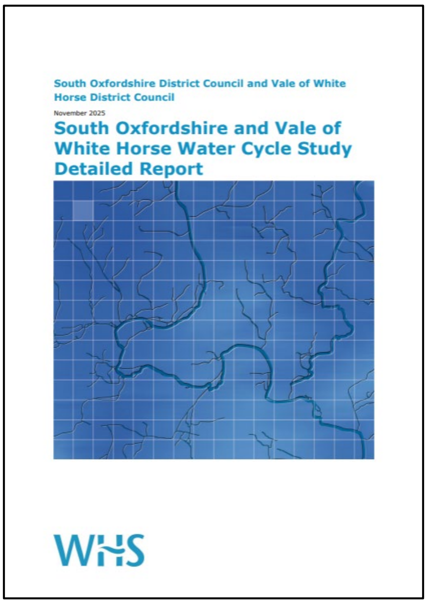
Cover note for the:

South Oxfordshire and Vale of White Horse Water Cycle Study Detailed Report (September 2025)


South Oxfordshire District Council and Vale of White Horse District Council

November 2025

South Oxfordshire and Vale of White Horse Water Cycle Study Detailed Report

WHS

This report builds upon the findings of the Councils' Water Cycle Study Scoping Report completed in September 2024 (examination library references CEQ18 and CEQ18.1). It considers issues related to wastewater infrastructure and water quality in further detail. It also provides additional analysis of water resources to address comments made by the Environment Agency at the Joint Local Plan Regulation 19 pre-submission publication stage.

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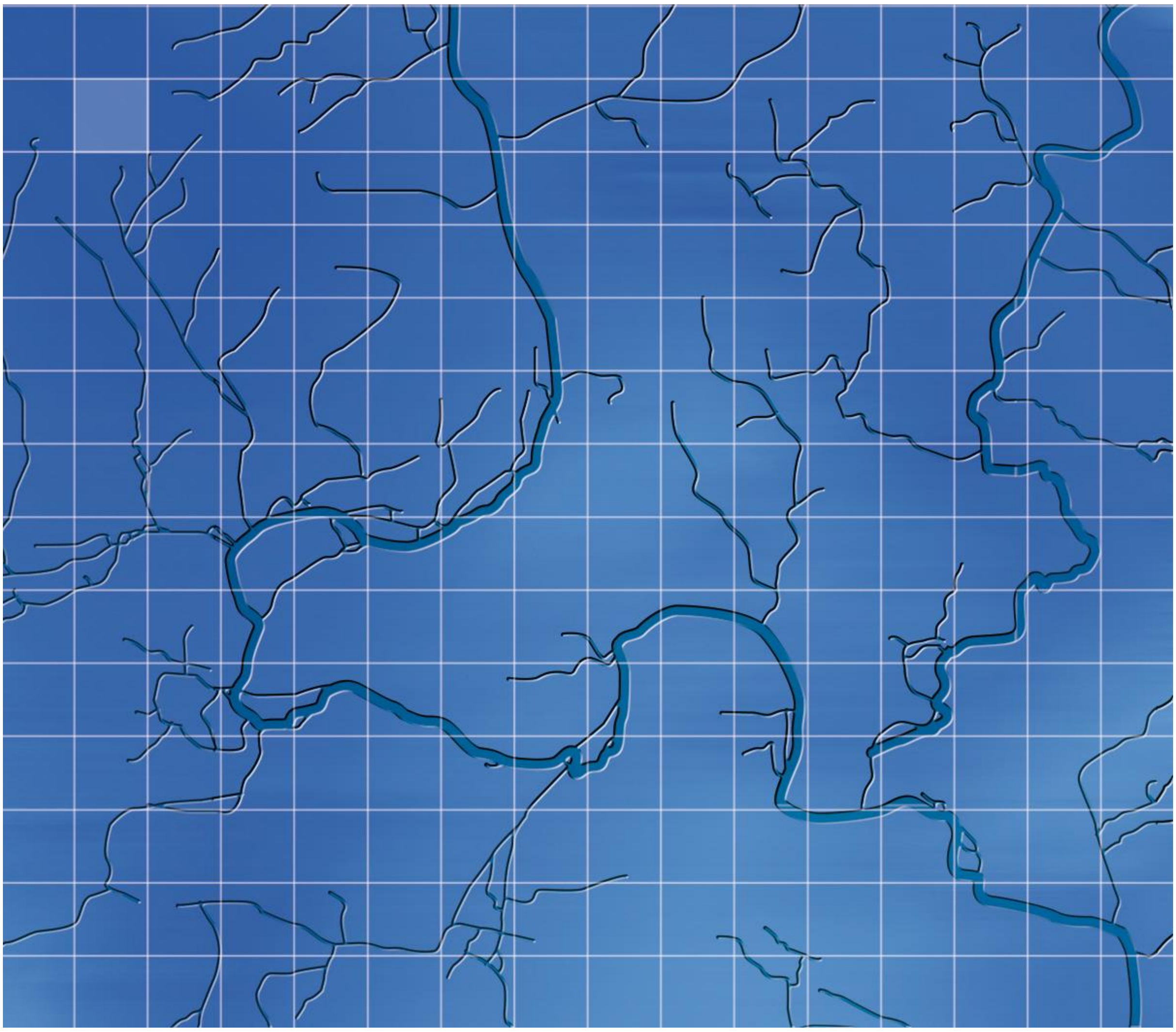

WHS

South Oxfordshire District Council and Vale of White Horse District Council

South Oxfordshire and Vale of White Horse Water Cycle Study Detailed Report

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2.9	13/11/2025	Final	Daniel Hamilton (*Principal Consultant*)	Paul Blackman (*Director*)

For and on behalf of Wallingford HydroSolutions Ltd.

CERTIFIED ISO 9001 · ISO 14001 UKAS MANAGEMENT SYSTEMS 001

The WHS Quality & Environmental Management system is certified as meeting the requirements of ISO 9001:2015 and ISO 14001:2015 providing environmental consultancy (including monitoring and surveying), the development of hydrological software and associated training.

WHS

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Glossary

95th Percentile (95th%ile)- The 95th percentile is a value that's greater than 95% of the numbers in a set. It is a useful statistic for measuring performance data and identifying anomalies.

Abstraction licence- Authorisation granted by the Environment Agency to allow the removal of water from a source.

Ammonia- Ammonia is an inorganic chemical compound of nitrogen and hydrogen with the formula NH_3. It is used as a fertilizer, cleaning product and in the production of plastics. Sewerage is also a source of ammonia.

Assessment Point (AP)- A significant point on a river, often where two major rivers join or at a gauging station.

Asset Management Period (AMP)- The AMP sets the framework for how water companies manage their assets, deliver services to customers, and invest in infrastructure over a five-year period. The AMP is regulated by Ofwat, the Water Services Regulation Authority in England and Wales. AMP 7 runs from 2020-2025. AMP8 will run from 2025-2030.

Biochemical Oxygen Demand (BOD)- BOD is a measure of how much oxygen is used to break down organic matter in water. It is an important indicator of water quality and organic pollution. A high BOD indicates that there is more organic pollution in the water. BOD is used to measure the level of organic pollution in wastewater before it's released to a watercourse.

Combined Sewer Overflows (CSOs)- Many parts of England have a combined sewage system, with clean rainwater and wastewater (including from toilets) carried in the same pipe. During heavy rainfall the capacity of these pipes can be exceeded, which means possible backing up of the system and inundation of Sewage Treatment Works (STWs) downstream. CSOs were developed as overflow valves to reduce the risk of sewage backing up during heavy rainfall. Where they regularly spill it can indicate underlying issues with the sewer system’s condition and capacity.

Compliance Assessment Report (CAR)- A written report compiled by Environment Agency officers when assessing compliance with an environmental permit. The CAR is used to record the findings of EA site inspections, audits and monitoring activities. It also includes reviews of other monitoring and data/reports.

Deployable Output (DO)- The reliable output of water available at a given time, which is determined by the climate and recent weather events, in addition to water abstraction, pumping of water from elsewhere, larger scale raw water transfers and well/aquifer properties.

Development Impact Assessment- Water companies conduct Development Impact Assessments to evaluate how new developments affect infrastructure and the environment. These assessments help determine if upgrades are needed to accommodate increased demand and mitigate potential negative impacts. The process typically involves modelling network capacity, collecting field data, and potentially requiring additional approvals for construction near assets.

Discharge Permit- An environmental permit granted by the Environment Agency to discharge liquid effluent or wastewater to a surface water or groundwater body.

District Metering Area (DMA)- A DMA is a discrete area of the water distribution network that can be isolated by closing valves so that the quantities of water entering and leaving the area can be metered. The volume of water into and out of the DMA is measured by a district meter. The purpose of a DMA is to divide each Water Resource Zone into manageable sections to detect and determine the location of burst mains, calculate the level of leakage in each DMA and compare DMAs so that activities can be targeted to where they will have the greatest impact in reducing leakage.

Drainage and Wastewater Plan (DWMP)- Strategic plans where wastewater companies take a company-wide approach to managing their wastewater and drainage assets. DWMP look at current and future capacity, pressures, and risks to their networks such as climate change and population growth over a 25-year period.

Drought Permit- An authorisation granted by the Environment Agency under drought conditions, which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis.

Dry Weather Flow (DWF)- Dry weather flow (DWF) is the average daily flow to/from a STW during a period without rain. The Environment Agency sets limits on the quality and quantity of treated effluent from STWs so that STWs do not cause an unacceptable impact on the environment. The flow that may be discharged in dry weather is one of these limits.

Dry Year Annual Average (DYAA)- The annual average value of water demand, deployable output or some other quantity over the course of a dry year.

Dry Year Critical Period (DYCP)- The water demand, deployable output or some other quantity during the time in a dry year when demand is greatest, often termed the peak week. Also commonly known as the summer peak period.

Environment Agency (EA)- The Environment Agency (EA) is a non-departmental public body, established in 1996 and sponsored by the UK government's Department for Environment, Food and Rural Affairs (DEFRA). Their responsibilities include water quality and resources, fisheries, inland river, estuary and harbour navigations, conservation and ecology, regulating major industry and waste, treatment of contaminated land and managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.

Environmental Impact Assessment (EIA)- Environmental Impact Assessment (EIA) is a tool used to assess the significant effects of a project or development proposal on the environment.

Flood Zone 1- Areas situated in Flood Zone 1 have a low probability of flooding, with less than a 0.1% probability of river or sea flooding.

Flood Zone 2- Areas situated in Flood Zone 2 have a medium probability of flooding, with an annual probability of river flooding between 1.0% and 0.1% and annual probability of sea flooding between 0.5% and 0.1%.

Flood Zone 3a- Areas situated in Flood zone 3a have a high probability of flooding, with a 1% or greater annual probability of river flooding or a 0.5% or greater annual probability of sea flooding.

Flood Zone 3b- The functional floodplain. This is where water from rivers or the sea has to flow or be stored in times of flood. Local authorities should identify areas of functional floodplain in their Strategic Flood Risk Assessment.

Flow Monitoring Zone (FMZ)- An FMZ is a section of the water supply network that is isolated by closing valves. These zones are typically comprised of multiple smaller District Metered Areas (DMAs). FMZs help water companies monitor and manage water flow and pressure and are essential for identifying and addressing leaks and other issues within the network.

Flow to Full Treatment (FFT)- A measure of how much wastewater a treatment works must be able to treat at any time. All STWs are built to be able to deal with a certain amount of wastewater, calculated depending on the area they serve, and many have a requirement in their environmental permit about the FFT level they must work to.

Good Ecological Status (GES)- Good ecological status (GES) is a measure of the health of a body of water, such as a river, lake, or coastal water. It indicates that the water is close to its natural state, with little human impact.

Groundwater Infiltration- Groundwater infiltration occurs when groundwater finds its way into the underground water and sewerage system. Small leaks, openings, defective joints and cracks are the main causes for infiltration.

Habitat Regulations Assessment (HRA)- HRA is a process to determine whether a plan or project could have a significant effect on a habitat site of international importance (a designated or proposed Special Area of Conservation, Special Protection Area or Ramsar site).

Hands off flow (HoF)- A condition attached to an abstraction license which states that if flow (in the river) falls below the level specified on the license, the abstractor will be required to reduce or stop the abstraction.

Headroom- The difference between the measured DWF and the consented DWF is termed headroom.

Household (HH) Consumption- Water consumed by household customers.

Leakage- Water that leaks from water mains or customer supply pipes.

Load Standstill- An improvement in the quality of effluent, so that extra pollution load will not result in a deterioration in the water quality of the watercourse.

Monte Carlo Simulation- A Monte Carlo simulation is a way to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It involves repeatedly generating random input values within a defined probability distribution to model a complex system and analysing the range of possible outcomes.

Non-Household (NHH) Consumption- Water consumed by non-residential uses.

Natural Flood Risk Management (NFM)- NFM involves working with nature to reduce the risk of flooding for communities. It uses various techniques to restore or mimic the natural functions of rivers, floodplains and the wider catchment.

Olfactometry- Olfactometry is the process of measuring the concentration and intensity of odour. Olfactometry is often used for monitoring wastewater infrastructure, where controlling odorous emissions is important for environmental and health reasons.

Orthophosphate- Orthophosphate is a phosphorus compound. It is commonly used for water treatment.

Price Review (PR)- This is the price determination process undertaken by Ofwat every five years. Each water and sewerage undertaker submits an asset management plan (AMP) which looks to maintain and improve infrastructure over a 5-year period. Based on these plans, Ofwat will determine the cost of water bills for consumers over the same 5-year period to support these plans.

Sewage Pumping Stations (SPS)- SPS typically move sewage from lower to higher elevations. The stations pump raw sewage and wastewater into pipes transporting the waste to a STW or other disposal site.

Sewerage Treatment Works (STW)- Sewage treatment works are plants designed to treat and clean sewage and wastewater before it is released into the environment. Treatment typically consists of three phases termed primary, secondary and tertiary water treatment.

Simulation of Catchments (SIMCAT)- SIMCAT is the EA's randomised water quality river model. It is a crucial tool for setting and reviewing discharge permits at a catchment scale and to quantify the source apportionment of both point and diffuse pollutant load within the receiving watercourse. Driven by summary statistics of flow and quality, SIMCAT uses Monte Carlo simulation to predict in-river summary statistics for direct comparison with environmental quality standards.

Site of Specific Scientific Interest (SSSI)- A SSSI is a national nature conservation designation. Usually, it describes an area that is of particular interest to science due to the rare species of fauna or flora it contains (Biological SSSI) - or important geological or physiological features that may lie in its boundaries (Geological SSSI).

Smarter Business Visit (SBV)- A location-based business programme that helps customers to fit water-saving devices, identify and potentially fix leaking toilets and fit free urinal controls if practical.

Source Protection Zones (SPZs)- SPZs are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.

Special Area of Conservation (SAC)- A site designated as being of special conservation value under the European Habitats Directive. It protects one or more special habitats and/or species – terrestrial or marine.

Storm Overflow Assessment Framework (SOAF)- The SOAF written by the EA sets out how sewer systems comply with current statutory requirements. The framework shows that any overflow reported to exceed the spill frequency thresholds set out in this document should be investigated.

Strategic Overview of Long-term Assets and Resources (SOLAR)- SOLAR is what Thames Water use to feed into their strategic upgrades plan, rather than waiting on approval of a site prior to undertaking modelling to understand what upgrades may be required.

Surface Water Mis-Connections- Occur when surface water pipes taking run-off from roofed or paved areas are incorrectly connected to foul water drains instead of the surface water sewer system, overwhelming the foul water system and potentially causing flooding.

Sustainable Drainage Systems (SuDS)- SuDS mimic nature and typically manage rainfall close to where it falls. SuDS can be designed to transport (convey) surface water and slow runoff down (attenuate) before it enters watercourses. They can provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground, evaporate from surface water and/or be lost or transpired from vegetation (known as evapotranspiration).

Total Phosphorous- Total phosphorus (TP) is the sum of all phosphorus in a sample, including dissolved and particulate forms. I' is a key measurement used to assess water quality and wastewater treatment. Sewerage, fertilizer and urban runoff are key sources.

Urban Creep- Urban creep is the increasing density of development, due to extension, paving over of gardens and other permeable areas, which increases the impermeability of developed areas and causes rates and volumes of surface water runoff to rise.

Water Available for Use (WAFU)- The overall amount of water that is available to use. This takes account of the total deployable output minus water lost through planned and unplanned events, sustainability reductions, climate change, water transferred out of our supply area to other companies (exports) and water received from other companies (imports).

Water Framework Directive (WFD)- The Water Framework Directive (WFD) 2000/60/EC is an EU directive to establish a framework for the protection of all water bodies. The WFD set a programme and timetable for Member States to produce River Basin Management Plans by 2009, which are then periodically updated every 5-years. The Water Environment Regulations 2017 (Water Framework Directive) (England and Wales) transpose the Water Framework Directive into UK law.

Water Resource Management Plan (WRMP)- WRMPs set out how water companies intend to achieve a secure supply of water for customers and to protect and enhance the environment. Water companies in England and Wales must prepare and maintain a WRMP every 5-years to align with the AMP.

Water Resource Zone (WRZ)- The largest possible zone in which all water resources, including external transfers, can be shared and hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall.

Water Services Regulation Authority (Ofwat)- The Water Services Regulation Authority, or Ofwat, is the body responsible for economic regulation of the privatised water and sewerage industry in England.

Water Trading- An agreement with an existing licence holder to give part or all of their water abstraction right permanently or temporarily.

Windfall Development- Development not specifically allocated in a development plan.

Executive Summary

Introduction

Wallingford HydroSolutions (WHS) was commissioned by South Oxfordshire and Vale of White Horse District Councils to produce a detailed water cycle study. The aim of this study is to build on the findings and evidence gaps identified in the Water Cycle Study Scoping Report completed in September 2024, providing further evidence to support the councils' emerging Joint Local Plan (JLP) 2041.

The detailed study has focused on:

- A headroom capacity assessment of 10 sewerage treatment works (STWs) impacted by development proposed in the JLP. The assessment determines whether the STWs have sufficient headroom under current permits and capacity to process the predicted additional wastewater flows up to the end of the plan period in 2041.
- An assessment of water quality impacts at the same 10 STWs using the latest version of the Environment Agency's (EA) SIMCAT model of the River Thames. This assesses how the Water Framework Directive (WFD) status of receiving watercourses may change as a result of the development proposed to 2041. The assessment of water quality impacts considers ammonia, biochemical oxygen demand (BOD), orthophosphate and total phosphorous.
- An additional analysis of water resources undertaken to address EA comments made during the JLP Regulation 19 pre-submission publication period. This included comparing the quantum of development proposed in the JLP with Thames Water's projections, assessing infrastructural capacity in key Flow Monitoring Zones (FMZs), and reviewing wider water supply pressures with input from Thames Water.

In undertaking these assessments, the study considers how development proposed in the JLP could affect the water environment. This allows for steps to be put in place by Thames Water, the EA and the councils to enable development to proceed sustainably without compromising the environment.

Development and the Water Cycle

New developments require the provision of clean water, safe disposal of wastewater and protection from flooding.

The safe disposal of wastewater is the primary focus of this detailed study, with the supply of clean water also considered. Development has the potential to increase the volume of flows to the sewer network and downstream STWs. The allocation of development in certain locations may result in the capacity of existing infrastructure being exceeded, a situation that could potentially result in service failures, adverse impacts to the water environment, and high costs for infrastructure upgrades. Sustainable planning for wastewater is therefore essential. It is important that there is engagement between the councils and Thames Water as the sewerage undertaker, so that Thames Water is aware of planned development. Once aware, it is Thames Water's responsibility to ensure that they upgrade their infrastructure so that development can progress without presenting a risk to the environment. Generally, Thames Water will undertake infrastructure capacity modelling once development has planning permission, and upgrades are funded by connection charges.

The EA is responsible for regulating sewage discharge releases via a system of Environmental Permits which set out the required effluent quality for a range of metrics in order to protect the environment. Sewerage undertakers like Thames Water must ensure compliance against the permits set.

Future development is likely to lead to increased wastewater flows arriving at STWs. Where there is insufficient headroom to treat these flows, it can lead to a greater volume of treated sewerage being discharged into receiving watercourses than permitted. A lack of headroom at a STW can also lead to the capacity of the sewer network upstream being exceeded more regularly, in turn contributing to a greater number of untreated sewer discharges via Combined Sewer Overflows (CSOs). This presents a water quality risk and could lead to negative impacts on indicators used to assess a watercourse's health under the WFD.

The WFD seeks to protect and enhance surface waters including watercourses. It assigns each watercourse an overall, ecological and chemical status based on a range of indicators. Under the WFD a watercourse should not deteriorate from its current WFD status, either as an overall watercourse or for each of the individual indicators assessed.

Furthermore, Paragraph 180e of the National Planning Policy Framework (NPPF)[1] (December 2023)[2] requires that planning policies and decisions should contribute to and enhance the natural and local environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of water pollution. Development should, wherever possible, help to improve local environmental conditions such as water quality, taking into account relevant information such as river basin management plans which implement the WFD at the river basin scale.

The NPPF also outlines how planning authorities should address water supply and resources in England. Paragraph 20(b) specifically emphasises that strategic policies must make adequate provision for both water supply and wastewater infrastructure.

Headroom Assessment

A headroom capacity assessment for 10 STWs impacted by development proposed in the JLP has been undertaken. The assessment has sought to determine whether the STWs have sufficient headroom under current permits and capacity to process the predicted additional wastewater flows to 2041.

Findings

- At three of the ten STWs (Abingdon, Culham and Stanford in the Vale) there is sufficient headroom to accommodate future development based on the current permits in place. However, at Abingdon this is only when considering both outfalls (Abingdon Lagoon and Abingdon New), and at Culham when applying the current maximum flow permit, which is expected to be reduced.
- At four of the ten STWs (Benson, Cholsey, Oxford and Wheatley) the current permitted flow will be exceeded by less than 25% by the end of the plan period.
- At three of the ten STWs (Appleton, Didcot and Wantage) the permitted flow is already regularly exceeded and will be exceeded by more than 25% by the end of the plan period. This is partly due to delays in planned infrastructure upgrades which are the responsibility of Thames Water.

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[1] Ministry of Housing, Communities and Local Government (December 2023) *National Planning Policy Framework* https://webarchive.nationalarchives.gov.uk/ukgwa/20231228093504/https://www.gov.uk/government/publications/national-planning-policy-framework--2

[2] The Planning Inspectorate is examining the JLP against the December 2023 NPPF in accordance with the transitional arrangements set out in Paragraph 234b of the December 2024 NPPF

Actions and Recommendations

- Thames Water will need to invest in many of the STWs assessed to ensure compliance to 2041. Upgrades have been identified for all of the STWs assessed, however further investment may be required later into the plan period.
- Thames Water will need to assess development demands as part of their wastewater asset planning activities and feedback to South Oxfordshire and Vale of White Horse District Councils if concerns arise.
- Thames Water should investigate and seek to resolve surface water misconnections and groundwater infiltration within its wastewater network - particularly at Didcot which is a high spilling STW, thought to be partly due to groundwater infiltration.
- Thames Water will need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.
- The EA will need to consider development against infrastructural and environmental capacity in setting future environmental permits to allow development to progress sustainably without presenting a risk to the water environment.
- South Oxfordshire and Vale of White Horse District Councils, in liaison with Thames Water, will need to consider available STW capacity when assessing planning applications and should seek to align the delivery of development and infrastructure upgrades (where required) in accordance with JLP Policies CE8 - Water quality, wastewater infrastructure and drainage and IN1 – Infrastructure and service provision.
- South Oxfordshire and Vale of White Horse District Councils should share their annual monitoring reports and housing land supply statements, which detail projected housing development in their administrative areas, with Thames Water.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council, with specific attention brought to the assessment at Oxford STW as the STW catchment crosses administrative boundaries. None of the other STWs assessed have catchments that extend beyond South Oxfordshire and Vale of White Horse.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to Thames Water, the EA and Oxfordshire County Council as the Waste Planning Authority.

Water Quality Assessment

The potential impacts of development on water quality have been assessed using the EA's Thames SIMCAT model. Impacts are assessed against three criteria - percentage deterioration, class deterioration and prevention from meeting Good WFD Status in the future. The assessment has considered the same 10 STWs impacted by development proposed in the JLP as the headroom assessment. Water quality impacts to 11 receiving watercourses were investigated, with the Abingdon STW having two outfalls draining to different watercourses.

Findings

- At 8 of the 11 receiving watercourses, the criteria can be met either with no infrastructure improvements or infrastructure upgrades within current technology limits.
- At the remaining 3 receiving watercourses drained to by Appleton STW, Stanford in the Vale STW and Didcot STW, whilst a deterioration in water quality would be prevented with infrastructure upgrades, it is not possible to achieve Good Status with current technology and future

development is considered to be a factor preventing this. At these sites environmental capacity could be a constraint on development in the short term.

Actions and Recommendations

- Wastewater infrastructure upgrades, the phasing of development, and mitigation against other pollution sources will be important to prevent a deterioration in water quality at many of the receiving watercourses assessed during the period to 2041.
- Of the three STWs where environmental capacity could be a constraint on development in the short term, both Appleton and Didcot already have upgrades scheduled during AMP 8 (2025-2030). Thames Water is also developing a project to increase the capacity of the storm tanks at Stanford in the Vale STW. Further upgrades may also be required over the plan period.
- For many of the receiving watercourses, other pollution sources (e.g. agriculture, industry) are also contributing reasons for the waterbodies not achieving Good Status. Therefore, reducing the contribution of other pollution sources should be a key priority to safeguard environmental capacity. The measures to achieve this should be set out by the EA through liaison with stakeholders in the Thames River Basin Management Plan.
- Thames Water will need to assess development demands as part of their wastewater asset planning activities and feedback to South Oxfordshire and Vale of White Horse District Councils if concerns arise.
- Thames Water will need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.
- South Oxfordshire and Vale of White Horse District Councils should consider WFD status when assessing planning applications in liaison with the EA and Thames Water in accordance with JLP Policy CE8 - Water quality, wastewater infrastructure and drainage.
- South Oxfordshire and Vale of White Horse District Councils should share their annual monitoring reports and housing land supply statements, which detail projected housing development in their administrative areas, with Thames Water.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to planning colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council, with specific attention brought to the assessment at Oxford STW as the STW catchment crosses administrative boundaries.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to Thames Water, the EA and Oxfordshire County Council as the Waste Planning Authority.

Water Resources

An assessment has been undertaken of water resources to address comments raised by the EA during the JLP Regulation 19 pre-submission publication period. This has included:

- A more detailed assessment of how development proposed in the JLP compares to the housing projections used in Thames Water's WRMP24.
- An evaluation of developments located within three FMZs identified by Thames Water as having limited water supply infrastructure capacity.
- A further review of water resource pressures across the districts, informed by further consultation with Thames Water.

Findings

- The dwelling forecasts in Thames Water's WRMP24 are greater than the residential development proposed in the JLP. For South Oxfordshire, the Thames Water forecast is 46% greater than the development proposed in the JLP and for the Vale of White Horse the Thames Water forecast is 32% greater. When aggregated across both districts, the Thames Water dwelling forecast is 39% greater than the development proposed in the JLP.
- Overall, this assessment indicates that the planned development in both districts is more than accounted for in the WRMP24 and that the development proposed in the JLP will not place unforeseen pressure on Thames Water's water resource plans and in turn the water environment. This is the case when considering both the full quantum of development across the plan period and the annual rate of growth.
- In terms of the FMZ assessments, the Culham FMZ includes three JLP allocations. One is a small employment site (AS11) with minimal impact on water supply, while the other two (AS1 and AS2) are large scale developments (>1,000 dwellings). AS1 is a mixed use residential and employment allocation and AS2 is a residential allocation. AS1 and AS2 are not due to start delivering homes until 2030/2031 and will be phased over several years, which means that there should be adequate time for infrastructure upgrades to take place.
- For the Hagbourne Hill and Wantage FMZs, there are sixteen and eight JLP allocations respectively. The quantum of development being brought forward could potentially cause lengthy lead-times as it is more likely to require strategic infrastructure investment. However, it is noted that a number of the largest allocations in both these FMZs already have outline planning permission, with some development phases that are either completed or have detailed planning consent.
- The planning applications related to these sites have been reviewed.These show that there has already been more detailed engagement with Thames Water in relation to water supply infrastructure for these sites through the relevant planning application processes. In most cases no issues have been flagged in terms of water supply infrastructure. In cases where issues have been flagged, appropriate steps have been taken to resolve these (for example through the use of planning conditions). The process followed by Thames Water to assess infrastructural capacity has also been confirmed.
- Based on further consultation with Thames Water, the overall supply-demand balance forecast for the SWOX WRZ indicates a future deficit, exceeding 100 million litres per day by 2050. This projected shortfall is driven by four key factors: the requirement to improve resilience to a 1 in 500-year level by 2040, anticipated future licence reductions, population growth, and climate change. Planned development in the JLP being lower than the growth forecast by Thames Water's WRMP could offset this deficit slightly, however the scale of the forecast deficit highlights the need for demand reductions and the development of new supply sources to ensure long-term resilience.

Actions and Recommendations

- Thames Water will continue its responsibilities in upgrading and providing water supply for new developments without presenting a risk to the environment.
- Thames Water will need to assess future development proposed in the JLP when developing their WRMP 2029.
- The EA will need to review and provide feedback on Thames Water's WRMP2029, ensuring that Thames Water address future water needs and provide a secure and sustainable water supply to the districts.

- The EA will continue to regulate the abstraction of water from rivers and other sources in the districts, ensuring it is sustainable and within legal limits.
- It is recommended that developers engage with Thames Water as early as possible so they can undertake modelled impact assessments to confirm if water supply upgrades are required.
- Should strategic infrastructure upgrades be required to supply new development, the option to phase some of the dwellings to later in the plan period should be considered, especially for larger scale residential developments (>1000 dwellings).
- The district councils will implement Joint Local Plan Policy CE7 – Water efficiency to ensure that new developments are water efficient and that the occupiers of new development use water resources carefully.
- The district councils will provide Thames Water with their Annual Monitoring Reports and Housing Land Supply Statements, which outline projected housing development within their administrative areas.

1 Introduction

1.1 Scope of Assessment

Wallingford HydroSolutions (WHS) has been commissioned by South Oxfordshire District Council and Vale of White Horse District Council to undertake a detailed water cycle study in relation to the emerging Joint Local Plan (JLP) 2041 being developed by both councils.

This follows on from recommendations made in the Water Cycle Study Scoping Report completed by WHS for the districts in September 2024 and subsequent comments raised by the Environment Agency (EA) at the JLP's Regulation 19 stage over the deliverability of the JLP in relation to water quality and water resources.

This detailed study undertakes headroom assessments and water quality modelling for the 10 Sewerage Treatment Works (STWs) identified by WHS in the scoping report, and agreed with the EA. In undertaking these assessments, the study considers how development proposed in the JLP could affect water quality. This allows for steps to be put in place by Thames Water, the EA and the councils to enable development to proceed sustainably without compromising the environment. This is embedded in the JLP through Policy CE8 – Water quality, wastewater infrastructure and drainage, which seeks to protect and enhance water quality and to align the delivery of development with new/upgraded wastewater infrastructure.

The detailed study also incorporates additional analysis of water resources to address comments made by the EA at the JLP Regulation 19 pre-submission publication stage. This includes, firstly, a more detailed assessment of how development proposed in the JLP compares with the housing projections used in Thames Water's Water Resources Management Plan 2024 (WRMP24)[3]. It also includes an evaluation of developments located within the Culham, Hagbourne Hill, and Wantage Flow Monitoring Zones — areas identified by Thames Water as having limited water supply infrastructure capacity and likely to require future infrastructure upgrades. Finally, a broader review of water resource pressures across the districts has been carried out, informed by further consultation with Thames Water.

1.2 Background

This detailed study is required to build on the findings and evidence gaps identified by the Water Cycle Study Scoping Report (September 2024). New homes and businesses are proposed in the JLP and will require the provision of clean water, safe disposal of wastewater and protection from flooding.

The safe disposal of wastewater is the primary focus of this detailed study, with the supply of clean water also considered. Development has the potential to increase the volume of flow to the sewer network and downstream STWs. The allocation of development in certain locations may result in the capacity of existing infrastructure being exceeded, a situation that could potentially cause service failures, adverse impacts to the environment, and high costs for the upgrade of assets. Sustainable planning for water is therefore essential. It is important that there is engagement between the councils and Thames Water as the sewerage undertaker, so that Thames Water is aware of planned development. Once aware, it is Thames Water's responsibility to ensure that they upgrade their infrastructure so that developments can progress without presenting a risk to the environment.

[3] Thames Water (2024) *Water Resources Management Plan 2024* https://www.thameswater.co.uk/about-us/regulation/water-resources

Thames Water will undertake infrastructure capacity modelling once development has planning approval, and upgrades are funded by connection charges.

Key to understanding the potential impacts of development on the sewer network, STWs and the downstream water environment is the sewerage treatment process. Wastewater first enters the sewer network via a series of drains, pipes and main sewer lines. The main sewer lines take the wastewater to a STW. At the STW, wastewater is passed through several cleaning and filtering processes which aim to return it safely into receiving waterbodies. Screening is the first step, where large solids are removed from the wastewater. This is followed by primary treatment which largely involves removing finer solids from wastewater using sedimentation tanks.

Wastewater after primary treatment still contains organic solid matter. It is at the secondary treatment stage where the majority of this matter is removed via means including biological treatment and disinfection. Secondary treatment looks to achieve a certain level of effluent quality for discharge into the receiving waterbody. Note, in some cases, a further treatment phase known as tertiary treatment is applied which uses stronger and more advanced treatment systems. This can be required when discharging to protected water bodies or to make water suitable for re-use.

The EA is responsible for regulating sewage discharge releases via a system of Environmental Permits which set out the required effluent quality for a range of metrics to protect the environment. Sewerage undertakers like Thames Water must ensure compliance against the permits set.

Future development is likely to lead to increased wastewater flows arriving at STWs. Where there is insufficient permit headroom to treat these flows, it can lead to a greater volume of treated sewerage being discharged into receiving watercourses than permitted. A lack of headroom at a STW can also lead to the capacity of the sewer network upstream being exceeded more regularly, in turn contributing to a greater number of untreated sewer discharges via Combined Sewer Overflows (CSOs). This presents a water quality risk and could lead to negative impacts on indicators used to assess a watercourse's health under the Water Framework Directive (WFD). The WFD seeks to protect and enhance surface waters including watercourses. It assigns each watercourse an overall, ecological and chemical status based on a range of indicators. Under the WFD a watercourse should not deteriorate from its current WFD status, either as an overall watercourse or for each of the individual indicators assessed.

Paragraph 180e of the National Planning Policy Framework (NPPF) further requires that planning policies and decisions should contribute to and enhance the natural and local environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of water pollution. Development should, wherever possible, help to improve local environmental conditions such as water quality, taking into account relevant information such as river basin management plans which implement the WFD at the river basin scale.

The NPPF also outlines how planning authorities should address water supply and resources in England, with a focus on promoting sustainable development and protecting the environment. Paragraph 20(b) specifically emphasises that strategic policies must make adequate provision for both water supply and wastewater infrastructure. Additionally, Paragraph 158 highlights the importance of taking a proactive approach to climate change mitigation and adaptation, including consideration of the long-term implications for both wastewater infrastructure and water supply.

This study helps meets these requirements in elucidating the potential impacts of future development on headroom, water quality, WFD status and water resources. This supports the EA and Thames Water in planning for the future and carrying out their responsibilities effectively. It also helps the JLP meet its aim to protect and enhance the quality of waterbodies where they, or their catchments, are wholly or partially located within South Oxfordshire and Vale of White Horse.

1.3 Water Cycle Study Detailed Report Objectives

Water cycle studies are voluntary studies that consider how strategic plans and development proposals will affect the water environment. The study's objectives include the following:

- Engage with stakeholders including the EA, Thames Water, Oxfordshire County Council (as the Waste Planning Authority) and relevant neighbouring authorities.
- Determine the quantum of development expected within each of the 10 STW catchments to 2041, with consideration given to JLP allocations as well as neighbourhood plan allocations, windfall development, Enterprise Zones and Local Development Orders, and, where applicable, development in neighbouring authority areas.
- Undertake a headroom assessment for each of the 10 STWs to determine projected changes in flows against permitted levels, identifying where there may be capacity concerns.
- Outline recommendations for future development and actions for regulators to manage projected changes in headroom.
- Undertake water quality modelling considering the current technology at each STW to assess the impact of development on ammonia, biochemical oxygen demand (BOD), orthophosphate and total phosphorous in the receiving watercourses drained to by the 10 STWs. This will consider i) development in both districts and ii) development in both districts plus development in neighbouring authorities where relevant.
- Determine potential impacts on waterbody WFD status and identify where there is a 10% deterioration in water quality for scenarios i) and ii).
- Undertake water quality modelling incorporating the Technically Achievable Limits (TAL) agreed with the EA at each STW for both scenarios to determine whether potential impacts on waterbody WFD status and deteriorations in water quality can be avoided when applying TAL.
- Outline recommendations for future development and actions for regulators to manage projected changes in water quality.
- Support the alignment of development and new/upgraded wastewater infrastructure to help protect and enhance water quality in accordance with JLP Policy CE8 - Water quality, wastewater infrastructure and drainage.
- Review the dwelling numbers used in Thames Water's WRMP24 against the residential development proposed in the JLP to confirm whether the WRMP24 adequately accounts for planned development in both districts.
- Assess the proposed JLP development allocations within the Culham, Hagbourne Hill, and Wantage FMZs to identify any additional measures required to reduce pressure on water supply infrastructure.
- Summarise and review water resource pressures across the districts based on the latest consultation with Thames Water.
- Ensure there is sufficient provision for wastewater and water supply infrastructure in accordance with National Planning Policy Framework (NPPF) paragraph 20[4].

[4] Ministry of Housing, Communities and Local Government (December 2023) *National Planning Policy Framework* https://webarchive.nationalarchives.gov.uk/ukgwa/20231228093504/https://www.gov.uk/government/publications/national-planning-policy-framework--2

- Prevent development from contributing to, being put at unacceptable risk from, or being adversely affected by water pollution in accordance with NPPF paragraph 180e.
- Where possible, helping development to improve local environmental conditions such as water quality in accordance with NPPF paragraph 180e.

2 Method Statement

The water cycle study has been completed using national EA guidance on water cycle studies[5]. It has also been guided by liaison with key stakeholders including South Oxfordshire and Vale of White Horse District Councils, Oxfordshire County Council (as the waste planning authority), relevant neighbouring authorities, the EA and Thames Water. Liaison and engagement has included:

- Early engagement with the EA to agree the appropriate scope and approach for the study.
- Engagement with the EA and Thames Water to gain a clear understanding of the water environment and water infrastructure for both districts.
- Engagement with the EA, Thames Water and neighbouring authorities to acquire the datasets required to progress the study.
- Sharing draft outputs with key stakeholders for review prior to finalising the report.

2.1 Scoping Report Recommendations and STW Selection

The main recommendations of the Water Cycle Study Scoping Report (September 2024) were to undertake the following:

- A headroom capacity assessment for all STWs that may be impacted by development proposed in the JLP. The assessment will determine whether the STWs have sufficient headroom under current permits and capacity to process the predicted additional wastewater flows to 2041.
- An assessment of water quality impacts, using the latest version of the EA's SIMCAT model. This will include an assessment of how the WFD status for receiving watercourses may change as a result of development proposed in the JLP, in addition to neighbourhood plan development, windfall development, Enterprise Zones and Local Development Orders, and development in relevant neighbouring authorities. The assessment of water quality impacts will consider BOD, ammonia, orthophosphate and total phosphorous.

A total of fourteen STWs were identified as having the potential to be impacted by future JLP development in the districts. Note, only neighbourhood plan allocations drain to Benson STW, however the EA has flagged this as a site of concern, so it has been included in the assessment. Table 1 lists these fourteen STWs and Figure 1 shows their locations. Following discussions with the EA it was agreed that four of the STWs could be scoped out of further assessment. The reasons for scoping in/out STWs are listed in Table 1. Note, the scoping report did not recommend further detailed work on water resources; however, additional analysis has since been carried out to address comments made by the EA during the JLP Regulation 19 pre-submission publication period, more detail is provided in section 2.4.

