Draft Water Resources Management Plan 2024

Section 5 – Environmental Forecast

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Background and Introduction

Our supplies come from a mix of surface water (from rivers) and groundwater (underground water holding rock formations, known as aquifers) sources. In some cases, taking water out of rivers and aquifers poses a risk of negatively impacting the environment. It is important that we plan to reduce abstractions where they cause environmental problems.

The relationship between abstraction and the environment can be very complicated, and so in some cases we do not currently know for certain whether abstractions are having a negative impact on the environment. Finding new sources of water and making changes to our complex supply network is expensive and can take a long time, and so it is important that we consider environmental risks alongside ensuring a resilient and affordable water supply for our customers.

Given that there is a lot of uncertainty over which sources we will need to take less water from in the future, it is sensible for us to look at different scenarios in order that we build a robust and efficient plan.

In this section we describe how we have determined different scenarios of future abstraction licence reductions through building 'Environmental Destination' scenarios. The impact that these licence scenarios would have on our supplies in our different Water Resource Zones (WRZs) is then presented, and we discuss how we will conduct investigations to reduce uncertainty going forward.

5.1 Water resources planning is based around the calculation of a supply-demand balance. We calculate the amount of water that we could reliably supply during a drought and compare this against the demand for water that we anticipate, including a buffer between supply and demand to account for uncertainty, called Target Headroom. Where there is a gap between our available supplies and the demand for water we know that we must provide solutions to ensure that our supplies are sufficiently resilient to drought events.

5.2 When calculating our supply forecast, one of the key factors that is considered when defining the supply capability, known as Deployable Output (DO), of a source or group of sources is the quantity of water that is licensed for abstraction. Our abstraction licences tell us how much water we can take from each of our sources over the course of a year and in any 24-hour period, as well as where we can take this water from. Some licences also set additional or variable limits, setting different daily limits depending on river flows.

5.3 Abstraction licences are granted by the Environment Agency, and the limits set by abstraction licences are designed to ensure that the volume of water that can be abstracted does not negatively impact the environment. This requires assessment of localised environmental impacts that could be caused by one or two abstractions, as well as much wider assessment of whether the total amount of water that is licensed across a catchment poses an environmental risk.

5.4 Knowledge of the link between abstractions and environmental impact is improving, and environmental standards are becoming stricter with increased ambition to reduce the adverse impact of abstraction on sensitive watercourses. Over the last 30 years we have gone through a process of investigating the impact that many of our sources have on the environment. Where it has been found that our existing abstraction licence limits are resulting in adverse environmental impact or pose a risk of causing environmental deterioration we have reduced our licensed

abstraction. We are also required to modify our licensed abstraction according to rules which are now set out in the Water Framework Directive (WFD).

5.5 Table 5 - 1, previously shown in Section 2, details the abstraction licence reductions that we have made to date. Having made licence reductions of over 130 Ml/d since 1995 demonstrates our commitment to making abstraction licence reductions and shows that we are not setting an environmental destination from a standing start.

Source	River	Volume of Reduction (Ml/d)	Date
Brasted	Darent	4.56	May 1995
Sundridge	Darent	12.278	Jan 1997
Lullingstone	Darent	4.592	Jan 1997
Eynsford	Darent	18.182	Jan 2005
Horton Kirby	Darent	7.97	Jan 2005
Hampden	Misbourne	3.68	Jun 1998
Wendover	Misbourne		Jun 1998
Mill End	Wye	18.184	Jan 2011
New Ground	Bulbourne	7.97	Jan 2011
Compton	Pang	13.638	Feb 2007
Blewbury	Blewbury Pond	9.092	Feb 2007
Speen	Kennet & Lambourn	4	Mar 2015
Axford	Kennet	4	Mar 2017
Ogbourne	Og	8.096	Mar 2017
Childrey Warren	Letcombe Brook	4.546	Mar 2020
Pann Mill	Wye	13.23	Mar 2020
Total		134.0	

Table 5 - 1: Previous Licence Reductions Made for Environmental Improvement

5.6 There is concern that in some locations, particularly vulnerable catchments such as chalk streams, the quantity of water that is licensed for abstraction could still be higher than is environmentally sustainable or could become unsustainable as climate change causes river flows to drop. We will continue investigating the impacts of our abstractions and making reductions where it is right to do so.

5.7 In previous iterations of the WRMP process, the Water Resources Planning Guideline has stated that we should consider abstraction licence reductions which are confirmed within the Water Industry National Environment Programme (WINEP). The WINEP only covers periods of five years at a time, and so in previous iterations of the WRMP we have not considered in detail abstraction licence reductions that could be required in the longer term (though in WRMP19 we did include a scenario of limited licence reduction in chalk stream catchments).

5.8 Following direction from the Water Resources Planning Guideline and National Framework for Water Resources, in this iteration of the WRMP we have considered different scenarios of licence reduction that may be required up to the year 2060 and have integrated these scenarios into our supply forecast. These scenarios are known as scenarios of 'Environmental Destination'. All companies across the WRSE region have developed scenarios of Environmental Destination.

5.9 Some of the difficulty in assessing the future licence reductions that may be necessary is that without conducting detailed investigations we do not know to what extent our abstractions are influencing river flows, or whether any influences that our abstractions are having could cause any ecological detriment. In addition, we cannot predict whether future government policy will cause further tightening of environmental legislation. Due to these factors, we have considered scenarios of potential future licence reduction which cover a wide range.

5.10 All of the scenarios that we have developed incorporate the need to cap some licences at 'Recent Actual' abstraction to prevent the risk of deterioration under the WFD, as set out in Environment Agency supplementary guidance.

5.11 In the rest of this section, we have described:

- The drivers behind our Environmental Destination scenarios
- The methods we have used when deriving scenarios of future licence reduction
- Presentation of our scenarios of future licence reduction

Drivers for our Environmental Destination Scenarios

5.12 There are a number of factors which have influenced our scenarios of abstraction licence reduction as set out in Section 2, both statutory and non-statutory, but all are focussed around delivering environmental improvement and so prioritising those reductions which are most likely to deliver these improvements. Many of the licence reductions that we have set out in our scenarios are in chalk catchments. The principal reason for the need to protect Chalk Streams is their unique status as identified in the Biodiversity Action Plan (BAP), but we have also recognised the need to protect other sensitive streams such as those in the Cotswolds where the principal aquifer is Limestone rather than Chalk.

