South Oxfordshire District Council and Vale of White Horse District Council

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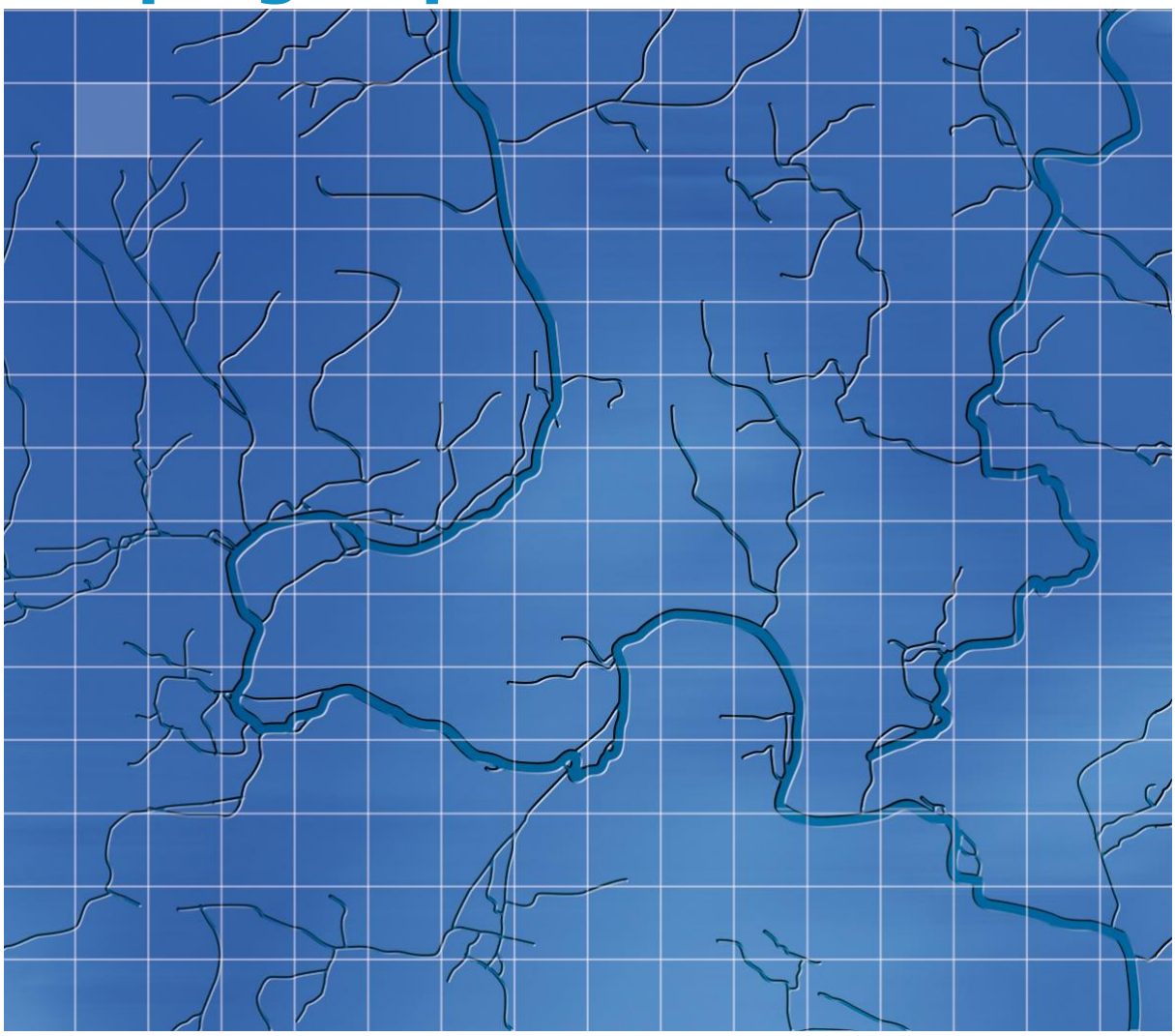
South Oxfordshire and Vale of White Horse Water Cycle Study Scoping Report



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For and on behalf of Wallingford HydroSolutions Ltd.

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.

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Glossary

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

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.

Combined Sewer Overflows (CSOs)- Many parts of England have a combined sewage system. with clean rainwater and wastewater conveyed 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 STWs downstream. CSOs were developed as overflow valves to reduce the risk of sewage backing up during heavy rainfall. They are a necessary part of the sewer system but 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's site inspections, audits and monitoring activities. It also includes reviews of monitoring and other data/reports.