[5] Environment Agency (2021) *Guidance- Water Cycle Studies* https://www.gov.uk/guidance/water-cycle-studies

Table 1- List of STWs considered, with reasons for scoping in or out

STWs	Reasons for scoping in or out
Abingdon	**Scoped in-** A significant quantum of development is proposed to drain to this STW. Notably JLP site allocation Policy AS10 Land at Dalton Barracks Garden Village, which is expected to deliver 1,450 homes to 2041, has been identified as potentially draining to this STW. The STW currently discharges below its permitted dry weather flow (DWF) however there is a risk that this will be exceeded if the STW is not upgraded in line with future development. Note, this STW has two outfalls and both are assessed in this study.
Appleton	**Scoped in-** Only two site allocations would drain to this STW, however in total these comprise more than 1,500 homes. This includes JLP site allocation Policy AS10 Land at Dalton Barracks Garden Village, which has also been identified as potentially draining to this STW. An upgrade to the STW's Flow to Full Treatment (FFT) is required but has been delayed. The STW also frequently spills and exceeded its DWF permit in 2023 and 2024.
Benson	**Scoped in-** This STW was flagged by the EA for assessment. Although no JLP allocations drain to it, four NDP allocations are proposed to drain to this STW. The STW currently discharges below its permitted DWF however there is a risk that this will be exceeded if the STW is not upgraded in line with future development.
Chalgrove	**Scoped out-** Only one smaller-scale JLP employment site allocation (Policy JT1e Monument Business Park) drains to the STW, in addition to two small NDP allocations. The waterbody discharged to has moderate WFD status with no signs of deterioration.
Cholsey	**Scoped in-** Two JLP allocations (site allocation Policies HOU2c Land West of Wallingford and JT1d Hithercroft Industrial Estate) and eight NDP allocations are proposed to drain to the STW. The Q80 flow to the STW (the flow exceeded 80% of the time) is >90% of the permitted DWF (typically set by the EA as the planned future Q80 flow) which suggests potential headroom concerns going forward. The waterbody discharged to is also at risk of deterioration.
Culham	**Scoped in-** The flow permit at Culham STW has significant capacity (relative to its size), however the development proposed in the JLP that would discharge to the STW is quite large compared to the size of the STW. This includes three large JLP strategic site allocations - Policies AS1 Land at Berinsfield Garden Village, AS2 Land adjacent to Culham Campus and AS11 Culham Campus. The permit is also currently a max flow permit which may switch to a tighter DWF permit during the plan period.
Didcot	**Scoped in-** A significant quantum of development is proposed to drain to this STW, including two large strategic JLP site allocations - Policies HOU2b Didcot North East and HOU2r Valley Park. It is a high spilling STW and exceeded its permitted DWF in 2020, 2021, 2023 and 2024.
Faringdon	**Scoped out-** No issues flagged by Thames Water in terms of capacity based on four JLP and four NDP site allocations proposed to drain to STW.
Nettlebed	**Scoped out-** Only one smaller-scale JLP site allocation (Policy HOU2e Joyce Grove) drains to the STW. STW discharges to groundwater via an infiltration system.
Oxford	**Scoped in-** A significant quantum of development is proposed to drain to this STW, including three large JLP strategic site allocations - Policies AS3 Land South of Grenoble Road, AS4 Land at Northfield and AS5 Land at Bayswater Brook. The STW's FFT is considered too small currently and there have been a number of significant breaches of the Environmental Permit in recent years.
Shrivenham	**Scoped out-** Only one smaller-scale JLP site allocation (Policy HOU2k North of Shrivenham) drains to the STW. The waterbody discharged to has shown an improvement in physico-chemical quality elements to Good status in last WFD cycle.
Stanford in the Vale	**Scoped in-** Only one development drains to the STW (JLP site allocation Policy HOU2l West of Stanford-in-the-Vale), however it is for 251 homes and the capacity of the STW is limited presenting a risk to the River Ock waterbody.
Wantage	**Scoped in-** A significant quantum of development is proposed to drain to this STW, including two large strategic JLP site allocations – Policy HOU2q Grove Airfield and HOU2u Crab Hill. The STW exceeded its DWF in 2023 and 2024.
Wheatley	**Scoped in-** Five site allocations are proposed to drain to the STW, including four NDP allocations and JLP site allocation Policy HOU2d Land at Wheatley Campus. The STW already exceeds permitted DWF in some years.

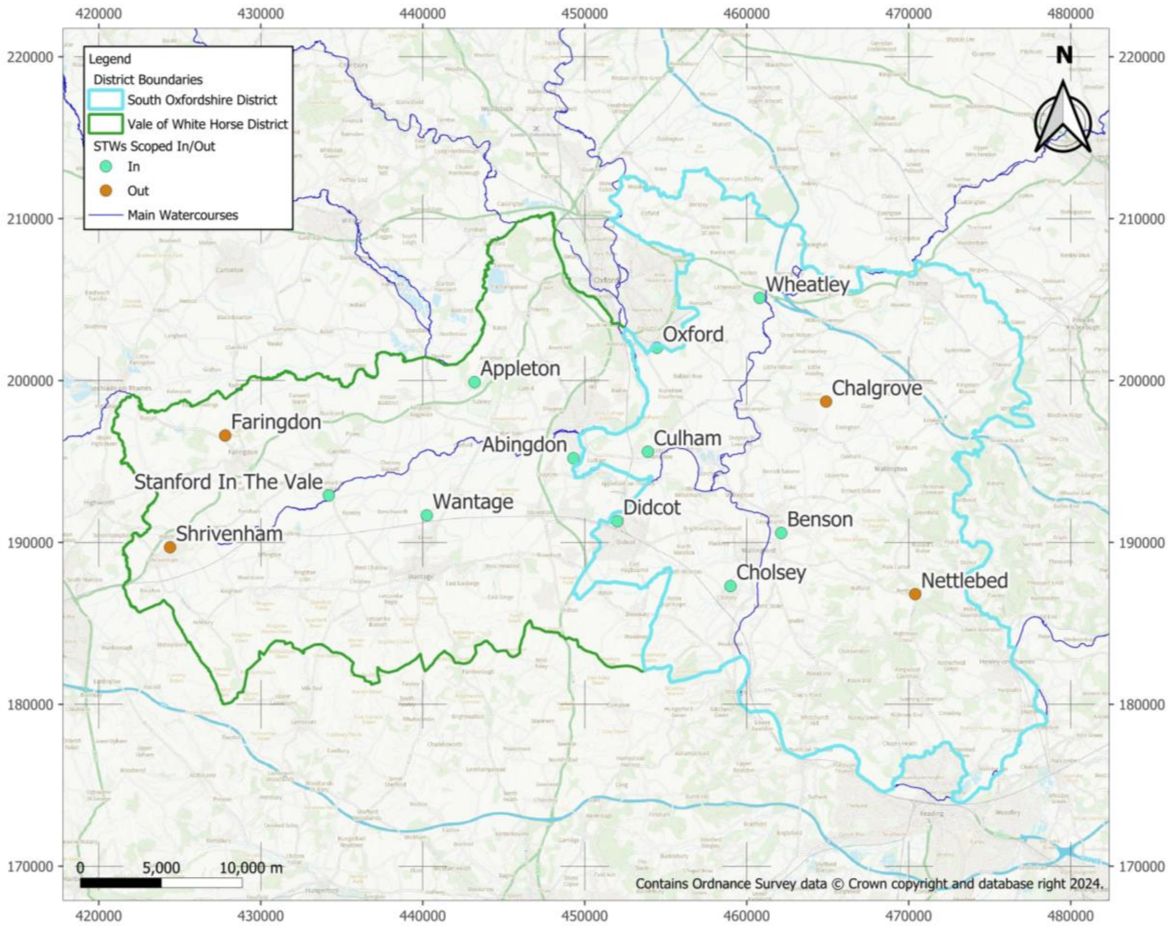

Figure 1- Locations of STWs scoped in and out of the detailed study

2.2 Headroom Assessment

The EA is responsible for regulating sewage discharge releases via a system of Environmental Permits.

Environmental permits can relate to treated sewage from STWs and untreated sewerage from combined sewer overflows (CSOs) on the sewer network. Permits for treated sewerage are used alongside water quality limits as a means of controlling the pollutant load discharged from STWs to a receiving watercourse. Sewage flow rates must be monitored for all STWs where the permitted discharge rate is greater than 50m3/day in dry weather.

Permitted discharges from STWs in the majority of cases are based on a statistic known as the Dry Weather Flow (DWF). As well as being used in the setting and enforcement of effluent discharge permits, the DWF is used for STW design, as a means of estimating the 'base flow' in sewerage modelling and for determining the flow at which discharges to storm tanks will be permitted (Flow to Full Treatment, FFT).

When setting a permitted DWF the EA typically use the Q80 flow (the flow exceeded 80% of the time). However, the Q90 flow (the flow exceeded 90% of the time) is monitored by the sewerage undertaker and the EA for compliance purposes. This is because, being a lower flow, the Q90 gives greater certainty of capturing an exceedance of the permitted DWF.

Ultimately in relation to flow volumes, a breach of an EA permit will only be considered to have occurred if the Q90 flow exceeds the DWF stated. However, a STW is still judged to have capacity issues if the Q80 is regularly exceeding the stated DWF.

For this study the Q90 has been used to assess headroom and potential water quality impacts. Whilst we recognise that assessing the Q80 flow in parallel could provide a more complete understanding of infrastructural capacity, we were unable to obtain the full Q80 data required. Using Q90 is noted as a less conservative approach and a potential limitation of the study. However, the study still clearly highlights potential risks associated with development.

Environmental Permits also consent for maximum concentrations of pollutants, in most cases suspended solids, BOD, ammonia, orthophosphate and total phosphorous. These look to ensure that the receiving watercourse is not prevented from meeting its environmental objectives, with specific regard to its WFD classification.

Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a STW. Where there is insufficient headroom at the works to treat these flows, this could lead to breaches in flows permitted leading to a greater volume of treated sewerage being discharged into receiving watercourses presenting a water quality risk. A lack of headroom at a STW can also lead to the capacity of the sewer network upstream being exceeded more regularly, in turn contributing to a greater number of untreated sewer discharges via CSOs.

An assessment of whether the STWs have sufficient headroom to manage the development proposed over the remaining JLP plan period (2024-2041) was carried out using the following data sources:

- Measured DWF flow data supplied by Thames Water for the years 2023-2024 - used to estimate baseline DWF at the 10 STWs assessed.
- Measured DWF flow data supplied by Thames Water for the years 2019-2023 compared to the baseline figures used (from the period 2023-2024) to check flow variability at the 10 STWs assessed.
- STW catchment extent data provided by Thames Water.
- Development allocations in the JLP and made neighbourhood plans provided by South Oxfordshire and Vale of White Horse District Councils. This included information on the number of residential dwellings and area of employment land expected during the plan period.
- Employment development expected to come forward on land subject to Enterprise Zones and Local Development Orders, provided by South Oxfordshire and Vale of White Horse District Councils.
- Estimates of annual windfall development within each STW catchment area provided by South Oxfordshire and Vale of White Horse District Councils.
- Development figures for relevant neighbouring authorities. The only STW assessed that is impacted by development in neighbouring authorities is Oxford STW. The Oxford STW catchment extends into:
    - i) Cherwell District – Part of Cherwell falls within the Oxford STW catchment. Cherwell District Council was contacted and provided information on site allocations within this area.
    - ii) Oxford City – The majority of Oxford drains to Oxford STW. Oxford City Council was contacted and provided the total number of dwellings and jobs expected to be created in Oxford to 2040.
    - iii) West Oxfordshire District - A very small part of West Oxfordshire drains to the Oxford STW. West Oxfordshire District Council was contacted and confirmed that there is no significant development proposed within this area.

- The current discharge permits in place at each STW supplied by the EA, to extract the permitted DWF or maximum flow condition. These were cross checked with the EA before undertaking the assessments.

Using the data sources above, the first step was to set a baseline DWF using the measured flow data for 2023-2024 provided by Thames Water in December 2024. The baseline DWF adopted was an average of the 90th percentile annual exceedance flow values across 2023 and 2024. Thames Water subsequently supplied in April 2025 additional flow data for prior years (2019-2023). This has been compared to the baseline figures used (from the period 2023-2024) to check flow variability at the 10 STWs assessed (see section 4.2).

The next step was to determine which development allocations would drain to each STW using the STW catchments also provided by Thames Water (see section 3.2). For each STW, the future DWF was calculated by estimating the expected increase in flows from future development across the plan period. This considered household consumption and consumption from employment uses. Household consumption was calculated using the equation below.

$$\textit{Household Consumption} = \textit{Dwellings} \times \textit{Occupancy Rate} \times \textit{Per Capita Consumption}$$

For residential dwellings an occupancy rate of 2.438 p/h was adopted, this is based on the projected occupancy rate for the Swindon and Oxfordshire (SWOX) water resource zone (between 2024-2041) used in Thames Water's latest water resource management plan (WRMP). A per-capita consumption of 137.1 l/p/d was adopted, again this is based on the projected rate for the SWOX water resource zone used in Thames Water's latest WRMP. It should be noted that this per capita rate only considers water efficiency measures introduced under Asset Management Period (AMP) 7, this is the 5-year investment cycle for the UK water industry from 2020 to 2025. Additional measures introduced as part of AMP8 which will run from April 2025 to 2030 and for AMPs beyond this are not accounted for. This means that the consumption estimates are considered to be precautionary, with likely further reductions in consumption following implementation of additional measures.

It is more difficult to estimate water use associated with employment site allocations because there are a range of employment uses that could come forward on these sites, each of which may result in different wastewater flows. This is because different employment uses will support different numbers of employees, for example an office may have many more employees per hectare than a warehouse. Furthermore, some employment uses may have additional water demands as part of their business operations. Nonetheless, a reasonable estimate may be obtained by using the formula below:

$$\textit{Employment Consumption} = \textit{Employment Area} \times \textit{Employees per Hectare} \times \textit{Per Capita Consumption}$$

The components of this formula and associated assumptions are as follows:

- *Employment area (hectares)* - Each employment site allocation has a hectarage of employment land associated with it. The hectarage of employment land associated with each JLP site allocation is combined to provide the total amount of land allocated for employment development in the JLP.
- *Employees per hectare* - The South Oxfordshire and Vale of White Horse Employment Land Needs Assessment (ELNA) forecasts the amount of employment land needed in the districts over the plan period. The employment forecasts and projections analysed in the ELNA were used to estimate the number of jobs expected to be created over the plan period. Dividing the total number of jobs by the total employment area gives an estimated average number of employees per hectare.

- *Per capita consumption* - A per-capita consumption rate of 50 l/p/d was used for employment sites based on estimates made by South Staffs Water for office buildings[6] which is expected to make up the majority of the employment land in the JLP. No equivalent rate is provided in Thames Water's WRMP. This consumption rate is higher than benchmark figures stated by Waterwise[7] of 15 l/p/d and is considered precautionary.

It was assumed that 100% of water used is returned to sewer. In reality this is unlikely to be the case but again guarantees that a precautionary approach is taken when assessing the capacity of the STWs. When assessing capacity, the permitted DWF and maximum flow at the STWs were used as a substitute for actual designed hydraulic capacity for each STW being assessed. It should be noted that whilst the permitted flows will relate well to the actual designed hydraulic capacity of a STW in some cases, in other cases it may not.

Appendix 1 provides a more detailed breakdown of the method and calculations applied in the estimation of headroom at each STW.

2.3 Water Quality Modelling

To assess the potential water quality impacts from future development in the districts, in combination with the impacts arising from development in neighbouring authorities, the EA's SIMCAT model for the River Thames has been used. SIMCAT (Simulation of Catchments) is the EA's water quality river modelling software and is a crucial tool for setting and reviewing discharge permits at a catchment scale and to quantify the source apportionment of both point and diffuse pollutant load within the receiving watercourse.

In this context, water quality impacts to receiving watercourses at the 10 STWs have been measured against overall WFD status and the WFD status for individual elements. For this study, these elements include BOD, ammonia, orthophosphate and total phosphorous. The aims of the WFD[8] are to enhance the status and prevent further deterioration of surface water bodies, groundwater bodies and their ecosystem. In this regard, the water quality modelling undertaken is used to assess the following criteria:

- Could the development cause a greater than 10% deterioration in water quality?
- Could the development cause a deterioration in WFD class of any element assessed?
- Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) when considering technically achievable limits (TAL)?

To achieve this, the first task was to review and run the Thames model to confirm it was fit for purpose. The model was run using SIMCATv15.7 with the default flows already in the model. The results from the model were collated for the 10 STWs and four parameters required for this study (BOD, ammonia, orthophosphate and total phosphorous). SIMCAT compares its modelled results to observed results recorded for flow and water quality at monitoring stations. The level of agreement between the modelled and observed results was used as a 'fit for purpose' test. It helps to identify if the model may be inappropriate for decision making (or where there may be some uncertainty associated with decision making). For mean and 95 percentile values the results showed a good level

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[6] South Staffordshire Water (2024) *Water Use in Your Business* https://www.south-staffs-water.co.uk/media/1509/waterusebusiness.pdf
[7] Waterwise (2023) *The Waterwise Guide for Offices* https://www.waterwise.org.uk/wp-content/uploads/2023/10/Waterwise-Guide-for-Offices-AND-POSTERS-FINAL.pdf
[8] European Commission, *Water Framework Directive (2000)*, http://ec.europa.eu/environment/water/water-framework/index_en.html

of agreement overall and therefore that the model is fit for purpose. More detail is provided in section 7. Once the Thames model was confirmed as fit for purpose, the second stage involved running the model for a new baseline considering the averaged 2023/2024 DWF values provided by Thames Water. Note, Thames Water did not supply recently monitored effluent quality data to align with the DWF values. Therefore, the values contained in the EA's SIMCAT model have been used. It is understood that these are from 2022 so still provide recent representation of effluent quality which can be used to review future impacts. However, this is noted as a potential limitation of the study.

In terms of the WFD classifications, the 2019 classifications contained in the EA's SIMCAT model have been used. However, a subsequent review has been undertaken of all of the STWs comparing the latest 2022 classifications against the 2019 classifications applied. This has identified whether there has been a change in WFD class for any of the metrics assessed. Where a change is identified, the potential implications on water quality and development are considered. The 2019 and 2022 WFD classifications are available from Defra's Data Services Platform.

The technically achievable limits (TALs) proposed by the EA were reviewed. The EA advised that the following permit values are achievable using TALs, and that these values should be used for modelling all STW potential capacity irrespective of the existing treatment technology and size of the works:

- Ammonia (95%-ile): 1mg/l
- BOD (95%-ile): 5mg/l
- Phosphorous (mean): 0.25mg/l

To review the appropriateness of the TALs two stages were undertaken. The first stage involved comparing the existing effluent quality values at each STW (contained in the SIMCAT data files provided by the EA) to the TAL values. The second stage involved running the model with and without TALs applied. The impacts of applying TALs on water quality and the WFD classification of receiving watercourses was then assessed. Note, a distinction is made here between effluent quality and water quality. Effluent quality relates to the treated wastewater that is discharged from a STW, whereas water quality is measured downstream in the receiving waterbody.

The model was also reviewed against the list of AMP8 schemes (planned schemes for the 5-year investment cycle for the UK water industry from 2025 to 2030) included in the EA's price review 2024 (PR24) Water Industry National Environment Programme (WINEP)[9]. The programme details proposed changes during AMP8 to permit limits. This includes those for Ammonia, BOD and Total Phosphorous. Where new limits are proposed, these have been reviewed against the mean (for Total Phosphorous) and 95th percentile values (for Ammonia and BOD) contained in the EA's supplied SIMCAT model. The review confirms whether any AMP8 schemes are already contained in the SIMCAT model supplied. The future implications of changes to permit limits is also discussed. Note, the EA has confirmed that the model contains all AMP7(2020-2025) schemes and limits.

The model was subsequently run with increased flows due to i) JLP development (including windfall development) to 2041, and ii) JLP development (including windfall development) plus relevant planned development in neighbouring authority areas to 2041 (applies to Oxford STW only). The model was once again run considering current technology and TAL. Including the baseline runs, six sets of results were generated.

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[9] Environment Agency (2025) *PR24 Water Industry National Environment Programme* https://environment.data.gov.uk/dataset/39b11ea0-3cfa-4cbb-b3a1-b5950019f169

The results for ammonia, BOD, orthophosphate and total phosphorous for the baseline runs were compared to the post-development results. The results were reviewed considering the environmental quality standards listed in Table 2 to determine the impacts on WFD status and individual WFD elements. Note, for total phosphorous there are no universal environmental quality standards, instead the watercourse specific values for orthophosphate have been used. In Table 2 these are presented as a range, the specific values for each STW are based on altitude and alkalinity. These are built into SIMCAT by the EA for every river reach. The specific values are provided in Appendix 2.

Table 2- Environmental Quality Standards for Ammonia and BOD

Element	High	Good	Moderate	Poor
Ammonia (90th Percentile, mg/l)	0.30	0.60	1.10	2.50
BOD (90th Percentile, mg/l)	4.00	5.00	6.50	9.00
Orthophosphate (Mean, mg/l)	0.043-0.048	0.080-0.087	0.195-0.208	1.054-1.084

The three criteria were subsequently assessed based on this information. Table 3 summarises the standards for passing or failing each criterion. The water quality results are provided in section 7.

Table 3- Environmental Quality Standards for Ammonia and BOD

Score	Criteria
Green	No Infrastructure upgrade required to achieve.
Amber	Infrastructure upgrade required, but achievable using TALs or by addressing other factors preventing objectives being met.
Red	Cannot be achieved using TAL. Environmental capacity could be a constraint on development.

To assess the impact of future development in more detail, the relative contributions from other pollution sources has also been reviewed at each STW. This has allowed for the relative impact of future development to be more accurately apportioned.

The final step was to undertake sensitivity testing. This has been carried out using the EA River Quality Planning (RQP) tool as SIMCAT does not contain a similar sensitivity test. The data for each STW was tested. The test re-runs the simulation several times with variations of 10% on the data. The results show which part of the data is sensitive to changes and can provide useful insights for permit setting. More detail is provided in section 7.

2.4 Water Resources

At the JLP Regulation 19 pre-submission publication stage, and through further discussions with the EA, the EA made several comments in relation to future water resources. These related to the following:

- The scoping report identified that residential development planned in the JLP may be higher than accounted for in Thames Water's WRMP24, potentially putting additional pressure on future water resources.
- The scoping report identified the need for water supply infrastructure upgrades. The EA has commented that it may be difficult to align the delivery of infrastructure upgrades with new development given the proposed pace of housing delivery.

- The EA also commented that the levels of housing delivery proposed in the JLP could put pressure on water resources, with less time available to mitigate issues using the demand and supply side options identified in the scoping report.

Regarding the first issue, the scoping report apportioned future dwelling numbers for the Swindon and Oxfordshire (SWOX) Water Resource Zone (WRZ), as outlined in the WRMP24, to individual districts based on their share of the WRZ's base population (2021/22 WRMP data and Office for National Statistics (ONS) 2022 mid-year estimates). For South Oxfordshire, adjustments were made to account for the Henley WRZ, which also covers part of the district and includes Henley-on-Thames and surrounding areas.

This high-level assessment aimed to identify whether levels of development proposed in the JLP align with Thames Water's projections. However, it relied on key assumptions — most notably, that population growth is uniform across the WRZ and that base-year population proportions and occupancy rates remain constant over time. In reality, growth is likely to vary based on local circumstances.

Thames Water's dwelling forecasts for each WRZ are based on aggregated local plan data and ONS trend-based population projections. These forecasts should reflect expected development in each district unless there are significant changes proposed in more recent and/or emerging local plans. For the JLP, this is not believed to be the case, as the proposed residential allocations are carried forward from the districts' existing adopted plans.

For this detailed study, Thames Water has been contacted to obtain the specific dwelling forecasts used in their WRMP24 for the South Oxfordshire and Vale of White Horse districts. The forecasts are based on local plan data obtained in March 2020 for both districts. This is expected to relate to the South Oxfordshire Local Plan 2035[10] and the Vale of White Horse Local Plan 2031[11]. The forecasts derived by Thames Water using this data have subsequently been compared to the housing supply figures in the JLP. The housing supply figures in the JLP include committed development (including sites allocated in neighbourhood development plans), sites proposed for allocation in the JLP and an allowance for windfall development. The comparison looks to confirm whether the planned development is accounted for in the WRMP24 both in terms of the full quantum of development across the plan period and the annual rate of growth. A high-level review is also undertaken of the location of development relative to sensitive sources within the districts, such as chalk streams.

In terms of the second issue related to water supply infrastructure, the scoping report assessed existing water supply infrastructure capacity based on RAG (red, amber, green) reports provided by Thames Water. To inform these reports, Thames Water was initially provided with a list of 135 sites (with dwelling numbers provided where available) that are either proposed for allocation in the JLP or allocated for development in made neighbourhood plans. Each site was then scored based on the district metering area (DMA) threshold. This is the threshold number of dwellings that Thames Water is able to serve with no issues. Based on the DMA threshold, a number of sites were scored amber or red, where there is a medium or high risk to the network requiring further assessment and potentially infrastructure upgrades. In relation to this the EA have commented that infrastructural upgrades may struggle to keep up with the pace of development. However, Thames Water's RAG

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[10] South Oxfordshire District Council (2020) *Adopted Local Plan 2035* https://www.southoxon.gov.uk/south-oxfordshire-district-council/planning-and-development/local-plan-and-planning-policies/local-plan-2035/adopted-local-plan-2035/

[11] Vale of White Horse Council (2019) *Local Plan 2031* https://www.whitehorsedc.gov.uk/vale-of-white-horse-district-council/planning-and-development/local-plan-and-planning-policies/local-plan-2031/

assessments evaluated the total quantum of development proposed for each site. In reality, many of these sites may have already been at least partially assessed by Thames Water, with some sites having phases either already built out or having planning permission for a substantial portion of development. For these sites, infrastructural capacity is assumed to either already exist or to be in process of being planned/delivered.

To further assess water supply constraints as part of this detailed study, Thames Water was contacted to provide further detail on any sites or areas where it envisions longer than usual lead times for upgrades (greater than 1-3 years for network infrastructure). For example, due to existing pressures, the rural setting of sites and/or the quantum of development being brought forward.

In its response, Thames Water flagged the Culham, Hagbourne Hill and Wantage FMZs where the quantum of development being brought forward could result in lengthy lead in times due to the likely requirement for strategic infrastructure investment. Given the potential limits on capacity in these areas, development may also pose increased environmental risks.

The FMZ areas for these locations have been obtained from Thames Water and compared with the JLP allocations to identify any sites falling within these areas. Where this is the case, the quantum of development proposed and expected phasing has been reviewed Following this, any additional mitigative actions required to safeguard water supply and protect the water environment.

On the final point, Thames Water has been consulted on any specific pressures it forecasts for the districts in terms of water resources. The scoping report largely outlined water resource challenges at the scale of the WRZs based on the findings of the WRMP24. For this detailed study, Thames Water has been asked to confirm if the conclusions of the WRMP24 for the wider SWOX WRZ are valid for both districts and whether there are any additional challenges that may arise.

3 Future Development

3.1 Introduction

This section outlines the assumptions related to future development used for the headroom assessments and water quality modelling at each of the 10 STWs. This includes development allocations in the JLP and made neighbourhood plans, in addition to estimates of windfall development and development in relevant neighbouring authorities.

3.2 Joint Local Plan and Neighbourhood Plan Allocations

As part of the Scoping Report, South Oxfordshire and Vale of White Horse District Councils provided a list of 135 sites that are either proposed for allocation in the JLP, have Local Development Orders or Enterprise Zone status, or are allocated for development in made neighbourhood plans. For each site, the number of dwellings expected during the plan period (2021-2041) was provided and/or the amount of employment land.

The STW catchment areas provided by Thames Water as part of the scoping stage were used to determine if sites drain to the 10 STWs scoped into the detailed study, and if so which of the STWs they drain to specifically. The only site where this is difficult to determine is JLP site allocation AS10 Land at Dalton Barracks Garden Village which straddles the border between the Abingdon and Appleton STW catchments. For the headroom assessments, two scenarios are presented - one with the site draining exclusively to Abingdon STW and another with the site draining exclusively to Appleton STW. For the purposes of the water quality modelling, the upper bound estimate of flows for each STW (i.e. with development at Dalton Barracks Garden Village draining exclusively to each of them) were used. This precautionary approach ensures that the potential impacts of development are not underestimated at either of the STWs. Table 4 overpage shows details for the JLP and neighbourhood plan allocations including which STW they drain to. It also includes Enterprise Zones and Local Development Orders (LDOs) which are not JLP or neighbourhood plan allocations, but have been included in the table as they are identified in the JLP as designated areas where employment development is likely to come forward during the plan period and therefore are relevant to this assessment.

Table 4- JLP and neighbourhood development plan allocations, LDOs, and Enterprise Zones draining to each STW

Draining STW	Site Name	JLP or NDP	Site Area (Ha)	No of Dwellings during the plan period	Employment Area (Ha)
ABINGDON	North of Abingdon-on-Thames	JLP	50.7	1030	0
ABINGDON	North West of Abingdon-on-Thames	JLP	12.6	200	0
ABINGDON	Abingdon Science Park	JLP	16.7	0	0.7
ABINGDON /APPLETON	Land at Dalton Barracks Garden Village	JLP	145	1450	7.4
APPLETON	South-East of Marcham	JLP	3.5	87	0
BENSON	Land at Howbery Park, Crowmarsh	NDP	0.3	0	0.3
BENSON	Land north and north east of The Sands	NDP	14.9	240	0
BENSON	Land off Hale Road	NDP	3.5	78	0
BENSON	Land to the north of Littleworth Road	NDP	18.4	192	0
CHOLSEY	Land West of Wallingford	NDP	29.9	537	0
CHOLSEY	Hithercroft Industrial Estate, Wallingford	JLP	1.1	0	0.6
CHOLSEY	Bosley's Orchard	NDP	1.2	20	0
CHOLSEY	Thorne's Nursery	NDP	1.3	4	0
CHOLSEY	Slade End South to West of Green Lane	NDP	0.1	1	0
CHOLSEY	Slade End Farm	NDP	0.5	6	0
CHOLSEY	Wallingford Site C	NDP	23.9	0	3.1
CHOLSEY	Site E	NDP	26.9	502	0
CHOLSEY	Land West of Wallingford Rd	JLP	9.2	106	0
CHOLSEY	Strange's (Slade End) Nursery	NDP	0.4	6	0
CULHAM	Land at Berinsfield Garden Village	JLP	132.4	1491	5
CULHAM	Land Adjacent to Culham Campus	JLP	217.3	1550	0
CULHAM	Culham Campus	JLP	77.3	0	2.3
CULHAM	Former Waggon and Horses	NDP	0.7	1	0
DIDCOT	Rich's Sidings and Broadway, Didcot	JLP	3	100	0
DIDCOT	Didcot Gateway, Didcot	JLP	4.3	144	0
DIDCOT	North West of Valley Park, Didcot	JLP	33.3	800	0
DIDCOT	Harwell Campus	JLP	282	0	93
DIDCOT	Vauxhall Barracks, Didcot	JLP	9.9	189	0
DIDCOT	Ladygrove East	JLP	23.5	750	0
DIDCOT	Didcot North East	JLP	147.9	2,211	0
DIDCOT	Milton Heights	JLP	25	357	0
DIDCOT	Valley Park	JLP	186	4180	0
DIDCOT	Southmead Industrial Estate, Didcot	JLP	2.6	0	2.7
DIDCOT	Didcot A	JLP	36.4	0	29
DIDCOT	Didcot Quarter (Enterprise Zone 2)	JLP	15.2	0	15.2
DIDCOT	Former Esso Research Centre	JLP	11	0	11
DIDCOT	Didcot Technology Park (LDO)	JLP	23.4	0	23.4
DIDCOT	Milton Park (LDO)	JLP	83	0	5.4
DIDCOT	Western Village Plotlands	NDP	3.47	74	0
OXFORD	Land South of Grenoble Road, Oxford	JLP	152.5	2750	10
OXFORD	Land at Northfield, Edge of Oxford	JLP	68	1230	0
OXFORD	Land at Bayswater Brook, Edge of Oxford	JLP	105	1513	0
OXFORD	Harcourt Hill Campus	JLP	22.7	0	0
OXFORD	North-West Radley	JLP	12.2	240	0
OXFORD	South of Kennington	JLP	11.8	283	0
STANFORD	West of Stanford in the Vale	JLP	11.6	251	0
WANTAGE	Northwest of Grove, Grove	JLP	28.3	624	0
WANTAGE	Monks Farm (North Grove)	JLP	60.6	526	0
WANTAGE	Grove Airfield	JLP	107.2	2187	0

WANTAGE	Crab Hill	JLP	98.7	1340	0
WANTAGE	North of East Hanney	JLP	3.4	80	0
WANTAGE	Grove Technology Park	JLP	13.2	0	5.4
WHEATLEY	Land at Wheatley Campus, Oxford	JLP	21.5	447	0
WHEATLEY	Littleworth Road Industrial Estate	NDP	0.5	25	0
WHEATLEY	Miss Tomb's Field	NDP	5.7	55	1.7
WHEATLEY	Mobb's Land	NDP	1.5	0	1.4
WHEATLEY	The Bungalows Site	NDP	0.9	10	0

3.3 Windfall Development

Windfall development in South Oxfordshire and the Vale of White Horse to 2041 has been accounted for by deriving approximate estimates for each STW catchment area based on a proportionate division of the windfall rates in the councils' Housing Land Supply Statements. These estimates were provided as part of the scoping stage. Since the scoping stage, the windfall assessment has been updated to incorporate more recent data. The windfall estimates for each of the 10 STW catchment areas are shown in Table 5.

Table 5- Windfall Development Estimates for STW catchments

STW Catchment	Dwellings per annum	Total Windfalls to 2041
Abingdon	51.2	870.0
Appleton	7.8	132.2
Benson	15.2	257.8
Cholsey	12.2	206.7
Culham	2.6	44.6
Didcot	37.0	629.3
Oxford	30.5	518.7
Stanford in the Vale	3.1	52.6
Wantage	32.2	547.8
Wheatley	3.9	67.0
Total	**195.7**	**3326.8**

3.4 Neighbouring Authorities

Future development in neighbouring authorities also needs to be considered where relevant. The only STW scoped into the detailed study which will be impacted by development in neighbouring authorities is the Oxford STW. This STW drains the majority of Oxford City, part of Cherwell district and a very small part of West Oxfordshire district. Figure 2 shows the extent of the Oxford STW catchment against the relevant local authority boundaries.

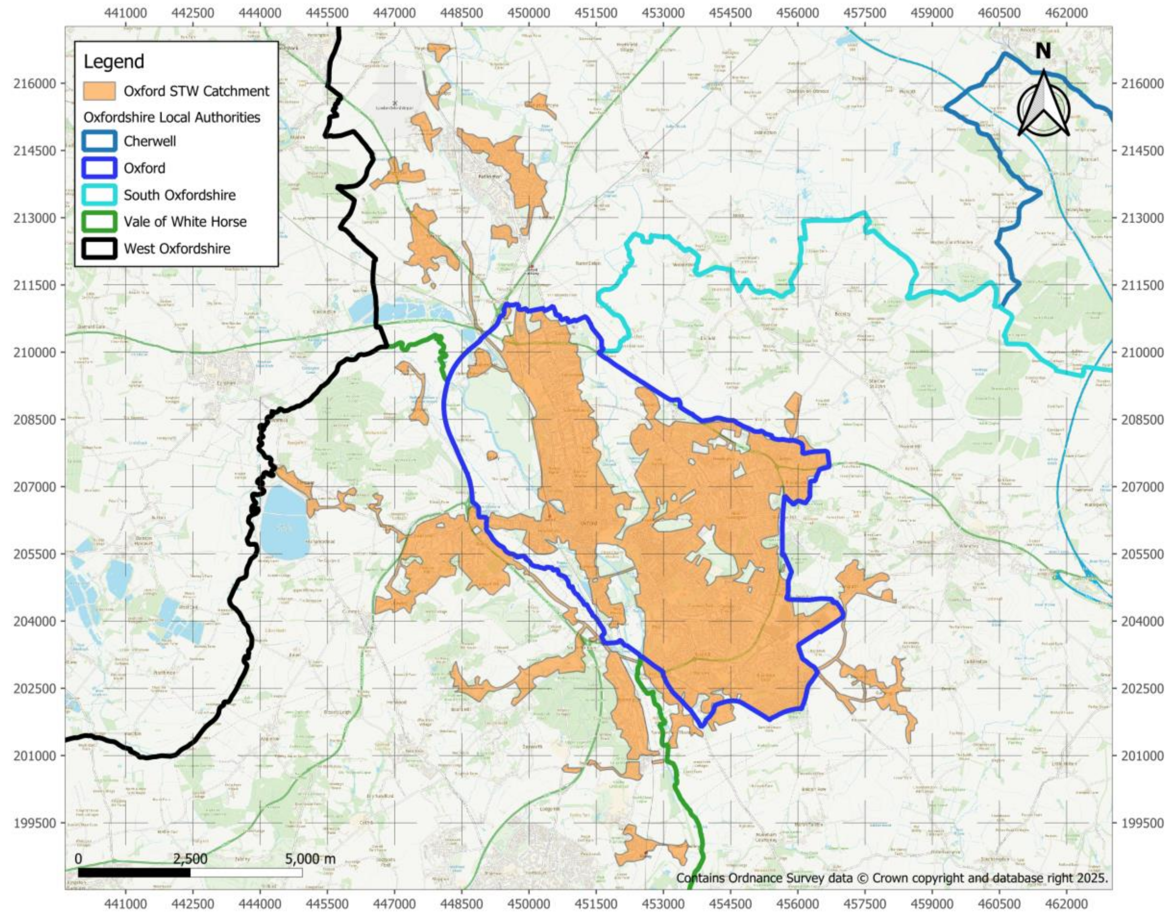

Figure 2- Extent of Oxford STW catchment relative to Local Authority Boundaries

In November 2024, Oxford City Council provided the number of dwellings expected to be delivered in in the city from 2020 to 2040, a total of 9,851 dwellings. This is a capacity figure based on their Housing and Economic Land Availability Assessment (HELAA) 2023. It equates to 493 dwellings per year. To be precautionary, and to align with the JLP plan period, a further 493 dwellings was added to account for an extra year from 2040-2041. This totals 10,344 dwellings to 2041. This figure includes an allowance for windfall development.

In November 2024, Oxford City Council also provided a range for the number of jobs estimated to be delivered in the city to 2040. This range was 8,847-11,417 jobs. The average of this range (9,952 jobs) was used as the number of employees for this assessment. The number of jobs was multiplied by the per capita consumption rate for employment development (50 l/p/d) set out in section 2.2.

Cherwell District Council was also contacted and in November 2024 provided details of six site allocations in their adopted local plan[12] that will drain to the Oxford STW. Cherwell District Council provided a link to their adopted local plan to obtain the number of dwellings and amount of employment land that each site is expected to deliver, as set out in Table 6. These figures were incorporated in the headroom assessment for the Oxford STW using the methodology set out in

[12] The Cherwell Local Plan 2011-2031 (Part 1) Partial Review – Oxford's Unmet Housing Need (adopted September 2020).

section 2.2. Cherwell District Council confirmed that there are no site allocations in its emerging local plan that are within the Oxford STW catchment.

Table 6- Cherwell Site Allocations draining to Oxford STW.[13]

Policy/Site	No of Dwellings	Employment Area (Ha)
PR6a Land East of Oxford Rd	690	0
PR6b Land West of Oxford Rd	670	0
PR7a Land South East of Kidlington	430	0
PR7b Land at Stratfield Farm	120	0
PR8 Land East of the A44	1950	14.7

The Oxford STW catchment only covers a very small rural part of West Oxfordshire. West Oxfordshire District Council was contacted in January 2025 to confirm whether any housing and/or employment development in their area is likely to drain to Oxford STW. West Oxfordshire District Council provided details of five development sites located close to the Oxford STW boundary. These five sites were reviewed and found to drain to the Woodstock and Cassington STWs, neither of which are affected by development proposed in the JLP.

3.5 Development Phasing

JLP Policy HOU2 identifies sources of housing supply to meet the housing requirements for both South Oxfordshire and Vale of White Horse. This includes housing completions, sites with planning permission, sites allocated in made neighbourhood plans, sites allocated in the JLP and an allowance for windfall development. Appendix 4 of the JLP includes trajectory graphs that show how this combination of sites will deliver homes in South Oxfordshire and Vale of White Horse over the plan period from 1 April 2021 to 31 March 2041. Overall, the number of homes the councils expect to come forward over the plan period exceeds the housing requirements. This is accounted for in the headroom and water quality assessments. The housing trajectories are summarised in Figure 3.

[13] Policy KID 1 of the Cherwell Local Plan Review 2042 Proposed Submission Document (Regulation 19) December 2024 states that these existing strategic site policies are retained and will not be replaced.

