoring and mitigation should be reviewed.
Post drought (commence after drought permit has been lifted)	• Continuation of baseline monitoring. • Continued increased frequency of ecological monitoring at designated sites for three years after the cessation of the drought permit. • Post-permit review of stakeholder engagement.

Table 6.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Other licenced abstractors	Groundwater drawdown may impact other licensed groundwater abstractors.	Once drought permit has been implemented, trigger mitigation if groundwater levels fall below pre-agreed levels.	Consideration of pump lowering, borehole deepening or compensation to other abstractors, if required. These should be discussed with all abstractors with permitted rights within the potentially affected area to identify potential derogation issues.
Designated Sites	Moderate impact on Breckland SAC in winter - potential for abstraction activities to extend the dry period, with potential impact on wetland bird species and habitat. Moderate impact at Didlington Park Lakes SSSI - potential for loss of habitat related to groundwater levels (summer and winter).	First drought trigger passed (before permit is in place). Walkover surveys of wetland required to determine impact.	Cessation rules to halt abstraction if groundwater levels deteriorate below acceptable levels. Variable abstraction to allow occasional pulses of water throughout the system to aid in the flushing of pollutants and prevent stagnation.

7. River Wensum (Costessey groundwater sources)

7.1 Background

The River Wensum is a Special Area of Conservation (SAC) from near its source downstream to Hellesdon Mill on the north-western outskirts of Norwich. We currently abstract from the River Wensum. When required, the groundwater source at Costessey is used to supplement water supply. To maintain security of supply, we have proposed a drought permit for the Costessey groundwater source that would allow a temporary increase in the maximum annual licensed abstraction rate. This increase in groundwater abstraction has the potential to impact groundwater dependent features within the study area as well as flows and river levels within the River Wensum.

The environmental assessment concludes that there may be minor impact on flows in the River Wensum, downstream of the Costessey intake point, for summer and winter. As a result, there is potential for up to moderate adverse effects on in-stream ecology as a result of the predicted reduction in flows on the River Wensum.

7.2 Description of proposed drought permit

It is possible that during a severe drought, flows in the River Wensum may be reduced, such that use of the River Wensum abstraction is compromised. In the event of a severe drought, it is proposed that the Costessey groundwater source could be used to support the supplies. To achieve this, the drought permit would support a temporary increase in the maximum annual licensed abstraction rate at Costessey groundwater source from 2000 Ml/yr to 4800 Ml/yr. As per current guidance, the drought permit would cover a six month period, and it is understood that reapplication for a further six months would be permissible.

From April 2019 a Hands Off Flow (HOF) value of 27 Ml/d will apply for abstraction from the river intake. A drought permit application may be triggered by a flow of about 80 Ml/d; this represents a small operating margin above the HOF plus average abstraction. A drought permit may also be triggered by poor water quality at the intake during periods of low flow.

7.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**. Table 7.1 summarises the recommended monitoring in relation to this assessment and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

7.4 Mitigation measures

Where impacts are predicted to be of moderate or higher significance, the related mitigation measures and their proposed triggers are outlined in Table 7.2.

Table 7.1: Summary of monitoring recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders. • Encourage business as usual water saving behaviour. • Investigation into current use of licenced and private abstractions.
Pre-drought (commence in potential drought)	• Frequent monitoring of flow / level data during periods of low flow to identify the trigger for initiating a drought permit application, at key sites along the River Wensum, at Costessey Pits and Taversham Lake. • Desmoulin's whorl snail surveys at Hellesdon Meadows (SSSI Units 40-44) and SSSI Units 38-39. • Creation of a water level management plan for River Wensum SSSI units 38-44 with Natural England. • Additional biological monitoring of macroinvertebrates, macrophytes, fish survey and water quality to supplement baseline monitoring, where required. • Contact all licensed abstractors within the potentially affected area, and initiate engagement with key stakeholders including navigational and recreational users. • Regular liaison with the Environment Agency.
During drought (commence in drought period)	• As above, plus enhanced monitoring of water quality and biological communities to quantify the immediate impact of the drought in River Wensum and Costessey Pits. • Monitoring of groundwater levels at observation boreholes outside 5 km radius of influence.
Post drought (commence after drought permit has been lifted)	• Continued ground and surface water monitoring at River Wensum SSSI units 38 to 44, Costessey Pits and Taverham Lake to assess when mitigation measures are no longer required. • Continued increased frequency of ecological monitoring for three years after the cessation of the drought permit.

Table 7.2: Predicted impacts of moderate significance and higher, proposed mitigation measures and proposed triggers for their use