Deployable Output (DO)- The reliable output of an active source, or group of sources, or of a bulk supply of water, which is constrained by: environment; licence, if applicable; pumping plant and/or well/aquifer properties; raw water mains and/or aquifers; transfer and/or output main; treatment; water quality.

Discharge Permit- An environmental permit granted by the EA to discharge liquid effluent or waste water to a surface water or the 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 WRZ 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 a STW during a period without rain. The EA sets limits on the quality and quantity of treated effluent from STW so that STW 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.

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 2- Areas situated in Flood Zone 2 have a medium probability of flooding and have 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 3- Flood zone 3 is distinguished as land which has a 1% or greater annual probability of river flooding or a 0.5% or greater annual probability of sea flooding.

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 Potential (GES)- GES is the ecological quality that can be achieved in the affected water bodies without a significant adverse impact on the benefits provided by the uses or a significant adverse impact on the wider environment.

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)- A HRA is a process that determines whether or not development plans could negatively impact local plans on a recognised protected European 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 our water mains and customer supplies pipes

Non-Household (NHH) Consumption- Water consumed by businesses

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.

Price Review (PR)- The price determination process undertaken by Ofwat every five years. Each water and sewerage undertaker submits a business plan covering the five-year period for which Ofwat will determine cost and revenue allowances.

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 waste water before they are released into the environment. Treatment typically consists of three phases termed primary, secondary and tertiary water treatment.

Site of Specific Scientific Interest (SSSI)- A SSSI is a formal conservation designation. Usually, it describes an area that's 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.

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, slow runoff down (attenuate) before it enters watercourses, they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water and lost or transpired from vegetation (known as evapotranspiration).

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 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 set up River Basin Management Plans by 2009, which are then periodically updated every 5-years.

Water Resource Management Plan (WRMP)- WRMP sets out how water companies intend to achieve a secure supply of water for your customers and a protected and enhanced environment.

Water companies in England or Wales, must prepare and maintain a water resources management plan (WRMP) every 5-years to align with the AMP.

Water Resource Zone (WRZ)- The largest possible zone in which all 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, but unexpectedly becomes available during the lifetime of a plan.

Executive Summary

Introduction

Wallingford HydroSolutions (WHS) were commissioned by South Oxfordshire District Council and the Vale of White Horse District Council to produce a water cycle study scoping report. The aim of this study is to provide evidence to support the emerging Joint Local Plan 2041 being developed by both councils.

The study considers how strategic plans and development proposals will affect the water environment. Unmitigated future development can adversely affect the infrastructure capacity of clean and wastewater infrastructure often resulting in environmental impacts. In this regard, the study looks to identify infrastructural and environmental constraints, in order to determine the steps required to ensure that development can occur without compromising the water environment.

Development and the Water Cycle

New homes and employment development require the provision of clean water, safe disposal of wastewater and protection from flooding. Development in certain locations may result in the capacity of existing infrastructure being exceeded, resulting in adverse impacts to the environment and potentially eliciting costly upgrades to clean and wastewater assets.

In addition to increased demand from development, climate change could bring an increased intensity in rainfall events and more frequent droughts. Both of which have the potential to add additional pressures to the water infrastructure network in many regions.

Increased wastewater flows into Sewerage Treatment Works (STWs) due to population growth can overwhelm existing infrastructure, increasing the risk of sewer flooding and, where present, the frequency of discharges from Combined Sewer Overflows (CSOs). Headroom at STWs can also be eroded by population growth requiring investment in additional treatment capacity. As the volume of effluent rises, the Environment Agency (EA), may tighten the permitted effluent permits, requiring investment by a water company to improve the quality of the treated effluent.

Development and associated population growth can also lead to further pressures on water resources leading to a shortfall in supplies. In response water companies may need to invest in demand reduction measures (e.g. metering, leakage reduction) and consider further supply options (e.g. new reservoirs, raw water transfers).

National Planning Practice Guidance (NPPF) requires that, in preparing Development Plans, Local Planning Authorities (LPAs) must have regard to the Water Framework Directive (WFD) and the EA's River Basin Management Plans which implement the WFD at the river basin scale. Developers should confirm that water and wastewater services will have sufficient capacity to serve their developments. In this regard, developers are encouraged to work with Thames Water early in the planning process to understand what infrastructure is required, in addition to where, when and how it will be delivered.