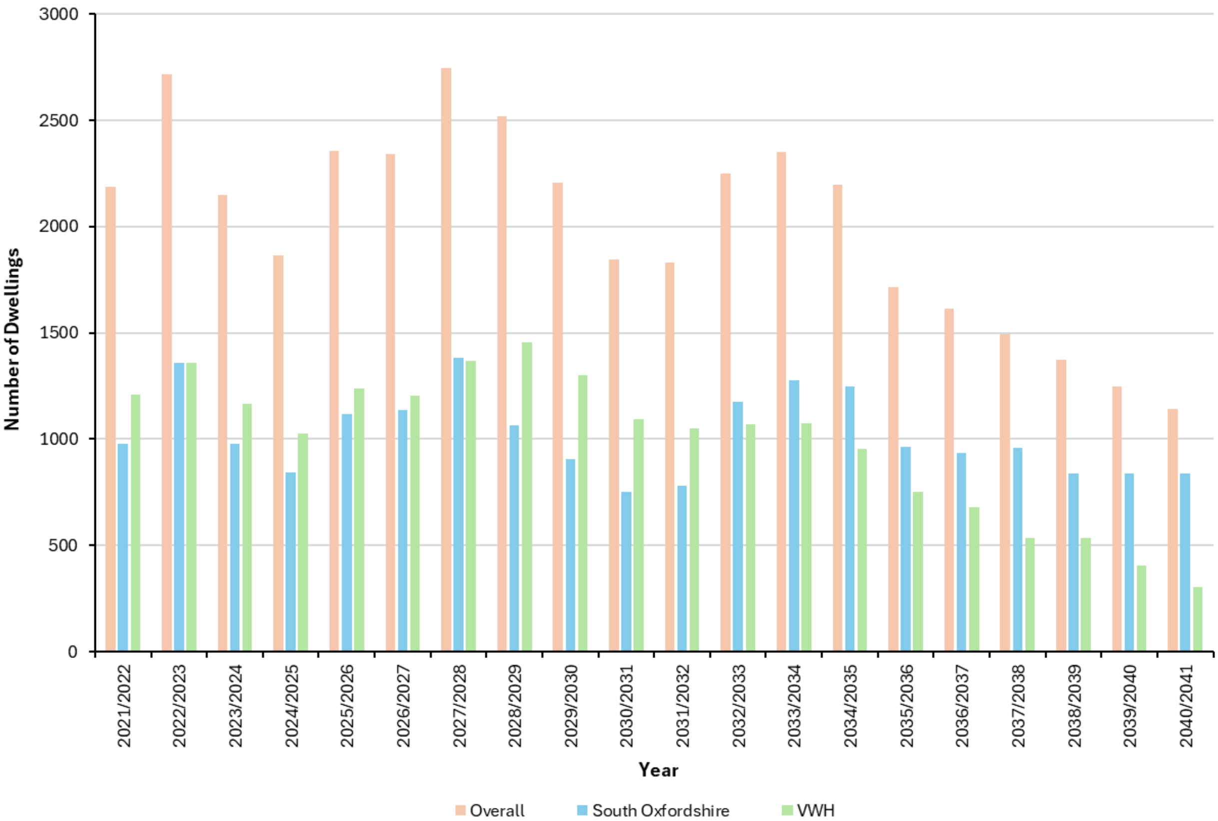

Figure 3- JLP housing trajectories for South Oxfordshire, the Vale of White Horse and overall

Understanding the likely trajectory of housing development over the plan period is important when considering the capacity of water and wastewater infrastructure, particularly in understanding when changes in demand are likely to occur and the time required to deliver any necessary infrastructure upgrades. Therefore, the trajectories have been considered in the assessment of headroom.

For the headroom assessments, an overall change in flows by the end of the plan period (2041) was estimated for each STW considering the development draining to each respective STW (see section 2.2). Rather than assume that this change is linear across the plan period, the changes in flow follow the same trend as the districts' housing trajectories. For STW sites in South Oxfordshire the trajectory for South Oxfordshire was applied, for those in the Vale of White Horse the trajectory for the Vale of White Horse was applied, and for STW sites draining both districts the overall trajectory was applied. This approach helps to ensure that the assessments capture how headroom is likely to change across the plan period.

It is important to recognise that the Oxford STW also drains neighbouring authorities. In January 2025, Oxford City Council provided details of their housing trajectory to 2040. In February 2025, Cherwell District Council also provided details on development phasing for the site allocations that were identified as draining to the Oxford STW. These trajectories have also been incorporated into the headroom assessments using the same approach as applied to South Oxfordshire and Vale of White Horse.

Appendix 1 provides a more detailed breakdown of the method and calculations applied in the estimation of headroom at each STW site.

4 Headroom Assessment

4.1 Introduction

Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a STW. Where there is insufficient headroom at the works to treat these flows, this could lead to breaches in flows permitted leading to a greater volume of treated sewage being discharged into receiving watercourses presenting a water quality risk. A lack of headroom at a STW can also lead to the capacity of the sewer network upstream being exceeded more regularly, in turn contributing to a greater number of untreated sewer discharges via CSOs.

To assess the headroom available at each of the 10 STWs in this study, the methodology in section 2.2 has been applied considering the quantum of development outlined in section 3. Appendix 1 provides a detailed breakdown of the method and calculations used in the estimation of headroom at each STW.

4.2 Review of Dry Weather Flow (DWF) Data

An initial assessment of headroom capacity at STWs was undertaken using DWF data supplied by Thames Water for the two most recent years 2023 and 2024. Subsequently, further DWF data were obtained from Thames Water for a wider period from 2019 to 2024 and a comparison was undertaken to ensure that the 2023 and 2024 data provide a representative baseline to use in the headroom assessment.

Table 7 shows the 90th percentile annual exceedance flow values recorded at each STW between 2019-2024. The baseline DWF used for the headroom assessments and water quality modelling is an average of the flow values across the two most recent years 2023 and 2024.

Table 7- 90th percentile annual exceedance flow values (2019-2024)

STW Name	2019	2020	2021	2022	2023	2024
ABINGDON STW (Lagoon)	5591.5	6688.4	6487.2	6772.3	8643.2	8191.8
ABINGDON STW (New)	3456.8	3493.9	4416.9	3049.3	2996.4	3291.1
ABINGDON STW (Combined)	9048.3	10182.2	10904.0	9821.6	11639.5	11482.9
APPLETON STW	1086.0	1496.4	1455.6	1222.9	1563.9	1710.9
BENSON STW	1542.3	2053.9	2121.8	1848.4	2309.0	2767.4
CHOLSEY STW	2560.4	3142.5	2928.0	2163.6	2831.1	3304.8
CULHAM STW	781.1	826.3	867.3	711.8	942.9	945.1
DIDCOT STW	9998.2	13170.7	12533.8	9824.9	14634.8	15525.6
OXFORD STW	38422.4	40854.7	41969.1	37774.4	48373.2	48374.2
STANFORD IN THE VALE STW	175.6	374.9	425.9	408.3	512.7	480.8
WANTAGE STW	5866.6	6777.5	6629.2	6159.7	6407.1	8106.3
WHEATLEY STW	918.0	973.9	966.0	817.3	1121.3	1083.7

Figure 4 shows the trends in the 90th percentile annual exceedance flow values between 2019-2024. The monitoring data generally shows an increasing trend in 90th percentile flows between 2019-2024, with a notable fall in 2022 likely associated with the drought event in this year.

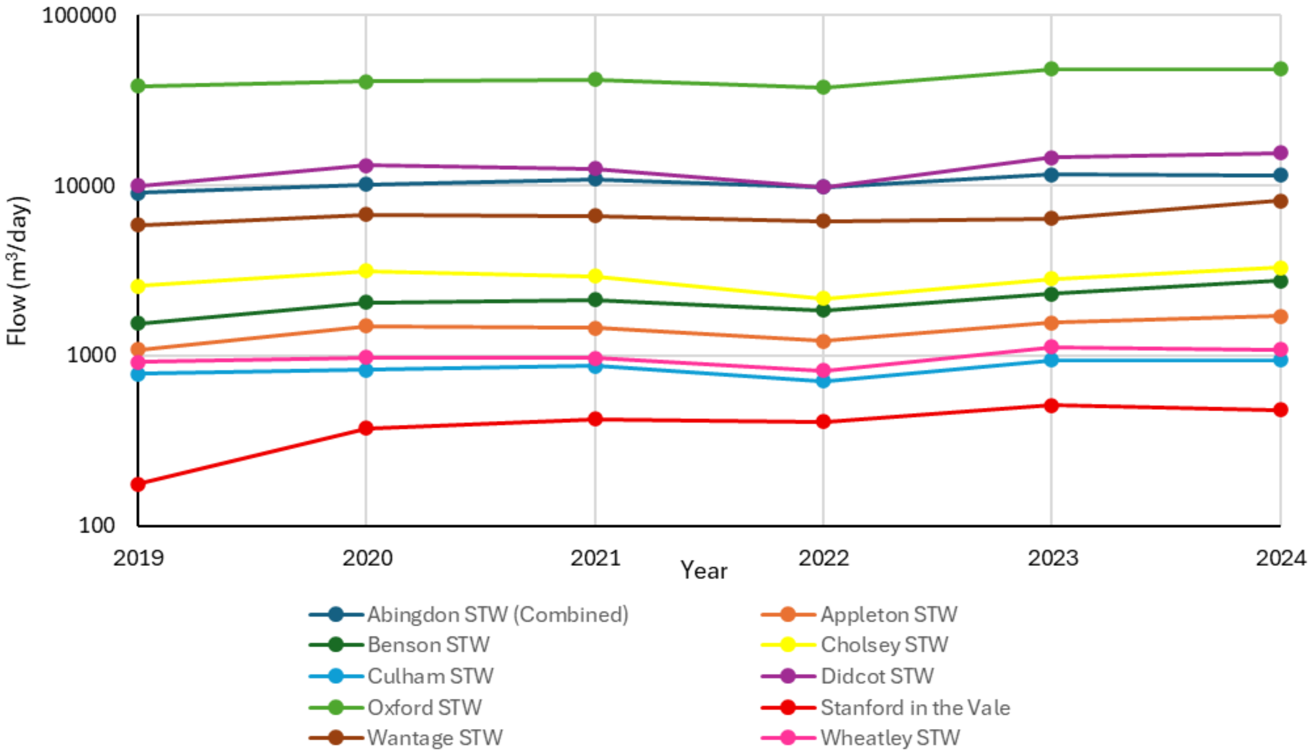

Figure 4- Trends in 90th percentile annual exceedance flow values (2019-2024)

Table 8 provides a comparison between the baseline DWF flows (average 2023-2024) and the longer-term average flows (average 2019-2024). For the majority of the STWs the flows recorded in 2023 and 2024 are the two highest recorded. This is with the exception of Cholsey STW, Wantage STW and the Abingdon (New) STW outfall. For Cholsey STW and Wantage STW, 2024 is the highest flow recorded and the average for 2023-2024 remains significantly higher (9%) than the long-term average (2019-2024). For the Abingdon (New) STW outfall the average for 2023-2024 is lower than the longer-term average. However, when flows across both outfalls at Abingdon STW are considered, the average for 2023-2024 remains significantly higher (10%) than the longer-term average.

Table 8- Comparison between adopted flows (average 2023/24) with longer term flows (average 2019-24)

STW Name	Average (2019-2024)	Average (2023-2024)	Percentage Difference (%)
ABINGDON STW (Lagoon)	7062.4	8417.5	19.2
ABINGDON STW (New)	3450.7	3143.7	-8.9
ABINGDON STW (Combined)	10513.1	11561.2	10.0
APPLETON STW	1422.6	1637.4	15.1
BENSON STW	2107.1	2538.2	20.5
CHOLSEY STW	2821.7	3068.0	8.7
CULHAM STW	845.7	944.0	11.6
DIDCOT STW	12614.7	15080.2	19.5
OXFORD STW	42628.0	48373.7	13.5
STANFORD IN THE VALE STW	396.4	496.8	25.3
WANTAGE STW	6657.7	7256.7	9.0
WHEATLEY STW	980.1	1102.5	12.5

The baseline flows used for the study (2023/2024) are based on the most recent available data and reflect a consistent upward trend in flow volumes since 2019. As they are higher than the longer-term average (2019-2024), they are precautionary in their nature and ensure that the available capacity at STWs is not overestimated.

It should be noted that the average 90th percentile flows across 2023-2024 are higher than the longer-term average (2019-2024) 80th percentile flows at all of the STWs, apart from at the Abingdon (New) STW outfall.

4.3 Results

4.3.1 Abingdon STW

The Abingdon STW has two outfalls to separate watercourses, Abingdon (Lagoon) which discharges secondary treated effluent and settled storage sewerage into the Odhay Hill Ditch (SU 4933 9509), and Abingdon (New) which discharges secondary treated effluent into the River Thames (SU 4985 9523). Abingdon (Lagoon) has a permitted DWF of 8,335 m^3/day and Abingdon (New) a permitted DWF of 4,524 m^3/day. Thames Water provided recorded DWF values (2023-2024) at each outfall. Headroom has been estimated at both outfalls independently and concurrently. For the independent assessments the proportion of increased flows from development draining to each outfall has been assumed to be the same as the ratio of the current DWF permits. In this regard, Abingdon (Lagoon) takes 64.8% of the increased flows whereas Abingdon (New) takes 35.2% of the increased flows.

During the scoping stage, the EA flagged concerns that Abingdon STW was close to the limits of its DWF permit. Based on the DWF monitoring data supplied by Thames Water, Abingdon (Lagoon) exceeded its DWF permit in 2023 and 2024, whereas the monitoring data for Abingdon (New) shows flows from 2023 and 2024 to sit significantly below its DWF permit.

JLP site allocations draining to Abingdon STW include North of Abingdon-on-Thames (1030 dwellings), North-West of Abingdon-on-Thames (200 dwellings), Abingdon Science Park (0.7 ha of employment land) and potentially Land at Dalton Barracks Garden Village (1450 dwellings & 7.4 ha of employment land).

The headroom assessment at Abingdon (Lagoon) shows that the DWF is already being exceeded and that additional development draining to the STW would cause a significant increase in the DWF (see Figure 5). By the end of the plan period (2041) the projected DWF is more than 10% greater than the current permitted DWF (when applying the assumption that the Land at Dalton Barracks Garden Village exclusively drains to Abingdon STW).

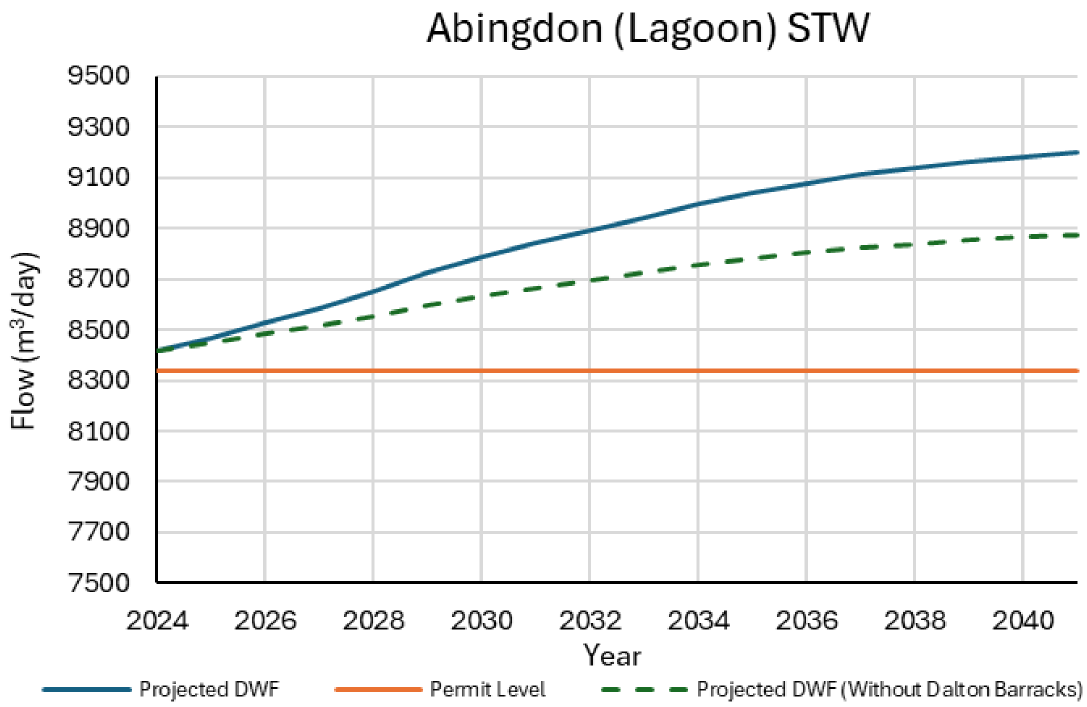

Figure 5- Abingdon (Lagoon) STW DWF Headroom Forecast

The headroom assessment at Abingdon (New) shows that the current DWF permit has sufficient headroom to accommodate future development (see Figure 6). By the end of the plan period (2041) the projected DWF is more than 21% less than the current permitted DWF (assuming that the Land at Dalton Barracks Garden Village drains exclusively to Abingdon STW).

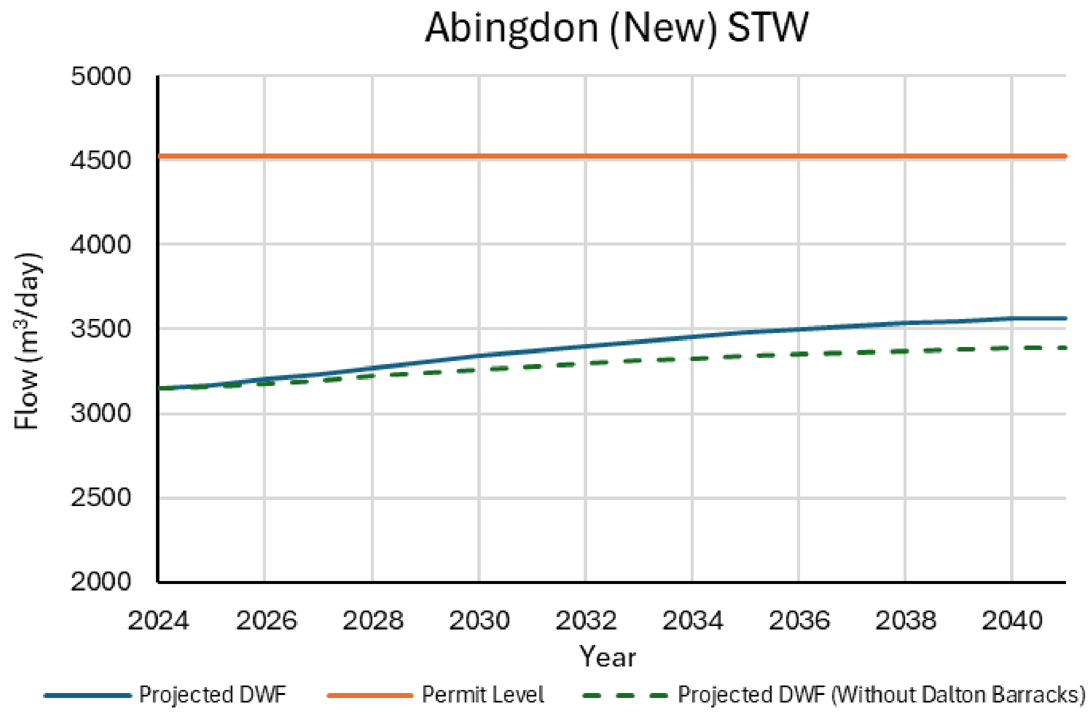

Figure 6- Abingdon (New) STW DWF Headroom Forecast

Viewing the STW as a whole, the recorded DWF values when combined would fall below the combined permitted DWF in the present day (see Figure 7). When development is accounted for the projected DWF shows a significant increase, however by the end of the plan period (2041) the DWF remains 0.7% lower than the combined value of the permits (assuming that the Land at Dalton Barracks Garden Village drains exclusively to Abingdon STW).

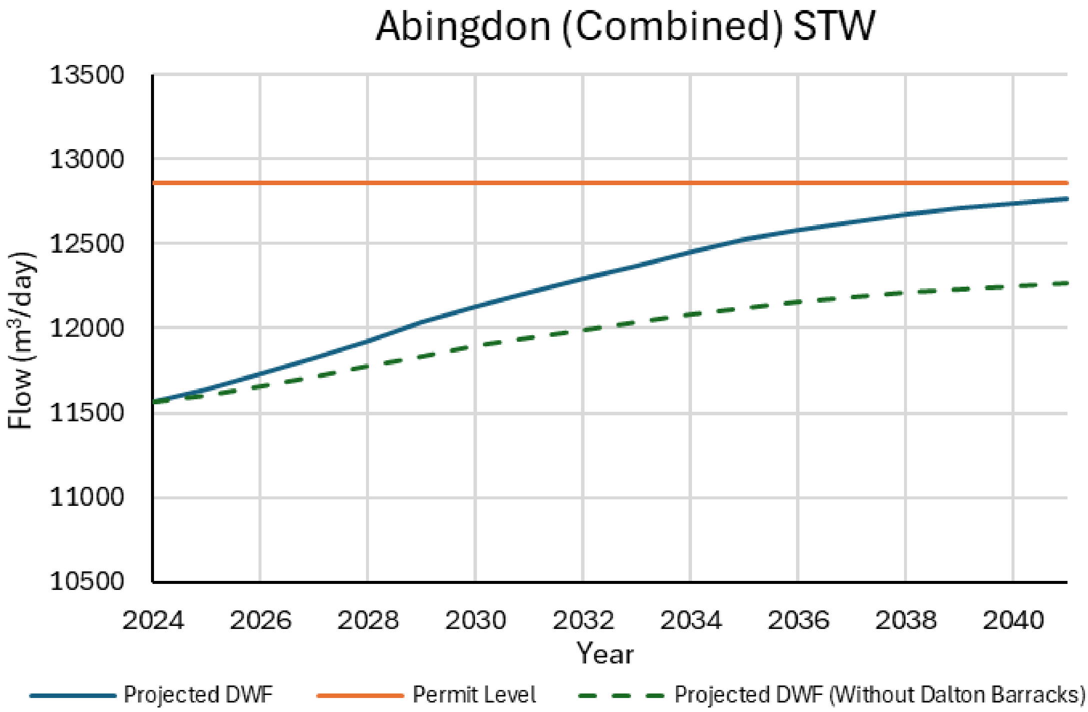

Figure 7- Abingdon (Combined) STW DWF Headroom Forecast

The headroom assessments at Abingdon STW indicate a large exceedance of the current permit at Abingdon (Lagoon), whilst headroom remains at the Abingdon (New) outfall throughout the plan period. This assumes that flows from development are proportional to the ratio of the current DWF permits.

It should be noted that if the Land at Dalton Barracks Garden Village were to drain exclusively to Appleton STW instead, the projected DWF at Abingdon (Lagoon) and Abingdon (New) would fall to 8,874 m^3/day (6.5% greater than DWF permit) and 3,391 m^3/day (25% lower than DWF permit) respectively. When combined this would result in 12,235 m^3/day, leaving 4.7% headroom at the STW as a whole by the end of the plan period.

Abingdon (Lagoon) is projected to exceed its permitted DWF flow in both scenarios and it is likely that a new DWF permit will need to be applied for. Viewing the STW as a whole there is still some headroom at the STW, however whether it is possible to redistribute treatment in the STW to discharge more flows to the Abingdon (New) outfall to make use of its greater headroom and reduce pressures on the Odhay Hill Ditch is unclear. If an increase in the DWF permit for Abingdon (Lagoon) is required, it should be noted that Abingdon is currently a low spilling STW, and an increase in storm overflows due to development would be seen as unacceptable. Therefore, to accommodate an increase in the permitted DWF flow, the FFT and storm tank size will likely need to be upgraded.

Improvements to Abingdon STW, as well as improvements to the sewerage system network and water supply network, are set to take place during AMP8 (2025-2030). This could have a positive impact on the headroom available at Abingdon STW.

4.3.2 Appleton STW

The Appleton STW outfalls to the Marcham Brook at SU 4370 9980. It has a permitted DWF of 1,368 m^3/day.

JLP site allocations draining to Appleton STW include South-East of Marcham (87 dwellings) and potentially Land at Dalton Barracks Garden Village (1450 dwellings & 7.4 ha of employment land).

The headroom assessment at Appleton STW shows that there would be a significant increase in the DWF if the Land at Dalton Barracks Garden Village drains to the STW (see Figure 8). By the end of the plan period (2041) the projected DWF is more than 60% greater than the current permitted DWF. It should be noted that if the Land at Dalton Barracks Garden Village were to drain exclusively to Abingdon STW instead, the projected DWF at Appleton STW would fall to 1,711 m^3/day. The DWF recorded in 2023/2024 exceeded the current permit level so there would still be insufficient headroom, however the amount of exceedance by the end of the plan period would fall to 25%.

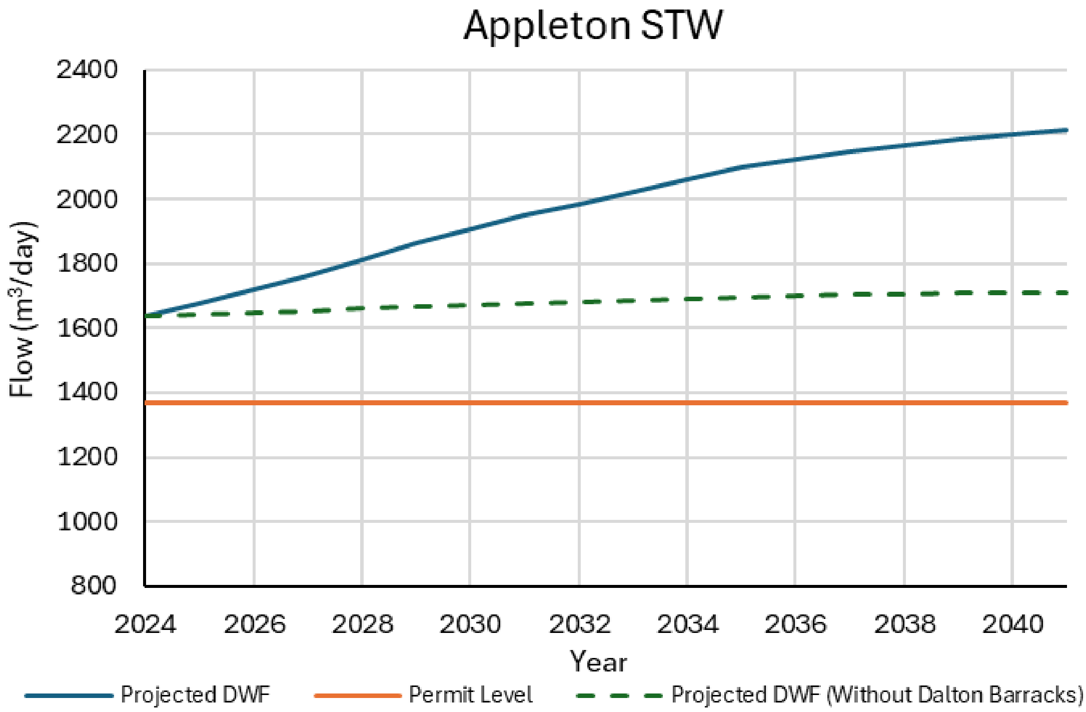

Figure 8- Appleton STW DWF Headroom Forecast

Given that Appleton STW is already regularly exceeding its permitted DWF flow, a new DWF permit is required. Should the Land at Dalton Barracks Garden Village drain to the Appleton STW, further amendments to the DWF permit are likely to be needed along with significant upgrades to the STW (i.e. FFT and storm tank size) in order to accommodate a 35% increase in flows to the STW. Application for the permits should occur well in advance of developments being built out.

Currently it is understood that as part of AMP7 (the 5-year investment cycle for the UK water industry from 2020 to 2025), Thames Water are required to increase the STW's FFT, however this scheme has been delayed. The EA stated in their representation made on the JLP during its Regulation 19 publication period that no additional flows are to connect to Appleton STW until the AMP7 scheme is completed by Thames Water. Appleton has a temporary deemed consent storm permit. This will be resolved and converted into an Environmental Permitting Regulations (EPR) permit on completion of the AMP7 scheme. It is recommended that this and subsequent permits agreed between Thames Water and the EA consider the development planned within the STW's catchment.

4.3.3 Benson STW

The Benson STW outfalls to the Howbery Ditch at SU 6201 9047. It has a permitted DWF of 2,517 m^3/day.

No JLP sites are proposed to drain to Benson STW, however four made neighbourhood plan allocations will, the largest of which is Land north and northeast of the Sands (240 dwellings).

The headroom assessment at Benson shows that the DWF is already being exceeded and that development draining to the STW would cause a significant increase in the DWF (see Figure 9). By the end of the plan period (2041) the projected DWF is more than 10% greater than the current permitted DWF.

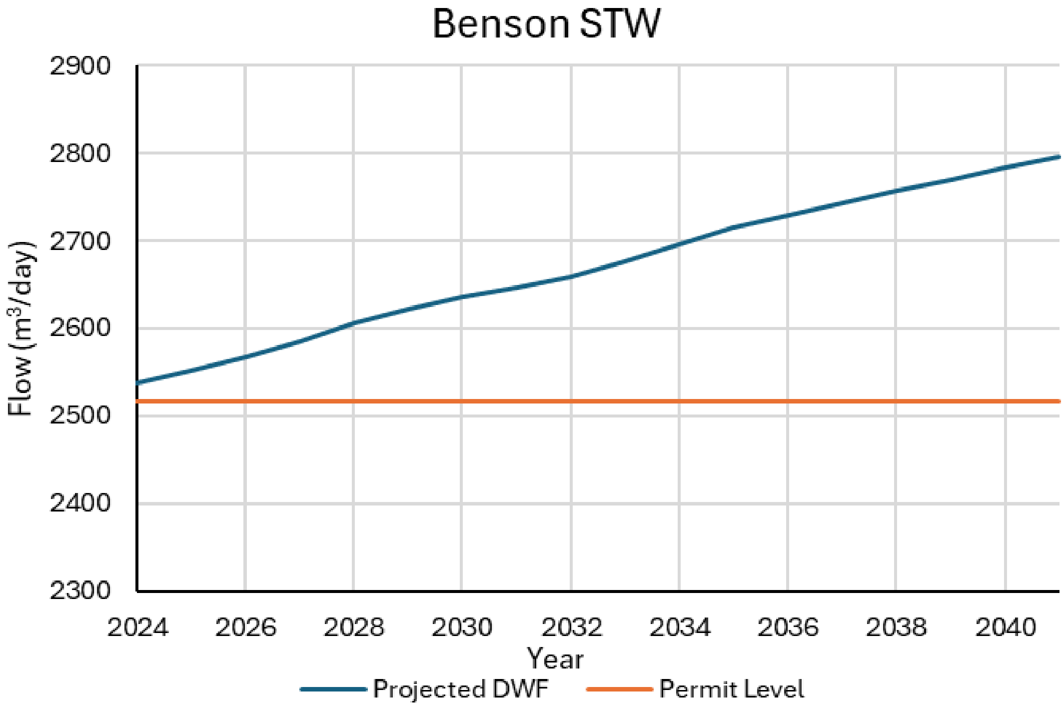

Figure 9- Benson STW DWF Headroom Forecast

Benson STW is already regularly exceeding its DWF capacity and will need to apply for a new permit in the near future. The STW has a AMP7 FFT scheme which Thames Water completed in 2024, this should allow for some additional capacity at the STW through increased flow capacity and storm tank storage.

Looking further into the plan period there is set to be a 10% increase in flows to the STW by the end of the plan period. Therefore, further amendments to the DWF permit may be required alongside upgrades to the STW's infrastructure. Application for the permits should occur well in advance of developments being built out.

4.3.4 Cholsey STW

The Cholsey STW outfalls to the Cholsey Brook at SU 5914 8723. It has a permitted DWF of 3,200 m^3/day.

Two JLP site allocations drain to Cholsey STW, Land West of Wallingford Road (106 dwellings) and Hithercroft Industrial Estate (0.6 ha of employment land).

The headroom assessment at Cholsey shows that development draining to the STW would cause a significant increase in the DWF (see Figure 10). The DWF is projected to exceed the current DWF in 2029. By the end of the plan period (2041) the projected DWF is more than 10% greater than the current permitted DWF.

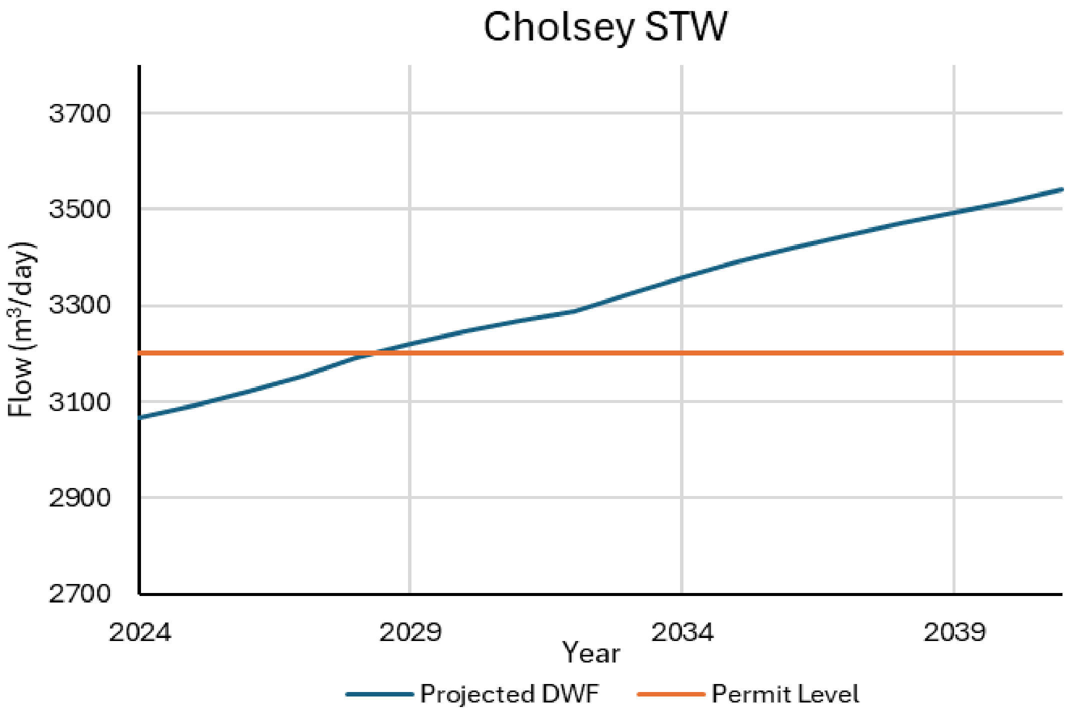

Figure 10- Cholsey STW DWF Headroom Forecast

The headroom assessment suggests that whilst Cholsey STW currently has sufficient headroom, it is projected to exceed this in the middle of the plan period. Cholsey's FFT is soon to be increased from 74 to 105 litres per second which should allow for some additional treatment capacity. This is being implemented to reduce the need for untreated discharges of sewerage in wet weather. An associated increase in storm tank capacity has also been completed recently.

Despite these upgrades, it is likely that a new DWF permit will be required along with further upgrades to the STW later in the plan period. Applications for the permits should occur well in advance of developments being built out.

4.3.5 Culham STW

The Culham STW discharges to the Clifton Hampden Ditch at SU 5390 9550. The current discharge permit for Culham is a maximum flow permit of 2,868 m^3/day. However, the EA plan to change this to a DWF permit and has recommended that the projected changes in flow are also compared to the equivalent DWF. In this regard, the EA has recommended that the maximum flow be divided by 3 to estimate an equivalent DWF of 956 m^3/day. This is the standard approach for converting maximum flow to DWF.

Three JLP site allocations drain to Culham STW, Land at Berinsfield Garden Village (1491 dwellings & 5 ha of employment land), Land Adjacent to Culham Campus (1550 dwellings) and Culham Campus (2.3 ha of employment land).

The headroom assessment at Culham shows that development draining to the STW would cause a significant increase in flows (see Figure 11). However, the projected DWF remains within the current maximum flow permit with 30% of the headroom still available. If measured against the equivalent DWF permit of 956 m^3/day, the projected DWF is more than double this value by the end of the plan period.

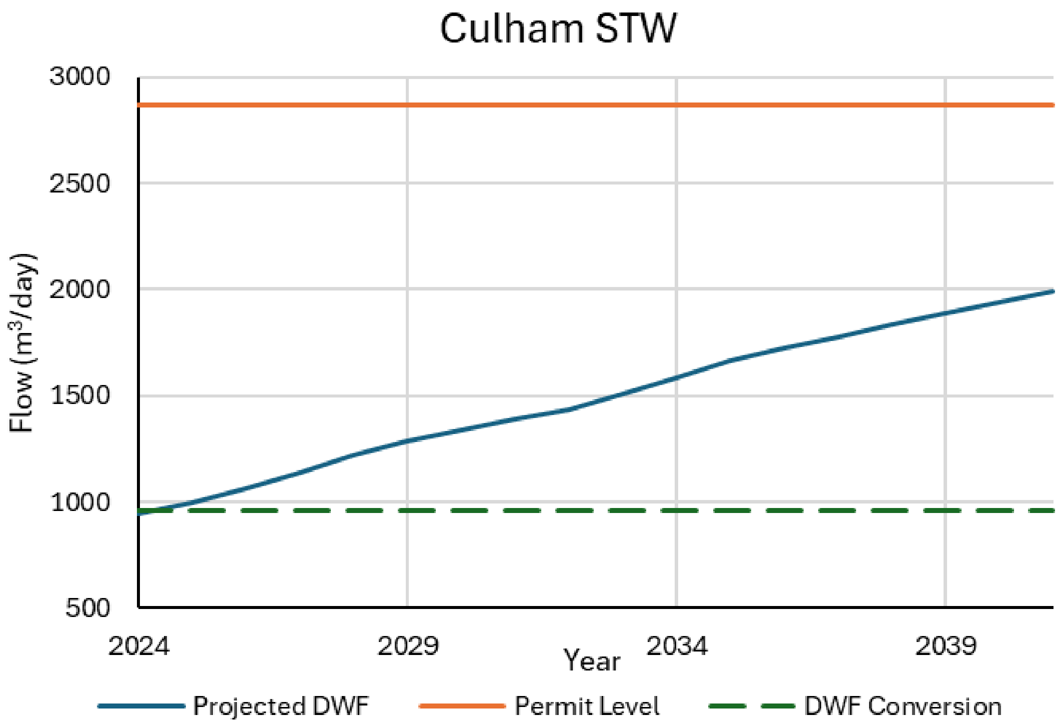

Figure 11- Culham STW Headroom Forecast

Should the flow permit at Culham be changed to a DWF permit, it would likely need to be set above the equivalent DWF rate of 956 m^3/day immediately given that this rate is already regularly exceeded. Culham STW had a 'Temporary Deemed Consent' for its storm overflow. This was to be converted into an EPR permit by the end of AMP7 (March 2025).

Thames Water will need to factor in sites allocated for development in the JLP in planning any upgrades to the STW which may be required. As part of Thames Water's enhancement case for sewerage treatment growth[14], Culham STW has been identified as 1 of 15 STWs that will have their treatment capacity exceeded during the period 2025-2030. An enhancement case has been submitted seeking additional allowances to invest at the 15 STWs identified to ensure that treatment capacity will be increased to cater for additional development. At Culham, Thames Water has specified that biological capacity, DWF, FFT and storm tank volume all need to be increased. No detail has yet been provided on the specific upgrades proposed, however if implemented they could have a positive impact on the headroom available at Culham STW.

4.3.6 Didcot STW

The Didcot STW outfalls to the Moor Ditch at SU 5195 9143. It has a permitted DWF of 11,476 m^3/day.

[14] Thames Water (2024) *TMS24 Enhancement case: Sewage Treatment Growth* https://www.thameswater.co.uk/media-library/home/about-us/regulation/our-five-year-plan/pr24-2023/sewage-treatment-growth.pdf

Many JLP site allocations are proposed to drain to Didcot STW. Residential JLP sites draining to Didcot STW include Valley Park (4180 dwellings), Didcot North-East (2211 dwellings), North-West of Valley Park (800 dwellings), Ladygrove East (750 dwellings), Milton Heights (357 dwellings), Vauxhall Barracks (189 dwellings), Didcot Gateway (144 dwellings) and Rich's Sidings and Broadway (100 dwellings). JLP employment sites draining to Didcot STW include Harwell Campus (93 ha of employment land), Didcot A (29 ha of employment land), Former Esso Research Centre (11 ha of employment land), and Southmead Industrial Estate (2.7 ha of employment land). Additionally, one enterprise zone identified in the JLP also drains to Didcot STW, Didcot Quarter Enterprise Zone 2 (15.2 ha of employment land), as well as two LDOs identified in the plan, Didcot Technology Park LDO (23.4 ha of employment land) and Milton Park LDO (5.4 ha of employment land).