5.13 In this section we briefly introduce factors which have influenced the scenarios that we have developed.

Environment Agency Guidance

5.14 The National Framework for Water Resources[1] introduced the concept of an 'Environmental Destination' and set out the requirement for Regional Groups to investigate and develop long-term Environmental Destinations. One component of this was the development of scenarios[2] using consistent methods across England to determine flow changes that would be necessary to meet Environmental Flow Indicators (EFIs[3]) across all catchments. The different scenarios represent different ways that a EFI could be calculated in the future, and some scenarios involve assigning different 'abstraction sensitivity bands' to some catchments; the abstraction sensitivity band determines what proportion of 'natural' flow should be left for the environment in calculation of an EFI.

5.15 Following the publication of the National Framework for Water Resources, the Environment Agency has set out guidance in the Water Resources Planning Guideline[4] which tells us how we should incorporate an Environmental Destination into our planning. This guidance covers the development of an environmental destination to reduce public water supply abstraction licences, with the expectation of reducing impact on water-dependent habitats and improving their health in line with the National Framework for Water Resources. The target is to achieve these abstraction licence reductions by 2050. As a result, there is a need to include the consequences of future potential abstraction licence reductions in developing the regional WRMP for WRSE, which covers the period 2025 to 2075. The consideration of licence reductions that may be required in the long term is a key change in the Water Resources Planning Guideline between WRMP19 and WRMP24.

No Deterioration – Water Framework Directive (WFD)

5.16 We are required to ensure that no waterbody is subject to deterioration under the WFD as a result of increases in our abstraction. As set out in Section 2 we are undertaking a series of

[1] Environment Agency, 2020, Meeting our Future Water Needs: A National Framework for Water Resource, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872759/National_Framework_for_water_resources_main_report.pdf
[2] Environment Agency, 2020, Meeting our Future Water Needs: A National Framework for Water Resource – Appendix 4: Longer Term Environmental Water Needs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872344/Appendix_4_Longer_term_environmental_water_needs.pdf
[3] Environment Agency, 2013, Environmental Flow Indicator: What it is and What it Does, http://www.hwa.uk.com/site/wp-content/uploads/2017/12/SWCD11.5-Environment Agency-Guidance-on-EFI-January-2013.pdf
[4] Environment Agency, 2022, Water Resources Planning Guideline, https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

investigations into the sources where a risk of deterioration has been identified through low-flow investigations. These investigations are ongoing and the risk of a requirement for licence reduction has been assessed in each case.

5.17 Water companies are also required to plan so that there are no instances where WFD status is worse than moderate as a result of water company activity. For cases where WFD status is worse than moderate due to river flow targets not being met we have reviewed our abstractions and in each case reductions required to address the failure are addressed in one or more of our scenarios.

5.18 Assessing whether abstractions may pose a risk of environmental deterioration requires interpretation of the WFD and it is often not clear cut what is required. The Environment Agency has recently applied a new approach and policy in assessing the risk of deterioration posed by existing abstraction licences. The new approach and policy is set out in the Supplementary Guidance described previously, and sets out that in some cases that we should cap licences at rates of abstraction that have occurred recently to prevent us from abstracting more than we have done previously. We often abstract less than our abstraction licences would allow, but the Environment Agency has assessed that retaining the potential for abstraction above rates that have occurred recently means that there could be a risk of deterioration.

Chalk Stream Strategy (part of the Catchment Based Approach (CaBA)).

The Chalk Stream Strategy has been developed jointly between Defra, the Environment Agency, water companies and other stakeholders. This is described in Section 2 which sets out the non-statutory strategy outlined in a document which has been agreed to represent a broad aspiration for the recovery of Chalk Streams and has been considered in the development of our scenarios. We support this strategy and are committed to delivering measures to help realise the goals of the strategy covering quantity, quality and physical habitat. We also recognise the constraints and the pragmatic realisation that it will take some time to get to the destination. The CaBA strategy has helped inform our scenarios principally through endorsing the requirement to address the adverse impact of abstraction on vulnerable chalk streams. We have used the prioritisation criteria which have been discussed and developed with input from the stakeholders involved in the development of the CaBA strategy to inform our scenario development.

Flagship Catchments

5.19 Rebecca Pow, the ex-DEFRA Minister, wrote to a number of water companies in June 2021 stressing that restoring England's internationally rare Chalk streams is a government priority and urging them to identify flagship catchments to prioritise for recovery of Chalk streams. We responded to this Government request nominating the Pang and Chess catchments as flagship catchments which we would work on to restore to good ecological status. These catchments will therefore be of particular focus for addressing the impacts of abstraction and all other adverse impacts on these rivers. This focus is reflected in our scenarios for abstraction reduction.

Water Industry National Environment Programme

5.20 Rather than a driver for our scenarios, the WINEP is the mechanism by which we anticipate our strategy will be implemented. In the WINEP our environmental improvement programme is set out and agreed through joint work with the Environment Agency. The WINEP is produced for each water company's 5-year Asset Management Planning (AMP) cycle and is used to specify the implementation of schemes to be undertaken during the following AMP to improve the environment, including the abstraction reductions that may be required to address low river flows exacerbated by abstraction. The WINEP is also used to set out the future investigations into the

impact of abstractions at our sources that are needed as well as measures to improve the environmental resilience of rivers such as river restoration. For previous AMP cycles the WINEP has been specified by the Environment Agency based on their assessments of the need for abstraction impacts to be addressed, taking into account investigations we have undertaken into the impact of our abstractions.

5.21 Our expectation is that licence reductions that are identified as necessary will be included in a future WINEP programme. In addition, our WINEP submissions for AMP8 and AMP9 will contain extensive programmes of investigation, which will help determine which of the licence reductions set out in our Environmental Destination scenarios we should make in future AMPs.

Methodology

5.22 The key outputs needed to shape our Environmental Destination scenarios are:

- Different plausible scenarios of licence reduction, translated into the impact of these reductions on our available supplies, to be incorporated into our adaptive planning (see sections 6 and 10 of our WRMP for further details of our adaptive planning techniques)
- A plan of action to determine which of the licence reductions set out in these scenarios we should make, requiring monitoring and investigation

5.23 Our monitoring and investigation plan is set out in Section 11 and will be detailed in our WINEP submission in November 2022. The rest of this chapter focuses on the development of scenarios of licence reduction, and the translation of licence reduction into supply capability reduction.