Feature / Receptor	Predicted impact (those of moderate significance or higher)	Proposed trigger for mitigation	Proposed mitigation measure
Other licenced abstractors	Groundwater drawdown may affect other groundwater abstractors within a 5 km radius of the Costessey groundwater sources. Groundwater drawdown at Costessey Pits 1, 2 and 3 and Taverham Lake may impact fish stocks and water sports.	Once drought permit has been implemented, trigger mitigation if groundwater levels fall below pre-agreed levels.	Consideration of pump lowering, borehole deepening or compensation to other abstractors, if required. These should be discussed with all abstractors with permitted rights within the potentially affected area to identify potential derogation issues.
Fish	Reduced flow in the Wensum, and levels in groundwater dependent watercourses, has the potential to affect fish population, including the brook lamprey species. The impact of lower river flows on white-clawed crayfish and bullhead may be compounded by low DO levels, but no significant impacts are expected as long as DO saturation is above 60%. Other issues could be caused by increased sedimentation and velocity changes. Pit 1 at Costessey Pits is at risk of drying out, whilst the other pits and Taverham Lake may suffer a deterioration in water quality that could adversely affect the fish populations. Modelled changes to flows in the River Tud, River Yare and Spixworth Beck are negligible, and hence river level changes in these watercourses and associated impacts on fish are expected to be negligible.	Trigger mitigation if river flow or levels drop below pre-agreed levels. Any issues are identified by AWS, the Environment Agency (e.g. during a visual inspection of the river or during ecological monitoring) or by local angling groups.	Variable or cessation of abstraction if river flow or levels drop below pre-agreed levels, if DO levels drop below bullhead requirements or ecological monitoring indicates a detrimental effect on the receptor. Groundwater dependent waterbodies: habitat work to improve general conditions in the waterbodies for lamprey species; Fish relocation from Costessey Pits or Taverham Lake if water levels drop or water quality deteriorates significantly.
River Wensum SAC / SSSI feature: Desmoulin's whorl snail	Potential impact on ecological structure of macroinvertebrates is minimal given impacts on hydrology and water quality and baseline community characteristics present. Desmoulin's whorl snail has been assessed separately with moderate impacts given possible wetland habitat loss within the SAC / SSSI sites, attributed to a decrease in groundwater levels.	Triggers for mitigation to be discussed and agreed with Natural England through Water Level Management Plan prior to the implementation of a drought permit application. Mitigation to be in line with the current management of the SAC.	Preparation of a Water Level Management Plan, including measures to retain suitable moisture conditions to sustain a population of Desmoulin's whorl snail. Potential for spray or drip irrigation to increase the humidity of the Desmoulin's whorl snail habitat and maintain water levels at SSSI Units 38-39. Consultation with Natural England suggests spray irrigation may not be the best solution for Land Parcels 40-44.

8. River Trent

8.1 Background

We abstract from the River Trent for Hall WTW. In times of low flow, we may wish to apply for a drought permit for its abstraction in order to maintain supplies to Lincolnshire. This would involve a reduced HOF of 1450 Ml/d, compared to the HOF of 1700 Ml/d specified in the licence.

The environmental assessment demonstrates that the proposed drought permit would result in negligible reductions in the water level and the net fluvial flow in the lower Trent, and that no significant adverse effects on environmental variables are expected. The predicted changes in flow are well within the maximum changes set out by UKTAG guidelines for maintaining Good Ecological Status, and are within the limits for High Ecological Status.

8.2 Description of proposed drought permit

The proposed drought permit would involve a reduced HOF of 1450 Ml/d, compared to the HOF of 1700 Ml/d specified in the licence. Based on the historic reference drought of 1976, this reduction could be needed for approximately two months.

The permit would slightly reduce net fluvial flows in the River Trent, for a limited period during a severe drought event. At the worst point of the adopted drought event (modelled flows for 1976 conditions, approximating to a 1 in 200 year return period event) the reduction in flow would be 1.4% for average abstraction, and up to 4.4% considering maximum daily abstraction rates. It has been found that this would have a minimal impact on areas of interest, including designated sites, ecology and water quality.

The 1976 conditions suggest that a threshold flow of around 2100 Ml/d would be needed to allow for the expected time for the Environment Agency to make a decision on a drought permit application. With this threshold a drought permit might need to be applied for in over 20% of years, but they would nearly always turn out to be unnecessary.

The environmental assessment concluded that the overall status of the WFD waterbodies within and downstream of the River Trent are unlikely to be affected, and it is unlikely that the proposals would prevent the potential for the River Trent waterbodies identified to achieve their overall goal of Good Ecological Status in the future.

8.3 Description of the need for monitoring and mitigation

The potential impact of the proposed drought permit option is assessed in the EAR, summarised in **Appendix 7**.

The environmental assessment for the River Trent intake has indicated no significant environmental impacts. To address remaining uncertainties, a study into the effect of the drought option on wetted widths will be performed. Lamprey surveys will be added to routine baseline physical environment monitoring to be conducted before, during and after a drought event. If baseline monitoring shows detrimental impacts to water quality, hydrology or ecological receptors within the Trent, ecological monitoring and mitigation will need to be reviewed. The suggested monitoring and mitigation measures have been summarised in Table 8.1 below and at which stage of the drought it is required. Please refer to **Appendix 7** or the EAR for further details of the impact assessment results.

AWS would be responsible for implementing any measures, but the need for these measures will be agreed at the time in collaboration with the Environment Agency, and any other relevant stakeholders.

Table 8.1: Summary of monitoring and mitigation recommendations at each stage of drought

Baseline (normal (non-drought) conditions)	• Baseline monitoring to establish baseline environmental conditions. • Identification of relevant stakeholders. • Encourage business as usual water saving behaviour.
Pre-drought (commence in potential drought)	• Continuation of baseline monitoring. • Undertake lamprey surveys.
During drought (commence in drought period)	• Continuation of baseline monitoring with lamprey surveys. Regularly track results to confirm no detrimental impacts to water quality, hydrology or ecological receptors. • If baseline monitoring identifies any impacts, additional ecological monitoring and mitigation should be reviewed.
Mitigation measures (commence on implementation of drought permit if needed)	• Drought permit abstraction will cease if: • The flow drops below the temporarily reduced HOF, based on flow monitoring results at North Muskham, or • Significant impacts on other receptors, such as water quality, hydrology, or ecology, are identified.
Post drought (commence after drought permit has been lifted)	• Continuation of baseline monitoring. • Undertake post drought lamprey surveys. • If any additional ecological monitoring has been undertaken, this monitoring should continue for up to three years after the drought.

Cover photo - Anglian Water's Taverham Mill, a 40-hectare nature reserve in Norfolk. It has four lakes and is situated by an old weir and mill pond on the River Wensum.