The headroom assessment at Didcot shows that the DWF is already being exceeded and that future development draining to the STW would cause a significant increase in the DWF (see Figure 12). By the end of the plan period (2041) the projected DWF is more than 60% greater than the current permitted DWF.

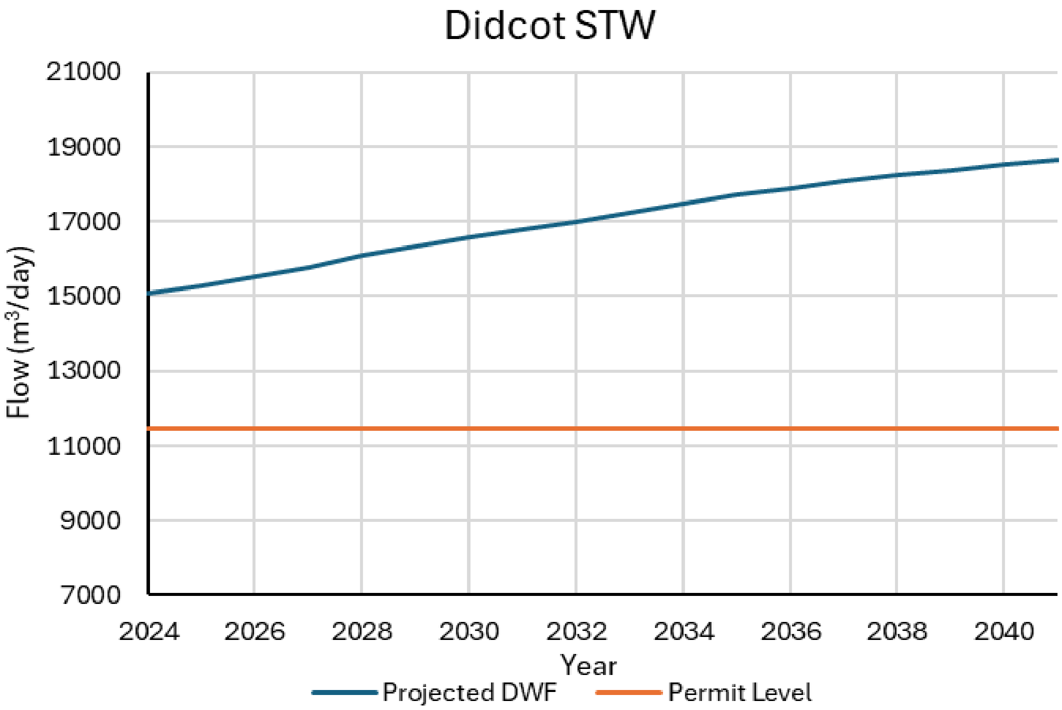

Figure 12- Didcot STW DWF Headroom Forecast

A large amount of development is planned within the Didcot STW catchment and the STW is a concern for the EA. It is already regularly exceeding its DWF permit and a new DWF permit that considers development over an appropriate period is required. This period will need to be agreed between the EA and Thames Water. FFT and storm tank size are known to be too small for the population served, therefore when Thames Water apply for a new DWF they will be expected to increase these to accommodate the population served. Until a new permit is in place, the EA will not support any development within the STW catchment. This was stated in their representation made on the JLP during its Regulation 19 publication period.

As part of Thames Water's enhancement case for sewage treatment growth, Didcot STW has been identified as 1 of 15 STWs that will have their treatment capacity exceeded during the period 2025-2030. At Didcot, Thames Water has specified that DWF, FFT and storm tank volume all need to be increased. No detail has yet been provided on the specific upgrades proposed, however if implemented they could have a positive impact on the headroom available at the STW and support in the application of a new DWF permit. It is likely that further upgrades to the STW will also be required later into the plan period. Application for the permits should occur well in advance of development being built out. It should also be noted that Didcot is a high spilling STW with known instances of sewer flooding in nearby residential areas, which is thought to be partly due to groundwater infiltration. Future improvements at the STW should also consider measures to reduce infiltration and prevent excessive spills.

4.3.7 Oxford STW

The Oxford STW outfalls to the Pottery Stream at SP 5439 0223. It has a permitted DWF of 50,985 m^3/day. The Oxford STW is the only STW assessed which also receives flows from neighbouring authorities.

Five JLP site allocations drain to Oxford STW, Land South of Grenoble Road (2750 dwellings & 10 ha of employment land), Land at Northfield (1230 dwellings) Land at Bayswater Brook (1513 dwellings), North-West Radley (240 dwellings) and South of Kennington (283 dwellings). Note, these are the total homes these sites are expected to deliver between 2021 and 2041, and not the total capacity of the sites.

Figure 13 shows the headroom assessments undertaken at Oxford STW. The headroom assessment at Oxford, when only accounting for development in South Oxfordshire and Vale of White Horse, leads to a moderate increase in the DWF. The current DWF permit would have sufficient headroom to accommodate this development. By the end of the plan period (2041) the projected DWF is 1% less than the current permitted DWF. The headroom assessment at Oxford, when also accounting for development in adjacent authorities, leads to a significant increase in the DWF. The DWF is projected to exceed the current permit DWF in 2030. By the end of the plan period (2041) the projected DWF is close to 10% greater than the current permitted DWF. This is largely driven by development in Oxford City.

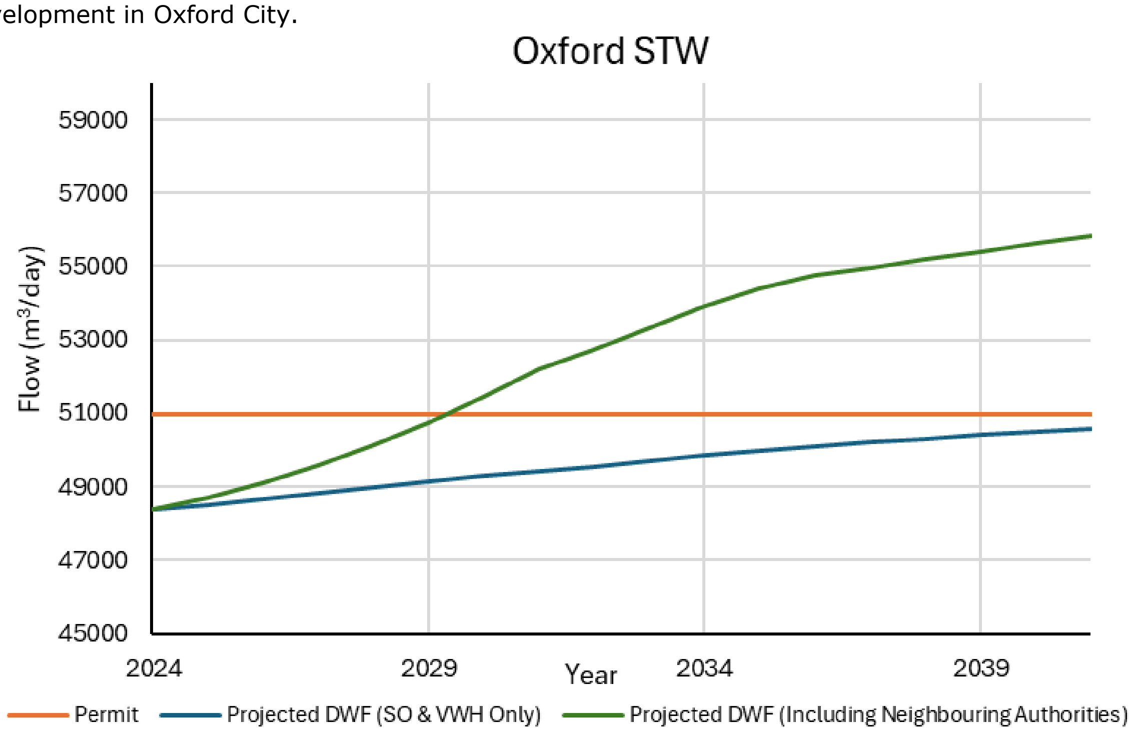

Figure 13- Oxford STW DWF Headroom Forecast

In recent years Oxford STW has faced a number of challenges. A Compliance Assessment Report (CAR) form was issued to Thames Water in November 2021. This outlined a number of significant and serious breaches of the Environmental Permit. In terms of infrastructural capacity, the FFT and permitted DWF have become unaligned, with the FFT considered too small to serve the current population. The available storm tank capacity is also understood to be significantly below what would be required for the population served. Given these issues, additional flows discharging to Oxford STW could present a significant environmental risk.

However, the Thames Water *Phase 1 plan* for the STW is underway and is expected to be completed by 2027. The scheme will increase the inlet capacity of the STW, with the FFT increasing from 1,040 l/s to 1,434 l/s. Thames Water has stated that the increase in capacity provides the additional capacity required to treat sewage from both the projected increase in non-residential development and the projected increase in the number of dwellings set out in local plan trajectories provided by Oxford City Council, Cherwell District Council and South Oxfordshire and Vale of White Horse District Councils. Thames Water states this totals 9,534 new homes between 2025–2031, and 10,902 between 2032-2041.

The EA issued a position statement in May 2025[15] to confirm that they are satisfied that the *Phase 1 plan* will ensure planned development is accommodated without deteriorating water quality in the Northfield Brook (or any other waterbody) once it is delivered in 2027.

All of Thames Water's AMP7 (2020-2025) improvements are due to be delivered by the end of 2031. Future phases will further increase capacity and build resilience at the STW. This should include further flow improvements and the introduction of a new treatment process later in 2025. The improvements collectively should support the Northfield Brook achieving Good status and reduce spills to the surrounding water environment and improve effluent quality.

Alongside the agreed upgrades, Thames Water are also finalising plans for a major upgrade to be delivered during AMP9 (2030-2035). This will provide a significant increase in treatment capacity, with larger storm tanks and a higher quality of treated effluent discharging to the river.

The majority of the JLP site allocations draining to Oxford STW are not expected to start delivering new homes until 2030, with dwelling numbers peaking towards the end of the plan period. Provided there are no delays to the current upgrade works (due in 2027 and 2031) it should mean that there is sufficient capacity to accommodate all of the JLP allocations. However, it should be noted that many of the upgrades are yet to be completed and there has been non-delivery issues at the STW previously. This said, the EA has confirmed that they have improved confidence in the delivery of the upgrades. The councils are intending to propose a modification to the submitted Joint Local Plan[16] regarding emerging Policy AS3: Land South of Grenoble Road, Edge of Oxford. This will allow for the major upgrades / expansion of the Oxford STW expected under AMP9 (2030-2035) and give greater certainty to its delivery.

A new DWF permit may be required along with the upgrades to the STW. Note, in the EA's price review 2024 (PR24) Water Industry National Environment Programme (WINEP)[17] a DWF limit of

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[15] Environment Agency (2025) 2025-05-22 EA Oxford STW Position.pdf WA/2023/130351/05-L01
[16] southandvale.gov.uk/app/uploads/2024/12/CSD01-Joint-Local-Plan-2041-Publication-Version.pdf
[17] Environment Agency (2025) *PR24 Water Industry National Environment Programme* https://environment.data.gov.uk/dataset/39b11ea0-3cfa-4cbb-b3a1-b5950019f169

52,816 m³/day is proposed for AMP8 (2025-2030). Applications for the permit should occur well in advance of developments being built out.

4.3.8 Stanford in the Vale STW

The Stanford in the Vale STW outfalls to the River Ock at SU 4370 9980. It has a permitted DWF of 650 m³/day.

One JLP site allocation drains to Stanford in the Vale STW, the West of Stanford in the Vale site (251 dwellings).

The headroom assessment at Stanford in the Vale shows that the current DWF permit has sufficient headroom to accommodate future development (see Figure 14). By the end of the plan period (2041) the projected DWF is more than 8% less than the current permitted DWF.

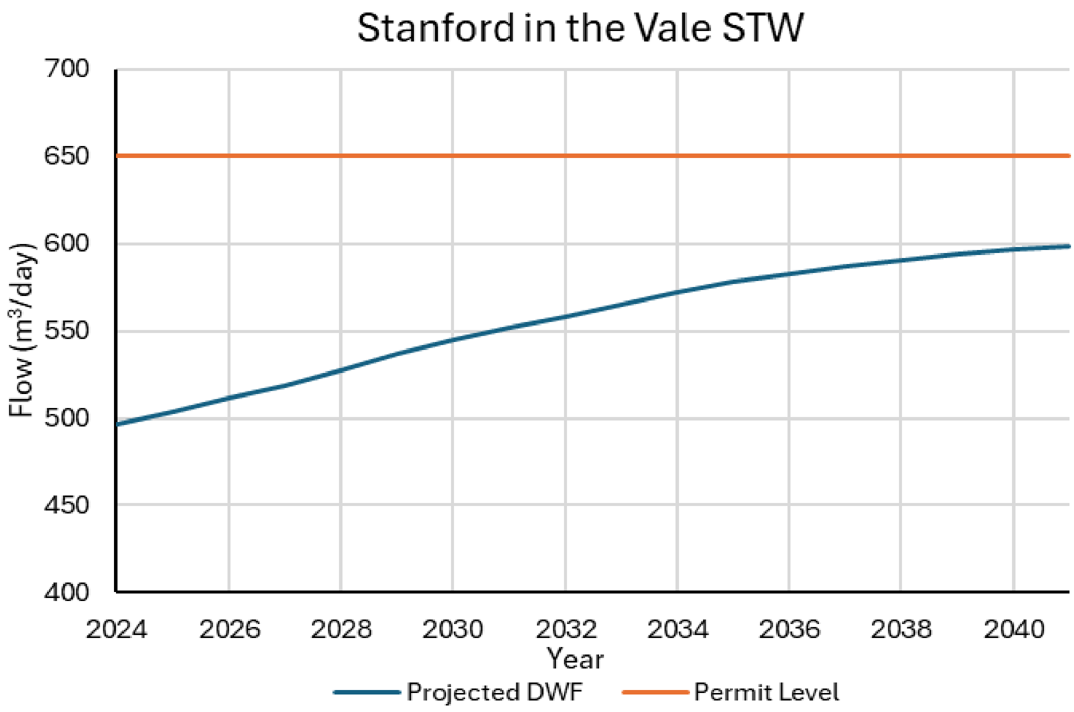

Figure 14- Stanford in the Vale STW DWF Headroom Forecast

Thames Water is progressing a project to increase the capacity of the storm tanks. This will reduce untreated sewage discharges during storm conditions.

4.3.9 Wantage STW

Wantage STW outfalls to Letcombe Brook at SU 4075 9171. It has a permitted DWF of 6,250 m³/day.

Six JLP site allocations drain to Wantage STW, North-West of Grove (624 dwellings), Grove Airfield (2187 dwellings) Crab Hill (1340 dwellings), North of East Hanney (80 dwellings) and Monks Farm, North Grove (526 dwellings) and Grove Technology Park (5.4 ha of employment land).

The headroom assessment at Wantage shows that the DWF is already being exceeded and that additional development draining to the STW would cause a significant increase in the DWF (see Figure 15). By the end of the plan period (2041) the projected DWF is 45% greater than the current permitted DWF.

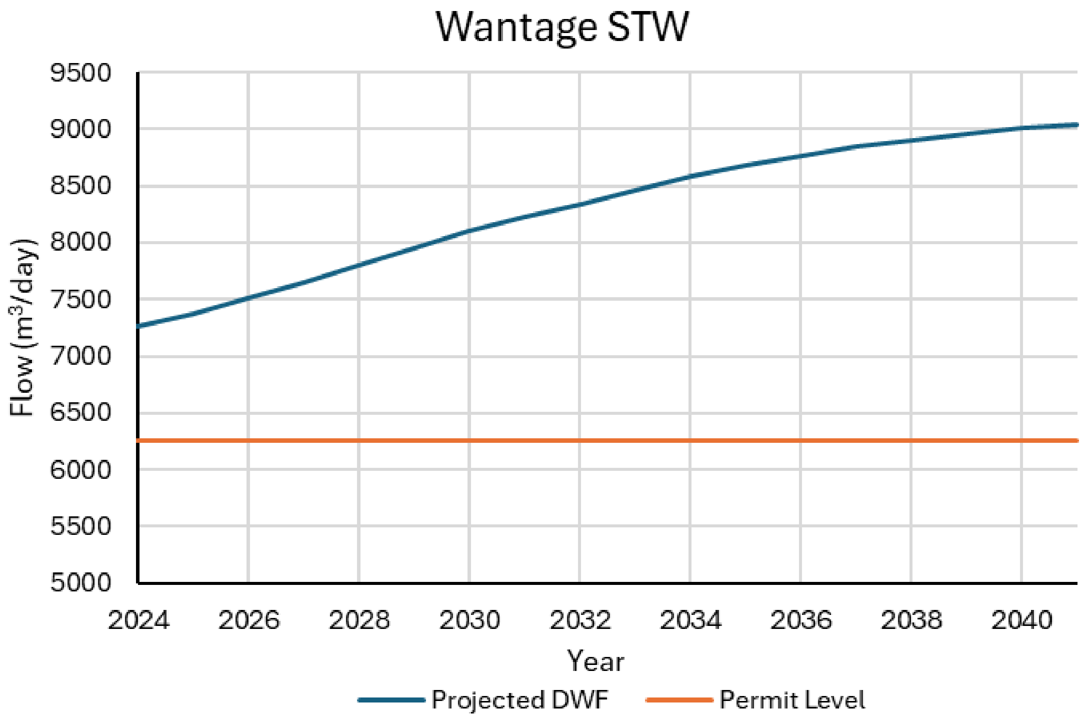

Figure 15- Wantage STW DWF Headroom Forecast

Wantage STW exceeded its permitted DWF in 2023 and 2024, and a significant quantum of development is proposed to drain to this STW. As a result, a new DWF permit that considers development up to an appropriate period is required. This period will need to be agreed between the EA and Thames Water.

As part of Thames Water's enhancement case for sewerage treatment growth, Wantage STW has been identified as 1 of 15 STWs that will have their treatment capacity exceeded during the period 2025-2030. Thames Water has specified that DWF and FFT both need to be increased. No detail has yet been provided on the specific upgrades proposed, however if implemented they could have a positive impact on the headroom available at the STW. It is likely that further upgrades to the STW will be required later into the plan period also. Application for the permits should occur well in advance of developments being built out.

4.3.10 Wheatley STW

The Wheatley STW discharges to the Wheatley Ditch at SU 4370 9980. It has a permitted DWF of 1,239 m^3/day.

One JLP site allocation drains to Wheatley STW, the Land at Wheatley Campus site (447 dwellings).

The headroom assessment at Wheatley shows that development draining to the STW would cause a significant increase in the DWF (see Figure 16). The DWF is projected to exceed the current permitted DWF in 2035. By the end of the plan period (2041) the projected DWF is 5.8% greater than the current permitted DWF.

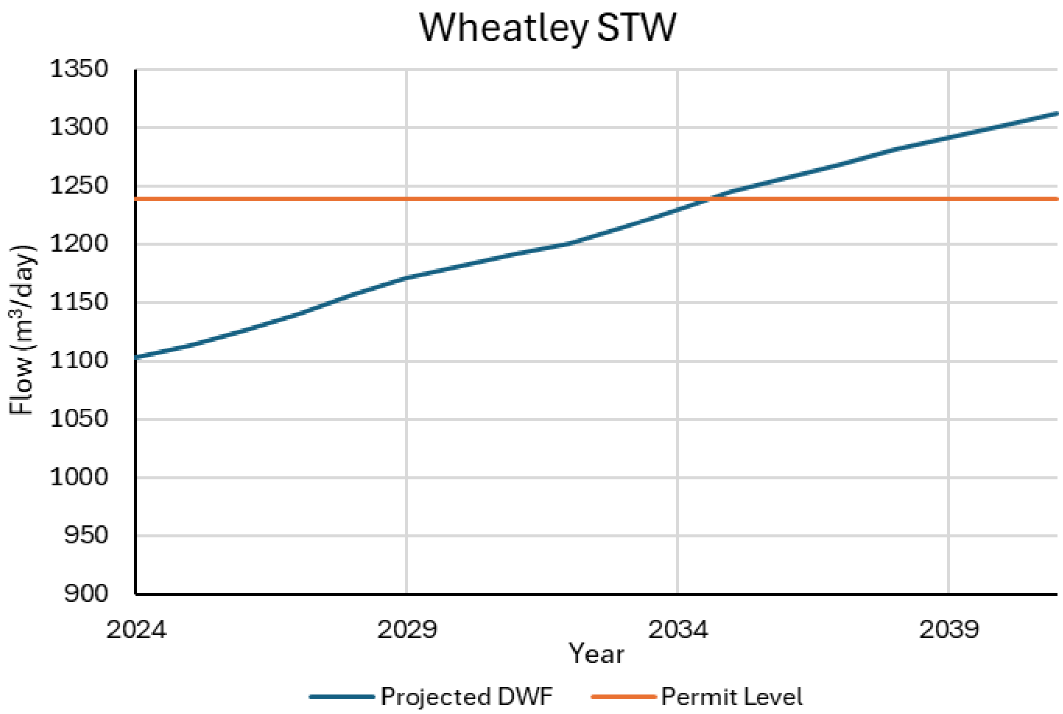

Figure 16- Wheatley STW DWF Headroom Forecast

Five development allocations are proposed to drain to the STW. Based on the permitted DWF, there is capacity at the STW currently, however the STW has been noted to exceed its permitted DWF in some years.

As part of Thames Water's enhancement case for sewerage treatment growth, Wheatley STW has been identified as 1 of 15 STWs that will have their treatment capacity exceeded during the period 2025-2030. At Wheatley, Thames Water have specified that FFT and storm tank capacity both need to be increased. No requirement to increase DWF is listed, however based on this headroom assessment increases to DWF are likely required further into the plan period. No detail has yet been provided on the specific upgrades proposed, however if implemented they could have a positive impact on the headroom available at the STW.

4.4 Summary

Table 9 provides a summary of the headroom assessments. The values listed for Abingdon and Appleton are the upper bound values with the Land at Dalton Barracks Garden Village assumed to drain exclusively to each STW.

At three of the ten STWs (Abingdon, Culham and Stanford in the Vale) there is sufficient headroom to accommodate future development based on the current permits in place. However, at Abingdon this is only when considering both outfalls (Abingdon Lagoon and Abingdon New), and at Culham when applying the current maximum flow permit, which is expected to be reduced in the near future.

At four of the ten STWs (Benson, Cholsey, Oxford and Wheatley) the current permitted DWF will be exceeded by the end of the plan period, albeit by less than 25%.

At three of the ten STWs (Appleton, Didcot and Wantage) the permitted DWF is already regularly exceeded and will be exceeded by more than 25% by the end of the plan period. This is partly due to delays in planned infrastructure upgrades which are the responsibility of Thames Water.

It should be noted that in all cases the assessments are precautionary in that they assume that all JLP allocations and neighbourhood plan allocations will be built out and do not take into account planned or longer-term increases in DWF and treatment capacity. For example, the upgrades to Oxford STW which are underway should ensure there is sufficient treatment capacity to accommodate all additional flows draining to the site across the plan period. It should also be noted that the assessments have considered the dwellings expected to be delivered during the JLP plan period (2021-2041), on some of the sites a significant number of dwellings have already been delivered between 2021-2024.

Table 9- Summary of Headroom Assessments

STW Name	DWF (2-yr average 23/24)	Projected DWF (Districts only)	Projected DWF (Neighbouring authorities)	Permitted DWF	Headroom Available Projected (%)
Abingdon (Lagoon)	8417.5	9198.5	9198.5	8335	-10.4
Abingdon (New)	3143.7	3567.7	3567.7	4524	21.1
Abingdon (Combined)	11639.6	12766.2	12766.2	12859	0.7
Appleton	1637.4	2212.0	2212.0	1368	-61.7
Benson	2538.2	2795.5	2795.5	2517	-11.1
Cholsey	3068.0	3540.4	3540.4	3200	-10.6
Culham	944.0	1992.0	1992.0	2868	30.5
Didcot	15080.2	18636.3	18636.3	11476	-62.4
Oxford	48373.7	50561.4	55862.6	50985	-9.6
Stanford in the Vale	496.8	598.3	598.3	650	8.0
Wantage	7256.7	9042.1	9042.1	6250	-44.7
Wheatley	1102.5	1311.4	1311.4	1239	-5.8

In its response to Ofwat's PR24 draft determinations[18] [19] Thames Water has committed to achieving 100% compliance with all permits to discharge wastewater in AMP8. However, Thames Water has stated that this will be challenging due to climate change and the inclusion of DWF assessment under AMP8. Currently, EA assessment of compliance with DWF permit conditions at each STW is ad-hoc. The EA has stated that it will be formalising and standardising its DWF compliance assessment for application in AMP8.

Thames Water will need to invest in many of the STWs assessed to ensure compliance to 2041. Upgrades have been identified for all of the STWs assessed, however further investment may be required later in the plan period. Once funding has been obtained for upgrading and/or building new infrastructure, there remain significant lead times for planning and construction before infrastructure can be considered functional. In this respect, wastewater companies require detailed information on likely housing development well in advance. Table 10 outlines the lead time estimates provided by Thames Water.

Table 10- Thames Water estimate of infrastructure lead in time

Resource	Lead in time
Sewerage network upgrades	1-3 Years
Wastewater treatment upgrade	3-5 Years
Major resource development (new reservoir, new STW etc)	8-10 Years

[18] Ofwat (2024) *PR24 draft determinations: Sector summary* https://www.ofwat.gov.uk/publication/pr24-draft-determinations-sector-summary/
[19] Thames Water (2024) *TMS-DD-039: Thames Water PR24 DD response – Outcomes* https://www.thameswater.co.uk/media-library/home/about-us/regulation/our-five-year-plan/draft-determination-2024/thematic-chapters/TMS-DD-039-Thames-Water-PR24-DD-response-Outcomes.pdf

The EA will need to consider development against infrastructural and environmental capacity in setting future environmental permits which allow development to progress sustainably without presenting a risk to the water environment.

South Oxfordshire and Vale of White Horse District Councils have already set out Policy CE8 - Water quality, wastewater infrastructure and drainage in the JLP. This policy aims to protect and enhance the quality of waterbodies where they, or their catchments, are wholly or partially located within South Oxfordshire and Vale of White Horse. This includes ensuring that there is sufficient wastewater infrastructure capacity to serve development.

It is recommended that South Oxfordshire and Vale of White Horse District Councils take the following actions:

- In liaison with Thames Water, consider available STW capacity in the assessment of planning applications and seek to align the delivery of development and infrastructure upgrades where required in accordance with JLP Policies CE8 - Water quality, wastewater infrastructure and drainage and IN1 – Infrastructure and service provision.
- Share their Annual Monitoring Reports and Housing Land Supply Statements, which details projected housing growth in their administrative areas, with Thames Water.
- Provide a copy of the WCS to planning colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council, with specific attention brought to the assessment at Oxford STW as the STW catchment crosses administrative boundaries. (None of the other STWs assessed have catchments that extend beyond South Oxfordshire and Vale of White Horse.) A copy should also be provided to Thames Water, the EA, and Oxfordshire County Council as the Waste Planning Authority.

In response to these actions, Thames Water will need to assess growth demands as part of their wastewater asset planning activities and feedback to South Oxfordshire and Vale of White Horse District Councils if concerns arise. Thames Water will also need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.

5 Water Quality Assessment

5.1 Introduction

An increase in the discharge of effluent from STWs due to development can lead to a negative impact on the water quality of the receiving watercourse. Under the Water Framework Directive (WFD) [20], a watercourse should not deteriorate from its current WFD status either as an overall watercourse or for each of the individual elements assessed. Table 11 gives a description of how the WFD defines each of the status or classes. For this study, the elements assessed include the following:

Ammonia- Ammonia is an inorganic chemical compound of nitrogen and hydrogen with the formula NH_3. It is used as a fertilizer, cleaning product and in the production of plastics. Sewerage is also a source of ammonia.

Biochemical Oxygen Demand (BOD)- BOD is a measure of how much oxygen is used to break down organic matter in water. It is an important indicator of water quality and organic pollution. A high BOD indicates that there is more organic pollution in the water. BOD is used to measure the level of organic pollution in wastewater before it's released to a watercourse.

Total Phosphorous- Total phosphorus is the sum of all phosphorus in a sample, including dissolved and particulate forms. It is a key measurement used to assess water quality and wastewater treatment. Sewage, fertilizer and urban runoff are key human-made sources.

Orthophosphate- Orthophosphate is the most readily used form of phosphorous. It is a phosphorus compound commonly used in water treatment of lead and copper. Sewage, fertilizer and urban runoff are key sources.

The impact of development on these elements has been determined by undertaking water quality modelling. The study also provides results for total phosphorous which is a key measurement to assess water quality however not one of the individual elements assessed by the WFD.

Table 11- Definition of status in Water Framework Directive

Status/Class	Definition
High	Near natural conditions. No restriction on the beneficial uses of the waterbody. No impacts on amenity, wildlife, or fisheries.
Good	Slight change from natural conditions because of human activity. No restriction on the beneficial uses of the waterbody. No impact on amenity or fisheries. Protects all but the most sensitive wildlife
Moderate	Moderate change from natural conditions because of human activity. Some restriction on the beneficial uses of the waterbody. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions because of human activity. Some restrictions on the beneficial uses of the waterbody. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions because of human activity. Significant restriction on the beneficial uses of the waterbody. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

[20] European Commission, *Water Framework Directive (2000)*, http://ec.europa.eu/environment/water/water-framework/index_en.html

Where the scale of development is such that a deterioration in water quality is predicted, a variation in the STW's Environmental Permit (EP) to improve the quality of the final effluent and prevent deterioration will be required. This is known as no deterioration load standstill and satisfies the no deterioration requirement of the WFD. In addition to safeguarding against deterioration, a further aim of the WFD is for all surface water bodies to achieve good ecological status. Thus, the WFD's aim of good ecological status and the need to meet other river quality targets is also considered by the EA when setting or varying a permit.

The standard framework for how the requirements and aims of the WFD should be implemented on inland waters has been set out by the EA. The potential impact of development is assessed in relation to the following criteria:

- **Could the development cause a deterioration in WFD status of any element assessed?**

  This is a requirement of the WFD to prevent a deterioration in status of individual contaminants.

- **Could the development alone prevent the receiving watercourse from reaching good ecological status?**

  This is a requirement of the WFD, it assesses whether good ecological status is possible after development with current technology or is technically possible when considering TALs.

- **Could the development cause a greater than 10% deterioration in water quality?**

  This objective is to ensure that all the environmental capacity is not taken up by one stage of development and ensure there is sufficient capacity for future development. It is assessed against current technology and TALs.

To assess these three criteria, the EA's SIMCAT model for the Thames catchment has been used. This has included a 'fit for purpose' test, review of the proposed TALs, baseline model runs, post-development model runs with current technology, post-development model runs considering TALs and sensitivity testing. Note, at Oxford STW, which is also affected by development in Oxford City and Cherwell District, two sets of post-development runs were undertaken i) considering development in the JLP area only and ii) considering development in the JLP area and neighbouring authorities. The results of these assessments are outlined in the sections below.

5.2 Review of EA SIMCAT River Thames Model

The EA's water quality river model SIMCAT (Simulation of Catchments) is a crucial tool for setting and reviewing discharge permits at a catchment scale and to quantify the source apportionment of both point and diffuse pollutant load within receiving watercourses.

In terms of wastewater, SIMCAT has been used for calculating the impact of discharges from STWs at a catchment scale and is often used to determine the permit standards required to meet the WFD's targets and requirements.

Driven by summary statistics defining the mean and standard deviations of flow and quality, SIMCAT uses Monte Carlo simulation to predict in-river summary statistics. Monte Carlo Simulation is a type of modelling that uses repeated random sampling to obtain the likelihood of a range of results of occurring.

In this study, the EA's SIMCAT model for the River Thames was run using SIMCAT v15.7, which was provided by the EA in October 2024. To assess whether it was fit for purpose, the results from the model were collated for ammonia, BOD and orthophosphate in the receiving watercourses for the 10 STWs scoped in for assessment (Table 1). SIMCAT can be used to compare the modelled results to observed results recorded for flow and water quality. Note, whilst modelled results are generated for total phosphorous observed results are not available, therefore they are not presented in this section.

The level of agreement between the modelled and observed results can be used as a 'fit for purpose' test. It helps to identify if the results for any of the STWs in the model may be inappropriate for decision making. Table 12 provides a summary of the results of the test. For the mean and 95th percentile values the results show a good level of agreement with observed values overall, confirming that the model is fit for purpose. The full results of the test are provided in Appendix 2.

Table 12- Comparison of modelled versus observed values for flow and water quality (mean and 95% values)

STW Name	Parameter	Mean Values		95% Percentile Values	
		Modelled	Observed	Modelled	Observed
Abingdon (Lagoon)*	Ammonia	0.059	0.115	0.124	0.252
	BOD	0.560	No data	0.894	No data
	Orthophosphate	0.144	0.257	0.260	0.422
Appleton	Ammonia	0.245	0.095	0.771	0.297
	BOD	3.180	No data	5.850	No data
	Orthophosphate	1.610	1.860	3.170	4.230
Benson	Ammonia	0.250	0.261	0.674	0.788
	BOD	3.020	3.610	5.230	7.460
	Orthophosphate	1.000	1.730	2.610	3.720
Cholsey	Ammonia	0.503	0.499	1.520	1.350
	BOD	3.290	No data	6.530	No data
	Orthophosphate	0.184	0.199	0.405	0.527
Culham	Ammonia	0.325	0.316	0.925	0.807
	BOD	3.440	2.620	5.900	5.640
	Orthophosphate	2.440	2.660	3.550	4.930
Didcot	Ammonia	0.129	0.089	0.412	0.318
	BOD	1.640	No data	2.930	No data
	Orthophosphate	0.425	0.541	0.934	1.340
Oxford	Ammonia	0.546	0.719	1.930	2.410
	BOD	3.450	3.960	6.090	10.900
	Orthophosphate	0.305	0.275	0.824	0.507
Stanford in the Vale	Ammonia	0.063	0.038	0.184	0.068
	BOD	0.510	1.240	0.793	1.620
	Orthophosphate	0.182	0.164	0.392	0.324
Wantage	Ammonia	0.257	0.196	0.693	0.441
	BOD	3.020	2.320	4.960	3.840
	Orthophosphate	0.372	0.208	0.723	0.365
Wheatley	Ammonia	0.043	0.035	0.103	0.064
	BOD	0.500	1.200	0.985	1.710
	Orthophosphate	0.333	0.418	0.599	0.759

*Observed values not available for Abingdon (New)

5.3 Comparison of 2019 and 2022 WFD Classifications

In terms of the WFD classifications, the 2019 classifications already contained in the EA's SIMCAT model have been used. However, a subsequent review has been undertaken of all of the STWs comparing the latest 2022 classifications against the 2019 classifications applied. This has identified whether there has been a change in WFD class for any of the metrics assessed. Where a change is identified, the potential implications on water quality and development are considered. The Water Framework Directive (WFD) uses a six-year cycle for managing river basins. These cycles involve planning, implementing measures, and reviewing progress to protect and improve water quality.

The Water Framework Directive (WFD) classifications for 2019 and 2022 represent assessments of the ecological and chemical status of water bodies in the UK. They are used to inform each six-year cycle, the 2019 classifications relate to cycle 2 (2016-2021) with the 2022 classifications relating to the latest cycle, cycle 3 (2022-2027).

The EA's SIMCAT model contains the 2019 WFD classifications. This section reviews the 2019 classifications applied in this study against the latest 2022 classifications. The classifications are reviewed for the WFD waterbody pertaining to each STW. Table 13 lists the receiving watercourses and WFD waterbody for each STW.

Table 13- Receiving watercourse and WFD waterbody for each STW

STW Name	Receiving Watercourse	WFD Waterbody
Abingdon Lagoon	Odhay Ditch	Thames (Evenlode to Thame)
Abingdon New	River Thames	Thames (Evenlode to Thame)
Appleton	Marcham Brook	Frilford and Marcham Brook
Benson	Howbery Ditch	Thames Wallingford to Caversham
Cholsey	Cholsey Brook	Cholsey Brook and tributaries
Culham	Clifton Hampden	Thames (Evenlode to Thame)
Didcot	Moor Ditch	Moor Ditch and Ladygrove Ditch
Oxford	Pottery Stream	Northfield Brook (Source to Thames)
Stanford in the Vale	River Ock	Ock (to Cherbury Brook)
Wantage	Letcombe Brook	Letcombe Brook
Wheatley	Wheatley Ditch	Thame (Scotsgrove Brook to Thames)

The overall ecological classification and the specific classifications for the parameters assessed in this study are reviewed where possible. Note, at the majority of the waterbodies BOD is not monitored, therefore the classification for Dissolved Oxygen (DO) has been used in its place. The 2019 and 2022 chemical classifications are not compared, given changes to assessment method between the two cycles.

Table 14 compares the 2019 and 2022 WFD classifications, where class changes have occurred, these are highlighted in bold text. For the majority of WFD waterbodies, the 2019 and 2022 classifications are the same. This indicates that no significant improvement or deterioration in the parameters assessed. However, in some cases, the 2019 classifications will have been used to inform and contribute to the 2022 classifications. This will be the case if the monitoring of a particular parameter has ceased at a monitoring location, meaning that there is no data to inform the 2022 classification. In these cases, the 2019 classifications will be utilised for the 2022 classification and cycle 3 assessments.

Table 14- Comparison between 2019 and 2022 WFD Classifications

WFD Waterbody	Classification	Ecological	Ammonia	DO	Phosphate
Thames (Evenlode to Thame)	2019	Moderate	High	High	Moderate
	2022	**Poor**	High	High	Moderate
Frilford and Marcham Brook	2019	Moderate	High	Good	Bad
	2022	Moderate	High	Good	**Poor**
Thames Wallingford to Caversham	2019	Moderate	High	High	Moderate
	2022	Moderate	High	High	Moderate
Cholsey Brook and tributaries	2019	Moderate	High	Good	High
	2022	Moderate	High	Good	High
Moor Ditch and Ladygrove Ditch	2019	Poor	High	Good	Moderate
	2022	Poor	High	High	**Poor**
Northfield Brook (Source to Thames)	2019	Moderate	Bad	Poor	Poor
	2022	Moderate	**Poor**	**Good**	Poor
Ock (to Cherbury Brook)	2019	Moderate	High	High	Moderate
	2022	Moderate	High	High	Moderate
Letcombe Brook	2019	Poor	High	High	Good
	2022	Poor	High	High	Good
Thame (Scotsgrove Brook to Thames)	2019	Moderate	High	High	Poor
	2022	Moderate	High	High	Poor

There are four WFD Waterbodies where changes in classification have occurred. The first of these is the Thames (Evenlode to Thame) waterbody where the overall ecological status has fallen from Moderate to Poor. This is related to a deterioration in biological quality elements, rather than the physico-chemical quality elements assessed in this study. Specifically, there was a fall in fish populations between the cycles attributed mostly to land drainage and physical modifications to the channel rather than sewage discharge. The Abingdon STW and Culham STW both drain to this waterbody.

The classification for Phosphate has changed for two WFD waterbodies, namely the Frilford and Marcham Brook, and the Moor Ditch and Ladygrove ditch. These affect the Appleton STW and Didcot STW respectively. The status for the Frilford and Marcham Brook improves from Bad to Poor, whereas the status for the Moor Ditch and Ladygrove ditch falls from Moderate to Poor. The change at Moor Ditch and Ladygrove ditch is understood to be caused by sewage discharge.

Finally, at the Northfield Brook (Source to Thames) there has been an improvement in Ammonia from Bad to Poor and an improvement in Dissolved Oxygen from Poor to Good. The Oxford STW drains to this waterbody.

Overall, the 2019 and 2022 classifications are very similar. Where changes have occurred, they tend to be to a specific parameter and in many cases show an improvement, meaning that the 2019 classification used in this study can be considered precautionary. This is with the exception of the Thames (Evenlode to Thame) waterbody and the Moor Ditch and Ladygrove Ditch waterbody. For the former, the fall in overall ecological status is caused by a deterioration in biological quality elements (i.e. fish), rather than the physico-chemical quality elements assessed in this study so is not considered significant given the scope of this study. For the Moor Ditch and Ladygrove Ditch, the fall in the classification for Phosphate is attributable to sewage discharge and therefore is relevant to this study. The discrepancy effects Didcot STW and should be noted when considering the results at this STW.