5.24 We have produced three scenarios which have been incorporated into our adaptive planning. We have named these High, Medium, and Low.

Starting Point: Environment Agency Scenarios of Flow Increase Required

5.25 In setting out its view of what an environmental destination looks like, the Environment Agency developed a number of scenarios that evolved progressively into some of the scenarios that we have included in our WRMP. These scenarios used nationally consistent methodologies, with the end product of each scenario being the required flow increase in each water body that would be required to meet EFI conditions. The differences between these scenarios were in how the EFI condition is defined when incorporating flow changes caused by climate change, and in the 'Abstraction Sensitivity Band' (used to define how much 'natural' flow must be left for the environment) applied to different catchments.

5.26 WRSE commissioned work to determine the reductions in abstraction that would be necessary to meet EFIs across all catchments in the WRSE Region, under these scenarios.

5.27 On initial review of the Environment Agency scenarios for Thames Water, two key things were noted:

- All scenarios involved very significant abstraction reductions
- There was relatively little difference between reductions required in different scenarios

5.28 As a specific example of the limited difference between the Environment Agency-defined scenarios, the details of the smallest licence reduction scenario, termed business as usual (BAU), and the largest licence reduction scenario (Enhanced) for us were as follows:

- In the 'BAU' scenario, 452 Ml/d of abstraction reduction was found to be required, with a loss of 834 Ml/d of licence
- In the 'Enhanced' scenario, 524 Ml/d of abstraction reduction was found to be required, with a loss of 1043 Ml/d of licence

5.29 These factors led to Thames Water and WRSE investigating other approaches in the development of Environmental Destination scenarios.

5.30 In developing our scenarios of licence reduction, we have followed two distinct methodologies, with some common steps. The first approach involves deriving licence reductions which would

satisfy EFI calculations. The second method involves a bottom-up assessment of licence reductions that we think are likely to be ecologically effective.

5.31 The first approach will satisfy the requirements of the guidance and gives us an upper bound on licence reductions that may be required. We then take a different approach for deriving other scenarios due to the assumptions made in deriving this upper bound. The key assumption made implicitly in the derivation of the upper bound scenario is that all licence reductions which would satisfy an EFI calculation will be made. Our experience is that sometimes we conduct investigations into the impact of abstraction on river flows and flow-dependent ecology and find that our abstraction is not having the impact that would be suggested in the EFI calculation, and/or that the ecological benefit derived from flow gains would not be sufficiently great to merit the large costs associated with building new sources of water and providing replacement infrastructure.

5.32 All companies in the WRSE regional group have adopted the same methodology in deriving abstraction licence reductions that would be required in the High scenario (High meaning a high level of abstraction reduction). Companies have then taken different approaches when defining Medium and Low scenarios of licence reduction. These scenarios were used in the WRSE emerging plan but were specified independently by each company and so were not developed using a consistent methodology.

5.33 As described below for Thames Water, the 'high' scenario was, therefore, based on the requirement to meet the EFI, while the 'low' and 'medium' scenarios were developed considering existing and previous WINEP investigations and known sensitive catchments together with some expert judgement.

High Scenario – Step 1: Transformation of catchment-scale reductions to source-scale reductions

5.34 As described in the preceding section, the Environment Agency produced environmental destination scenarios for all river catchments based on achieving the Environmental Flow Indicator (EFI) at specific assessment points by reducing licensed abstraction quantities. Outputs from the 'Enhanced' scenario are the basis for the High scenario. As the proposed licence reductions were calculated at a catchment scale, no information was available for assessing reductions potentially required at specific licensed abstraction sources. To transform the catchment scale view of licence reductions, Mott MacDonald, on behalf of the WRSE group of companies, developed and implemented a process[5] to apportion the proposed reductions to specific abstraction sources.

High Scenario - Step 2: Calculation of resultant Deployable Output Reductions

5.35 Outputs from Mott MacDonald's work included, for each licence, a value which specifies the future maximum licensed quantity that would be available. If future licensable abstraction identified from Mott MacDonald's work is less than the current source DO, then Annual Average DO is capped at the future licensable volume. The DO impact is then calculated as the original DO minus the capped DO. For some sources this required consideration of multiple licences and sources, where for example, there may be a single licence with abstraction from multiple individual abstraction points. For other sources, aggregated licences were also considered. For some sources, WRZ-level water resources modelling was carried out.

[5] Mott MacDonald, 2020, WRSE Environmental Ambition – TW Internal Link: 100412624-011-SSTNB-01B Sustainability reductions for WRSE environmental ambition.pdf

5.36 Where DO reductions are required as part of the AMP7 WINEP programme, it has been ensured that reductions are not double counted.

5.37 The main target of the Environment Agency's Environmental Destination is reduction in annual (as opposed to daily, also known as peak) licence quantities but in some cases these reductions would leave sources difficult to manage, having large peak to average licence ratios. For the Dry Year Critical Period (DYCP) planning scenario, therefore, a method has been used to establish peak DO reductions from the average DO remaining. This assumes that the maximum feasible ratio of DYCP to DYAA DO for each source is the maximum of:

- The current ratio of the source peak DO to average DO
- The current ratio of Peak DO to Average DO for the WRZ in which the source is located
- The ratio of peak to average distribution input (DI), for the WRZ in which the source is located, during the extended 2018 hot, dry period
- 1.1:1; this was set as a default value, i.e., peak DO will as a minimum be allowed to be 10% greater than annual average DO.

5.38 The maximum feasible peak DO for each source was identified by multiplying the capped average DO by the maximum ratio found. This was compared with the current peak DO to determine whether a peak (PDO) reduction is implied.