Study Findings

The water cycle study has been completed using national Environment Agency (EA) guidance on water cycle studies. It has also been guided by the specification provided by and further consultation with the councils. It considers how strategic plans and development proposals will affect the water environment, based on the following four elements which form the basis of the scoping assessment.

- Water resources and supply
- Wastewater infrastructure, water quality and environmental capacity
- Flood risk
- Other environmental issues

The conclusions for each of these four areas are listed below. The project to date has consisted of a scoping study. This advises on the need and scope for a detailed report based on any infrastructural or environmental constraints and any evidence gaps identified during the scoping study.

Water Resources and Supply

- Based on the forecasts in Thames Water's latest Water Resource Management Plan (WRMP) there could be shortfalls in water supply up to 2041 and beyond.
- The majority of the proposed allocations in the JLP are being rolled forward from the existing adopted local plans for each district, however these plans and the JLP are bringing forward a greater allocation of dwellings than currently forecasted by the WRMP, so could exacerbate the shortfalls predicted.
- The WRMP has identified and forecasted the effects of several design management options on household consumption, non-household consumption and leakage. The options should be sufficient to offset some of the deficits in the development scenarios tested by Thames Water
- Thames Water have also identified several resource options including new reservoirs, raw water transfers and groundwater abstractions. These supply options offer large increases in yield, however, are subject to significant lead times.
- New interventions from the district councils such as stricter water use standards may also be required during the plan period.
- At many of the sites the proposed level of development will require a Development Impact Assessment to determine likely upgrades to the supply network, as the net dwelling equivalent increase is above Thames Water's current upper threshold for growth.
- Abstractions across both districts predominantly come from agriculture; overall, their impact thought to be small. However, considering the scale of development proposed in the JLP and adopted local plans, further abstractions for water supply may be required going forward.
- A water cycle study detailed report is not required to assess water resource and supply, however following adoption of the JLP further technical work by Thames Water could be helpful in deriving specific deficits for both districts considering the latest development allocations.
- The deliverability of upgrades to the water network would also require further technical input from Thames Water as sites are brought forward through the planning process.

Wastewater Infrastructure, Water Quality and Environmental Capacity

- The STWs serving the districts are the most important infrastructural asset with respect to future development in the districts. There are delays in the upgrades earmarked at some of the STWs and uncertainty regarding the headroom available at a number of other STWs.
- At many of the sites, the proposed level of development presents a medium risk to the wastewater network. At the remaining sites there are no capacity concerns.
- In terms of environmental capacity, the EA's catchment data explorer suggests that most of the watercourses in the study area have *Poor* ecological status and *Fail* with regard to chemical status. This suggests that overall, they are vulnerable at present.
- Future upgrades to the sewer network alongside measures identified in the Thames River Basin Management Plan and Thames Water's DWMP could help in this regard but will take time.
- Further work is required as part of a water cycle study detailed report to understand the infrastructural and environmental capacity within some parts of the districts, enabling mitigation measures to be identified. This will include modelling and headroom assessments at several STWs.

Flood Risk

- The assessment of flood risk undertaken to date is high level. The specific upgrades required to the sewer network in response to development are likely to require further technical work by Thames Water in collaboration with developers.
- In terms of the risk posed by increases in discharge volumes from STWs, the additional work proposed for the detailed report on wastewater infrastructural capacity should give a clearer indication of the potential changes for permits required at key STW sites.
- The EA and Thames Water will also be contacted as part of the production of water cycle study detailed report to establish how the current discharge volumes have been estimated and whether they have concerns at any specific STWs.

Other Environmental Constraints

- The districts include a number of protected sites and designated habitats which present constraints to development in certain areas.
- At this stage, this study has identified the main environmental constraints with respect to protected sites. More technical work and consultation will be required to elucidate the potential impacts of development on protected sites through the JLP Habitats Regulations Assessment and the Lowland Fen Study.
- Further work at the planning application stage including Environmental Impact Assessments (EIAs) and HRAs may be required to determine impacts on specific SACs and SSSIs and any required mitigation.
- In terms of odour risk, a number of sites proposed in the JLP could encroach on land close to STWs. For the sites identified where odour risk could be a concern, developers should contact Thames Water prior to submitting a planning application.
- The assessments outlined above for other environmental constraints should be sufficient to address the evidence gaps identified in this study without the need for further assessment as part of a water cycle study detailed report.