5.4 Review of TALs against existing effluent quality

Once the model had been confirmed as fit for purpose, the existing effluent quality values at each STW (contained in the SIMCAT data files provided by the EA) were compared to the proposed TAL values for ammonia, BOD and total phosphorous. Orthophosphate was not included as there are no proposed TAL values for this parameter. The results of this exercise are shown in Table 15. These show that in most cases the TAL values for effluent quality were better than the existing effluent quality values at the STWs, these are marked as green in the table. There were two exceptions, at Stanford in the Vale STW and Didcot STW where the existing effluent concentrations are lower than the TAL values for BOD and ammonia respectively, these are marked in red in the table. The approach taken updates all existing effluent values to the TAL values even where the existing values show lower concentrations. This could mean that applying TALs leads to a deterioration in water quality at Stanford in the Vale STW and Didcot STW. Note, the quality of effluent discharged from STWs is not subject to the WFD unlike water quality in the receiving watercourses.

Table 15- Comparison of the existing STW effluent quality and TAL values

STW Name	Parameter	Existing effluent quality (mg/l)	TAL values (mg/l)
Abingdon (Lagoon)	Ammonia	2.1	1.0
	BOD	10.6	5.0
	Total Phosphorous	0.95	0.25
Abingdon (New)	Ammonia	6	1.0
	BOD	16.2	5.0
	Total Phosphorous	1.28	0.25
Appleton	Ammonia	2.3	1.0
	BOD	12.8	5.0
	Total Phosphorous	2.84	0.25
Benson	Ammonia	1.6	1.0
	BOD	9.4	5.0
	Total Phosphorous	2.71	0.25
Cholsey	Ammonia	4.4	1.0
	BOD	12.8	5.0
	Total Phosphorous	1.07	0.25
Culham	Ammonia	3.2	1.0
	BOD	12.2	5.0
	Total Phosphorous	5.09	0.25
Didcot	Ammonia	0.8	1.0
	BOD	5.2	5.0
	Total Phosphorous	0.94	0.25
Oxford	Ammonia	1.6	1.0
	BOD	6.8	5.0
	Total Phosphorous	0.51	0.25
Stanford in the Vale	Ammonia	18.6	1.0
	BOD	4.3	5.0
	Total Phosphorous	6	0.25
Wantage	Ammonia	1.9	1.0
	BOD	10.6	5.0
	Total Phosphorous	1.14	0.25
Wheatley	Ammonia	2.3	1.0
	BOD	9	5.0
	Total Phosphorous	7.09	0.25

5.5 AMP 8 Schemes

The SIMCAT model was reviewed against the list of AMP8 schemes (planned schemes for the five year investment cycle for the UK water industry from 2025 to 2030) included in the EA's price review 2024 (PR24) Water Industry National Environment Programme (WINEP). The programme details proposed changes during AMP8 to permit limits. This includes those for Ammonia, BOD and Total Phosphorous. Where new limits are proposed, these have been reviewed against the mean (for Total Phosphorous) and 95th percentile values (for Ammonia and BOD) contained in the EA's supplied SIMCAT model. The review confirms whether any AMP8 schemes are already contained in the SIMCAT model supplied. The future implications of changes to permit limits is also discussed. Note, the EA has confirmed that the model contains all AMP7(2020-2025) schemes and limits.

To check the EA's SIMCAT model against the AMP8 schemes planned between 2025-2030, the EA's price review 2024 (PR24) Water Industry National Environment Programme (WINEP)[21] has been assessed. This WINEP, published in January 2025, represents a set of actions that the EA has requested wastewater companies to complete between 2025 and 2030, in order to contribute towards meeting their environmental obligations.

The programme details current and proposed changes to permit limits including those for Ammonia, BOD and Total Phosphorous. These have been reviewed against the mean (for Total Phosphorous) and 95th percentile values (for Ammonia and BOD) contained in the EA's supplied SIMCAT model.

The WINEP programme identifies proposed changes in the permit values at five of the STWs assessed in this study. The STWs include the Appleton STW, Didcot STW and Wantage STW where there is a proposed reduction in the Total Phosphorous limit to reduce Phosphorous loading in the receiving watercourses. At the two other STWs, Culham STW and Oxford STW, there are reductions proposed for Ammonia, BOD and Total Phosphorous. Table 16 compares the values contained in the SIMCAT model with the current and proposed permit limits across the five STWs. Where a proposed AMP8 limit has been set, the table values are in bold.

In most cases the values contained in the SIMCAT model are below the current permit limit, but above the proposed permit limit (marked in amber in the table). This is with the exception of Oxford STW where the modelled values for Ammonia and BOD are below both the current and proposed permit limits (marked in green), and the Wantage STW where the modelled Total Phosphorous value is above the current and future permit limits (marked in red). Based on these findings, it is concluded that no AMP8 schemes are included in the model for the STWs assessed.

Table 16- Comparison of values in EA SIMCAT model with current and proposed AMP8 limits

STWs	Parameter	Values in EA SIMCAT Model	Current Limit (mg/l)	Proposed AMP8 Limit (mg/l)
Appleton	Ammonia	2.31	20	-
	BOD	12.80	51	-
	Total Phosphorous	**2.84**	**5**	**0.25**
Culham	Ammonia	**3.23**	**6**	**3**
	BOD	**12.20**	**15**	**12**
	Total Phosphorous	**5.09**	**-**	**0.25**
Didcot	Ammonia	0.83	12	-
	BOD	5.20	50	-
	Total Phosphorous	**0.94**	**2**	**0.25**
Oxford	Ammonia	**1.63**	**14**	**3**
	BOD	**6.79**	**50**	**10**
	Total Phosphorous	**0.51**	**1**	**0.25**
Wantage	Ammonia	1.92	20	-
	BOD	10.60	64	-
	Total Phosphorous	**7.09**	**2**	**0.25**

For the STWs identified above, where there is a proposed reduction in permit limits as highlighted in bold, the proposed permit limits will be achievable if associated AMP8 upgrades at the STWs are delivered, and this should in turn improve water quality. However, there could be an increased risk of environmental permit breaches if the STWs are not upgraded in time.

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[21] Environment Agency (2022) *PR24 Water Industry National Environment Programme* https://environment.data.gov.uk/dataset/39b11ea0-3cfa-4cbb-b3a1-b5950019f169

For the other five STWs where changes in permit values are not proposed, it has been assumed that the current permit limits will remain in place through AMP8 (2025-2030). The modelled values at these STWs have a been reviewed and are all below the current permit levels. The EA have also confirmed that AMP7 schemes are included in the model.

For this study, the impacts on future WFD status from development are considered to be precautionary given that future improvements to effluent quality, including those planned for AMP8, are not taken into account.

5.6 Baseline Model Results

5.6.1 Current Technology and with TALs applied

The SIMCAT model was subsequently run for a new baseline considering the averaged 2023-2024 DWF values provided by Thames Water, also used in the headroom assessments. The model was run first with current technology and then with TALs applied. It should be noted that total phosphorus and orthophosphate are not linked in the model, so orthophosphate is insensitive to the application of TAL. However, in reality if the removal of total phosphorous is improved at a STW it should also lead to a lowering of orthophosphate which is a phosphorous compound and included in the measurement of total phosphorous. To obtain an estimate of the impact of the TALs on orthophosphate concentrations and WFD status at each STW (noting that total phosphorous has no defined standard in the WFD), the ratio of orthophosphate to total phosphorous in the baseline runs has been estimated. It has then been multiplied by the total phosphorous estimated following the application of TALs. It should be noted that the relationship between total phosphorous and orthophosphate is complex, so the orthophosphate values derived using this method are subject to greater uncertainty. The estimated ratios are provided in Appendix 2.

The results at each of the 11 receiving watercourses (Abingdon STW has two outfalls) are presented in Table 17 with the colours showing the WFD classification. Note, there are no WFD Environmental Quality Standards for total phosphorous hence these are not colour coded. Values are presented in bold where there has been a WFD class improvement with the application of TALs. The key findings are summarised after the table.

Table 17- Comparison of Baseline (Current) and Baseline (TALs applied) water quality results

STW Name	Parameter	Baseline water quality (mg/l)	Baseline water quality with TAL applied (mg/l)
Abingdon (Lagoon)	Ammonia	1.71	**1.05**
	BOD	8.77	**4.89**
	Orthophosphate	0.647	0.211
	Total Phosphorous	0.946	0.309
Abingdon (New)	Ammonia	0.092	0.077
	BOD	0.752	0.71
	Orthophosphate	0.138	0.131
	Total Phosphorous	0.372	0.352
Appleton	Ammonia	0.951	0.838
	BOD	6.91	**4.26**
	Orthophosphate	2.11	**0.374**
	Total Phosphorous	1.81	0.321
Benson	Ammonia	0.528	0.754
	BOD	4.79	**4.00**
	Orthophosphate	1.03	**0.101**
	Total Phosphorous	1.24	0.122
Cholsey	Ammonia	1.53	**0.81**
	BOD	5.99	**4.07**
	Orthophosphate	0.214	**0.057**
	Total Phosphorous	0.602	0.16
Culham	Ammonia	2.33	**1**
	BOD	10.30	**4.99**
	Orthophosphate	4.15	**0.204**
	Total Phosphorous	5.02	0.247
Didcot	Ammonia	0.536	0.524
	BOD	2.91	3.4
	Orthophosphate	0.441	0.244
	Total Phosphorous	0.617	0.341
Oxford	Ammonia	1.26	**1.09**
	BOD	5.45	**4.88**
	Orthophosphate	0.312	**0.164**
	Total Phosphorous	0.496	0.261
Stanford in the Vale	Ammonia	0.372	**0.069**
	BOD	0.772	0.802
	Orthophosphate	0.229	0.223
	Total Phosphorous	2.52	2.45
Wantage	Ammonia	0.664	**0.53**
	BOD	4.56	**2.92**
	Orthophosphate	0.390	**0.116**
	Total Phosphorous	0.549	0.163
Wheatley	Ammonia	0.115	0.113
	BOD	0.943	0.934
	Orthophosphate	0.338	0.305
	Total Phosphorous	0.516	0.465

WFD Status
High
Good
Moderate
Poor
Bad

Baseline results (current technology)

- The baseline model results for ammonia show four of the receiving watercourses to have Poor WFD status (Abingdon- Lagoon, Cholsey, Culham and Oxford), two to have Moderate WFD status (Appleton and Wantage), three to have Good WFD status (Benson, Didcot and Stanford in the Vale) and two to have High WFD status (Abingdon- New and Wheatley).
- The baseline model results for BOD show one of the receiving watercourses to have Bad WFD status (Culham), two to have Poor WFD status (Abingdon- Lagoon and Appleton), two to have Moderate WFD status (Cholsey and Oxford), two to have Good WFD status (Benson and Wantage) and four to have High WFD status (Abingdon- New, Didcot, Stanford in the Vale and Wheatley).
- The baseline model results for orthophosphate show two of the receiving watercourses to have Bad WFD status (Appleton and Culham), seven to have Poor WFD status (Abingdon (Lagoon), Benson, Didcot, Oxford, Stanford in the Vale, Wantage and Wheatley), two to have Moderate WFD status (Abingdon (New) and Cholsey), with none having Good or High WFD status.

Application of TALs

- For Abingdon (Lagoon), Cholsey, Culham, Oxford, Wantage and, applying the TAL values would lead to WFD class improvements for ammonia and BOD, with total phosphorus decreasing.
- For Appleton, there would be WFD class improvements for BOD and orthophosphate.
- For Benson STW when applying TAL values there would be a WFD class deterioration for ammonia from Good status to Moderate status. This is thought to be due to ammonia at Benson having a high standard deviation in the SIMCAT model, in addition to a significant amount of ammonia coming from diffuse pollution. A full explanation for the ammonia results at Benson STW is provided in section 5.4.2. There would be a WFD within class improvement for BOD and total phosphorus would decrease downstream.
- For Abingdon (New), Wheatley and Didcot STW there would be no WFD class changes when applying TAL values. For Didcot, the concentration of ammonia would decrease, and the concentration of BOD would increase. This is counter intuitive as the TAL values are worse with respect to the existing effluent quality for ammonia, with the opposite trend apparent for BOD. This is thought to be due to ammonia and BOD at Didcot having a high standard deviation in the SIMCAT model, in addition to a significant amount of ammonia and BOD coming from diffuse pollution sources. A full explanation for the results at Didcot STW is provided in section 5.4.2.
- For Stanford in the Vale when applying TAL values there would be a WFD class improvement for ammonia and a decrease in total phosphorous. There is an increase in BOD concentration, which is likely due to the existing effluent concentration for BOD (mg/l) already being lower than the proposed TAL values (mg/l). This means that applying the TAL for BOD leads to a water quality deterioration relative to the baseline scenario, although the deterioration is still within WFD class.

5.6.2 Results at Benson STW and Didcot STW

For Benson STW when applying TAL values there would be a WFD class deterioration for ammonia from Good status to Moderate status, despite the TAL value for ammonia (1.0 mg/l) being at a lower concentration than the current value (1.6 mg/l). At Didcot when applying TAL values the concentration of ammonia decreases, despite the TAL value (1.0 mg/l) for ammonia being at a higher concentration than the current value (0.8 mg/l). A counter intuitive trend is also seen for BOD at Didcot STW, BOD increases with the application of TALs despite the TAL value for BOD (5.0 mg/l) being at a lower concentration than the current value (5.2 mg/l).

Other sources of pollution are one potential reasons for these results. At Didcot, urban runoff, diffuse pollution such as agricultural run-off and industrial discharges are significant sources of Ammonia and BOD. This means that whilst changes in effluent quality at the STW are important they may have a more limited impact on the water quality results for ammonia and BOD in the receiving watercourse. At Benson, a high proportion of ammonia also originates from upstream diffuse sources.

Another potential reason is the nature of the SIMCAT model. SIMCAT applies Monte Carlo simulation which uses repeated random sampling of the distributions associated with the input parameters to predict in river summary statistics. This generates a distribution of results (i.e. mean, 90th Percentile, 95th percentile) for each element assessed.

At Didcot STW the SIMCAT model has low mean values for ammonia and BOD but large standard deviations. Benson STW has the same trend for ammonia. This means that when the model is run the distribution associated with these parameters is wider and the spread in the results generated tends to be greater. This in turn means that small changes in the input values may not always have the effect expected with the model randomly sampling across a slightly shifted distribution rather than only considering the step change in one value. For example, when the ammonia effluent quality is changed from 0.8 to 1.0 mg/l and when BOD is changed from 5.2 to 5.0 mg/l in the analysis of TALs at Didcot.

It should be noted that sensitivity testing (see section 5.9) was undertaken at Benson STW and Didcot STW to further test the robustness of the results. Overall, the sensitivity testing did not find any significant issues with the input data and model structure. The flagged results for ammonia and BOD are considered a consequence of the model and are unlikely to represent reality, in this regard they should be treated with caution.

5.7 Post-Development Model Results

5.7.1 Current Technology

The SIMCAT model was run considering future development to 2041 within the STW catchment areas. The model runs applied the projected increased DWF flows for each STW estimated as part of the headroom assessments and presented in Table 9 of this report. The model was run first with current technology. Table 18 shows the changes in the relevant parameters between the baseline and post-development runs when considering current technology, with the colours showing the WFD classification. The key findings are summarised after the table.

It should be noted that the results at Abingdon STW and Appleton STW are based on the assumption that the Land at Dalton Barracks Garden Village site drains exclusively to each of them. This precautionary approach ensures that the potential impacts of development are not underestimated at either of the STWs. However, given the size of the site (1450 dwellings & 7.4 ha of employment land to 2041), it has a significant impact on the projected flow volumes draining to each STW (see section 4.3) and the water quality results presented. This is especially the case at Appleton which is a smaller STW and only has one other smaller scale JLP site allocation planned to drain to it (Policy HOU2t South-East of Marcham - 87 dwellings).

Table 18- Comparison of Baseline and Post-Development water quality results

STW Name	Parameter	Baseline Existing water quality (mg/l)	Post-Development water quality (mg/l)
Abingdon (Lagoon)	Ammonia	1.71	1.72
	BOD	8.77	8.82
	Orthophosphate	0.647	0.647
	Total phosphorus	0.946	0.950
Abingdon (New)	Ammonia	0.09	0.09
	BOD	0.75	0.73
	Orthophosphate	0.138	0.138
	Total phosphorus	0.372	0.375
Appleton	Ammonia	0.95	1.14
	BOD	6.91	7.52
	Orthophosphate	2.110	2.350
	Total phosphorus	1.810	1.970
Benson	Ammonia	0.53	0.56
	BOD	4.79	4.90
	Orthophosphate	1.030	1.080
	Total phosphorus	1.240	1.300
Cholsey	Ammonia	1.53	1.54
	BOD	5.99	6.01
	Orthophosphate	0.214	0.217
	Total phosphorus	0.602	0.591
Culham	Ammonia	2.33	2.34
	BOD	10.30	10.40
	Orthophosphate	4.150	4.170
	Total phosphorus	5.020	5.050
Didcot	Ammonia	0.54	0.62
	BOD	2.91	2.97
	Orthophosphate	0.441	0.496
	Total phosphorus	0.617	0.659
Oxford (JLP area Only)	Ammonia	1.26	1.28
	BOD	5.45	5.41
	Orthophosphate	0.312	0.311
	Total phosphorus	0.496	0.493
Oxford (JLP area & Neighbouring Authorities)	Ammonia	1.26	1.26
	BOD	5.45	5.47
	Orthophosphate	0.312	0.314
	Total phosphorus	0.496	0.495
Stanford in the Vale	Ammonia	0.37	0.48
	BOD	0.77	0.78
	Orthophosphate	0.229	0.262
	Total phosphorus	2.520	2.610
Wantage	Ammonia	0.66	0.71
	BOD	4.56	4.81
	Orthophosphate	0.390	0.413
	Total phosphorus	0.549	0.579
Wheatley	Ammonia	0.12	0.12
	BOD	0.94	0.94
	Orthophosphate	0.338	0.340
	Total phosphorus	0.516	0.515

WFD Status
High
Good
Moderate
Poor
Bad

Overall Results (Current Technology)

- For seven of the 11 receiving watercourses (at Abingdon (Lagoon), Abingdon (New), Culham, Oxford, Stanford in the Vale, Wantage and Wheatley) the flow change would lead to within class changes but would not lead to WFD class changes for any of the parameters.
- For four of the 11 receiving watercourses (at Appleton, Benson, Cholsey and Didcot) the flow change would lead to a WFD class deterioration in one of the relevant parameters. In all cases this is limited to one of the parameters.
- For some of the receiving watercourses, despite an increase in flows from the STWs, there is negligible impact on water quality and in specific cases even an improvement in certain parameters. This may be attributed to the effluent quality being similar or better than the water quality in the receiving watercourse.

Results at each STW (Current Technology)

- For Abingdon STW (Lagoon) the flow change would not lead to WFD class changes for any of the parameters, but there would be WFD within class small deteriorations for ammonia and BOD. The concentration of total phosphorus would increase slightly.*
- For Abingdon STW (New) the flow change would not lead to WFD class changes for any of the parameters. The concentration of total phosphorus would increase slightly.*

  *For both Abingdon outfalls, if the Land at Dalton Barracks Garden Village site drains to Appleton STW instead, the deteriorations modelled are likely to be significantly less given that the site allocation contributes more than 40% of the total additional flow to the STW.
- For Appleton STW the flow change would lead to a WFD class change for ammonia from Moderate status to Poor status. There would be WFD within class deteriorations for BOD and orthophosphate. The concentration of total phosphorus would increase slightly. If the Land at Dalton Barracks Garden Village site drains to Abingdon STW instead, the changes in water quality from the baseline at Appleton STW are likely to be negligible, given that the site contributes more than 85% of the total additional flow to the STW.
- For Benson STW the flow change would lead to a WFD class change for orthophosphate from Poor status to Bad status. There would be WFD within class deterioration for ammonia and BOD. The concentration of total phosphorus would increase slightly.
- For Cholsey STW the flow change would lead to a WFD class change for orthophosphate from Moderate status to Poor status. There would be WFD within class deterioration for ammonia and BOD. The concentration of total phosphorus would decrease slightly.
- For Culham STW the flow change would not lead to WFD class changes for any of the parameters, however it would lead to WFD within class deteriorations for all parameters. The concentration of total phosphorus would increase slightly.
- For Didcot STW the flow change would lead to WFD class change for ammonia from Good status to Moderate status. There would be WFD within class deteriorations for BOD and orthophosphate. The concentration of total phosphorus would increase slightly.
- At Oxford STW when considering development in South Oxfordshire and Vale of White Horse only, the flow change would not lead to WFD class changes for any of the parameters. However, there would be a WFD within class deterioration for ammonia and a marginal WFD within class improvement for BOD and orthophosphate. The concentration of total phosphorus would decrease slightly.

- At Oxford STW when considering development in in South Oxfordshire and Vale of White Horse plus relevant development in neighbouring authority areas, the flow change would not lead to WFD class changes for any of the parameters, but there would be marginal WFD within class deteriorations for BOD and orthophosphate. The concentration of total phosphorus would decrease slightly.
- For Stanford in the Vale STW the flow change would not lead to WFD class changes for any of the parameters, however it would lead to WFD within class deteriorations for all parameters. The concentration of total phosphorus would increase slightly.
- For Wantage STW the flow change would not lead to WFD class changes for any of the parameters however it would lead to WFD within class deteriorations for all parameters. The concentration of total phosphorus would decrease slightly.
- For Wheatley STW the flow change would not lead to WFD class changes for any of the parameters however it would lead to WFD.

5.7.2 TALs Applied

The model was subsequently run with the post-development flows applying the TALs agreed with the Environment Agency. Table 19 shows the changes in the relevant parameters between the baseline run with current technology, the post-development run with current technology and the post development run with TALs applied. The colours show the WFD classification. Values are presented in bold where there has been a WFD class improvement with the application of TALs relative to the baseline WFD class.

Table 19- Comparison of Post-Development (Current) and Post-Development (TALs applied) water quality results

STW Name	Parameter	Baseline Existing water quality (mg/l)	Post-Development water quality (mg/l)	Post-Development water quality TALs applied (mg/l)
Abingdon (Lagoon)	Ammonia	1.71	1.72	**1.05**
	BOD	8.77	8.82	**4.90**
	Orthophosphate	0.647	0.647	0.209
	Total phosphorus	0.946	0.950	0.305
Abingdon (New)	Ammonia	0.09	0.09	0.08
	BOD	0.75	0.73	0.71
	Orthophosphate	0.138	0.138	0.130
	Total phosphorus	0.372	0.375	0.351
Appleton	Ammonia	0.95	1.14	0.88
	BOD	6.91	7.52	**4.43**
	Orthophosphate	2.110	2.350	**0.361**
	Total phosphorus	1.810	1.970	0.31
Benson	Ammonia	0.53	0.56	0.77
	BOD	4.79	4.90	4.08
	Orthophosphate	1.030	1.080	**0.105**
	Total phosphorus	1.240	1.300	0.126
Cholsey	Ammonia	1.53	1.54	**0.83**
	BOD	5.99	6.01	**4.17**
	Orthophosphate	0.214	0.217	**0.059**
	Total phosphorus	0.602	0.591	0.166
Culham	Ammonia	2.33	2.34	**1.00**
	BOD	10.30	10.40	**4.99**
	Orthophosphate	4.150	4.170	**0.206**
	Total phosphorus	5.020	5.050	0.249
Didcot	Ammonia	0.54	0.62	0.57
	BOD	2.91	2.97	3.56
	Orthophosphate	0.441	0.496	0.239
	Total phosphorus	0.617	0.659	0.334
Oxford (Districts Only)	Ammonia	1.26	1.28	**1.09**
	BOD	5.45	5.41	**4.89**
	Orthophosphate	0.312	0.311	**0.164**
	Total phosphorus	0.496	0.493	0.26
Oxford (Districts & Neighbouring Authorities)	Ammonia	1.26	1.26	**1.08**
	BOD	5.45	5.47	**4.9**
	Orthophosphate	0.312	0.314	**0.164**
	Total phosphorus	0.496	0.495	0.261
Stanford in the Vale	Ammonia	0.37	0.48	**0.07**
	BOD	0.77	0.78	0.83
	Orthophosphate	0.229	0.262	0.222
	Total phosphorus	2.520	2.610	2.44
Wantage	Ammonia	0.66	0.71	**0.58**
	BOD	4.56	4.81	**3.13**
	Orthophosphate	0.390	0.413	**0.121**
	Total phosphorus	0.549	0.579	0.171
Wheatley	Ammonia	0.12	0.12	0.11
	BOD	0.94	0.94	0.94
	Orthophosphate	0.338	0.340	0.305
	Total phosphorus	0.516	0.515	0.465

WFD Status
High
Good
Moderate
Poor
Bad

To visualise the results, three graphs have been generated showing the changes in ammonia (Figure 17), BOD (Figure 18) and total phosphorus (Figure 19) across the three scenarios. These graphs show the impacts of development and the subsequent changes if TALs are applied. No graph is provided for orthophosphate, given that the results were post-processed using the method outlined in section 5.6.1 and that the WFD standards are reach specific. The colours in the background of the plots show the WFD classification bands. The key findings from the post-development runs are summarised after the graphs.

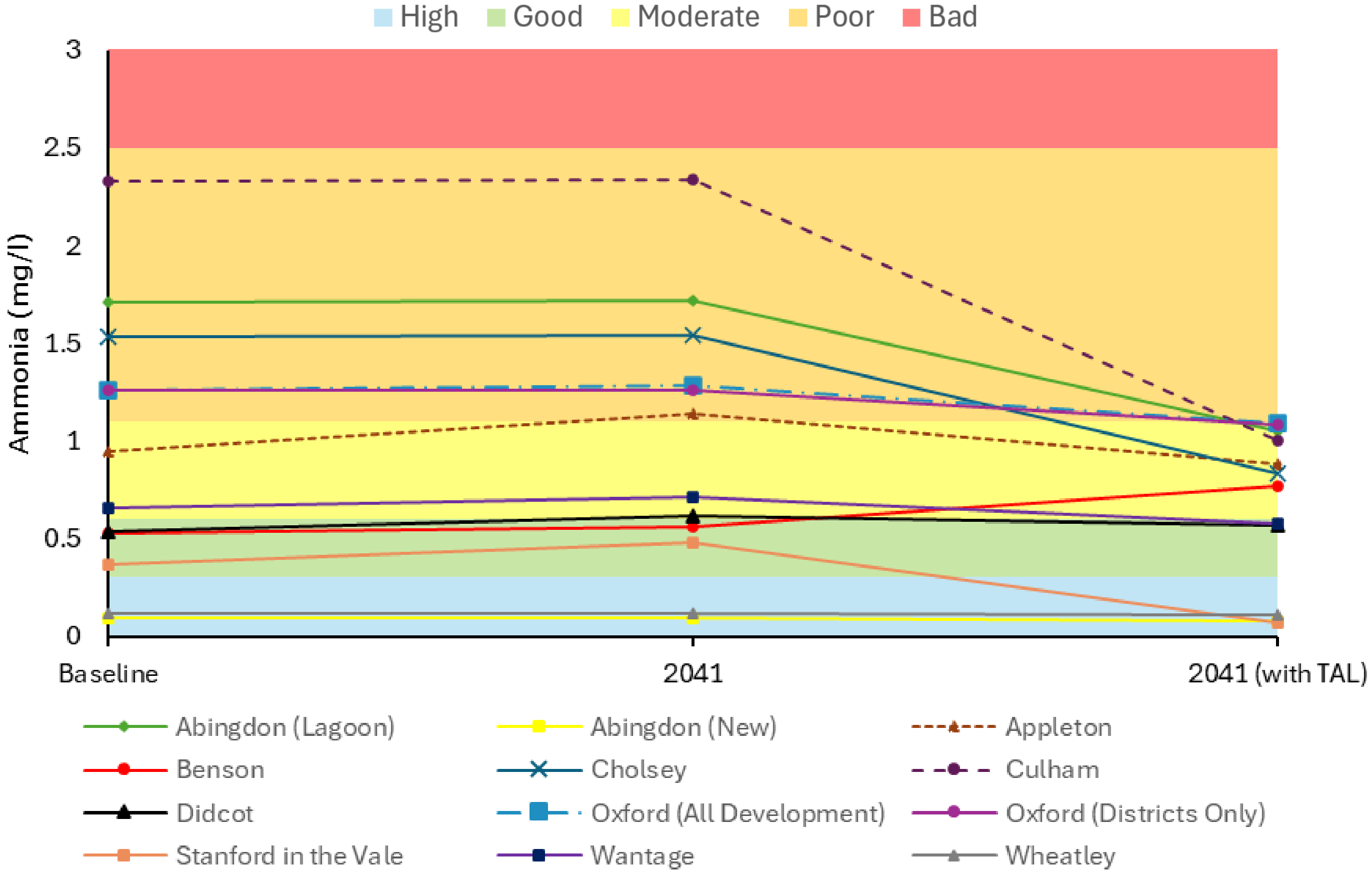

Figure 17- Changes in Ammonia (mg/l) across the three scenarios assessed

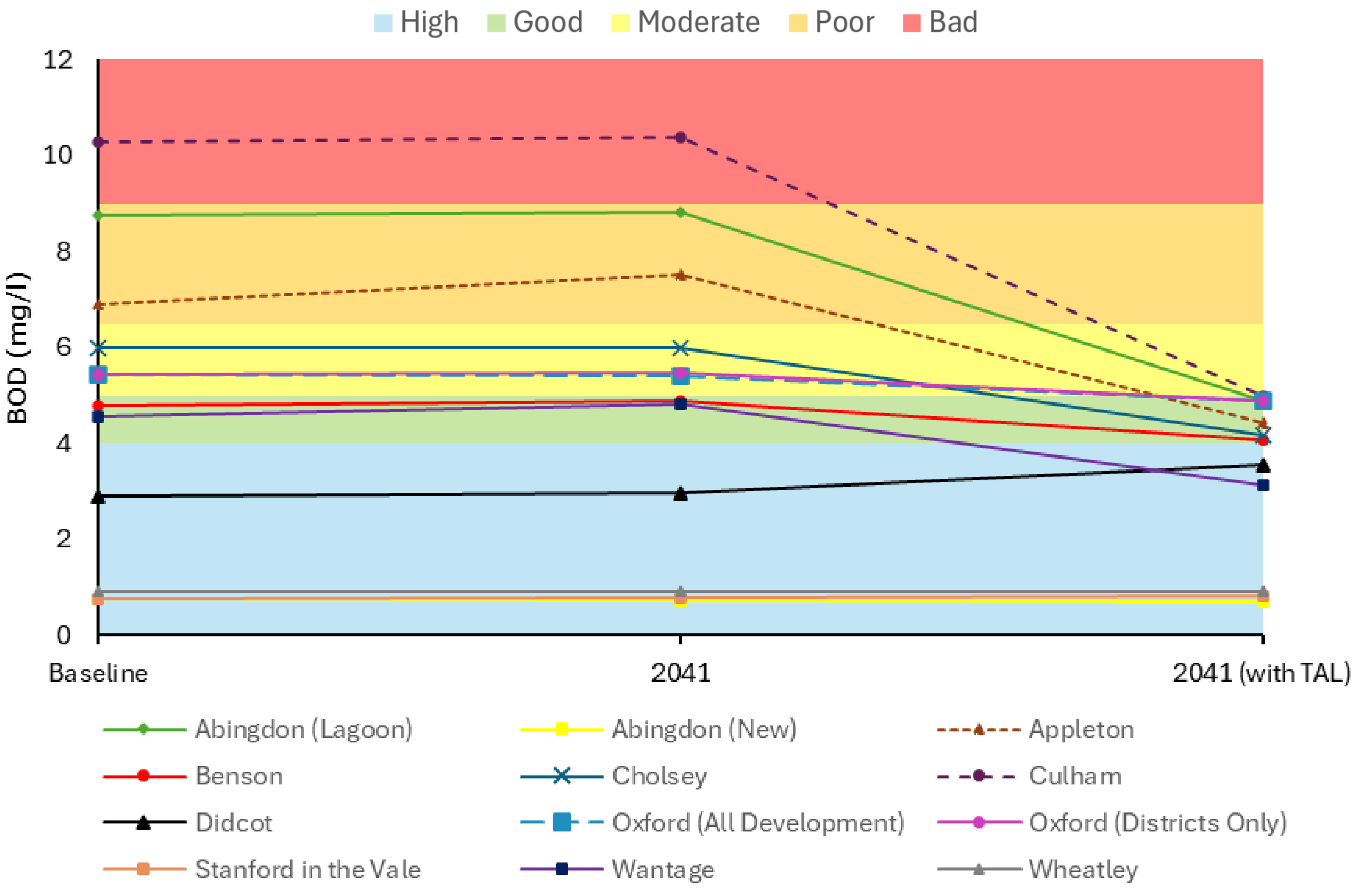

Figure 18- Changes in BOD (mg/l) across the three scenarios assessed

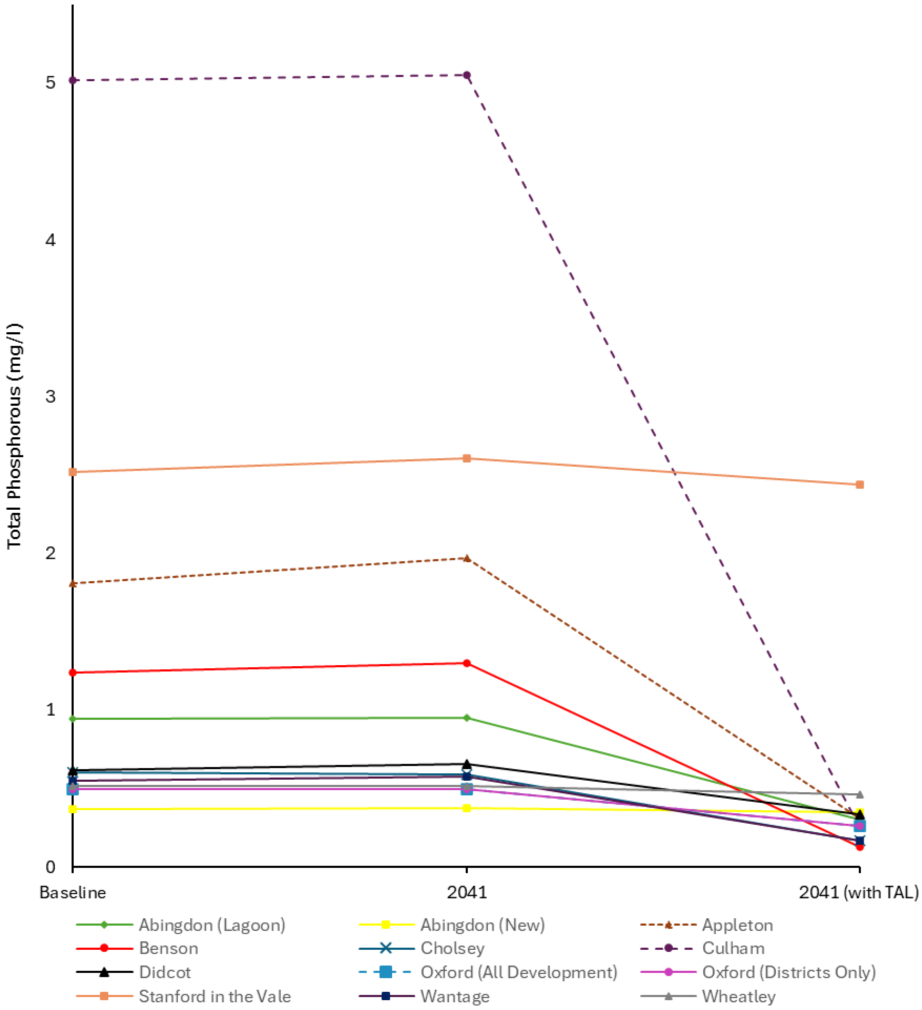

Figure 19- Changes in Total Phosphorous (mg/l) across the three scenarios assessed

Overall Results (TALs Applied)

- For nine of the 11 receiving watercourses the post-development with TAL scenario shows a decrease in ammonia relative to the present-day baseline scenario. The exceptions are Benson STW and Didcot STW.
- For nine of the 11 receiving watercourses the post-development with TAL scenario shows a decrease in BOD relative to the baseline scenario. The exceptions are Didcot STW and Stanford in the Vale STW.
- At all of the receiving watercourses the post-development with TAL scenario shows a decrease in total phosphorous and orthophosphate relative to the present-day baseline scenario.

Results at each STW (TALs Applied)

- For Abingdon (Lagoon),** if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would improve from Poor to Moderate status, and BOD would improve from Poor to Good status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a within class improvement relative to the baseline scenario.

- For Abingdon (New),** if TAL values were applied there would be a WFD within class improvement for ammonia and BOD. Total phosphorous would reduce with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate from the total phosphorous results is a within class improvement relative to the baseline scenario.**

  **As noted previously, the Abingdon STW results assume the Land at Dalton Barracks Garden Village drains exclusively to Abingdon STW. If development at this site drains to Appleton STW instead, the application of TALs would likely cause a greater improvement over the baseline scenario.
- For Appleton STW, if TAL values were applied there would be a WFD class improvement for BOD relative to both the baseline and post-development current technology scenarios. BOD would improve from Poor to Good status. Ammonia would be returned to Moderate status from the post-development current technology scenario and there would be a WFD within class improvement relative to the baseline current technology scenario. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Bad to Poor status relative to the baseline scenario. As noted previously, the Appleton STW results assume the Land at Dalton Barracks Garden Village development drains exclusively to Appleton STW. If it drains to Abingdon STW instead, then the application of TALs would likely cause a greater improvement over the baseline scenario.
- For Benson STW, if TAL values were applied there would be a WFD class deterioration for ammonia relative to both the baseline and post-development current technology scenarios. Ammonia would deteriorate from Good to Moderate status. For BOD there would be a WFD within class improvement relative to both the baseline and post-development current technology scenarios. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Poor to Moderate status relative to the baseline scenario. Similar to the baseline, the explanation provided in section 5.6.2 for Benson STW should be considered when reviewing the impact of TALs on the post-development results.
- For Cholsey STW, if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would improve from Poor to Moderate status, and BOD would improve from Moderate to Good status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Moderate to Good status relative to the baseline scenario.
- For Culham STW, if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would change from Poor status to Moderate status, and BOD would change from Bad status to Good status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Bad to Poor status relative to the baseline scenario.
- For Didcot STW, if TAL values were applied Ammonia would be returned to Good status, however there would be a WFD within class deterioration relative to the baseline current technology scenario. There would be a WFD within class deterioration for BOD. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is

a within class improvement relative to the baseline scenario. Similar to the baseline, the impacts of applying TAL at Didcot are counter intuitive and the explanation in section 5.6.2 should be considered.

- For Oxford STW when considering development in South Oxfordshire and Vale of White Horse only, if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would improve from Poor to Moderate status, and BOD would improve from Moderate to Good status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Poor to Moderate status relative to the baseline scenario.
- For Oxford STW when considering development in South Oxfordshire and Vale of White Horse plus relevant development in neighbouring authority areas, if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would improve from Poor to Moderate status, and BOD would improve from Moderate to Good status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Poor to Moderate status relative to the baseline scenario.
- For Stanford in the Vale STW, if TAL values were applied there would be a WFD class improvement for ammonia relative to both the baseline and post-development current technology scenarios. Ammonia would improve from Good to High status. For BOD there would be a WFD within class deterioration relative to both current technology scenarios. This is expected given that the existing effluent quality for BOD (mg/l) at Stanford is already lower than the proposed TAL values (mg/l) (see Table 15). Total phosphorous would reduce with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a within class improvement relative to the baseline scenario.
- For Wantage STW, if TAL values were applied there would be a WFD class improvement for ammonia and BOD relative to both the baseline and post-development scenarios applying current technology. Ammonia would improve from Moderate status to Good status, and BOD would improve from Good status to High status. Total phosphorous would reduce significantly with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results is a WFD class improvement from Poor to Moderate status relative to the baseline scenario.
- For Wheatley STW, if TAL values were applied there would be WFD within class improvements for ammonia and BOD. Total phosphorous would reduce with TALs applied relative to both the baseline and post-development scenario. The estimated change in orthophosphate derived from the total phosphorous results would be a within class improvement relative to the baseline scenario.

5.7.3 Water Quality Deterioration

Following the generation of the model results, the percentage change in the four parameters assessed (ammonia, BOD, orthophosphate and total phosphorous) was estimated to determine if development could cause a greater than 10% deterioration in water quality. This has been estimated both with current technology and with TALs applied. Table 20 presents the results of this analysis at each of the STWs. Values highlighted in yellow denote where there has been a greater than 10% deterioration. The key findings are summarised after the table.