Medium and Low Scenarios: Prioritisation of Abstraction Sources to Define Sources for Future Licence Reduction Scenarios

5.39 The prioritisation of abstraction sources to be included in the Low and Medium scenarios provided for WRSE use has been defined on the following basis:

- Prioritisation of chalk streams taking into account the high profile of some chalk streams established through historic stakeholder concern
- Insight gained from sustainability reductions implemented previously at groundwater abstraction sources following investigations
- Insight gained from abstraction impact investigations during pre-AMP7 WINEP investigations, including those where no licence reductions were made
- Abstractions that have been prioritised in AMP7 for WINEP and specific WFD No Deterioration investigations
- Focus on priorities identified through discussions with the Environment Agency

5.40 Considering these aspects, the river catchments and abstraction sources located within them that have been identified as priorities for inclusion in our Low and Medium scenarios are collated in Table 5 - 2. This includes potentially vulnerable Chalk River catchments, as well as other potentially vulnerable catchments that depend on groundwater from the Cotswolds Oolitic Limestone aquifers and groundwater from the Lower Greensand (LGS) aquifers. Note: Bibury is included in Table 5 - 2 because the Environment Agency requested a scenario with a reduction at this source. We proposed a reduction, retaining some licence for supply resilience, and endorsed by the Environment Agency, however the need for reduction needs further investigation.

5.41 Although these information sources have been used to guide the focus on river catchments and sources that may require abstraction licence reductions to help restore river health, the selection

is also based on a degree of expert judgement. We will continue to work on the prioritisation of the reductions required in the future. Our future prioritisation will also be informed by the further investigations that will be required in some catchments to confirm whether adverse impacts from abstraction are occurring or could occur, and that benefits from reductions will be delivered.

Information Source	Catchment	Abstraction Sources
Previous sustainability reductions	Darent (C)	Horton Kirby Eynsford Lullingstone Sundridge (LGS)
	Wye (C)	Pann Mill
	Misbourne (C)	Hampden Bottom
Pre-AMP7 WINEP investigations	Darent (C)	Westerham
	Cray (C)	Bexley
	Lee (C)	Lower Lee
	Wandle (C)	Waddon
	Wye (C)	Radnage
	Upper Thames	Farmoor
AMP7 WINEP investigations	Hogsmill (C)	Epsom sources
	Lee (C)	New Gauge Northern New River Wells
	Chiltern Scarp (C)	Chinnor Watlington
	Pang (C)	Pangbourne Bradfield
	Upper Kennet (C)	Marlborough Clatford
	Churn	Latton Ashton Keynes
	Dikler	Upper & Lower Swell
	Tillingbourne	Netley Mill Shalford
Other Environment Agency requirements	Coln	Bibury

Note: (C) = Chalk river catchment, (LGS) = Lower Greensand aquifer source

Table 5 - 2: Collated river catchments and abstraction sources in Low and Medium scenarios

Prioritisation criteria

5.42 We have considered a number of other criteria in determining the scenarios for abstraction reductions. These criteria have been developed in consultation with the Environment Agency and with the Environmental Advisory Group set up for input to the WRSE process. These criteria are:

- Likelihood of ecological benefit
- Environmental Sensitivity
- Stakeholder accessibility

All Scenarios: Definition of Dates for Delivering Reductions in DO

5.43 The definition of dates for delivering reductions in source DO reflects a combination of several drivers, including the following:

- Priority vulnerable catchment – Where catchments are currently perceived to be higher priority for abstraction reductions, based on previous investigations, an earlier delivery in the environmental destination programme is more likely
- Potential investigation outcomes – Where there are ongoing WINEP investigations in AMP7, either for low flow or WFD No Deterioration, an assumption is made that the outcomes are more likely to result in earlier abstraction reductions
- Magnitude of abstraction reduction – Where abstraction reductions are relatively small, e.g. reductions to recent actual abstractions, the reductions may be delivered relatively early. Conversely, where large abstraction reductions are proposed the reductions may be delayed until later into the environmental destination programme
- Outputs from further abstraction impact investigations - Where further investigations are required to increase confidence in decisions taken, later delivery of potential abstraction reductions will result
- Interaction between existing assets and asset solutions – Where the asset solutions required to enable abstraction reductions interact with existing critical water supply assets, and/or assets in the process of being upgraded, this will influence the potential achievement of the required scheme and is likely to delay the delivery of the reduction
- WRZ resilience and solution lead time – WRZ resilience to changes in water supply source changes and the lead time for delivery of the required strategic solution are considered, leading to reductions being later in the programme

5.44 These drivers are set out in Table 5 - 3 with examples of the sources whose reduction they influence.

Driver	Examples of Sources
Priority vulnerable catchment	Horton Kirby Eynsford Lullingstone
Potential investigation outcomes	Epsom sources Bradfield
Magnitude of abstraction reduction	Netley Mill Bexley Lower Lee New Gauge
Outputs from further abstraction impact investigations	Bexley Sundridge Westerham
Interactions between existing assets and asset solutions	Marlborough Clatford New Gauge
WRZ resilience and need for strategic solution	Latton Marlborough Clatford

Table 5 - 3: Drivers influencing timing of abstraction reductions

5.45 All reductions are assumed to be delivered by 2050 at the latest, as is required by guidance, apart from reductions associated with the Lee Valley surface water system. This is because ecological benefits from reductions in the Lee Valley surface water system would require significant modifications to the channel morphology of the Middle and Lower Lee, and it is not considered that 2050 is a realistic date for these modifications to have been achieved. 2060 has been proposed as an alternative date in this case.

5.46 We have also used other criteria to determine the prioritisation of sources for reductions in the AMP8 period

5.47 The outputs from the steps up to this point are 'High', 'Medium', and 'Low' scenarios of DO reduction associated with individual source licence reductions.

All Scenarios: Accounting for Increases in River Flows Resulting from Affinity Water and Thames Water Licence Reductions

5.48 A further important outcome resulting from the delivery of licence reduction in the environmental destination scenarios is the return of water to the environment. In particular, the benefit of increased river flows that may support increased direct river abstraction downstream needs to be taken into account in calculating water supply system capability. This needs to account for the potential magnitude of increased abstraction as well as the timing of these increases in WRMP supply forecast scenarios.

5.49 The potential benefits for river flows and river abstractions that accrue from abstraction reductions in the environmental destination set out by Affinity Water are especially important for water supply to our customers in the London WRZ. This relates to benefits from reductions at Affinity Water groundwater sources in the Colne and Lee catchments and the potential for us to increase abstraction from the rivers Lee and Thames in north and west London, respectively.