1 Introduction

1.1 Scope of Assessment

Wallingford HydroSolutions (WHS) has been commissioned by South Oxfordshire District Council and the Vale of White Horse District Council to undertake a water cycle study scoping report. This will review proposed local plan allocations against the infrastructural capacity of water resource infrastructure, wastewater infrastructure and existing pressures on the water environment.

The study will inform the emerging Joint Local Plan (JLP) 2041 being developed by both councils. The plan will allocate land for housing and employment development. The majority of the proposed allocations in the JLP are being rolled forward from the existing adopted local plans for each district. The only additional development proposed is the proposed extension of the allocation at Dalton Barracks (AS10) in the Vale of White Horse. The JLP also proposes to remove existing allocations at Chalgrove Airfield and part of the existing Bayswater Brook allocation in South Oxfordshire. In this regard the overall quantum of development is not changing significantly from previously adopted plans.

The project to date has consisted of a scoping study. This advises on the need and scope for a detailed report based on any infrastructural or environmental constraints and any evidence gaps identified during the scoping study.

1.2 Water Cycle Study Scoping 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:

- Review the South Oxfordshire District Council and Vale of White Horse District Council extents and amount of proposed development.
- Communicate with key stakeholders including both district councils, the Environment Agency (EA), Thames Water and Natural England.
- Identify existing evidence on water quality, water resources and flood risk.
- Identify environmental issues and constraints on development.
- Identify potential solutions.
- Identify evidence gaps where further assessment may be required through a further detailed report.
- Inform wider policy planning requirements.

2 Method Statement

The water cycle study has been completed using national EA guidance on water cycle studies[1]. It has also been guided by the specification provided by and further consultation with the councils.

2.1 Initial Liaison and Data Collation

Development of the water cycle study scoping report has been underpinned by early stakeholder liaison and collaboration. The stakeholders identified to inform the study include the EA, Thames Water, Natural England, the Canal and River Trust, neighbouring and downstream local authorities, River Catchment Partnerships (including for the South Chilterns, Ock and Thame), the Letcombe Brook Project, the Freshwater Habitats Trust and the River Thames Conservation Trust. They have been engaged with in order to obtain the datasets required to progress the study and to gain a clear understanding of the water environment and water infrastructure for both districts, in addition to the development pressures in neighbouring districts.

2.2 Data Sources

Following the initial liaison stage the following data sources were used to inform the water cycle study scoping report.

- Thames Water Revised Draft Water Management Plan 2024[2]- To determine future water demand and water resource options across both districts.
- Thames Water Drainage and Wastewater Management Plan (DWMP)[3]- To determine Thames Water's future goals with regard to drainage and wastewater infrastructure.
- Thames Water Oxfordshire, Swindon, Wiltshire, Gloucestershire and Warwickshire Catchment Strategic Plan[4]- To determine Thames Water's future plans with regard to drainage and wastewater infrastructure in the study area.
- Thames Water Red, Amber and Green (RAG) Reports- To identify local pressures on the clean and wastewater sewer network across both districts in the context of future development.
- Thames Water Annual Returns with watercourses[5]- Records of CSO spills to further understand local pressures on the sewer network.
- Thames Water Sewerage Treatment Work (STW) Catchments- To link development to specific STWs.
- EA Thames River Basin Management Plan[6]- To help understand current and existing pressures on the water environment and mitigation measures.
- EA Discharge Consents and Abstraction License Locations[7]- To gain spatial understanding of current discharges and abstractions to determine future management.

[1] Environment Agency (2021) *Guidance- Water Cycle Studies* https://www.gov.uk/guidance/water-cycle-studies
[2] Thames Water (2024) *Revised Draft Water Resources Management Plan 2024* dn9cxogfaqr3n.cloudfront.net/revised-draft/Technical+Report/rdWRMP24+-+Section+1+-+Introduction+and+Background.pdf
[3] Thames Water (2023) *Drainage and Wastewater Management Plan (DWMP)* https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management/our-dwmp
[4] Thames Water (2023) *Oxfordshire, Swindon, Wiltshire, Gloucestershire and Warwickshire Catchment Strategic Plan* https://www.thameswater.co.uk/media-library/home/about-us/regulation/drainage-and-wastewater/oxfordshire-swindon-wiltshire-gloucestershire-warwickshire-catchment-strategic-plan.pdf
[5] EA (2024) Annual Returns with watercourses *EIR-24-25-094 Annual Returns with watercourses.xlsx*
[6] EA (2022) Thames River basin district river basin management plan: updated 2022 https://www.gov.uk/guidance/thames-river-basin-district-river-basin-management-plan-updated-2022
[7] EA (2024) Discharge consents and Abstractions licenses *THM356241_DC South Oxon & VWH.xlsx*