Table 20- Percentage change in Baseline (BSC) and Post-Development (PDP) water quality results

STW name	Parameter	BSC-PDP % change	BSC-PDP with TALs applied % change
Abingdon (Lagoon)	Ammonia	0.6	-38.6
	BOD	0.6	-44.1
	Orthophosphate	0.0	-67.8
	Total phosphorus	0.4	-67.8
Abingdon (New)	Ammonia	0.0	-11.1
	BOD	0.0	-2.7
	Orthophosphate	0.0	-5.6
	Total phosphorus	0.8	-5.6
Appleton	Ammonia	**20.0**	-7.4
	BOD	8.8	-35.9
	Orthophosphate	**11.4**	-82.9
	Total phosphorus	8.5	-82.9
Benson	Ammonia	5.7	**45.3**
	BOD	2.3	-14.8
	Orthophosphate	4.9	-89.8
	Total phosphorus	4.7	-89.8
Cholsey	Ammonia	0.7	-45.8
	BOD	0.3	-30.4
	Orthophosphate	1.4	-72.4
	Total phosphorus	-1.8	-72.4
Culham	Ammonia	0.4	-57.1
	BOD	1.0	-51.6
	Orthophosphate	0.5	-95.0
	Total phosphorus	0.6	-95.0
Didcot	Ammonia	**14.8**	5.6
	BOD	2.1	**22.3**
	Orthophosphate	**12.5**	-45.9
	Total phosphorus	6.6	-45.9
Oxford (Districts only)	Ammonia	1.6	-13.5
	BOD	-0.7	-10.3
	Orthophosphate	-0.3	-0.3
	Total phosphorus	-0.6	-47.6
Oxford (All Development)	Ammonia	0.0	-14.3
	BOD	0.4	-10.1
	Orthophosphate	0.6	-47.4
	Total phosphorus	-0.2	-47.4
Stanford on Vale	Ammonia	**29.7**	-81.1
	BOD	1.3	7.8
	Orthophosphate	**14.4**	-3.2
	Total phosphorus	3.5	-3.2
Wantage	Ammonia	7.6	-12.1
	BOD	5.5	-31.4
	Orthophosphate	5.9	-68.9
	Total phosphorus	5.3	-68.9
Wheatley	Ammonia	0.0	-8.3
	BOD	0.0	0.0
	Orthophosphate	0.6	-9.9
	Total phosphorus	-0.2	-9.9

Overall Results

- When considering current technology, at eight of the 11 receiving watercourses there would be no water quality deteriorations of 10% or greater due to planned development. However, deteriorations of 10% or greater are observed at Appleton STW, Didcot STW and Stanford in the Vale STW.
- When considering TALs, at nine of the 11 receiving watercourses there would be no water quality deteriorations of 10% or greater due to planned development. Deteriorations of 10% or greater are observed at Benson STW and Didcot STW, however these results are suspect for the reasons outlined below and detailed in section 5.6.2.

Results at each STW

- At Appleton STW, with current technology the ammonia and orthophosphate concentrations would increase by 20.0% and 11.4% due to future development. However, with the TALs applied there would be a water quality improvement of 7.4% and 82.9% respectively. As noted previously, the Appleton STW results assume the Land at Dalton Barracks Garden Village drains exclusively to Appleton STW, if it drains to Abingdon STW instead, the improvements in water quality with TALs applied are likely to be greater.
- At Benson STW, there are no water quality deteriorations of 10% or greater due to future development when considering current technology. However, when the TAL value for ammonia is applied it leads to a water quality deterioration of 45.3%. The explanation provided in section 5.6.2. for Benson STW and Didcot STW should be considered when reviewing the impact of TALs on the post-development results.
- At Didcot STW the ammonia and orthophosphate concentrations would increase by 14.8% and 12.5% due to future development. However, with the TAL values applied there would be a water quality deterioration of less than 10% (5.6%) for ammonia and an improvement of 45.9% for orthophosphate. BOD shows a less than 10% (2.1%) deterioration due to future development when current technology is considered, however this increases to 22.3% when TALs are applied. This result is counter intuitive, and the explanation provided in section 5.6.2 for Benson STW and Didcot STW should be considered when reviewing the impact of TALs on the post-development results. The large percentage change is also attributable to the low initial BOD values and despite this increase the WFD classification for BOD remains at High status.
- At Stanford on Vale STW the ammonia and orthophosphate concentrations would increase by 29.7% and 14.4% due to future development. However, with the TAL values applied the water quality would improve significantly for ammonia by 81.1% and by 3.2% for orthophosphate, leading to a WFD class change from Good Status to High Status for ammonia.

5.8 Review of Other Pollution Sources

STWs represent one source of pollution to a watercourse, however other sources such as agricultural and urban run-off and industrial discharges also contribute to overall pollution in a watercourse and can also affect its WFD status. These other pollution sources are also modelled in the SIMCAT model and the relative contributions from these sources has been reviewed for each STW and its associated WFD waterbody. This provides a wider context to the analysis of the STW pollution sources and their relative impact on WFD status of a waterbody.

This has involved reviewing the SIMCAT model data to determine the percentage of net load from all sources in the post-development (current technology) results. The percentages are extracted in locations immediately downstream of the STWs and at the downstream point of each WFD waterbody catchment.

Table 21, Table 22 and Table 23 summarise the results at each STW and associated downstream WFD waterbody. The proportion of pollution from STWs is marked red where it exceeds 80%, amber where it is between 50-80% and green where it is below 50%. The specific results at each STW are discussed in more detail below the table.

As expected, the contribution to waterbody pollution from STWs is higher immediately downstream of the STWs. The impact of STWs on pollution tends to be greatest where a STW drains to a smaller watercourse, where contributions from other sources may be less due to catchment size and where dilution effects are reduced.

In general, the proportion of pollution from STWs falls when considering the wider WFD waterbody. This is due to increased dilution effects moving away from the STW and contributions from other pollution sources downstream of the STW. Note, in some cases the contribution of pollution from STWs increases, this is likely where discharges from other STWs drain to the WFD waterbody downstream of the STW being assessed. The relative impact of STWs on pollution tends to reduce significantly where the STW discharges into a tributary within a larger WFD catchment. For example, the Abingdon (Lagoon) STW discharges to the Odhay ditch before it joins the Thames (Evenlode to Thame) WFD waterbody.

Table 21- Percentages of net load from all sources for Abingdon, Appleton and Benson STWs with associated WFD Waterbody catchments

Sewage Treatment Works	Abingdon (New)				Abingdon (Lagoon)				Appleton				Benson			
Parameters	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**
Upstream diffuse sources	51.1	72.7	0.0	0.0	10.8	4.3	0.0	0.0	1.1	21.9	0.0	0.0	27.9	60.9	0.0	0.0
Sewage treatment works	**30.3**	**25.5**	**51.6**	**32.4**	**84.9**	**95.7**	**91.4**	**86.9**	**97.7**	**78.1**	**93.5**	**84.1**	**71.7**	**39.1**	**96.9**	**98.9**
Intermittent discharges	2.6	0.0	1.3	2.4	1.6	0.0	3.4	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial discharges	1.2	1.9	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	32.1	45.4	0.0	0.0	1.8	1.2	0.0	0.0	3.0	10.2	0.0	0.0	1.9	0.8
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban runoff	12.7	0.0	13.6	14.4	2.4	0.0	3.1	2.3	0.9	0.0	2.9	2.9	0.4	0.0	1.1	0.3
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	2.0	0.0	1.3	5.2	0.3	0.0	0.2	0.7	0.3	0.0	0.6	2.8	0.0	0.0	0.0	0.0
WFD Waterbody	**Thames (Evenlode to Thame)**				**Thames (Evenlode to Thame)**				**Frilford and Marcham Brook**				**Thames Wallingford to Cavesham**			
Upstream diffuse sources	48.6	70.0	0.0	0.0	48.6	70.0	0.0	0.0	2.2	39.2	0.0	0.0	29.2	63.9	0.0	0.0
Sewage treatment works	**31.4**	**27.2**	**52.1**	**33.5**	**31.4**	**27.2**	**52.1**	**33.5**	**78.3**	**60.8**	**82.6**	**64.6**	**67.1**	**36.2**	**92.9**	**96.7**
Intermittent discharges	2.7	0.0	1.4	2.5	2.7	0.0	1.4	2.5	16.6	0.0	1.9	9.1	2.2	0.0	0.3	1.0
Industrial discharges	1.1	2.8	0.1	0.1	1.1	2.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	29.1	42.3	0.0	0.0	29.1	42.3	0.0	0.0	7.2	16.8	0.0	0.0	2.3	0.9
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban runoff	14.0	0.0	15.8	16.0	14.0	0.0	15.8	16.0	2.1	0.0	6.9	4.8	1.4	0.0	4.4	1.3
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	2.1	0.0	1.4	5.5	2.1	0.0	1.4	5.5	0.8	0.0	1.5	4.6	0.1	0.0	0.1	0.1

Table 22- Percentages of net load from all sources for Cholsey, Culham, Didcot and Oxford STWs with associated WFD Waterbody catchments

Sewage Treatment Works	Cholsey				Culham				Didcot				Oxford			
Parameters	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**	**Amm**	**BOD**	**PO4**	**TP**
Upstream diffuse sources	3.4	25.2	0.0	0.0	0.3	1.3	0.0	0.0	5.7	20.4	0.0	0.0	44.2	8.7	0.0	0.0
Sewage treatment works	**91.9**	**74.8**	**79.4**	**77.5**	**99.6**	**98.7**	**100**	**100**	**75.3**	**55.8**	**75.9**	**54.2**	**54.8**	**91.3**	**99.1**	**89.4**
Intermittent discharges	3.4	0.0	9.1	11.7	0.0	0.0	0.0	0.0	9.7	0.0	3.7	5.8	0.3	0.0	0.4	1.5
Industrial discharges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.9	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	8.4	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.4	8.4
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban runoff	1.0	0.0	2.7	1.8	0.0	0.0	0.0	0.0	8.5	0.0	18.9	31.6	0.7	0.0	0.1	0.6
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	0.2	0.0	0.4	1.1	0.0	0.0	0.0	0.0	0.9	0.0	1.2	7.9	0.0	0.0	0.0	0.0
WFD Waterbody	**Cholsey Brook and Tributaries**				**Thames (Evenlode to Thame)**				**Moor Ditch and Ladygrove Ditch**				**Northfield Brook (Source-Thames)**			
Upstream diffuse sources	6.4	35.7	0.0	0.0	48.6	70.0	0.0	0.0	9.9	29.9	0.0	0.0	43.2	9.1	0.0	0.0
Sewage treatment works	**88.4**	**64.3**	**74.9**	**72.7**	**31.4**	**27.2**	**52.1**	**33.5**	**65.2**	**49.1**	**68.3**	**45.2**	**51.4**	**90.9**	**97.0**	**79.5**
Intermittent discharges	3.3	0.0	8.6	11.0	2.7	0.0	1.4	2.5	10.6	0.0	3.7	5.4	1.5	0.0	1.9	8.1
Industrial discharges	0.0	0.0	0.0	0.0	1.1	2.8	0.1	0.1	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	12.0	11.8	0.0	0.0	29.1	42.3	0.0	0.0	0.4	0.6	0.0	0.0	0.4	9.0
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Urban runoff	1.6	0.0	3.9	2.7	14.0	0.0	15.8	16.0	12.9	0.0	25.9	39.1	3.8	0.0	0.6	3.2
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	0.4	0.0	0.6	1.7	2.1	0.0	1.4	5.5	1.4	0.0	1.6	9.8	0.1	0.0	0.0	0.2

Table 23- Percentages of net load from all sources for Stanford, Wantage and Wallingford STWs with associated WFD Waterbody catchments

Sewage Treatment Works	**Stanford in the Vale**				**Wantage**				**Wheatley**			
Parameters	Amm	BOD	PO4	TP	Amm	BOD	PO4	TP	Amm	BOD	PO4	TP
Upstream diffuse sources	23.8	91.7	0.0	0.0	3.5	25.8	0.0	0.0	56.3	63.9	0.0	0.0
Sewage treatment works	**71.4**	**8.2**	**45.3**	**8.4**	**94.3**	**74.2**	**98.1**	**85.3**	**31.5**	**36.1**	**51.5**	**46.1**
Intermittent discharges	0.7	0.0	0.3	0.2	1.5	0.0	0.8	1.7	2.4	0.0	0.6	1.7
Industrial discharges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	51.1	82.5	0.0	0.0	0.3	7.2	0.0	0.0	42.0	44.9
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban runoff	2.1	0.0	2.1	2.8	0.6	0.0	0.7	5.5	6.9	0.0	4.9	4.2
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	2.0	0.0	1.2	6.3	0.0	0.0	0.0	0.3	2.8	0.0	1.1	3.2
WFD Waterbody	**Ock (to Cherbury Brook)**				**Letcombe Brook**				**Thame (Scotsgrove Brook to Thames)**			
Upstream diffuse sources	29.3	93.2	0.0	0.0	4.4	27.9	0.0	0.0	47.3	66.4	0.0	0.0
Sewage treatment works	**65.1**	**6.8**	**41.7**	**7.4**	**87.2**	**72.1**	**94.2**	**76.5**	**42.6**	**33.5**	**48.2**	**42.2**
Intermittent discharges	0.6	0.0	0.3	0.1	7.3	0.0	4.3	8.0	2.1	0.0	0.5	1.3
Industrial discharges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture (Livestock & Arable)	0.0	0.0	54.4	83.3	0.0	0.0	0.3	7.6	0.0	0.0	44.1	49.3
Highway runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban runoff	2.5	0.0	2.2	2.8	1.1	0.0	1.1	7.4	5.7	0.0	6.0	4.2
Atmospheric deposition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Septic tanks	2.4	0.0	1.3	6.4	0.0	0.0	0.0	0.4	2.3	0.0	1.3	3.1

Results at each STW

For the waterbodies assessed, STWs are generally the dominant source of Ammonia, BOD, Orthophosphate, and Total Phosphorus, particularly in small watercourses with limited dilution capacity. However, contributions vary:

- Abingdon (Lagoon), Appleton, Benson, Cholsey, Didcot, Oxford, and Wantage STWs — STWs are the dominant source of pollution in the receiving waterbodies for most parameters. These STWs tend to drain to small receiving watercourses where dilution is less and relative contributions from other sources may be limited due to the size of the upstream catchment. Note, for Didcot STW whilst STWs are the dominant source for all parameters, there are also significant contributions from upstream diffuse sources, industrial discharges and urban runoff.
- Abingdon (New) and Stanford in the Vale STWs — STWs are significant but not always the dominant source of pollution in the receiving waterbodies; agriculture and upstream diffuse sources play a larger role, particularly for Total phosphorus and BOD. Both these STWs drain to larger watercourses - the River Thames and River Ock. The size of their catchments means that there are a number of other upstream pollution sources and greater dilution. Stanford in the Vale STW is also a small STW which means that its effluent volume is relatively low.
- Wheatley STW — STWs remain a significant source of pollution in the receiving waterbody, however generally they contribute less than in other catchments, especially with respect to ammonia. Significant pollutant loads come from agriculture and diffuse sources, reflecting the smaller size of the STW and its small receiving watercourse.

Results for WFD Waterbodies

Across the districts' WFD Waterbodies, STWs are a significant source of pollution in all cases, although their contributions vary between locations. Waterbodies where STWs are the dominant source of pollution by a significant margin are considered more sensitive to future development, while in other waterbodies, managing alternative sources will also be crucial. The detailed findings are outlined below:

- For the Thames (Evenlode to Thame) WFD Waterbody drained to by Abingdon STW and Culham STW, STWs are a significant source of pollution for all parameters, however in some cases upstream diffuse sources and agriculture have a greater effect on concentrations. Therefore, whilst the waterbody is sensitive to future development, the future management of other sources will also be important.
- For the Ock (to Cherbury) WFD waterbody drained to by Stanford in the Vale STW, STWs are a significant source of pollution in terms of Ammonia and Orthophosphate, therefore these parameters are likely to be sensitive to future development. BOD and Total Phosphorous are less sensitive to future development, with the management of agriculture and upstream diffuse sources likely to be more important.
- For the Moor Ditch WFD Waterbody drained to by the Didcot STW, STWs are the largest source of pollution for all parameters, but only marginally. Therefore, it is sensitive to future development. However, the management of other sources, namely upstream diffuse sources, industrial discharges and urban runoff, will also be important.
- For the Thame (Scotsgrove Brook to Thames) WFD Waterbody drained to by Wheatley STW, STWs are a significant source for all parameters however in some cases upstream diffuse sources and agriculture have a greater effect on concentrations. In this regard whilst the waterbody is sensitive to future development the management of other sources will also be important.

- For the four WFD waterbodies drained to by Appleton STW, Cholsey STW, Oxford STW and Wantage STW, STWs are the largest source for all of the parameters by a significant margin. Therefore, they have the greatest effect on the current and future concentration of these parameters. As the flows from STWs are heavily dependent on development draining to them, it makes these WFD waterbodies more sensitive to future development.

5.9 Sensitivity Testing

Sensitivity testing was undertaken to test the robustness of the model results. The testing was carried out at five of the STWs. Appleton, Benson, Didcot and Stanford in the Vale STWs were chosen for sensitivity testing as they were the four STWs where future development or the application of TALs led to a water quality deterioration of 10% or greater. For these sites, the parameters which showed a deterioration were tested. Despite having no water quality deterioration of 10% or greater, Oxford STW was also tested given its importance in the wider Oxfordshire context and the EA's concerns with the site raised at the JLP Regulation 19 stage (detailed in Section 4.3.7). The remaining STWs were not chosen for sensitivity testing as their water quality values were more stable, and no potential issues were identified with their sampling data. The following sensitivity tests were undertaken:

- Appleton STW - ammonia and orthophosphate.
- Benson STW - ammonia.
- Didcot STW - all parameters.
- Oxford STW - all parameters.
- Stanford in the Vale STW - ammonia and orthophosphate.

The testing was carried out by using the EA's River Quality Planning (RQP) tool, specifically, the Monte Carlo simulation programme in RQP version 6. The input data used for the Monte Carlo simulation in RQP is outlined below:

- Upstream mean flow
- Upstream 95% percentile flow
- Upstream mean quality
- Upstream quality standard deviation
- Discharge mean flow
- Discharge flow standard deviation
- Discharge mean quality
- Discharge quality standard deviation.

In the sensitivity test the RQP software re-runs the Monte Carlo simulation making variations of 10% automatically to the following input data. The results are expressed for each input data value as the percentage effect on the downstream river quality. In practice a 10% change in downstream river quality indicates that the data should be investigated before decisions are taken about improving the model structure and inputs. The full results for this exercise at each STW are provided in Appendix 2. Overall, the sensitivity testing did not find any significant issues with the input data and model structure. It is therefore concluded that the overall results are robust. The key findings were as follows:

- At Appleton STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Benson STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Didcot STW the sensitivity testing showed that a 10% perturbation in the mean discharge quality value led to a 10.2% change for ammonia. The standard deviation in ammonia at this site is high relative to its mean. The testing could suggest that the data used by the EA contains a few high values (e.g. values associated with unusual rainfall events and higher flows at the STW). Ideally, the effluent data should already have been screened to remove outliers. However, in this case as the percentage change is only slightly over 10% the effect of removing any outliers is unlikely to have a significant effect on water quality at the STW. It is however recommended that the EA review the dataset for this site in the future.
- At Oxford STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Stanford on Vale STW the sensitivity testing showed that a 10% perturbation in the mean discharge value led to a 10.7% change for ammonia. The standard deviation for ammonia at this site is high relative to its mean value. The testing could suggest that the data used by EA contains a few high values (e.g. values associated with unusual rainfall events and higher flows at the STW). Ideally, the effluent data should already have been screened to remove outliers. However, in this case as the percentage change is only slightly over 10% the effect of removing any outliers is unlikely to have a significant effect on water quality at the STW. It is however recommended that the EA review the dataset for this site in the future.

5.10 Summary

The aims of the WFD are to enhance the status and prevent further deterioration of surface water bodies, groundwater bodies and their ecosystems. In this regard, the water quality modelling results have been used to assess the following criteria:

- Could the development cause a greater than 10% deterioration in water quality?
- Could the development cause a deterioration in WFD class of any element assessed?
- Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) when considering technologically achievable limits (TAL)?

Table 24 provides a summary of the modelling results for meeting each of these criteria. A green, amber or red score is assigned to each criterion for the STWs assessed based on the barriers to future development. The findings are discussed further after the table.

Table 24- Summary of modelling results in relation to water quality objectives

STW name	Could development cause a greater than 10% deterioration in water quality?	Could development cause a deterioration in WFD Class of any element?	Could development prevent the receiving waterbody from achieving Good Status?
Key	No infrastructure upgrade required to achieve water quality objective.		
	Infrastructure upgrade required to achieve water quality objective, but achievable using TALs or other factors preventing objectives.		
	Water quality objective cannot be achieved using TALs. Environmental capacity could be a constraint on development.		
Abingdon (Lagoon)	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has Poor Status for ammonia, BOD and orthophosphate. Development has a minor impact (<1%) on these values so this is not considered a factor preventing Good Status. Application of TALs leads to ammonia and BOD achieving Moderate and Good Status.
Abingdon (New)	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently achieving High Status for ammonia and BOD. This remains the case when accounting for development. Orthophosphate status is currently Poor; future development has no impact (0%) and TALs only a small impact (-5.6%) on its concentration, therefore it is not considered a factor preventing Good Status.
Appleton	Predicted deterioration is 10% or greater for ammonia and orthophosphate. Deterioration is reversed with application of TALs.	Class deterioration is predicted for ammonia, but returns to baseline class with application of TALs.	Receiving waterbody currently has Moderate Status for ammonia, Poor Status for BOD and Bad Status for orthophosphate. Development leads to a significant deterioration (>10%) in ammonia and orthophosphate. With application of TALs, ammonia is returned to Moderate Status, BOD achieves Good Status, however orthophosphate remains at Bad Status. Environmental capacity could be a constraint on growth in the short term.
Benson	Predicted deterioration is <10% for current technology scenario. Deterioration >10% considering TALs but result is questioned.	Class deterioration predicted for orthophosphate. Improvement from baseline class with application of TALs.	Receiving waterbody currently achieving Good status for ammonia and BOD, orthophosphate has Poor status. Development leads to orthophosphate deteriorating to Bad status. However, with application of TALs there is an improvement relative to baseline to Moderate status.
Cholsey	Predicted deterioration is <10%.	Class deterioration predicted for orthophosphate. Improvement from baseline class with application of TALs.	Receiving waterbody currently has Poor Status for ammonia and Moderate Status for BOD and orthophosphate. Development has a minor impact (<2%) on these values so is not considered a factor preventing Good Status. Application of TAL leads to BOD and Orthophosphate achieving Good status and Ammonia achieving Moderate status.
Culham	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has Poor Status for ammonia and Bad Status for BOD and orthophosphate. Development has a minor impact (<1%) on these values so is not considered a factor preventing Good Status. Application of TAL leads to BOD achieving Good status and Ammonia achieving Moderate status.

STW name	Could development cause a greater than 10% deterioration in water quality?	Could development cause a deterioration in WFD Class of any element?	Could development prevent the receiving waterbody from achieving Good Status?
Didcot	Predicted deterioration is 10% or greater for ammonia and orthophosphate. Deterioration is reversed with application of TALs. Deterioration >10% considering TALs but result is questioned.	Class deterioration is predicted for ammonia, but returns to baseline class with application of TALs.	Receiving waterbody is currently achieving Good and High status for ammonia and BOD respectively, orthophosphate has Poor status. Development leads to ammonia deteriorating to Moderate status and a significant deterioration in orthophosphate (>10%). Ammonia is returned to Good Status with application of TALs, however orthophosphate remains at Poor status. Environmental capacity could be a constraint on growth in the short term.
Oxford (Districts only)	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has Poor Status for ammonia and orthophosphate, with moderate status for BOD. Development has little impact (<1%) on these values so is not considered a factor preventing Good Status. Application of TAL leads to BOD achieving Good Status.
Oxford (All Dev)	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has Poor Status for ammonia and orthophosphate, with moderate status for BOD. Development has little impact (<1%) on these values so is not considered a factor preventing Good Status. Application of TAL leads to BOD achieving Good Status.
Stanford in the Vale	Predicted deterioration is 10% or greater for ammonia. Deterioration is reversed with application of TALs.	No WFD class deterioration is predicted.	Receiving waterbody currently achieving Good and High status for ammonia and BOD respectively, orthophosphate has Poor status. Development leads to a significant deterioration in Orthophosphate (>10%). With application of TALs, orthophosphate remains at Poor status. Environmental capacity could be a constraint on growth in the short term.
Wantage	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has High Status for ammonia and BOD; orthophosphate has Poor status. Development has a minor impact (<1%) on these values so is not considered a factor preventing Good Status. Application of TAL leads to no changes in WFD class.
Wheatley	Predicted deterioration is <10%.	No WFD class deterioration is predicted.	Receiving waterbody currently has High Status for ammonia and BOD; orthophosphate has Poor Status. Development has a minor impact (<1%) on these values so is not considered a factor preventing Good Status for orthophosphate. Application of TAL leads to no changes in WFD status.

The findings show that at eight of the 11 receiving watercourses the WFD objectives can be met either with no infrastructure improvements or infrastructure upgrades within current TALs. In these cases, timely interventions implemented by Thames Water and the EA are required to prevent deterioration; this will include improving the technology currently employed at the STWs. At the remaining three STWs (Appleton, Stanford in the Vale and Didcot) whilst a deterioration in water quality is prevented with the application of TALs, it is not possible to achieve Good Status and future development is considered to be a factor preventing this. Note development was considered a factor where it caused more than a 10% deterioration and where the contribution from diffuse sources was more limited. In all three cases this is associated with orthophosphate in isolation. At these STWs, environmental capacity could be a constraint on development in the immediate future, however through upgrades to wastewater infrastructure, development phasing and mitigation against other pollution sources, development should be possible moving through the plan period.

As noted previously, the results at Abingdon STW and Appleton STW are based on the assumption that the Land at Dalton Barracks Garden Village site drains exclusively to each of them. This precautionary approach ensures that the potential impacts of development are not underestimated at either of the STWs. However, the site has a significant impact on the projected flow volumes draining to each STW (see section 4.3) and the water quality results presented. This is especially the case at Appleton which is a smaller STW and has very few other sites planned to drain to it. It should also be noted that at Appleton STW, the waterbody is not currently achieving Good status for any of the parameters assessed. This means that future development alone cannot be considered to be preventing the waterbody getting to Good status.

The assessments undertaken to date adopt a precautionary approach and assume that all JLP allocations and neighbourhood plan allocations will be built out. It should also be noted that the assessments have considered the dwellings expected between 2021-2041 and on some of the sites a significant number of dwellings have already been delivered between 2021-2024. Additionally, the assessments do not take into account any planned or longer-term increases in treatment capacity at the STW sites, which could allow STWs to store effluent for longer and maintain existing discharge volumes. The TALs applied are based on present day technology and technology may improve over the plan period to 2041. The timing of development will therefore be an important factor.

For many of the receiving watercourses, other pollution sources (e.g. agriculture, industry) are also contributing reasons for the waterbodies not achieving Good Status. Therefore, reducing the contribution of other pollution sources should be a key priority to safeguard environmental capacity. The measures to achieve this should be set out by the EA through liaison with other stakeholders in the Thames River Basin Management Plan[22].

South Oxfordshire and Vale of White Horse District Councils have included Policy CE8 – Water quality, wastewater infrastructure and drainage in their JLP. This policy aims to protect and enhance the quality of waterbodies where they, or their catchments, are wholly or partially located within South Oxfordshire and Vale of White Horse. This includes ensuring that there is sufficient wastewater infrastructure capacity to serve development.

It is also recommended that South Oxfordshire and Vale of White Horse District Councils take the following actions:

- Consider potential impacts on WFD status when assessing planning applications in liaison with the EA and Thames Water. This is particularly the case for larger scale developments (>1000

[22] Thames Water (2022) *Thames river basin district management plan* https://www.gov.uk/guidance/thames-river-basin-district-river-basin-management-plan-updated-2022

Dwellings) in the Appleton, Stanford in the Vale and Didcot STW catchments where environmental capacity could be a constraint on development. This includes the JLP allocations of the Land at Dalton Barracks Garden Village site which will potentially drain to Appleton STW, and the Valley Park and Didcot North-East sites draining to Didcot STW. Currently no larger scale developments are proposed to drain to Stanford in the Vale STW, however water quality and the timely delivery any necessary infrastructure upgrades will still be a key consideration for development of the West of Stanford in the Vale site (251 dwellings).

- Development phasing and liaison with the EA and Thames Water should also be a key consideration when assessing planning applications for larger scale developments (>1000 Dwellings) in STW catchments draining to receiving watercourses with Bad to Poor Status. This includes Abingdon STW, Culham STW, Didcot STW, Wantage STW and Wheatley STW. The larger scale JLP site allocations affected would be the following:
  - Abingdon STW- Land at Dalton Barracks Garden Village site (will potentially drain to Appleton STW) and North of Abingdon-on-Thames site
  - Culham STW- Land at Berinsfield Garden Village and Culham Campus sites
  - Didcot STW- Valley Park and Didcot North-East sites
  - Wantage STW- Grove Airfield and Crab Hill Sites
  - Wheatley STW- Currently no larger scale developments are proposed to drain to this STW, however water quality and the timely delivery of any necessary infrastructure upgrades will still be a key consideration for the Land at Wheatley Campus site (447 dwellings).
- Share Annual Monitoring Reports and Housing Land Supply Statements, which detail projected housing development in their administrative areas, with Thames Water.
- Provide a copy of the WCS to colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council, with specific attention brought to the assessment at Oxford STW, as the catchment extends across local authority boundaries.
- Provide a copy of the WCS to Oxfordshire County Council as the Waste Planning Authority.
- A copy of the WCS should also be provided to Thames Water and the EA.

In response to these actions, Thames Water will need to assess growth demands as part of their wastewater asset planning activities and feedback to the district councils if concerns arise.

Thames Water will need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.

6 Water Resources

6.1 Review of Thames Water Dwelling Forecasts

This section compares the dwelling numbers for each district in Thames Water's WRMP24 against the residential development planned in the JLP (this includes committed development, including sites allocated in neighbourhood plans, sites proposed for allocation in the JLP and an allowance for windfall development). This comparison confirms whether the planned development in the JLP is captured in Thames Water's WRMP24.

Thames Water has provided the population and dwelling forecasts for South Oxfordshire and Vale of White Horse used in the WRMP24, which were developed by Edge analytics in March 2022. The forecasts provided are informed by local plan evidence and ONS trend-based population projections.

Table 25 compares the Thames Water local plan-based and ONS trend-based forecasts aggregated across both districts with the dwellings proposed in the JLP. Thames Water's forecasted dwelling numbers in 2024 and 2041 are listed for both districts, with the change in dwellings between these two years listed in the final column. These numbers are compared to the number of homes expected to be delivered in the districts from 1 April 2024 to 31 March 2041 according to the JLP's housing trajectory. This detailed report refers to 32,968 dwellings being delivered between 1 April 2024 -and 31 March 2041. This differs to the figure in the WCS Scoping Report because:

- It only considers housing delivery from 1 April 2024 to 31 March 2041 (i.e. it does not include homes already delivered in the early years of the plan period from 1 April 2021 to 31 March 2024; it also does not consider housing delivery beyond the plan period).
- It is based on updated housing supply figures which were proposed as a modification to the JLP when it was submitted for examination in December 2024[23].

Table 25- Comparison of dwelling forecasts

Dwelling Forecast	District	Dwellings (2024)	Dwellings (2041)	Change in dwellings (2024-2041)
Thames Water (ONS-Trend Based)	S.Oxon	64,878	69,637	4,759
	VWH	63,439	73,182	9,743
	Total	128,317	142,819	14,502
Thames Water (Local Plan Based)	S.Oxon	67,737	92,752	25,015
	VWH	65,285	86,109	20,824
	Total	133,022	178,861	45,839
JLP	S.Oxon			17,145
	VWH			15,823
	Total			32,968

It should be noted that for water companies supplying customers in England, future infrastructural requirements are based on the local plan-based forecasts, hence these are reviewed in more detail. As can be seen in Table 25 above, the Thames Water local plan-based dwelling forecasts exceed the residential development planned in the JLP across both districts. For South Oxfordshire, the Thames

[23] South Oxfordshire District Council and Vale of White Horse District Council (2025) *Joint Local Plan examination library reference CSD01.1 0 – Schedule of proposed modifications for submission.* https://www.southandvale.gov.uk/app/uploads/2024/12/CSD01.1-Joint-Local-Plan-2041-–-Schedule-of-proposed-modifications-for-submission.pdf

Water local plan-based dwelling forecast is 46% greater than the development planned in the JLP and for the Vale of White Horse the Thames Water forecast is 32% greater. When aggregated across both districts, the local plan-based dwelling forecast is 39% greater than the residential development proposed in the JLP.

The forecasts used in the WRMP24 exceed the development proposed in the JLP by a significant margin, showing that the planned development in both districts is more than accounted for in the WRMP24.

It is noted that the Thames Water local plan-based forecasts also integrate trend projections which include published output from ONS and consider fertility, mortality and migration components, in addition to local plan data. This may partly explain some of the disparity between the Thames Water local plan-based forecasts and the JLP dwelling projections.

In terms of the rate of development, the annual number of dwellings in Thames Water's local plan-based forecasts has been extracted between the years 2024-2041. These have then been compared to the JLP housing trajectory which sets out expected housing delivery for the remaining years of the plan period from 2024 to 2041. Figure 20 shows the results of this analysis. It shows that the rate of housing delivery in Thames Water's local plan-based forecasts is higher for all years to 2041. In general, both forecasts show a peak in housing delivery between 2025 and 2030, with supply tending to fall in the later years of the plan period from 2035 to 2041. However, there is less variation in housing delivery in the JLP, with the number of dwellings per annum varying between 1,530 to 2,401. For Thames Water's local plan-based forecasts this number varies between 1,817 and 3,689.

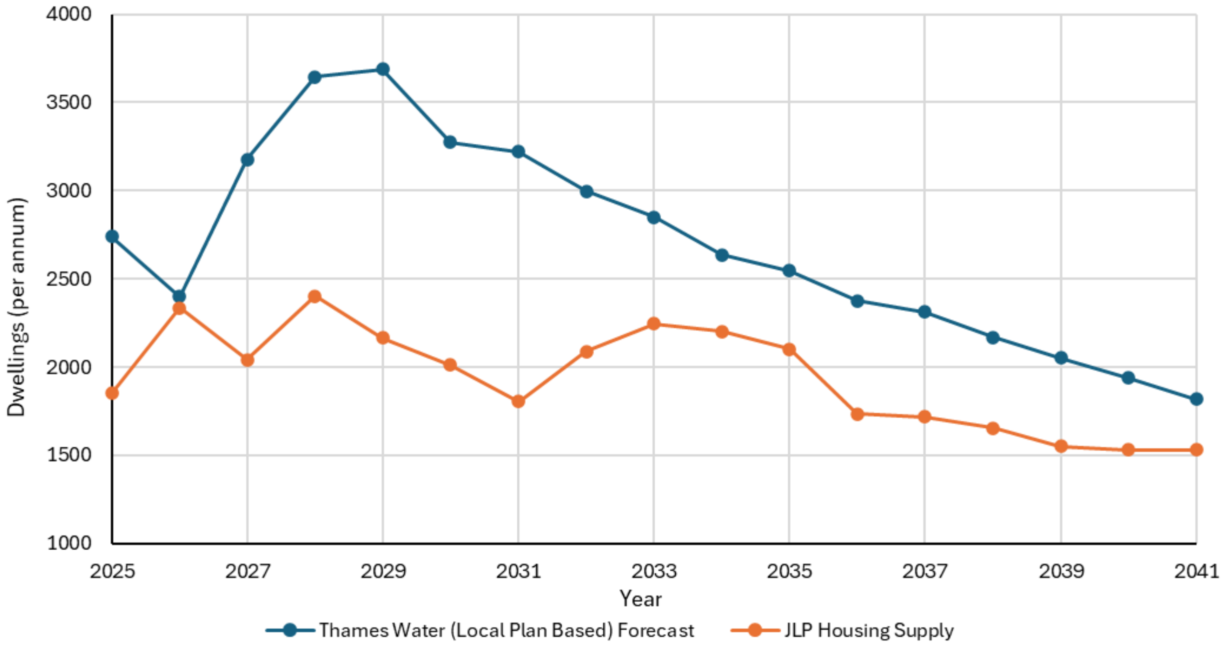

Figure 20- Comparison of Thames Water (Local Plan Based) Forecast and JLP Housing Supply Numbers

Overall, this assessment indicates that the development proposed in the JLP will not place unforeseen pressure on Thames Water's water resource plans and in turn the water environment. This is the case when considering both the full quantum of development across the plan period and the housing supply forecast for each year (i.e. the rate of growth).

The WRMP24 has already been developed with several environmental goals and priorities in mind, including protecting the condition of designated and functionally important habitats and leaving more water in environments that are abstraction sensitive. As the JLP proposes significantly fewer dwellings than anticipated by Thames Water currently, it has the potential to ease pressure on the water environment and support the achievement of these goals and priorities.

Regarding abstraction sensitive sources in particular, Thames Water has identified chalk streams, such as those that reside in the south of the districts as sensitive. Most major JLP site allocations lie outside these areas. Therefore, they will not impact land use and are less likely to utilise the water resources within these catchments. Policy NH6 of the JLP further ensures that development is only permitted where it protects and, where possible, enhances landscape features, including chalk streams. As such, the JLP is not expected to increase pressure on these vulnerable areas.

Note, Thames Water is currently at the early stages of tendering work to support its WRMP 2029 which will cover the period from 2030-2090. This will include commissioning demographics analysts who will obtain data from local authorities to update their population and dwelling forecasts. The WRMP 2029 should incorporate the development proposed in the JLP and should also be in place before many of the larger JLP allocations start to deliver.

WRMP 2029, along with subsequent WRMPs for 2034 and 2039, will continue to prioritise water security and the protection of the water environment, informed by the latest data on climate change and population growth. It is Thames Water's responsibility to ensure that there is a sufficient supply of water so that developments can progress without presenting a risk to the environment and the WRMPs will help to ensure an adaptive response to future water resource challenges in the districts.

6.2 Review of development in Culham, Hagbourne Hill and Wantage FMZs

As well as ensuring there is sufficient water available, there also needs to be sufficient infrastructural capacity in place to enable water to be transferred to new developments. Through the JLP Regulation 19 pre-submission publication period, the EA commented that water supply infrastructure upgrades may not be able to keep up with the proposed pace of development in some areas.

To explore this further, Thames Water was asked to identify any areas where infrastructure upgrades might take longer to deliver. In response, it identified the Wantage, Hagbourne Hill, and Culham FMZs as areas where delays may occur if a large quantum of development comes forward.

The FMZ boundaries for these areas have been obtained from Thames Water and compared with the JLP allocations. Figure 21 shows the sites expected to be supplied by these FMZs. These sites are identified in Table 26.