5.50 To account for water resource system benefits resulting from reduction in Affinity Water groundwater abstractions, Affinity Water requested a run of the WRSE Pywr model. The outputs from this model run were used to derive benefit that should be added to the London WRZ DO to reflect flow gains associated with licence reductions made by Affinity Water.

5.51 It is important to note that, in this run, it was not assumed that 1 Ml/d of groundwater abstraction reduction upstream would equate to 1 Ml/d of flow gain in London, due to the complex groundwater-surface water relationships that exist, particularly in chalk catchments. Instead, based on a range of evidence collected by Affinity Water, including empirical data where previous groundwater reductions have been made, and reflecting the need to be prudent in determining the security of supply, an assumption was made that, at low flows (those relevant for DO calculation), around 0.3 Ml/d of flow gain could be relied upon per 1 Ml/d of abstraction reduction. This same assumption was applied when considering flow gains from Thames Water sources featured in our licence reduction scenarios. This ratio of 0.3 Ml/d flow gain to 1 Ml/d abstraction reduction is based on analysis of regional groundwater modelling and analysis of data observed from previous cessation of abstraction at sources.

5.52 Profiles of DO gain for London were derived based on the steps above and incorporated into each of our Environmental Destination scenarios accordingly.

5.53 Combining all steps above, profiles of net DO change across the planning period were defined for each WRZ for each of the Low, Medium, and High environmental destination scenarios. The net DO change in each year of the planning period is a balance of the following:

- DO reduction at individual abstraction sources
  - Thames Water sources
- DO increase from return of water to river flows, with benefits where river flow increases are upstream of Thames Water abstraction points from
  - Thames Water source DO reductions
  - Affinity Water source DO reductions
- Changes programmed to reflect the timing of abstraction reductions made by
  - Thames Water
  - Affinity Water

Licence Capping Requirement

5.54 Subsequent to the development of our main, long-term abstraction reduction scenarios, the Environment Agency issued guidance relating to the requirement for licence capping to avoid the potential for deterioration under the WFD. The document 'Water resources planning guideline supplementary guidance – actions required to prevent deterioration' was provided by the Environment Agency on 4 April 2022. The Environment Agency has also provided two Information Letters – 'Addressing deterioration risk from existing abstractions' - one on 15 November 2021 and a further letter on 4 April 2022.

5.55 As is described above we are currently investigating a number of sources to determine the risk of deterioration under WFD as a result of increase up to full licence.

5.56 We have assessed the pre-WRMP licence information, licence capping guidance and letters, alongside abstraction records for 2009-15 and other source/Water Body information and have developed a view of which licences may need to be capped during AMP8. We have taken this initial view and determined a potential series of reductions which could be required in AMP8, subject to the outcome of investigations currently being undertaken. We have then reviewed the requirements on a source-by-source basis considering whether the sources already feature in our scenarios and other factors relating to the risk of deterioration that would result from the abstraction including periods of outage. We have used this to modify the likely requirement for reductions in AMP8, ensuring that we then do not double-count reductions from a single source.

Results: Our Environmental Destination Scenarios

5.57 High, Medium, and Low scenarios of DO reduction resulting from potential future abstraction licence reductions were developed using the methods described above (Table 5 - 4). To reiterate, the scenarios can be described as:

- High – This is a view of licence reductions that would be required to meet requirements of the 'Enhanced' environmental destination scenario set out by the Environment Agency based on achieving the Environmental Flow Indicator (EFI) at specific assessment points
- Medium – This is a scenario that we defined based on insight from previous abstraction impact investigations plus abstractions prioritised for AMP7 investigation
- Low – This is a scenario we defined on a similar basis as the Medium scenario, but which includes only those sustainability reductions that we consider to form a 'plausible low' scenario

5.58 It is important to note that none of our scenarios align exactly with the Environment Agency's 'BAU+' scenario. Our High scenario will align most closely with the BAU+ scenario, as such a scenario would be based on achievement of the EFI at specific assessment points, and we have seen that there is limited difference between the different Environment Agency scenarios.

5.59 The principal difference between these three scenarios is the total magnitude of licence reductions proposed across the Thames Water supply area. It should be noted that although the Environment Agency set a nominal target date of 2050 for reaching the environmental destination, no phased programme of reductions has been defined by the Environment Agency. Therefore, we have set out a timetable of reductions that is broadly the same across each of the High, Medium and Low scenarios but of different total magnitudes.

5.60 Further investigations will be required to confirm whether adverse impacts from abstraction are occurring or could occur, and that benefits from reductions will be delivered.

5.61 The sources, magnitudes, and timing of DYAA DO reduction at each source for each scenario are detailed in the table below

5.62 The Low scenario for south London includes three of the remaining groundwater sources in the mid-Darent which abstract from the Chalk, these are included because of the high historical stakeholder profile of the Darent and their location in the sensitive middle reaches of the river. The source at Bexley abstracts from the chalk in the lower reaches of the Cray and is included because previous investigations have highlighted potential adverse impact from the abstraction, although it has previously not been cost beneficial to deliver the reduction. The Epsom sources are included because of the current AMP7 investigation and the location of the abstraction in the sensitive headwaters of a chalk fed stream.

5.63 For north London the reductions reflect concern highlighted by the Environment Agency that measures should be taken to move towards the abstraction reduction requirements for the lower and middle Lee. These reductions will also deliver the statutory requirement for no deterioration in the middle Lee.

5.64 In the Thames Valley the sources at Bradfield and Pangbourne are included because of the high-profile nature of the river Pang, a sensitive chalk streams which is also a Flagship Catchment. The reduction at Bradfield would also mean that we would have reduced abstraction such that there

is no significant abstraction remaining in the catchment that could adversely affect the flow of the river Pang. This meets the prioritisation requirement of attempting to address a number of catchments fully so that they are soon as close to free from abstraction pressures as can be reasonably achieved. The sources at Marlborough and Clatford have been included because of the high-profile nature of the river Kennet and their location in the sensitive headwaters of the Kennet catchment. The reductions at Pann Mill and Radnage are included to address the impact on the river Wye – a sensitive Chilterns Chalk stream where investigations have been undertaken in the past and in which some reductions have already been made. The remaining reductions would mean that no abstraction would remain in the Wye catchment and would leave very little chalk abstraction by us in the area of the sensitive Chilterns chalk streams. The reduction at Netley Mill is require because of the AMP7 investigation that is ongoing and the requirement for no deterioration. Its location in the upper reaches of a chalk stream reinforces this priority. Finally, reductions at Bibury and Latton are included to address impacts on sensitive Cotswolds streams including no deterioration requirements in relation to the Latton source. For Bibury the Environment Agency has requested inclusion of a reduction to reduce potential adverse impact on the river Coln.