- EA Discharge Permits[8]- To understand current discharge permits in place and determine likely changes going forward.
- EA Fluvial Flood Maps[9]– to quantify fluvial flood risk across the study area.
- EA Surface Water Flood Maps[10] – to quantify the pluvial flood risk across the study area.
- Preferred Options consultation comments received from the EA[11], Thames Water[12], Natural England[13] and Freshwater Habitats Trust[14]- Incorporated into the development of water cycle study and JLP.
- Proposed JLP and made Neighbourhood Development Plan Site Allocations[15]- To determine future development and localised demand.
- Past development rates for STW catchments[16]- To estimate future windfall development over the plan period.

2.3 Structure of Scoping Study

The first stage of the scoping study has sought to identify the baseline conditions of the current water environment. Information has been gathered on precipitation, surface water, groundwater, water quality, land use and other relevant factors across the study area. The two previous water cycle studies for South Oxfordshire and the Vale of White Horse have also been reviewed.

After establishing the baseline conditions, the following four elements have been assessed, forming the basis of the scoping assessment.

- Water resources and supply
- Wastewater infrastructure, water quality and environmental capacity
- Flood risk
- Other environmental issues

The scoping study has reviewed these four elements in the context of planned and proposed development across both districts and climate change. Opportunities to manage future development and protect and enhance the water environment have been identified, alongside any evidence gaps and constraints on development.

In order to gain a deeper understanding of these four elements, as part of liaison with stakeholders key documents have been identified to supplement this water cycle study. These include water company resource management plans, drainage and wastewater management plans, river basin management plans and abstraction licensing strategies.

The scale and distribution of development already planned in the districts through adopted local plans and made neighbourhood plans, in addition to development being put forward in the emerging JLP has been determined through a review of the policy documents currently supporting the JLP and

[8] EA (2024) *Discharge Permits for South Oxon and Vale of White Horse Districts*
[9] EA (2023) *Flood Map for Planning (Rivers and Sea) – Flood Zone 2* https://www.data.gov.uk/dataset/cf494c44-05cd-4060-a029-35937970c9c6/flood-map-for-planning-rivers-and-sea-flood-zone-2
[10] EA (2023) *Risk of surface water flooding* https://environment.data.gov.uk/DefraDataDownload/?Mode=rofsw
[11] EA (2024) *Joint Local Plan Preferred Options Consultation* Environment Agency Reg18(2) Response.pdf
[12] Thames Water (2024) *Joint Local Plan Preferred Options Consultation* Thames Water Reg18(2) Response.pdf
[13] Natural England (2024) *Joint Local Plan Preferred Options Consultation* Natural England Reg18(2) Response.pdf
[14] Freshwater Habitats (2024) *Joint Local Plan Preferred Options Consultation* Freshwater Habitats Trust.pdf
[15] South Oxfordshire and Vale of White Horse District Councils (2024) *Joint Local Plan and Neighbourhood Development Plan Site Allocations* developmentscales_dh_s&v comments 21.06.24.xlsx
[16] South Oxfordshire and Vale of White Horse District Councils (2024) *South and Vale STW Windfall calculations* South and Vale STW Windfall calculations.xlsx

consultation with the district councils. Windfall development has also been accounted for by deriving approximate estimates for the STW catchment areas across both districts based on past growth trends. This has been used to assess further pressures on wastewater infrastructure and gain an idea of the amount of additional water demand as a result of windfall development.

2.4 Water Resources and Supply

Future water demand has been assessed against Thames Water's latest revised Water Resource Plan published in 2024. It sets out how they plan to provide a secure and sustainable supply of water for customers over the next 50 years (2025-2075), thereby incorporating the period being assessed in this study. South Oxfordshire District Council and the Vale of White Horse District Council administrative boundaries are mostly located within the Swindon and Oxfordshire Water Resource Zone (SWOX WRZ). This is with the exception of a small area of South Oxfordshire near Henley-on-Thames which lies in the Henley Water Resource Zone (Henley WRZ). The plan also considers the whole Thames Water network, which is vital for putting development in both districts in the context of cumulative development across other functional catchment areas. Also considered are the impacts of climate change, the current and future supply and demand position, and potential resource options moving forward.