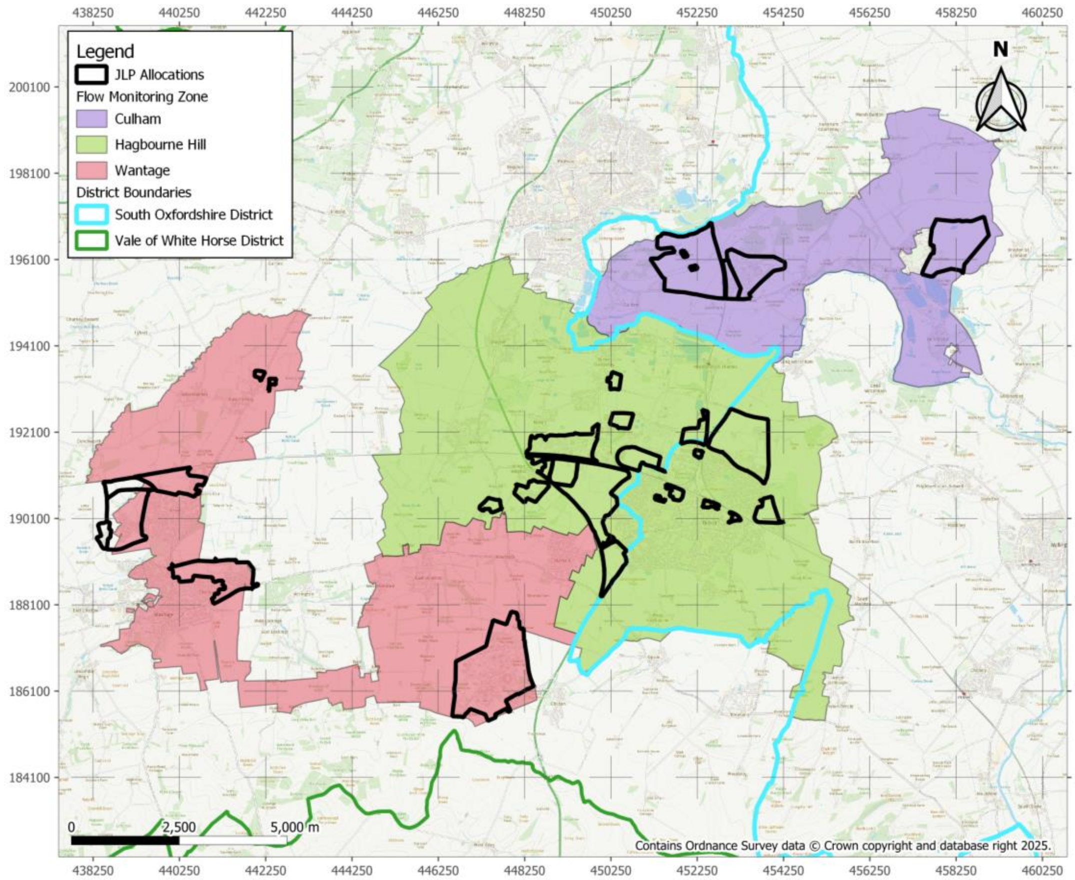

Figure 21-FMZs and JLP Allocations

Table 26- JLP allocations in each FMZ

Site Reference	Site Name	Dwellings expected in Plan period (2021-2041)	Employment Area (ha)
Culham FMZ			
AS1	Land at Berinsfield Garden Village	1491	5.0
AS2	Land Adjacent to Culham Campus	1550	0
AS11	Culham Campus	0	2.3
Hagbourne Hill FMZ			
AS6	Rich's Sidings and Broadway, Didcot	100	0
AS7	Didcot Gateway, Didcot	144	0
AS9	North West of Valley Park, Didcot	800	0
AS16	Vauxhall Barracks, Didcot	189	0
HOU2a	Ladygrove East	750	0
HOU2b	Didcot North East	2211	0
HOU2h	Milton Heights	357	0
HOU2r	Valley Park, Didcot	4180	0
HOU2x	East Sutton Courtenay	175	0
JT1a	Southmead Industrial Estate, Didcot	0	2.7
JT1c	Land next to Milton Interchange (Enterprise Zone 2)	0	8.2
JT1g	Didcot A	0	29
JT1h	Didcot Quarter (Enterprise Zone 2)	0	15.22
JT1i	Former Esso Research Centre	0	11
JT1l	Didcot Technology Park	0	23.4
JT1m	Milton Park	0	5.36
Wantage FMZ			
AS8	North West of Grove, Grove	624	0
AS12	Harwell Campus	0	93
HOU2p	Monks Farm (North Grove)	526	0
HOU2q	Grove Airfield	2187	0
HOU2u	Crab Hill (NE Wantage & SE Grove)	1340	0
HOU2w	North of East Hanney	80	0
JT1b	Grove Technology Park	0	5.4

Culham FMZ

Within the Culham FMZ, there are three JLP allocations. One of these allocations is a relatively small-scale (<10-ha) employment allocation (AS11) which is not expected to place a significant burden on water supply infrastructure. However, the other two allocations (AS1 and AS2) are larger scale developments (>1000 dwellings). AS1 is a mixed use residential and employment allocation and AS2 is a residential allocation. Both sites were scored red in Thames Water's RAG reports completed as part of the scoping study. This suggests that the proposed level of development will require a Development Impact Assessment as the increase in dwellings is above the current upper threshold for growth. These assessments evaluate how new developments affect infrastructure and the environment before determining if upgrades are needed to accommodate increased demand and/or mitigate potential negative impacts.

In terms of development phasing, Figure 23 shows a plot of the dwellings expected to come forward across all of the allocations in the Culham FMZ between 2025-2041. At AS1 78 dwellings are expected to be delivered in 2031/32 with 157 dwellings completed per annum in the years following this up to 31 March 2041. For AS2, 50 dwellings are planned to come forward in 2030/31, with 150 dwellings completed per annum in the years following this up to 31 March 2041.

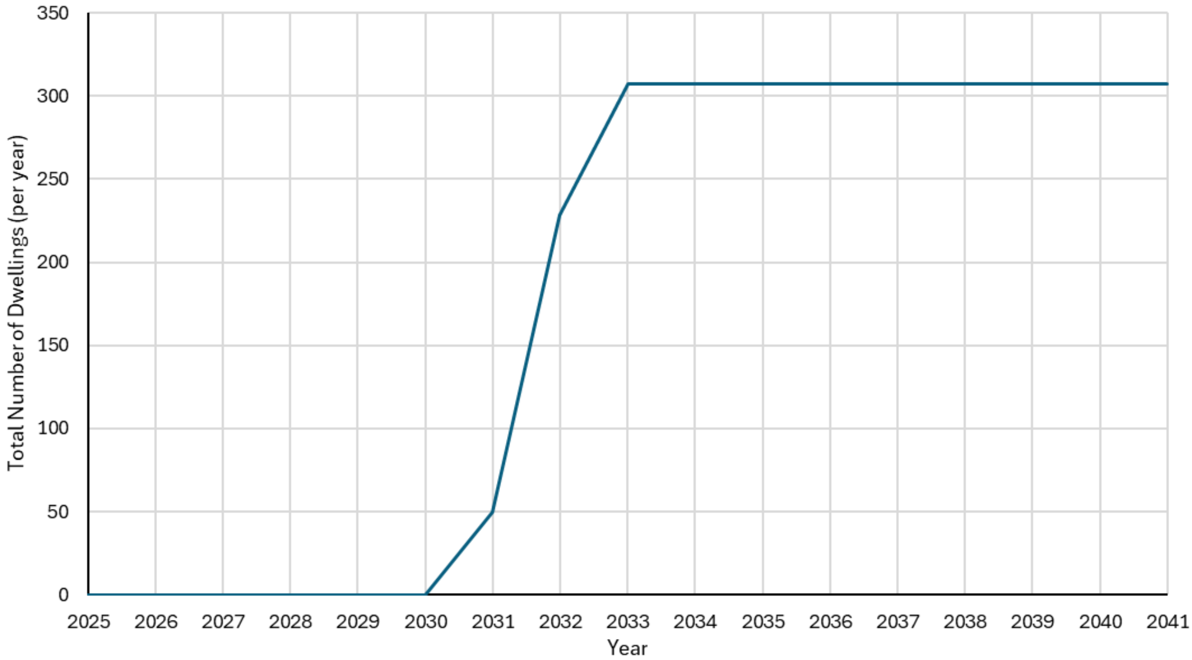

Figure 22- Total dwellings per annum for JLP allocations in Culham FMZ

The fact that these allocations are not expected to start delivering homes until 2030 and will be built out over a number of years, means that there will be a significant amount of time for infrastructure upgrades to take place. Despite this time being available, developers are recommended to engage with Thames Water as early as possible in the planning process to identify any potential constraints and solutions. Engagement with Thames Water may be in the form of a pre-planning enquiry[24]. This is an early-stage query to confirm if there is sufficient water and/or wastewater network capacity available to serve the proposed development. Should capacity issues be identified, Thames Water will discuss how these issues could be resolved and the likely timescales for doing so. Thames Water

[24] Thames Water (2025) Pre-Planning Enquiry https://www.thameswater.co.uk/developers/larger-scale-developments/planning-your-development/water-and-wastewater-capacity

will summarise this in a letter which can be submitted to the councils for consideration as part of a planning application.

Thames Water is only a statutory consultee for planning applications where development involves the boring for or getting of oil and natural gas from shale as set out in the Town and Country Planning (Development Management Procedure) (England) Order 2015. However, the councils will generally consult Thames Water on planning applications for major development, providing a further opportunity to identify any potential network constraints and possible solutions. Where constraints are identified, the councils may grant planning permission subject to a condition (for example a condition requiring further assessment of water supply infrastructure to be completed prior to the commencement of development).

Thames Water's subsequent involvement with developers regarding water supply is generally associated with the discharge of any relevant planning conditions (where these apply). Where planning permission is granted subject to a condition related to water supply, developers should contact Thames Water after planning approval and land ownership confirmation. Thames Water will then model the site to identify if any network upgrades are required. If upgrades are needed, once the modelling stage is complete, the design and construction phases can commence. The full process usually takes between 18 months to 3 years to complete.

Developers may submit the results of the modelling study to the relevant local planning authority as part of an application to discharge a condition to demonstrate that they have engaged with Thames Water and that a plan is in place to upgrade the water supply network. When Thames Water is consulted on the discharge of a planning condition, they review the submitted information and, provided it aligns with the recommendations of their modelling report, Thames Water will support the discharge of the planning condition. By following this process efficiently developers can help to prevent any delays to development coming forward without compromising the water environment.

Hagbourne Hill FMZ

Within the Hagbourne Hill FMZ, there are sixteen JLP allocations. Three of these allocations are relatively small-scale (<10-ha) employment allocations (JT1a, JT1c and JT1m) which are not expected to place a significant burden on water supply infrastructure. In terms of the remaining allocations, nine of these are residential allocations, all of which scored red in Thames Water's RAG reports. HOU2b (Didcot North East) and HOU2r (Valley Park, Didcot) are the largest of these sites and are both larger scale residential developments (>1000 dwellings) delivering 2,211 and 4,180 dwellings respectively. The remaining residential allocations are set to deliver a further 2,515 dwellings during the plan period. There are also large employment sites (>10-ha) proposed in this FMZ, which may bring additional pressures on water supply infrastructure.

In terms of development phasing, Figure 23 shows a plot of the dwellings expected to come forward across all of the allocations in the FMZ between 2025-2041 (note, it is understood that 764 dwellings were completed in the FMZ between 2021-2024). The plot shows close to half of the dwellings to come forward between 2025-2030. The majority of these come from the larger HOU2b and HOU2r allocations.

It is important to note that HOU2b and HOU2r have been identified for development for several years and have outline planning permission in place. HOU2b was first allocated in the South Oxfordshire Core Strategy, adopted in December 2012, while HOU2r was allocated in the Vale of White Horse Local Plan 2031 Part 1, adopted in December 2016. Both sites are being delivered in multiple phases. Some phases have already been completed or have received detailed planning consent.

Concerns related to water supply infrastructure were raised for HOU2b at the outline planning application stage. The outline planning permission[25] for the site granted in June 2017 included a condition requiring a study of the existing water supply infrastructure to determine additional capacity needs and suitable connection points, to be approved by the local planning authority in consultation with Thames Water. The purpose was to ensure adequate capacity in line with the NPPF. In January 2018, this condition was discharged[26] following the submission of a Potable Water Study Technical Note, which was agreed with Thames Water. South Oxfordshire District Council continues to consult with Thames Water on the reserved matters applications received for HOU2b and, to date, Thames Water have not raised any comments or objections to these applications in relation to water supply infrastructure.

Thames Water did not raise concerns about HOU2r related to water supply infrastructure at the outline planning application stage, therefore the outline planning permission[27] granted in February 2022 did not include a condition on this matter. Vale of White Horse District Council continues to consult with Thames Water on the reserved matters applications received for HOU2r and, to date, Thames Water have not raised any comments or objections to these applications in relation to water supply infrastructure.

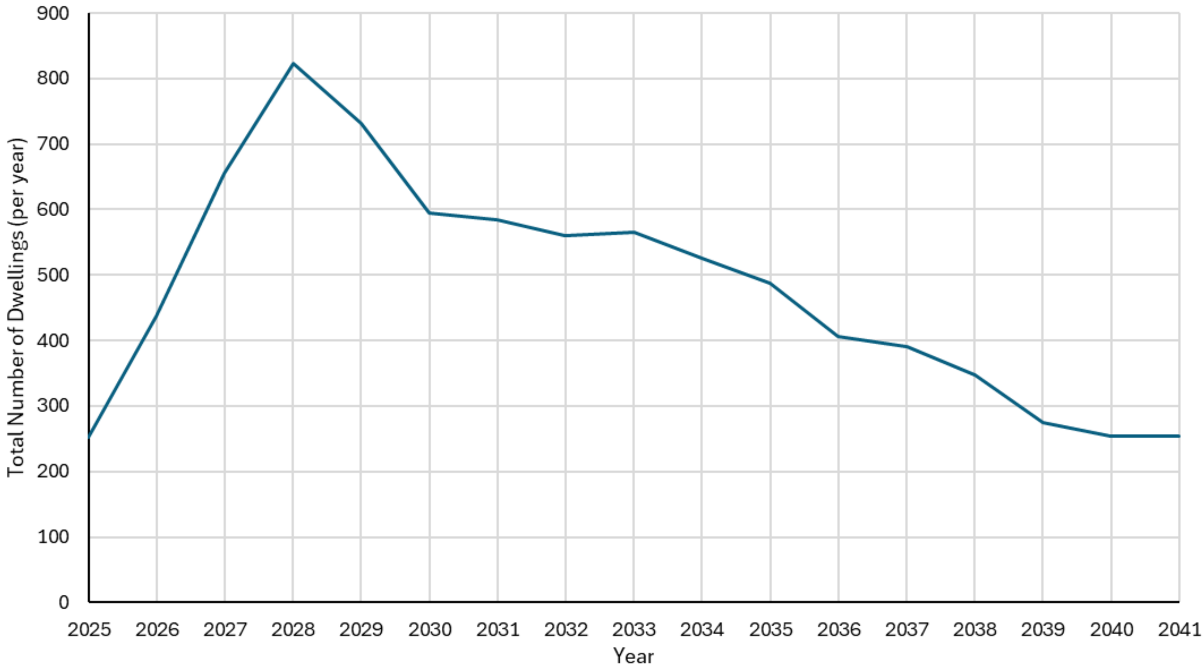

Figure 23- Total dwellings per annum for JLP allocations in Hagbourne Hill FMZ

For the Hagbourne FMZ, HOU2b and HOU2r are the largest contributors to housing delivery in the FMZ prior to 2030. There has already been detailed engagement with Thames Water in relation to water supply infrastructure for these sites through the relevant planning application processes.

For all development sites within this FMZ, it is recommended that developers engage with Thames Water as early as possible in the planning process through submission of a pre-planning enquiry. This will ensure the developer is aware of any constraints that may exist and allow Thames Water to undertake modelled impact assessments at an early stage to confirm if strategic infrastructure investment is required. Thus, mitigating against longer lead-times and protecting the water

[25] P15/S2902/O
[26] P17/S3860/DIS
[27] P14/V2873/O.

environment. Development phasing may need to be considered to allow infrastructure upgrades to take place (where required), however this will become clearer following Thames Water's modelled impact assessments and can be addressed at the planning application stage as appropriate.

Wantage FMZ

Within the Wantage FMZ, there are eight JLP allocations. One of these allocations is a relatively small-scale (<10-ha) employment allocation (JT1b) which is not expected to place a significant burden on water supply infrastructure. The remaining allocations include a number of residential developments, which scored red in Thames Water's RAG reports.

HOU2q (Grove Airfield) and HOU2u (Crab Hill) are the largest of these and are both larger scale residential developments (>1000 dwellings) delivering 2,187 and 1,340 dwellings during the plan period respectively. It is important to note that these sites have been identified for development for several years and have outline planning permission in place. Both sites are being delivered in multiple phases. Some phases have already been completed or have received detailed planning consent.

In terms of HOU2q, no concerns regarding water supply infrastructure were raised by Thames Water at the outline planning application stage[28]. Therefore, no conditions relating to water supply infrastructure were attached to the outline planning permission granted in July 2017. Vale of White Horse District Council continues to consult with Thames Water on the reserved matters applications received for HOU2q and, to date, Thames Water have not raised any comments or objections to these applications in relation to water supply infrastructure.

For HOU2u, no concerns regarding water supply infrastructure were raised by Thames Water at the outline planning application stage[29]. Therefore, no conditions relating to water supply infrastructure were attached to the outline planning permission granted in July 2015. Vale of White Horse District Council continues to consult with Thames Water on the reserved matters applications received for HOU2u and, to date, Thames Water have not raised any comments or objections to these applications in relation to water supply infrastructure.

In terms of the remaining residential allocations in the Wantage FMZ, these are set to deliver a further 1,278 dwellings during the plan period. Figure 24 shows a plot of the dwellings expected to come forward across all of the allocations in the Wantage FMZ between 1 April 2025 and 31 March 2041. Allocation AS12, a major employment site of up to 93 hectares is not included, however it could increase pressure on water supply infrastructure. The plot shows the greatest number of dwellings to come forward between 2025-2030 with numbers tending to fall towards the end of the plan period. It is important to note, that 987 dwellings were completed between 2021-2024. This is a significant number, and it is assumed that existing infrastructure already has capacity to supply these dwellings.

[28] P12/V0299/O
[29] P13/V1764/O

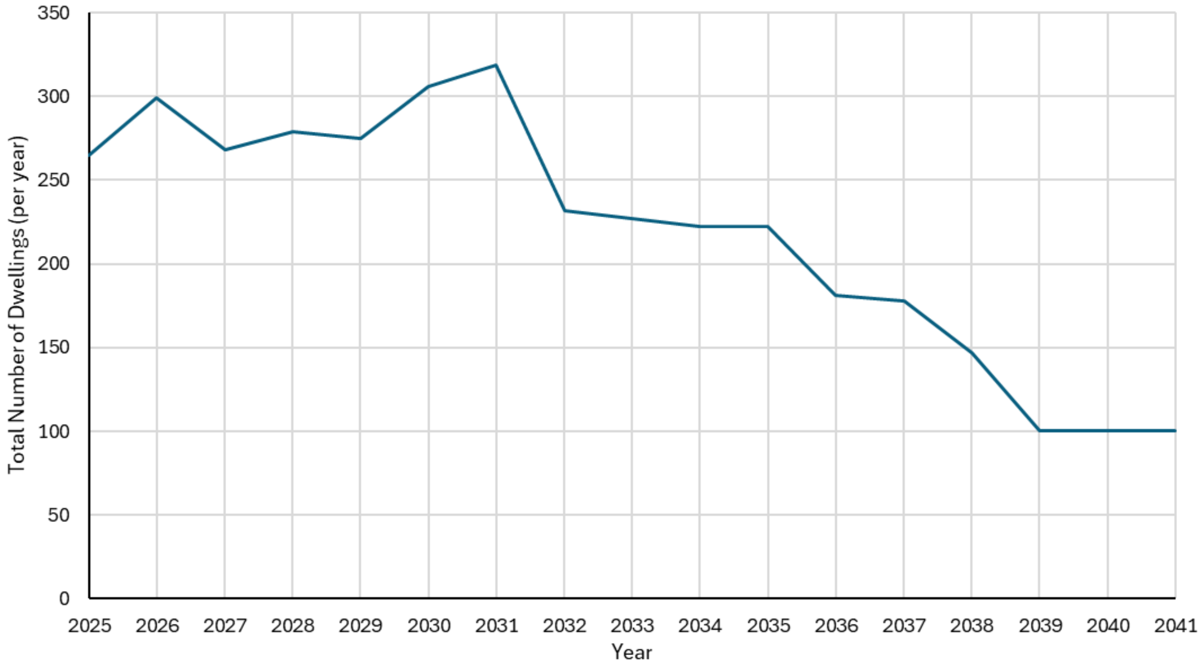

Figure 24- Total dwellings per annum for JLP allocations in Wantage FMZ

For the Wantage FMZ, HOU2b and HOU2r are the largest contributors to housing delivery in the FMZ prior to 2031. There has already been detailed engagement with Thames Water in relation to water supply infrastructure for these sites through the relevant planning application processes.

For all development sites within this FMZ it is recommended that developers engage with Thames Water as early as possible in the planning process through submission of a pre-planning enquiry. This will ensure the developer is aware of any constraints that may exist and allow Thames Water to undertake modelled impact assessments at an early stage to confirm if strategic infrastructure investment is required. Thus, mitigating against longer lead-times and protecting the water environment. Development phasing may need to be considered to allow for upgrades to take place (where required), however this will become clearer following Thames Water's modelled impact assessments and can be addressed at the planning application stage as appropriate.

Across all of the FMZs in the districts, it is Thames Water's responsibility to ensure that they upgrade their infrastructure so that developments can progress without presenting a risk to the environment. Generally, Thames Water will undertake infrastructure capacity modelling once development has outline permission, and upgrades are funded by connection charges. As already stated, developers are recommended to engage with Thames Water as early as possible in the planning process to avoid any delays to development coming forward.

6.3 Future water resource challenges

In further discussions with the EA following the JLP Regulation 19 pre-submission publication period it was flagged that there may be limited time available to mitigate water resource issues using the demand and supply side options given the housing delivery proposed in the JLP.

It is important to note that these discussions were in the context of the scoping report which showed the development proposed by the JLP potentially exceeding what was forecast by the WRMP24. A significant finding of this detailed report is that the WRMP24 dwelling forecasts in fact exceed the development proposed in the JLP by a significant margin. This is the case, when considering the full quantum of development and the annual rate of growth. Ultimately, this shows that the planned development in both districts is more than accounted for by the WRMP24.

In any case it is recognised that while the level of development proposed in the JLP is lower than Thames Water's forecasts, water availability across the districts will be influenced by pressures across Thames Water's supply area, with any local surpluses potentially redirected to address shortages elsewhere.

With this in mind, Thames Water have been consulted to provide more detail on the water resource pressures it forecasts for its supply area and the districts specifically. They have outlined how the WRMP24 sets out the forecasts of supply-demand balance for each Water Resource Zone. The SWOX WRZ, which encompasses most of South Oxfordshire and the entirety of the Vale of White Horse, is a complex zone with an interconnected supply system. Due to this complexity, it is challenging to identify concerns specific to sub-areas (including the districts) within the SWOX WRZ.

The overall supply-demand balance forecast for the SWOX WRZ indicates a substantial future deficit, exceeding 100 million litres per day by 2050. This projected shortfall is driven by four key factors: the requirement to improve resilience to a 1 in 500-year level by 2040 (in line with the Water Resources Planning Guideline[30]), anticipated future licence reductions based on the Environment Agency's guidance under the National Framework for Water Resources[31], population growth, and climate change. The scale of the forecast deficit highlights the need for demand reductions and the development of new supply sources to ensure long-term resilience.

These pressures were identified in the scoping report and the JLP recognises these pressures. Both district councils are committed to demand reductions. Policy CE7 of the JLP is related to water efficiency and will seek to make sure that occupiers of new development in South Oxfordshire and Vale of White Horse use water resources carefully. Under this policy, all development must demonstrate that it has been designed to be water efficient and to minimise water consumption. For residential developments, all new homes should be built to high water efficiency standards, with water use limited to 100 litres per person per day or any future, more stringent target, and are also required to be fitted with at least one water butt if they have a garden. The policy also sets out that site allocations and major developments should maximise water efficiency through large-scale rainwater harvesting and grey water recycling schemes where feasible.

Further to this policy, the district councils will provide Thames Water with their Annual Monitoring Reports and Housing Land Supply Statements, outlining projected housing development within their administrative areas. This information should improve the accuracy of Thames Water's water resource forecasting and help Thames Water carry out its actions in terms of planning necessary infrastructure upgrades and identifying appropriate supply and demand management options going forward.

Developers should also engage with Thames Water as early as possible so that they can carry out more detailed site-by-site modelled impact assessments to confirm if specific water supply upgrades are required and when.

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[30] Environment Agency, Office for Water Services (2023) *Water resources planning guideline* https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

[31] Environment Agency (2025), *National Framework for Water Resources 2025* https://www.gov.uk/government/publications/national-framework-for-water-resources-2025-water-for-growth-nature-and-a-resilient-future

7 Conclusions & Recommendations

The conclusions and recommendations from this study are as follows:

Headroom Assessment

A headroom capacity assessment at 10 STWs impacted by development proposed in the JLP has been undertaken. The assessment has sought to determine whether the STWs have sufficient headroom under current permits and capacity to process the predicted additional wastewater flows to 2041. It should be noted that the assessments assume all JLP and neighbourhood plan allocations will be built out and do not account for planned or longer-term increases in treatment capacity.

Findings

- At three of the ten STWs (Abingdon, Culham and Stanford in the Vale) there is sufficient headroom to accommodate future development based on the current permits in place. However, at Abingdon this is only when considering both outfalls (Abingdon Lagoon and Abingdon New), and at Culham when applying the current maximum flow permit, which is expected to be reduced.
- At four of the ten STWs (Benson, Cholsey, Oxford and Wheatley) the current permitted DWF will be exceeded by less than 25% by the end of the plan period.
- At three of the ten STWs (Appleton, Didcot and Wantage) the permitted DWF is already regularly exceeded and will be exceeded by more than 25% by the end of the plan period. This is partly due to delays in planned infrastructure upgrades which are the responsibility of Thames Water.

Actions and Recommendations

To help protect water quality and to support the timely delivery of necessary infrastructure upgrades, the following actions and recommendations are provided:

- Thames Water will need to invest in many of the STWs assessed to ensure compliance to 2041. Upgrades have been identified for all of the STWs assessed, however further investment may be required later into the plan period.
- Thames Water will need to assess development demands as part of their wastewater asset planning activities and feedback to South Oxfordshire and Vale of White Horse District Councils if concerns arise.
- Thames Water should investigate and seek to resolve surface water misconnections and groundwater infiltration within its wastewater network - particularly at Didcot which is a high spilling STW, thought to be partly due to groundwater infiltration.
- Thames Water will need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.
- The EA will need to consider development against infrastructural and environmental capacity in setting future environmental permits to allow development to progress sustainably without presenting a risk to the water environment.
- South Oxfordshire and Vale of White Horse District Councils, in liaison with Thames Water, will need to consider available STW capacity when assessing planning applications and should seek to align the delivery of development and wastewater infrastructure upgrades where they are required in accordance with JLP Policies CE8 – Water quality, wastewater infrastructure and drainage and IN1 – Infrastructure and service provision.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council,

with specific attention brought to the assessment at Oxford STW, as the STW catchment crosses administrative boundaries. None of the other STWs assessed have catchments that extend beyond South Oxfordshire and Vale of White Horse.

- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to Thames Water, the EA and Oxfordshire County Council as the Waste Planning Authority.

Water Quality Assessment

The potential impacts of development on water quality have been assessed using the EA's Thames SIMCAT model. Impacts are assessed against three criteria - percentage deterioration, class deterioration and prevention from meeting Good WFD Status in the future. The assessment has included the 10 STWs impacted by development proposed in the JLP and investigated the water quality impacts to 11 receiving watercourses, with Abingdon STW having two outfalls to different watercourses. It should be noted that the assessments assume all JLP and neighbourhood plan allocations will be built out and do not account for planned or longer-term increases in treatment capacity.

Findings

- The impacts on water quality from future development has been assessed using the EA's Thames SIMCAT model, with impacts against three criteria related to percentage deterioration, class deterioration and prevention from meeting Good WFD Status in the future.
- The findings show that at 8 of the 11 receiving watercourses the targets can be met either with no infrastructure improvements or infrastructure upgrades within current technology limits.
- At the remaining 3 receiving watercourses drained to by Appleton STW, Stanford in the Vale STW and Didcot STW, whilst a deterioration in water quality would be prevented with infrastructure upgrades, it is not possible to achieve Good Status with current technology and future development is considered to be a factor preventing this. At these sites environmental capacity could be a constraint on development in the immediate future. In all cases this is associated with orthophosphate in isolation.

Actions and Recommendations

To help protect water quality and to support the timely delivery of necessary infrastructure upgrades, the following actions and recommendations are provided:

- Wastewater infrastructure upgrades, the phasing of development, and mitigation against other pollution sources will be important to prevent a deterioration in water quality at many of the receiving watercourses assessed during the period to 2041.
- Of the three STWs where environmental capacity could be a constraint on development in the short term, both Appleton and Didcot already have upgrades scheduled for 2025-2030. Thames Water is also developing a project to increase the capacity of the storm tanks at Stanford in the Vale STW. Further upgrades may also be required over the plan period.
- For many of the receiving watercourses, other pollution sources (e.g. agriculture, industry) are also contributing reasons for the waterbodies not achieving Good Status. Therefore, reducing the contribution of other pollution sources should be a key priority to safeguard environmental capacity. The measures to achieve this should be set out by the EA through liaison with other stakeholders in the Thames River Basin Management Plan.
- Thames Water will need to assess development demands as part of their wastewater asset planning activities and feedback to South Oxfordshire and Vale of White Horse District Councils if concerns arise.

- Thames Water will need to secure relevant planning permissions to upgrade its wastewater facilities. Thames Water should work proactively with Oxfordshire County Council as the Waste Planning Authority to do this.
- South Oxfordshire and Vale of White Horse District Councils, in liaison with the EA and Thames Water, should consider WFD status when assessing planning applications in accordance with JLP Policy CE8 – Water quality, wastewater infrastructure and drainage.
- South Oxfordshire and Vale of White Horse District Councils will need to share their Annual Monitoring Reports and Housing Land Supply Statements detailing projected housing development in their administrative areas with Thames Water.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to planning colleagues at Oxford City Council, Cherwell District Council and West Oxfordshire District Council, with specific attention brought to the assessment at Oxford STW as the STW catchment crosses administrative boundaries.
- South Oxfordshire and Vale of White Horse District Councils should provide a copy of this WCS to Thames Water, the EA and Oxfordshire County Council as the Waste Planning Authority.

Water Resources

An assessment has been undertaken of water resources to address comments raised by the EA during Regulation 19 pre-submission publication period. This has included:

- A more detailed assessment of how planned development outlined in the JLP compares with the housing projections used in Thames Water's WRMP24.
- An evaluation of developments located within three FMZs identified by Thames Water as having limited water supply infrastructure capacity.
- A further review of water resource pressures across the districts, informed by further consultation with Thames Water.

Findings

- The dwelling forecasts in Thames Water's WRMP24 are greater than the residential development proposed in the JLP. For South Oxfordshire, the Thames Water forecast is 46% greater than the development proposed in the JLP and for the Vale of White Horse the Thames Water forecast is 32% greater. When aggregated across both districts, the Thames Water dwelling forecast is 39% greater than the development proposed in the JLP.
- Overall, this assessment indicates that the planned development in both districts is more than accounted for in the WRMP24 and that the development proposed by the JLP will not place unforeseen pressure on Thames Water's water resource plans and in turn the water environment. This is the case when considering the full quantum of development across the plan period and the annual rate of growth.
- In terms of the FMZ assessments, the Culham FMZ includes three JLP allocations. One is a small employment site (AS11) with minimal impact on water supply, while the other two (AS1 and AS2) are large scale developments (>1,000 dwellings). AS1 is a mixed use residential and employment allocation and AS2 is a residential allocation. AS1 and AS2 are not due to start delivering homes until 2030/2031 and will be phased over several years, which means that there should be adequate time for infrastructure upgrades to take place.
- For the Hagbourne Hill and Wantage FMZs, there are sixteen and eight JLP allocations respectively. The quantum of development being brought forward could potentially cause lengthy lead-times as it is more likely to require strategic infrastructure investment. However, it is noted that a number of the largest allocations in both these FMZs have outline planning permission with

development phases that are either completed or have detailed planning consent and there has been detailed engagement with Thames Water through the planning application processes.

- Based on further consultation with Thames Water, the overall supply-demand balance forecast for the SWOX WRZ indicates a future deficit, exceeding 100 million litres per day by 2050.
- This projected shortfall is driven by four key factors: the requirement to improve resilience to a 1 in 500-year level by 2040, anticipated future licence reductions, population growth, and climate change.
- Planned development in the JLP being lower than the growth forecast by Thames Water's WRMP could offset this deficit slightly however the scale of the forecast deficit highlights the need for demand reductions and the development of new supply sources to ensure long-term resilience.

Actions and Recommendations

- Thames Water will continue its responsibilities in upgrading and providing water supply for new developments without presenting a risk to the environment.
- Thames Water will need to assess future development earmarked in the JLP when developing their WRMP2029.
- The EA will need to review and provides feedback on Thames Water's WRMP2029, ensuring that Thames Water address future water needs and provide a secure and sustainable water supply to the districts.
- The EA will continue to regulate the abstraction of water from rivers and other sources in the districts, ensuring it is sustainable and within legal limits.
- It is recommended that developers engage with Thames Water as early as possible so they can undertake modelled impact assessments to confirm if specific water supply upgrades are required and when.
- Should strategic infrastructure upgrades be required to supply new development, the option to phase some of the dwellings to later in the plan period should be considered, especially for larger scale residential developments (>1000 dwellings).
- The district councils will implement Joint Local Plan Policy CE7 – Water efficiency to ensure that new developments are water efficient and that the occupiers of new development use water resources carefully.
- The district councils will provide Thames Water with their Annual Monitoring Reports and Housing Land Supply Statements, which outline projected housing development within their administrative areas.

Appendix 1 – Headroom Assessments Technical Detail

Appendix 2 – Water Quality Modelling Technical Detail

Appendix 1- Headroom Assessments Technical Detail

Residential Development

For the purpose of the headroom assessments, household consumption was calculated using the equation below.

$$\textit{Household Consumption} = \textit{Dwellings} \times \textit{Occupancy Rate} \times \textit{Per Capita Consumption}$$

The components of this formula and associated assumptions are as follows:

- *Dwellings* - The number of new residential dwellings expected across the plan period were provided by the district councils. This included JLP allocations, made neighbourhood plan allocations, and windfall development. Relevant residential dwelling figures were also provided by neighbouring authorities (applies to Oxford STW only).
- *Occupancy Rate* - For residential dwellings, an occupancy rate of 2.438 p/h was adopted. This is consistent with the projected occupancy rate for the Swindon and Oxfordshire (SWOX) water resource zone used in Thames Water's latest water resource management plan (WRMP)[1]. Table 1 projected shows the occupancy rates provided in the WRMP for 2024-25, 2029-30 and 2049-50 respectively. An occupancy rate for the end of the plan period (2041) was derived using linear interpolation between these rates. The final value adopted was the average of the three values across the plan period (i.e. 2024, 2029 and 2041). The rate is considered precautionary given that it is weighted more heavily to the higher values in the early plan period. The same occupancy rate is applied to the districts and neighbouring authorities.

Table 1- Occupancy Rates for SWOX area (2024-2050)

	2024-25	2029-30	2041 (Interpolated)	2049-50
Occupancy Rate	2.48	2.45	2.384	2.34

- *Per Capita Consumption* (PCC) - A rate of 137.1 l/p/d was adopted. This was estimated by taking the projected PCC rates for the SWOX water resource zone used in Thames Water's latest WRMP. Values were provided for measured and unmeasured PCC in the years 2025-26 and 2049-50. An aggregated PCC value was then calculated based on the measured and unmeasured values using the population forecasts also contained in the WRMP. The forecasts provide the proportion of consumption that will be measured and unmeasured, from this the aggregated value can be weighted accordingly. The values listed in the WRMP are provided in Table 2.

Table 2- Populations and PCC for SWOX area (2025-2050)

Component	2025-26	2049-50
Measured Household – Population (000s)	963.91	1,261.48
Unmeasured Household – Population (000s)	147.47	115.21
Measured Household (%)	86.73	91.63
Measured Household – PCC	133.65	133.14
Unmeasured Household - PCC	169.29	171.29
Aggregated Household - PCC	138.38	136.33

The final PCC rate adopted of 137.1 l/p/d is the value expected for 2041 assuming a linear interpolation between 2025 and 2049. The same PCC rate is applied to the districts and neighbouring

[1] Thames Water (2024) *Water resources Management Plan 2024* https://www.thameswater.co.uk/about-us/regulation/water-resources

authorities. Despite being taken from the end of the plan period, this rate is still considered to be an upper bound estimate for consumption across the plan period. This is because the rates listed in the WRMP only consider water efficiency measures introduced under Asset Management Period (AMP) 7. Additional measures introduced as part of AMP8 and beyond are not accounted for. Furthermore, the PCC rates are for the SWOX area, the adopted local plans for the South Oxfordshire and the Vale of White Horse districts have already implemented a tighter standard of 110 l/p/day for new development which may see it having a lower PCC trajectory than the wider water resource zone.

Employment Development

It is more difficult to estimate water use associated with employment site allocations because there are a range of employment uses that could come forward on these sites, each of which may result in different wastewater flows. This is because different employment uses will support different numbers of employees, for example an office may have many more employees per hectare than a warehouse. Furthermore, some employment uses may have additional water demands as part of their business operations. Nonetheless a reasonable estimate may be obtained by using the formula below:

$$\text{Employment Consumption} = \text{Employment Area} \times \text{Employees per Hectare} \times \text{Per Capita Consumption}$$

The components of this formula and associated assumptions are as follows:

- *Employment area (hectares)* - Each employment site allocation has a hectarage of employment land associated with it. The hectarage of employment land associated with each Joint Local Plan (JLP) site allocation is combined to provide the total amount of land allocated for employment development in the JLP.
- *Employees per hectare* - The South Oxfordshire and Vale of White Horse Employment Land Needs Assessment (ELNA) forecasts the amount of employment land needed in the districts over the plan period. We can use the employment forecasts and projections analysed in the ELNA to estimate the number of jobs created over the plan period. Dividing the total number of jobs by the total employment area gives an estimated average number of employees per hectare.
- *Per capita consumption* - A per-capita consumption rate of 50 l/p/d was used for employment land based on estimates made by South Staffs Water for office buildings[2] which is expected to make up the majority of the employment land in the JLP. No equivalent rate is provided in Thames Water's WRMP. This consumption rate is higher than benchmark figures stated by Waterwise[3] of 15 l/p/d and is considered precautionary.

For employment development in South Oxfordshire and the Vale of White Horse, in addition to the neighbouring Cherwell district, employment area data was used and the equation above applied. Note for Cherwell district, employment development relates to 14.7ha of employment land on the Land East of the A44 (site allocation PR8) for the potential expansion of Begbroke Science Park. No job numbers were provided in the plan, so an assumption of 50 employees per hectare has been adopted for the site, which is considered precautionary, with actual employee numbers likely to be lower.

In November 2024, Oxford City Council also provided a range for the number of jobs estimated to be delivered in the city to 2040. This range was 8,847-11,417 jobs. The average of this range (9,952

[2] South Staffordshire Water (2024) *Water Use in Your Business* https://www.south-staffs-water.co.uk/media/1509/waterusebusiness.pdf

[3] Waterwise (2023) *The Waterwise Guide for Offices* https://www.waterwise.org.uk/wp-content/uploads/2023/10/Waterwise-Guide-for-Offices-AND-POSTERS-FINAL.pdf

jobs) was used as the number of employees for this assessment. The number of jobs was multiplied by the per capita consumption rate for employment development (50 l/p/d).

It was assumed that 100% of water used is returned to sewer. In reality this is unlikely to be the case but again guarantees that a precautionary approach is taken when assessing the capacity of the STWs. When assessing capacity, the permitted DWF and maximum flow at the STWs were used as a substitute for actual designed hydraulic capacity for each STW being assessed. It should be noted that whilst the permitted flows will relate well to the actual designed hydraulic capacity of a STW in some cases, in other cases it may not.

Based on the methodology outlined consumption figures for the JLP and Neighbourhood Plan allocations are provided in Table 3, note greyed out sites drain to STWs not scoped into the final assessment. Consumption figures for the neighbouring authorities of Cherwell and Oxford City are provided in Table 4 and Table 5 respectively, these only impact upon the Oxford STW. Consumption figures for windfall development in each STW catchment are provided in Table 6.