5.65 The medium scenario is based on the same principles as the Low scenario but including more reductions to provide a greater level of environmental ambition. For south London the Sundridge and Westerham sources are included to provide further reductions in the upper reaches of the sensitive river Darent. For north London the medium scenario includes further reduction at our surface water abstractions on the River Lee to help reduce abstraction pressures in relation to the flow targets for the Lower Lee. In the Thames Valley further reductions are planned at Hampden Bottom to further reduce abstraction in the Chilterns, specifically addressing pressures on the sensitive River Misbourne, an important chalk stream. Reductions at Chinnor and Watlington are included for the benefit of sensitive Chiltern scarp spring fed rivers. Finally, the reductions at Ashton Keynes and Upper and Lower Swell are included in relation to sensitive Cotswolds streams.

		Low Scenario		Medium Scenario		High Scenario	
Source	WRZ	DO Reduction	Year	DO Reduction	Year	DO Reduction	Year
Environment Agency Area – Kent & South London							
Horton Kirby and Eynsford	London	3.4	2035	3.4	2035	6.8	2035
Lullingstone	London	4.5	2035	4.5	2035	4.49	2035
Waddon	London	7.56	2040	7.56	2040	7.56	2040
Bexley	London	9	2050	15	2050	31.7	2040
Epsom Sources	London	10.2	2030	10.2	2030	10.2	2030
Sundridge	London			1.355	2050	1.36	2050
Westerham	London			0.972	2050	0.88	2050
Darenth	London					20.7	2050
Wilmington	London					19	2050
Dartford	London					3.63	2050
Orpington	London					8.55	2050
Crayford	London					13.6	2050
Wansunt	London					13.6	2050
Green St Green	London					4.46	2050

		Low Scenario		Medium Scenario		High Scenario	
Environment Agency Area – Thames Valley							
Marlborough	SWOX	2.5	2040	2.5	2040	2.5	2040
Clatford	SWOX	1.24	2040	1.24	2040	1.24	2040
Pann Mill	SWA	7.5	2050	7.5	2050	7.5	2050
Radnage	SWA	1.58	2040	1.58	2040	1.58	2040
Bradfield	Kennet Valley	1.64	2030	1.64	2030	1.64	2030
Pangbourne	Kennet Valley	5	2035	5	2035	5	2035
Bibury	SWOX	3	2040	3	2040	0.67	2040
Latton	SWOX	5	2040	5	2040	9.74	2040
Netley Mill	Guildford	1.18	2030	4.5	2040	4.5	2040
Ashton Keynes	SWOX			1.71	2050	1.71	2050
Upper & Lower Swell	SWOX			1.82	2050	1.82	2050
Chinnor	SWOX			1.61	2040	1.61	2040
Watlington	SWOX			0.26	2040	0.26	2040
Seven Springs	SWOX					1	2050
Syreford	SWOX					0.52	2050
Ashdown Park	SWOX					0.95	2050
Woods Farm	SWOX					1.59	2040
Bishops Green	Kennet Valley					0.8	2040
East Woodhay	Kennet Valley					3.87	2040
Ufton Nervet	Kennet Valley					11.58	2050
Playhatch	Kennet Valley					6.5	2040
Fognam Down	Kennet Valley					0	2050
Sheeplands	Henley					6.21	2050
Datchet	SWA					13.08	2050
Bourne End	SWA					5.65	2050
Medmenham	SWA					16.3	2050
Albury	Guildford					3.58	2040
Mousehill & Rodborough	Guildford					1.48	2040
Shalford	Guildford					20.32	2050
Farmoor	SWOX			15	2050	35	2050
Environment Agency Area – Herts and North London							
Lower Lee	London	25	2060	50	2060	65	2060
Northern New River Wells	London	17.96	2040	17.96	2040	40	2060
Hampden Bottom	SWA	0		2	2040	2	2040
New Gauge	London	0		60	2050	80	2050

Table 5 - 4: Licence Reductions Included in our Environmental Destination Scenarios

5.66 The impact of each scenario on WRZ DO for each of our WRZs for the Annual Average condition is shown in the figures below.

London

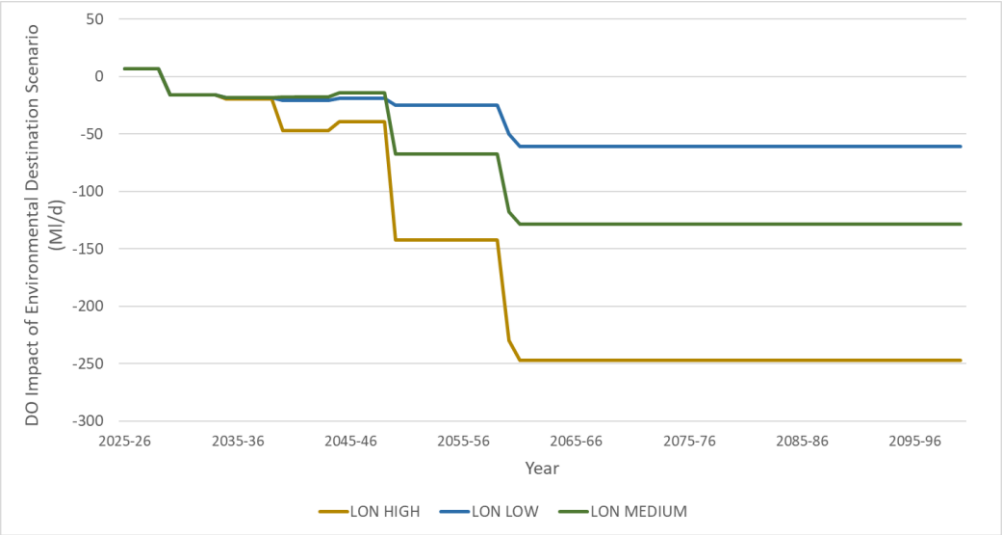

Figure 5 - 1: London DYAA Environmental Destination Scenarios

SWOX

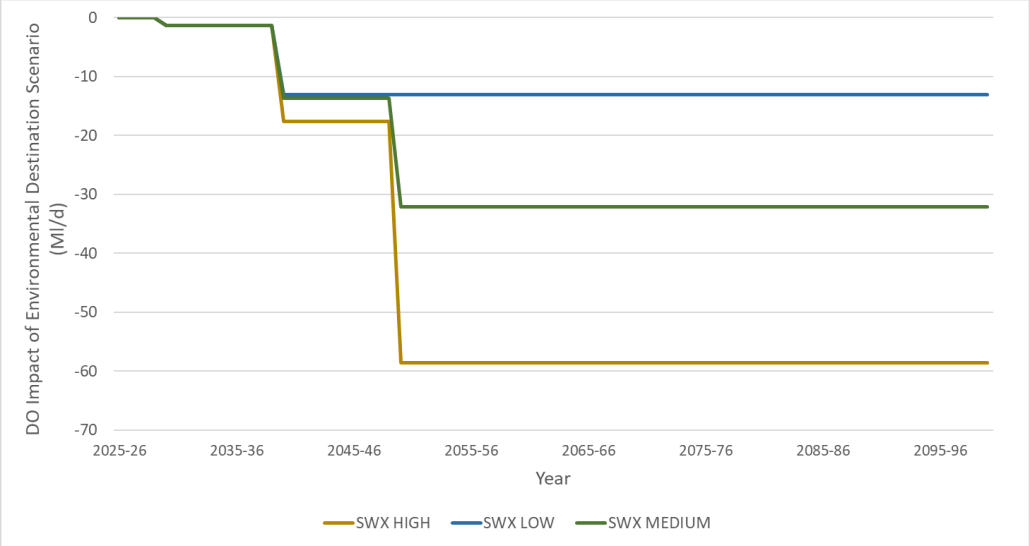

Figure 5 - 2: SWOX DYAA Environmental Destination Scenarios

SWA

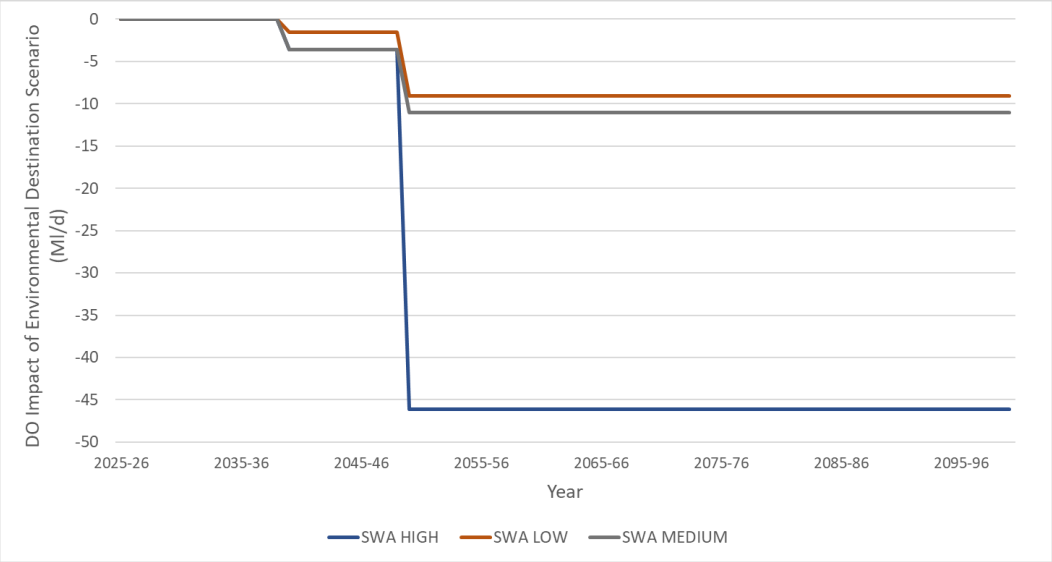

Figure 5 - 3: SWA DYAA Environmental Destination Scenarios

Kennet Valley

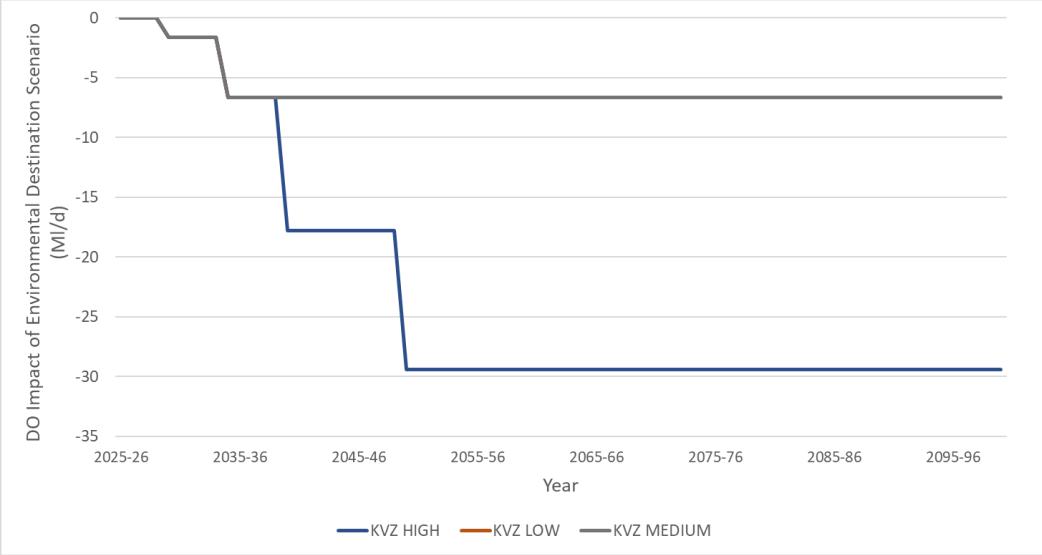

Figure 5 - 4: Kennet Valley DYAA Environmental Destination Scenarios

Guildford

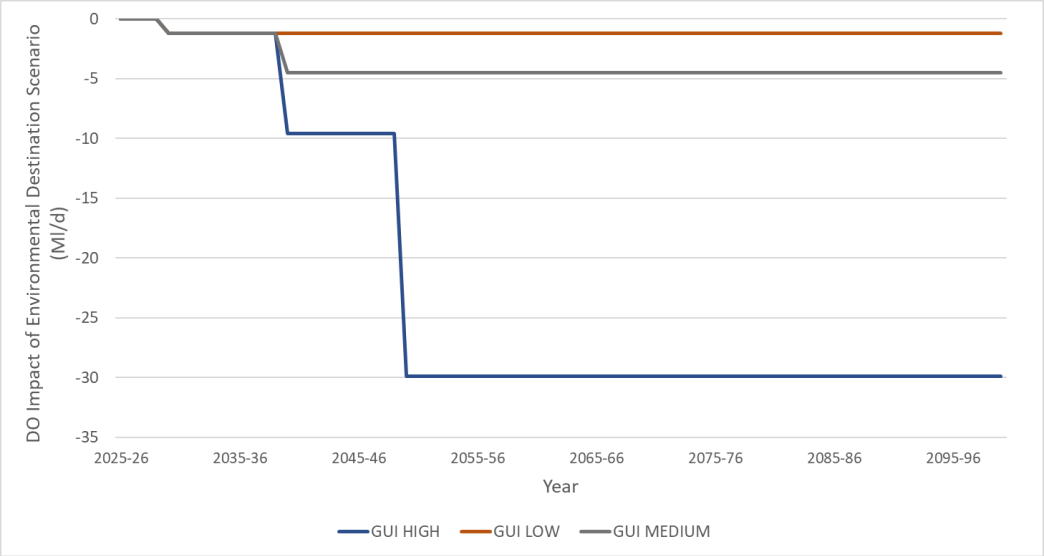

Figure 5 - 5: Guildford DYAA Environmental Destination Scenarios

Henley

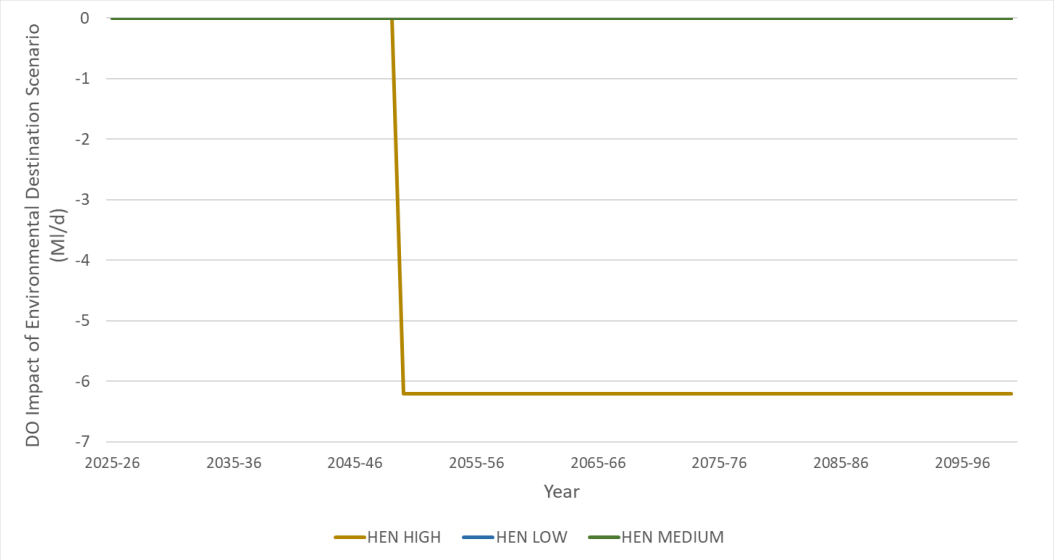

Figure 5 - 6: Henley DYAA Environmental Destination Scenarios

Further Work – Determining Which Pathway We Should Follow

5.67 As has been described, and as our resultant profiles show, there is a wide range of potential future scenarios of licence reduction that we could encounter, depending on future legislation that is put in place, and depending on the outcome of future investigations that we will undertake. For each of our WRZs, the 'High' scenario would involve around five times the magnitude of supply capability reduction seen in the 'Low' scenario. The 'High' scenario would involve reducing our overall supply capability by around 15%, with the reduction in supply capability in some WRZs being up to around 50%.

5.68 In the shorter term, the key action that we must take is investigating the impact of our abstractions on the environment to establish where licence reductions would result in environmental benefit. This will be undertaken across AMP8 and AMP9 in order that by 2035 we have a good idea of the licence reductions we will need to make up to 2050. Our AMP8 WINEP programme will set out the need to undertake a number of detailed investigations, as shown in Table 5 - 5.