Table 3- Joint Local Plan and Neighbourhood Plan Allocation Consumption Figures

Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
Land at Berinsfield Garden Village	JLP	Residential & Employment	458271	196420	132.4	1491	5	CULHAM	3635.1	224.0	0.510
Land Adjacent to Culham Campus	JLP	Residential & Employment	452254	196142	217.3	1550	0	CULHAM	3778.9	0.0	0.518
Land South of Grenoble Road, Edge of Oxford	JLP	Residential & Employment	454941	201441	152.5	2750	10	OXFORD	6704.5	448.1	0.942
Land at Northfield, Edge of Oxford	JLP	Residential	456649	203476	68	1230	0	OXFORD	2998.7	0.0	0.411
Land at Bayswater Brook, Edge of Oxford	JLP	Residential	454756	208598	105	1513	0	OXFORD	3688.7	0.0	0.506
Rich's Sidings and Broadway, Didcot	JLP	Residential	453134	190097	3	100	0	DIDCOT	243.8	0.0	0.033
Didcot Gateway, Didcot	JLP	Residential	452573	190425	4.3	144	0	DIDCOT	351.1	0.0	0.048
North West of Grove, Grove	JLP	Residential	439074	190903	28.3	624	0	WANTAGE	1521.3	0.0	0.209
North West of Valley Park, Didcot	JLP	Residential	449237	191210	33.25	800	0	DIDCOT	1950.4	0.0	0.267
Land at Dalton Barracks Garden Village, Shippon	JLP	Residential & Employment	447544	198705	145	1450	7.4	ABINGDON /APPLETON	3535.1	331.6	0.501
Culham Campus	JLP	Employment	453419	195842	77.3	0	2.3	CULHAM	0.0	103.1	0.005
Harwell Campus	JLP	Employment	447530	186588	282	0	93	DIDCOT	0.0	4167.0	0.208
Harcourt Hill Campus	JLP	Other	448734	204785	22.7	0	0	OXFORD	0.0	0.0	0.000
Vauxhall Barracks, Didcot	JLP	Other	451685	190671	9.9	189	0	DIDCOT	460.8	0.0	0.063
Ladygrove East	JLP	Residential	453872	190244	23.5	750	0	DIDCOT	1828.5	0.0	0.251
Didcot North East	JLP	Residential	453339	191858	147.9	2,211	0	DIDCOT	5390.4	0.0	0.739
Land West of Wallingford	JLP	Residential	459440	189968	29.9	537	0	CHOLSEY	1309.2	0.0	0.179
Land at Wheatley Campus, Oxford Brookes University	JLP	Residential	460200	206017	21.5	447	0	WHEATLEY	1089.8	0.0	0.149
Joyce Grove, Nettlebed	JLP	Residential	470088	186550	10.9	20	0	NETTLEBED	48.8	0.0	0.007
North-East of East Hanney	JLP	Residential	442399	193254	2.4	0	0	WANTAGE	0.0	0.0	0.000
South-West Faringdon	JLP	Residential	427821	194735	10.5	190	0	FARINGDON	463.6	0.0	0.066
Milton Heights	JLP	Residential	448407	190739	25	357	0	DIDCOT	870.4	0.0	0.119

Table 3- Joint Local Plan and Neighbourhood Plan Allocation Consumption Figures

Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
North-West Radley	JLP	Residential	452076	199009	12.2	240	0	OXFORD	585.1	0.0	0.080
South of Kennington	JLP	Residential	452600	200803	11.8	226	0	OXFORD	551.0	0.0	0.076
North of Shrivenham	JLP	Residential	423750	189412	31.5	515	0	SHRIVENHAM	1256.6	0.0	0.180
West of Stanford in the Vale	JLP	Residential	433602	193322	11.6	251	0	STANFORD	611.9	0.0	0.084
Land South of Park Road, Faringdon	JLP	Residential	429068	194483	27.8	535	0	FARINGDON	1305.4	0.0	0.187
North of Abingdon-on-Thames	JLP	Residential	450371	199473	50.7	1030	0	ABINGDON	2511.1	0.0	0.344
South of Faringdon	JLP	Residential	427872	194283	18.4	325	0	FARINGDON	793.0	0.0	0.113
Monks Farm (North Grove)	JLP	Residential	440142	190949	60.6	526	0	WANTAGE	1282.4	0.0	0.176
Grove Airfield	JLP	Residential	439012	190116	107.2	2187	0	WANTAGE	5331.9	0.0	0.731
Valley Park	JLP	Residential	449985	190308	186	4180	0	DIDCOT	10190.8	0.0	1.397
East of Kingston Bagpuize with Southmoor	JLP	Residential	441391	198180	34.7	600	0	KINGSTON BAGPUIZE	1464.0	0.0	0.209
South-East of Marcham	JLP	Residential	446019	196606	3.5	87	0	APPLETON	212.1	0.0	0.029
Crab Hill (North East Wantage and South East Grove)	JLP	Residential	441162	188789	98.7	1340	0	WANTAGE	3266.9	0.0	0.448
North West of Abingdon-on-Thames	JLP	Residential	449169	198779	12.6	200	0	ABINGDON	487.6	0.0	0.067
North of East Hanney	JLP	Residential	442107	193438	3.44	80	0	WANTAGE	195.0	0.0	0.027
East Sutton Courtenay	JLP	Residential	450344	193284	8.8	175	0	DRAYTON	427.0	0.0	0.061
Southmead Industrial Estate, Didcot	JLP	Employment	452280	191604	2.6	0	2.7	DIDCOT	0.0	121.0	0.006
Grove Technology Park	JLP	Employment	438511	189733	13.2	0	5.4	WANTAGE	0.0	242.0	0.012
Land next to Milton Interchange	JLP	Employment	448419	190743	8	0	8.2	DRAYTON	820.0	367.4	0.082
Hithercroft Industrial Estate, Wallingford	JLP	Employment	459852	189004	1.1	0	0.57	CHOLSEY	0.0	25.5	0.001
Monument Business Park, Chalgrove	JLP	Employment	464852	197406	2.3	0	2.25	CHALGROVE	225.0	100.8	0.023

Table 3- Joint Local Plan and Neighbourhood Plan Allocation Consumption Figures

Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
Abingdon Science Park	JLP	Employment	451051	197380	16.7	0	0.7	ABINGDON	0.0	31.4	0.002
Didcot A	JLP	Employment	450859	191490	36.4	0	29	DIDCOT	0.0	1299.4	0.065
Didcot Quarter (Enterprise Zone 2)	JLP	Employment	450218	192274	15.2	0	15.22	DIDCOT	0.0	682.0	0.034
Former Esso Research Centre	JLP	Employment	447475	190428	11	0	11	DIDCOT	0.0	492.9	0.025
South of Park Road, Faringdon	JLP	Employment	429068	194483	27.8	0	3	FARINGDON	300.0	134.4	0.030
Didcot Technology Park (LDO)	JLP	Employment	452288	192081	23.4	0	23.4	DIDCOT	0.0	1048.5	0.052
Milton Park (LDO)	JLP	Employment	449160	191776	83	0	5.36	DIDCOT	0.0	240.2	0.012
South of the High Street	NDP	Residential	447838	193877	9.7	50	0	DRAYTON	122.0	0.0	0.017
North of Barrow Road	NDP	Residential	447789	195005	8	56	0	DRAYTON	136.6	0.0	0.020
Manor Farm	NDP	Residential	447803	194358	3.9	140	0	DRAYTON	341.6	0.0	0.049
Wicklesham Quarry	NDP	Employment	429253	194186	11.9	0	11.94	FARINGDON	1194.0	535.0	0.119
Land North West of Gloucester Street Car Park	NDP	Mixed use	428648	195697	1.2	0	1.17	FARINGDON	117.0	52.4	0.017
Land behind Pioneer Road	NDP	Employment	428933	195076	0.9	0	0.86	FARINGDON	86.0	38.5	0.009
Wicklesham Farm	NDP	Employment	429598	194171	1	0	1.01	FARINGDON	101.0	45.3	0.010
Land at Howbery Park, Crowmarsh Gifford	NDP	Employment	461682	190094	0.3	0	0.28	BENSON	0.0	12.5	0.001
02 - TB	NDP	Residential	456771	200690	0.75	3	0	NUNEHAM COURTNEY	7.3	0.0	0.001
04 - TB	NDP	Residential	456326	200574	0.26	3	0	NUNEHAM COURTNEY	7.3	0.0	0.001
08 - TB	NDP	Residential	456574	199729	0.16	3	0	NUNEHAM COURTNEY	7.3	0.0	0.001
09 - TB	NDP	Residential	456614	199555	0.24	3	0	NUNEHAM COURTNEY	7.3	0.0	0.001
15 - MB	NDP	Residential	456471	199616	0.12	6	0	NUNEHAM COURTNEY	14.6	0.0	0.002
16 - MB	NDP	Residential	456163	199450	0.29	6	0	NUNEHAM COURTNEY	14.6	0.0	0.002
20 - MB	NDP	Residential	455898	199094	0.04	6	0	NUNEHAM COURTNEY	14.6	0.0	0.002
21 - MB	NDP	Residential	455883	199105	0.12	6	0	NUNEHAM COURTNEY	14.6	0.0	0.002
18 - MB	NDP	Residential	456504	199289	0.32	6	0	NUNEHAM COURTNEY	14.6	0.0	0.002
Land north and north east of The Sands	NDP	Residential	462075	192484	14.94	240	0	BENSON	585.1	0.0	0.080

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Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
Land off Hale Road	NDP	Residential	461682	192275	3.48	78	0	BENSON	190.2	0.0	0.026
Land to the north of Littleworth Road	NDP	Residential	461341	192176	18.44	192	0	BENSON	468.1	0.0	0.064
Bosley's Orchard	NDP	Residential	458560	191043	1.2	20	0	CHOLSEY	48.8	0.0	0.007
Thorne's Nursery	NDP	Residential	457879	191019	1.3	4	0	CHOLSEY	9.8	0.0	0.001
Strange's (Slade End) Nursery	NDP	Residential	458867	190540	0.39	6	0	CHOLSEY	14.6	0.0	0.002
Slade End South to West of Green Lane	NDP	Residential	458894	190505	0.08	1	0	CHOLSEY	2.4	0.0	0.000
Slade End Farm	NDP	Residential	458943	190474	0.48	6	0	CHOLSEY	14.6	0.0	0.002
Land to the East of Chalgrove	NDP	Residential	464311	196612	7.15	120	0	CHALGROVE	292.8	0.0	0.042
Land to the west of Marley Lane	NDP	Residential	462666	197401	16.78	200	0	CHALGROVE	488.0	0.0	0.070
CHi21 - Land South of Greenwood Avenue	NDP	Residential	475343	200245	3.81	140	0	CHINNOR	341.6	0.0	0.049
Former Waggon and Horses	NDP	Residential	450982	195316	0.74	1	0	CULHAM	2.4	0.0	0.000
Western Village Plotlands	NDP	Residential	452431	188465	3.47	74	0	DIDCOT	180.4	0.0	0.025
Cleeve Park Cottages	NDP	Residential	460796	181571	0.67	14	0	GORING	34.2	0.0	0.005
Manor Road	NDP	Residential	460112	180184	2.62	20	0	GORING	48.8	0.0	0.007
Thames Court	NDP	Residential	459972	180838	0.32	14	0	GORING	34.2	0.0	0.005
Wallingford Road	NDP	Residential	460470	181758	3.79	46	0	GORING	112.2	0.0	0.016
The site next to Gatehampton Road	NDP	Residential	460556	180260	0.6	16	0	GORING	39.0	0.0	0.006
Henley Youth Club	NDP	Residential	475824	182341	0.35	23	0	HENLEY	56.1	0.0	0.008
Part of 357 Reading Road	NDP	Mixed use	476808	181461	0.48	50	0	HENLEY	122.0	0.0	0.017
Chiltern's End	NDP	Residential	475139	181811	0.97	27	0	HENLEY	65.9	0.0	0.009
Land at Newton Road	NDP	Employment	476712	181709	0.17	0	0.17	HENLEY	17.0	7.6	0.002
Site M1 Land at Highlands Farm	NDP	Mixed use	474348	181488	7.3	110	1	HENLEY	268.4	44.8	0.043
Site Y Chiltern Centre	NDP	Residential	475182	181806	0.09	3	0	HENLEY	7.3	0.0	0.001
Site A1 Land West of Fairmile	NDP	Residential	475301	183450	4.4	72	0	HENLEY	175.7	0.0	0.025
Site C Gillotts School Playing Field	NDP	Residential	475288	181310	3.37	50	0	HENLEY	122.0	0.0	0.017

Table 3- Joint Local Plan and Neighbourhood Plan Allocation Consumption Figures

Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
Site E Stuart Turner/Empstead Works	NDP	Mixed use	475928	182480	1.14	42	0	HENLEY	102.5	0.0	0.015
CSF8 Tokers Green Lane	NDP	Residential	469717	179073	0.21	4	0	SONNING COMMON	9.8	0.0	0.001
Long Wittenham Community Hub	NDP	Mixed use	454841	193476	6.42	45	0	LONG WITTENHAM	109.8	0.0	0.016
Long Wittenham School Site	NDP	Residential	454766	193933	0.35	5	0	LONG WITTENHAM	12.2	0.0	0.002
Long Wittenham Village Hall Site	NDP	Residential	454692	193847	0.18	2	0	LONG WITTENHAM	4.9	0.0	0.001
Former MoD site	NDP	Residential	469288	195111	2.05	15	0	WATLINGTON	36.6	0.0	0.005
Chiltern Edge Top	NDP	Residential	470243	179852	1.98	50	0	SONNING COMMON	122.0	0.0	0.017
Kidby's Yard	NDP	Employment	470647	179692	0.61	0	0.61	SONNING COMMON	61.0	27.3	0.006
Little Sparrows	NDP	Residential	471349	180478	4.52	133	0	SONNING COMMON	324.5	0.0	0.046
Lord William's Lower School	NDP	Residential	471764	205577	8.13	135	0	THAME	329.4	0.0	0.047
Park Meadow Cottage	NDP	Residential	471120	204954	0.61	12	0	THAME	29.3	0.0	0.004
Jane Morbey Road	NDP	Residential	470971	205062	0.44	18	0	THAME	43.9	0.0	0.006
Reserve site C	NDP	Residential	471746	204680	5.69	57	0	THAME	139.1	0.0	0.020
Reserve site F	NDP	Residential	469392	206001	6.96	78	0	THAME	190.3	0.0	0.027
Site F	NDP	Residential	469675	206219	29.59	203	0	THAME	495.3	0.0	0.071
Thame Site C	NDP	Residential	471389	204723	21.51	187	0	THAME	456.3	0.0	0.065
Land at Howland Road	NDP	Employment	472156	205125	2.96	0	2	THAME	200.0	89.6	0.020
Cattle Market	NDP	Mixed use	470836	206069	1.29	0	0	THAME	129.0	0.0	0.018
Site D	NDP	Residential	470835	204856	21.79	175	0	THAME	427.0	0.0	0.061
The Elms	NDP	Residential	470829	205568	2.88	45	0	THAME	109.8	0.0	0.016
Wallingford Site C	NDP	Employment	459739	189134	23.87	0	3.1	CHOLSEY	0.0	138.9	0.007
Site E	NDP	Residential	460127	188499	26.9	502	0	CHOLSEY	1223.9	0.0	0.168
Six Acre Field	NDP	Residential	459871	193394	2.29	29	0	DORCHESTER	70.8	0.0	0.010
Land off Pyrton Lane	NDP	Residential	468515	195092	4.6	60	0	WATLINGTON	146.4	0.0	0.021
Land Off Cuxham Road and Willow Close	NDP	Residential	468249	194967	6.26	60	0	WATLINGTON	146.4	0.0	0.021

Table 3- Joint Local Plan and Neighbourhood Plan Allocation Consumption Figures

Site Name	JLP or NDP	Development Type	Eastings	Northings	Site Area (Ha)	No of Dwellings (during plan period)	Employment Area (Ha)	Draining STW	Residential Occupants	Employees	Consumption (Ml/d)
Land between Britwell Road and Cuxham Road	NDP	Residential	468139	194611	9.87	140	0	WATLINGTON	341.6	0.0	0.049
Littleworth Road Industrial Estate	NDP	Residential	458778	205511	0.5	25	0	WHEATLEY	61.0	0.0	0.008
Former Reservoir Site, Greenmore	NDP	Residential	464705	181341	0.47	20	0	GORING	48.8	0.0	0.007
Chiltern Rise Cottage and surrounding land	NDP	Residential	465071	182193	0.85	24	0	GORING	58.6	0.0	0.008
The Smallholding, Land at the end of Wood Lane	NDP	Residential	463880	181666	0.78	9	0	GORING	22.0	0.0	0.003
Woodcote Garden Centre, Reading Road	NDP	Residential	464903	182152	0.24	9	0	GORING	22.0	0.0	0.003
Land behind Yew Tree Farmhouse 1	NDP	Residential	463839	181932	0.29	5	0	GORING	12.2	0.0	0.002
Land behind Yew Tree Farmhouse 2	NDP	Residential	463809	181884	0.38	4	0	GORING	9.8	0.0	0.001
Beechwood Court	NDP	Residential	464569	181103	0.25	14	0	GORING	34.2	0.0	0.005
Church Farm	NDP	Residential	464735	182130	1.48	30	0	GORING	73.2	0.0	0.010
Old Coal Yard Greenmore	NDP	Employment	464771	181406	0.34	0	0.37	GORING	37.0	16.6	0.004
Land west of Church Farmhouse	NDP	Employment	464493	182153	0.35	0	0.29	GORING	29.0	13.0	0.003
Wards Farm	NDP	Employment	464989	181698	0.23	0	0.14	GORING	14.0	6.3	0.001
Miss Tomb's Field	NDP	Mixed use	460639	205357	5.65	55	1.7	WHEATLEY	134.1	76.2	0.022
Mobb's Land	NDP	Employment	460644	205203	1.46	0	1.4	WHEATLEY	0.0	62.7	0.003
Land West of Wallingford Rd	NDP	Residential	459327	186778	9.16	106	0	CHOLSEY	258.4	0.0	0.035
The Bungalows Site	NDP	Residential	461012	205178	0.89	10	0	WHEATLEY	24.4	0.0	0.003

Table 4- Cherwell District Consumption Figures

Site Ref	Site Name	No of Dwellings (during plan period)	Employment Area (Ha)	STW	Occupants	Employees	Consumption (Ml/d)
PR6a	Land East of Oxford Rd	690	0	Oxford	1683.6	0	0.23
PR6b	Land West of Oxford Rd	670	0	Oxford	1634.8	0	0.22
PR7a	Land South East of Kidlington	430	0	Oxford	1049.2	0	0.14
PR7b	Land at Stratfield Farm	120	0	Oxford	292.8	0	0.04
PR8	Land East of the A44	1950	14.7	Oxford	4758.0	735	0.68

Table 5- Oxford City Consumption Figures

	No of Dwellings (during plan period)	Occupants	Employees	Consumption (Ml/d)
Housing	10344	25239.4	-	3.46
Employment	-	-	9952.0	0.50

Table 6- South Oxfordshire and Vale of White Horse Windfall Development Consumption Figures

STW Name	Per annum	Total Windfalls to 2041	Occupants	Consumption (Ml/d)
Abingdon	51.2	870.0	2122.7	0.29
Appleton	7.8	132.2	322.7	0.04
Benson	15.2	257.8	629.1	0.09
Cholsey	12.2	206.7	504.4	0.07
Culham	2.6	44.6	108.9	0.01
Didcot	37.0	629.3	1535.4	0.21
Oxford	30.5	518.7	1265.7	0.17
Stanford in the Vale	3.1	52.6	128.4	0.02
Wantage	32.2	547.8	1336.6	0.18
Wheatley	3.9	67.0	163.4	0.02

The consumption values listed in Table 3 to Table 6 were summed together to give the expected increase in flows at each STW by the end of the plan period. These values are presented in Table 7.

Table 7- Increase in flows by end of plan period (2041)

STW Name	JLP & NDPs (Ml/d)	Windfall (Ml/d)	CDC (Ml/d)	OCC (Ml/d)	Total (Ml/d)	Total w/ CDC and OCC (Ml/d)
Abingdon	0.91	0.29	-	-	1.20	1.20
Appleton	0.53	0.04	-	-	0.57	0.57
Benson	0.17	0.09	-		0.26	0.26
Cholsey	0.40	0.07	-	-	0.47	0.47
Culham	1.03	0.01	-	-	1.05	1.05
Didcot	3.35	0.21	-	-	3.56	3.56
Oxford	2.01	0.17	1.32	3.96	2.19	7.47
Stanford in the Vale	0.08	0.02	-	-	0.10	0.10
Wantage	1.60	0.18	-	-	1.79	1.79
Wheatley	0.19	0.02	-	-	0.21	0.21

The values in Table 7 were added to the baseline DWF to give the projected DWF by the end of the plan period for each STW. The baseline DWF was calculated as the average 90th percentile annual exceedance flow based on two values provided by Thames Water for 2023 and 2024 respectively Table 8 shows the baseline DWF values and the projected DWF values at each STW.

Table 8- Baseline DWF values (2023, 2024, Average) and Projected DWF values (2041)

STW Name	DWF Dec 23 (Ml/d)	DWF Dec 24 (Ml/d)	Average DWF (23/24)	Projected DWF (2041)	Projected DWF (2041) w/ OCC & CDC
Abingdon (Lagoon)	8.64	8.19	8.42	9.20	9.20
Abingdon (New)	3.00	3.29	3.14	3.57	3.57
Abingdon (Combined)	11.64	11.48	11.56	12.77	12.77
Appleton	1.56	1.71	1.64	2.21	2.21
Benson	2.31	2.77	2.54	2.80	2.80
Cholsey	2.83	3.30	3.07	3.54	3.54
Culham	0.94	0.95	0.94	1.99	1.99
Didcot	14.63	15.53	15.08	18.64	18.64
Oxford	48.37	48.37	48.37	50.56	55.84
Stanford in the Vale	0.51	0.48	0.50	0.60	0.60
Wantage	6.41	8.11	7.26	9.04	9.04
Wheatley	1.12	1.08	1.10	1.31	1.31

A final step was to estimate the rate of change in DWF across the plan period. This was estimated using the district councils' housing trajectories for the JLP. The housing trajectories consider housing completions, sites with planning permission, sites allocated in neighbourhood plans, sites allocated in the JLP and an allowance for windfall development. These show how this combination of sites will deliver homes in each district over the plan period from 1 April 2021 to 31 March 2041. For the headroom assessments, an overall change in flows by the end of the plan period (2041) was estimated for each STW considering the development draining to each respective STW. Rather than assume that this change is linear across the plan period, the changes in flow follow the same trend as the districts' housing trajectories. For STW sites in South Oxfordshire the trajectory for South Oxfordshire was applied, for those in the Vale of White Horse the trajectory for the Vale of White Horse was applied, and for STW sites draining both districts the overall trajectory was applied. This approach helps to ensure that the assessments capture how headroom is likely to change across the plan period.

It is important to recognise that the Oxford STW also drains neighbouring authorities. In January 2025, Oxford City Council provided details of their housing trajectory to 2040. In February 2025, Cherwell District Council also provided details on development phasing for the site allocations within Cherwell district that were identified as draining to the Oxford STW. These trajectories have incorporated into the headroom assessments using the same approach as applied to South Oxfordshire and the Vale of White Horse.

Table 9 displays the projected DWF for each year between 2024-2041 with the changes in DWF assumed to scale to the housing trajectories provided.

Table 9- Projected DWF for each year (2024-2041)

STW Name	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Abingdon (Lagoon)	8.42	8.47	8.53	8.59	8.65	8.72	8.79	8.84	8.89	8.94	9.00	9.04	9.08	9.11	9.14	9.16	9.18	9.20
Abingdon (New)	3.14	3.17	3.20	3.24	3.27	3.31	3.34	3.37	3.40	3.43	3.46	3.48	3.50	3.52	3.53	3.55	3.56	3.57
Abingdon (Combined)	11.56	11.64	11.73	11.82	11.92	12.03	12.13	12.21	12.29	12.37	12.45	12.52	12.58	12.63	12.67	12.71	12.74	12.77
Appleton	1.64	1.67	1.72	1.76	1.81	1.86	1.91	1.95	1.99	2.02	2.06	2.10	2.12	2.15	2.17	2.19	2.20	2.21
Benson	2.54	2.55	2.57	2.58	2.61	2.62	2.64	2.65	2.66	2.68	2.70	2.71	2.73	2.74	2.76	2.77	2.78	2.80
Cholsey	3.07	3.09	3.12	3.15	3.19	3.22	3.25	3.27	3.29	3.32	3.36	3.39	3.42	3.44	3.47	3.49	3.52	3.54
Culham	0.94	1.00	1.06	1.13	1.22	1.28	1.34	1.39	1.43	1.51	1.59	1.66	1.72	1.78	1.84	1.89	1.94	1.99
Didcot	15.08	15.28	15.53	15.79	16.08	16.35	16.59	16.79	16.98	17.22	17.48	17.71	17.90	18.07	18.23	18.38	18.51	18.64
Oxford (Districts only)	48.37	48.50	48.65	48.81	48.99	49.16	49.30	49.42	49.54	49.69	49.85	49.99	50.11	50.21	50.31	50.40	50.49	50.56
Oxford (All development)	48.37	48.71	49.12	49.58	50.15	50.73	51.45	52.23	52.73	53.34	53.94	54.41	54.74	54.96	55.20	55.40	55.62	55.84
Stanford in the Vale	0.50	0.50	0.51	0.52	0.53	0.54	0.54	0.55	0.56	0.57	0.57	0.58	0.58	0.59	0.59	0.59	0.60	0.60
Wantage	7.26	7.37	7.51	7.64	7.79	7.96	8.10	8.22	8.34	8.46	8.58	8.68	8.77	8.84	8.90	8.96	9.01	9.04
Wheatley	1.10	1.11	1.13	1.14	1.16	1.17	1.18	1.19	1.20	1.21	1.23	1.25	1.26	1.27	1.28	1.29	1.30	1.31

Appendix 2- Water Quality Modelling Technical Detail

Environmental Quality Standards for Orthophosphate

Standards for Orthophosphate in UK Rivers were introduced under the Water Framework Directive (WFD) and associated regulations. The standards are specific to each receiving watercourse and depend upon the altitude and alkalinity in the location assessed. The standards for the receiving watercourses at each STW assessed in this study are listed in Table 1.

Table 1- Watercourse specific environmental quality standards for orthophosphate

STW name	High status (mg/l)	Good status (mg/l)	Moderate status (mg/l)	Poor status (mg/l)
Abingdon (Lagoon)	0.0460	0.0850	0.2030	1.0720
Abingdon (New)	0.0450	0.0830	0.1990	1.0640
Appleton	0.0460	0.0840	0.2030	1.0710
Benson	0.0460	0.0840	0.2020	1.0690
Cholsey	0.0480	0.0870	0.2080	1.0840
Culham	0.0440	0.0810	0.1965	1.0580
Didcot	0.0465	0.0850	0.2035	1.0735
Oxford	0.0440	0.0800	0.1950	1.0550
Stanford in the Vale	0.0440	0.0810	0.1960	1.0570
Wantage	0.0430	0.0800	0.1950	1.0540
Wheatley	0.0470	0.0860	0.2050	1.0770

Results of Fit for Purpose Test

The Environment Agency baseline SIMCAT model for the River Thames was run using SIMCAT v15.7 (the model name is PR24_Thames_Calibn_19Jul22). The timestamp shown in the model output (the SCN file) was 25/11/18.

The results from the model were collated for ammonia, BOD and orthophosphate in the receiving watercourses for the 10 STWs. Note, whilst modelled results are generated for total phosphorous, observed results are not available and therefore are not presented in this section.

SIMCAT compares the modelled results to observed results recorded for flow and water quality monitoring stations. Table 2 shows the results for the mean values for each parameter.

Table 2- Comparison of modelled versus observed values for flow and water quality (mean values)

STW Name	Modelled flow (Ml/d)	Observed flow (Ml/d)	Modelled water quality (mg/l)	Observed Water quality (mg/l)
Abingdon (Lagoon)+	2434	2434	Ammonia 0.059 BOD 0.56 Orthophosphate 0.144	Ammonia 0.115 BOD N/A* Orthophosphate 0.257
Appleton			Ammonia 0.245 BOD 3.18 Orthophosphate 1.61	Ammonia 0.095 BOD N/A* Orthophosphate 1.86
Benson			Ammonia 0.250 BOD 3.02 Orthophosphate 1.00	Ammonia 0.261 BOD 3.61 Orthophosphate 1.73
Cholsey	3124	2877	Ammonia 0.503 BOD 3.29 Orthophosphate 0.184	Ammonia 0.499 BOD N/A* Orthophosphate 0.199
Culham			Ammonia 0.325 BOD 3.44 Orthophosphate 2.44	Ammonia 0.316 BOD 2.62 Orthophosphate 2.66
Didcot			Ammonia 0.129 BOD 1.64 Orthophosphate 0.425	Ammonia 0.0893 BOD N/A* Orthophosphate 0.541
Oxford			Ammonia 0.546 BOD 3.45 Orthophosphate 0.305	Ammonia 0.719 BOD 3.96 Orthophosphate 0.275
Stanford in the Vale			Ammonia 0.0633 BOD 0.51 Orthophosphate 0.182	Ammonia 0.0376 BOD 1.24 Orthophosphate 0.164
Wantage			Ammonia 0.257 BOD 3.02 Orthophosphate 0.372	Ammonia 0.196 BOD 2.32 Orthophosphate 0.208
Wheatley	274	274	Ammonia 0.043 BOD 0.50 Orthophosphate 0.333	Ammonia 0.035 BOD 1.20 Orthophosphate 0.418

+Observed values not available for Abingdon (New).
* N/A means ‘not applicable’ and indicates a site where BOD is not being monitored.

The results for the 95 percentile values were also compared and these are shown in Table 3.

Table 3- Comparison of modelled versus observed values for flow and water quality (95%iles)

STW Name	Modelled flow (Ml/d)	Observed flow (Ml/d)	Modelled water quality (mg/l)	Observed water quality (mg/l)
Abingdon (Lagoon)	411	345	Amm 0.124 BOD 0.894 Orthophosphate 0.260	Amm 0.252 BOD N/A* Orthophosphate 0.422
Appleton			Amm 0.771 BOD 5.85 Orthophosphate 3.17	Amm 0.297 BOD N/A* Orthophosphate 4.23
Benson			Amm 0.674 BOD 5.23 Orthophosphate 2.61	Amm 0.788 BOD 7.46 Orthophosphate 3.72
Cholsey	550	499	Amm 1.52 BOD 6.53 Orthophosphate 0.405	Amm 1.35 BOD N/A* Orthophosphate 0.527
Culham			Amm 0.925 BOD 5.90 Orthophosphate 3.55	Amm 0.807 BOD 5.64 Orthophosphate 4.93
Didcot			Amm 0.412 BOD 2.93 Orthophosphate 0.934	Amm 0.318 BOD N/A* Orthophosphate 1.34
Oxford			Amm 1.93 BOD 6.09 Orthophosphate 0.824	Amm 2.41 BOD 10.9 Orthophosphate 0.507
Stanford in the Vale			Amm 0.184 BOD 0.793 Orthophosphate 0.392	Amm 0.0683 BOD 1.62 Orthophosphate 0.324
Wantage			Amm 0.693 BOD 4.96 Orthophosphate 0.723	Amm 0.441 BOD 3.84 Orthophosphate 0.365
Wheatley	57	57	Amm 0.103 BOD 0.985 Orthophosphate 0.599	Amm 0.0636 BOD 1.71 Orthophosphate 0.759

The level of agreement between the modelled and observed results is a 'fit for purpose' test. It helps to identify if the results for any STWs in the model may be inappropriate for decision making (or where there may be some uncertainty associated with decision making). For the mean and 95 percentile values the results show there was a good level of agreement overall and that the model is fit for purpose.

Total phosphorous and Orthophosphate ratios

Total phosphorus and orthophosphate are not linked in the SIMCAT model, so orthophosphate is insensitive to the application of the TAL for phosphorous of 0.25 mg/l. However, in reality, if the removal of total phosphorous is improved at a STW it should also lead to a lowering of orthophosphate.

SIMCAT takes the approach of unlinking the two parameters, because at STWs the relationship between total phosphorous and orthophosphate is complex and site specific. To obtain an estimate of the impact of the TALs on orthophosphate concentrations and WFD status (noting that total phosphorous has no defined standard in the WFD) at each site, the ratio of orthophosphate to total phosphorous in the baseline runs has been estimated. It has then been multiplied by the total phosphorous estimated following the application of TALs.

Table 4- Mean total phosphorus and orthophosphate values from SIMCAT Baseline Runs

STW Name	Mean total phosphorus (mg/l)	Mean orthophosphate (mg/l)	Ratio OP/TP
Abingdon (Lagoon)	0.946	0.647	0.684
Abingdon (New)	0.372	0.138	0.371
Appleton	1.81	2.11	1.166
Benson	1.24	1.03	0.831
Cholsey	0.602	0.214	0.355
Culham	5.02	4.15	0.827
Didcot	0.617	0.441	0.715
Oxford	0.496	0.312	0.629
Stanford in the Vale	2.52	0.229	0.091
Wantage	0.549	0.390	0.710
Wheatley	0.516	0.338	0.655

Sensitivity Testing

Sensitivity testing was undertaken to test the robustness of the model results. The testing was carried out at 5 of the STWs. Appleton, Benson, Didcot and Stanford in the Vale STWs were chosen for sensitivity testing as they were the four STWs where future development or the application of TALs led to a water quality deterioration of 10% or greater. For these sites, the parameters which showed a deterioration were tested. Despite having no water quality deterioration of 10% or greater, Oxford STW was also tested given its importance in the wider Oxfordshire context and the EA's concerns with the site (detailed in Section 4.2.7). The remaining STWs were not chosen for sensitivity testing as their water quality values were more stable, and no potential issues were identified with their sampling data. The following sensitivity tests were undertaken:

- Appleton STW - ammonia and orthophosphate.
- Benson STW - ammonia.
- Didcot STW - all parameters.
- Oxford STW - all parameters.
- Stanford in the Vale STW - ammonia and orthophosphate.

Sensitivity testing was carried out by using the Environment Agency River Quality Planning (RQP) tool, specifically the Monte Carlo simulation programme in RQP version 6. The input data used for the Monte Carlo simulation in RQP is outlined below:

- Upstream mean flow
- Upstream 95 percentile flow
- Upstream mean quality
- Upstream quality standard deviation
- Discharge mean flow
- Discharge flow standard deviation
- Discharge mean quality
- Discharge quality standard deviation.

In the sensitivity test the RQP software re-runs the Monte Carlo simulation making variations of 10% automatically to the input data. The results are expressed for each input data value as the percentage effect on the downstream river quality. In practice a 10% change in downstream river quality is considered to be a value which indicates that the data for a site should be investigated before decisions are taken about improving the model structure and inputs. The results from the sensitivity testing are shown in the tables below.

Table 5- Appleton STW Ammonia Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	1.4 %
	95-river flow	1.2 %
	mean discharge flow	3.5 %
	standard deviation	0.3 %
	u/s river quality	0.1 %
	standard deviation	0.0 %
	mean discharge quality	9.3 %
	standard deviation	0.7 %
0.1 change in correlation of river and discharge flow		0.0 %
0.1 change in correlation of river flow and quality		0.1 %
0.1 change for discharge flow and quality		1.6 %

Table 6- Appleton STW Orthophosphate Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	1.1 %
	95-river flow	1.3 %
	mean discharge flow	3.1 %
	standard deviation	0.7 %
	u/s river quality	0.1 %
	standard deviation	0.0 %
	mean discharge quality	7.5 %
	standard deviation	2.7 %
0.1 change in correlation of river and discharge flow		0.2 %
0.1 change in correlation of river flow and quality		0.2 %
0.1 change for discharge flow and quality		1.2 %

Table 7- Benson STW Ammonia Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	1.8 %
	95-river flow	2.0 %
	mean discharge flow	4.8 %
	standard deviation	0.5 %
	u/s river quality	0.3 %
	standard deviation	0.0 %
	mean discharge quality	7.8 %
	standard deviation	2.3 %
0.1 change in correlation of river and discharge flow		0.1 %
0.1 change in correlation of river flow and quality		0.2 %
0.1 change for discharge flow and quality		1.8 %

Table 8- Didcot STW Ammonia Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	3.8 %
	95-river flow	0.4 %
	mean discharge flow	5.9 %
	standard deviation	1.3 %
	u/s river quality	1.1 %
	standard deviation	0.0 %
	mean discharge quality	10.2 %
	standard deviation	1.3 %
0.1 change in correlation of river and discharge flow		0.3 %
0.1 change in correlation of river flow and quality		0.6 %
0.1 change for discharge flow and quality		3.3 %

Table 9- Didcot STW BOD Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	2.1 %
	95-river flow	0.1 %
	mean discharge flow	3.0 %
	standard deviation	0.2 %
	u/s river quality	2.3 %
	standard deviation	0.2 %
	mean discharge quality	4.9 %
	standard deviation	2.6 %
0.1 change in correlation of river and discharge flow		0.4 %
0.1 change in correlation of river flow and quality		0.3 %
0.1 change for discharge flow and quality		1.1 %

Table 10- Didcot STW Orthophosphate Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	3.5 %
	95-river flow	0.7 %
	mean discharge flow	5.1 %
	standard deviation	0.6 %
	u/s river quality	0.9 %
	standard deviation	0.1 %
	mean discharge quality	6.3 %
	standard deviation	3.1 %
0.1 change in correlation of river and discharge flow		0.6 %
0.1 change in correlation of river flow and quality		0.2 %
0.1 change for discharge flow and quality		1.3 %

Table 11- Oxford STW Ammonia Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	0.2 %
	95-river flow	0.2 %
	mean discharge flow	0.3 %
	standard deviation	0.1 %
	u/s river quality	0.4 %
	standard deviation	0.1 %
	mean discharge quality	8.4 %
	standard deviation	0.7 %
0.1 change in correlation of river and discharge flow		0.1 %
0.1 change in correlation of river flow and quality		0.0 %
0.1 change for discharge flow and quality		2.0 %

Table 12- Oxford STW BOD Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	0.4 %
	95-river flow	0.2 %
	mean discharge flow	0.6 %
	standard deviation	0.1 %
	u/s river quality	0.2 %
	standard deviation	0.1 %
	mean discharge quality	6.9 %
	standard deviation	3.3 %
0.1 change in correlation of river and discharge flow		0.1 %
0.1 change in correlation of river flow and quality		0.0 %
0.1 change for discharge flow and quality		0.1 %

Table 13- Oxford STW Orthophosphate Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	0.6 %
	95-river flow	0.4 %
	mean discharge flow	1.1 %
	standard deviation	0.0 %
	u/s river quality	0.0 %
	standard deviation	0.0 %
	mean discharge quality	6.9 %
	standard deviation	3.5 %
0.1 change in correlation of river and discharge flow		0.1 %
0.1 change in correlation of river flow and quality		0.2 %
0.1 change for discharge flow and quality		0.7 %

Table 14- Stanford in the Vale STW Ammonia Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	4.0 %
	95-river flow	5.5 %
	mean discharge flow	10.7 %
	standard deviation	1.8 %
	u/s river quality	0.5 %
	standard deviation	0.0 %
	mean discharge quality	8.8 %
	standard deviation	0.8 %
0.1 change in correlation of river and discharge flow		3.9 %
0.1 change in correlation of river flow and quality		0.0 %
0.1 change for discharge flow and quality		3.6 %

Table 15- Stanford in the Vale STW Orthophosphate Sensitivity Results

Sensitivity test changes		Effects on the downstream river quality
10% change in:	mean upstream river flow	1.5 %
	95-river flow	5.1 %
	mean discharge flow	7.6 %
	standard deviation	1.6 %
	u/s river quality	2.8 %
	standard deviation	0.4 %
	mean discharge quality	6.8 %
	standard deviation	0.0 %
0.1 change in correlation of river and discharge flow		4.0 %
0.1 change in correlation of river flow and quality		1.5 %
0.1 change for discharge flow and quality		1.3 %

Overall, the sensitivity testing did not find any significant issues with the input data and model structure. The key findings were as follows:

- At Appleton STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Benson STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Didcot STW the sensitivity testing showed that a 10% perturbation in the mean discharge quality value led to a 10.2% change for ammonia. The standard deviation in ammonia at this site is high relative to its mean. The testing could suggest that the data used by the EA contains a few high values (e.g. values associated with unusual rainfall events and higher flows at the STW). Ideally, the effluent data should already have been screened to remove outliers. However, in this case as the percentage change is only slightly over 10% the effect of removing any outliers is unlikely to have a significant effect on water quality at the STW. It is however recommended that the EA review the dataset for this site in the future.
- At Oxford STW the sensitivity testing showed that downstream river quality was not sensitive to a 10% change in any of the input data, with all changes in quality within 10%.
- At Stanfordin the Vale STW the sensitivity testing showed that a 10% perturbation in the mean discharge value led to a 10.7% change for ammonia. The standard deviation for ammonia at this site is high relative to its mean value. The testing could suggest that the data used by EA contains a few high values (e.g. values associated with unusual rainfall events and higher flows at the STW). Ideally, the effluent data should already have been screened to remove outliers. However, in this case as the percentage change is only slightly over 10% the effect of removing any outliers is unlikely to have a significant effect on water quality at the STW. It is however recommended that the EA review the dataset for this site in the future.