High Priority	Medium Priority	Low Priority	
AMP8	AMP8/9	AMP9	
Eynsford	Sundridge	Orpington	Wansunt
Horton Kirby	Hampden Bottom	Darenth	Dartford
Lullingstone	Westerham	Wilmington	Mousehill & Rodborough
Lower Lee	Farmoor	Fognam Down	Fobney
Waddon (& Brantwood Road)		Ashdown Park	Datchet
Pann Mill		Green St Green	Medmenham
Bexley		Seven Springs	Sheeplands
Radnage		Syreford	Woods Farm
Broxbourne		Shalford	Playhatch
Pangbourne		Crayford	
Bibury			
Latton			

Table 5 - 5: Investigations to be Carried Out

5.69 Making the reductions set out in the 'High' scenario would require major measures to ensure WRZ integrity, alongside those needed to keep customers in supply and to maintain an adequate level of drought resilience. Given the magnitude of licence reduction involved in this High scenario and the uncertainty involved in the derivation of this scenario, within the WRMP we have not set out to determine the investment needed to maintain WRZ integrity in the High scenario. Over the next 25 years we will need to maintain adaptive water resources, resilience and network infrastructure plans which are resilient to the potential range of futures that we may encounter. These plans need to consider population growth and licence reduction uncertainty, as well as new sources that may be integrated into our supply system, the level of drought resilience that we are planning for and the level of system resilience that we need to provide.


Thames
Water