Thames Water has been closely consulted throughout the development of this part of the study to confirm their understanding of the resource plan and identify any specific pressures in the study area. This has included the provision of Red, Amber and Green (RAG) reports on clean water capacity throughout both districts in view of the development being brought forward as part of the JLP.

In the context of the assessment and liaison with Thames Water, the potential for higher water efficiency standards have been considered for the districts. The study seeks to provide comment on the tighter standards being put forward in the government's Environmental Improvement Plan, identify exemplar standards that developers could aim for and consider standards for non-residential development.

Abstraction licences from the EA have been obtained and analysed for both districts. Subsequently, a high-level review has been undertaken, looking at the current abstraction strategy in both districts and likely changes going forward.

Based on the findings of the above, the water cycle study scoping report advises on future demand and resource management in the study area. It also confirms if there are any evidence gaps that may warrant further review as part of a detailed report.

2.5 Wastewater Infrastructure, Water Quality and Environmental Capacity

The water cycle study scoping report reviews the infrastructural capacity of the wastewater system and environmental capacity of the receiving water environment. This assessment has been undertaken in the context of the level of development identified and climate change.

In terms of infrastructural capacity, relevant information from Thames Water has been obtained, including information on the major STWs, DG5 sewer flooding records and RAG reports on wastewater sewer capacity throughout both districts. This has enabled a high-level assessment of locations which are close to or at capacity and where upgrades to manage future development may be necessary. The existing district water cycle studies have also been reviewed to see if there is any additional information that needs to be updated and incorporated into the joint study. Comments received from the EA on specific STWs and permit capacities in relation to the JLP preferred options consultation have also been considered.

To assess environmental capacity, the EA's catchment data explorer has been used to find the current trends in ecological and chemical status for a number of watercourses in the study area, with a particular focus on those containing STWs. The Thames River Basin Management Plan has been reviewed to identify the current measures in place to maintain water quality across both districts.

In the context of these findings and the future development proposals put forward, risk areas have been identified and high-level recommendations on potential measures to protect and where possible enhance water quality identified.

Through a review of infrastructural and environmental capacity, any evidence gaps and constraints which may need further assessment as part of a detailed report have been identified. It is understood that the information provided as part of this chapter will be used to inform future infrastructure requirements (including timescales and funding arrangements). Therefore, where it is considered that there are insufficient data to confidently advise on suitable mitigation, this is flagged.

2.6 Flood Risk

A high-level review of flood risk in the South Oxfordshire and the Vale of White Horse areas has been carried out. The review of flood risk has focused on the potential impacts of future development.

An evaluation of the areas most sensitive to flood risk has been extrapolated to 2041 to consider the overall impact of the development proposed. This has used the EA national flood maps and DG5 records of sewer flooding. As well as accounting for the scale of development, climate change, local SuDS policy and urban creep have also been considered.

In addition to the impact of development on land use, the specific impact it may have on increasing discharges from STWs has been reviewed. This has involved a review of the existing discharge permits at the STWs across the study area and the information garnered from the assessment of infrastructural capacity to assess areas where discharges could increase if capacity is not increased.

2.7 Other Environmental Constraints

Any other relevant environmental constraints have been identified through consultation with the councils and the EA in the early stages of the project. This section principally covers protected sites and odour.

There are a number of sites designated for their biodiversity importance within and surrounding South Oxfordshire and the Vale of White Horse districts. Natural England have also issued nutrient neutrality advice for the River Lambourne Special Area of Conservation (SAC), the catchment of which extends into the Vale of White Horse.

The location of STWs in relation to developments is also discussed in the context of odour risk. If it is deemed certain developments are at reasonable risk of odour from treatment works, presently or in the future, WHS will comment on future steps and any need for further assessment.

The findings of this chapter are likely to inform nature recovery and potential environmental improvements within the district, which are considered to be a key aim of the JLP.

3 Baseline Assessment

The study area and main watercourses across it are shown in Figure 1. The study area comprises the administrative areas of both South Oxfordshire District Council and the Vale of White Horse District Council.

The EA has classified the area served by Thames Water (which includes South Oxfordshire and Vale of White Horse) as being in "serious water stress"[17]. Serious water stress is defined in the Water Industry (Prescribed Conditions) Regulations 1999[18] as where *'the current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand'.*

In terms of watercourses, the River Thames is the main watercourse, it forms part of the boundary with West Oxfordshire and the City of Oxford. It also forms a boundary between the two Districts close to Didcot, and to the south part of the boundary between South Oxfordshire and Berkshire.

Significant tributaries joining the Thames within the districts include the Windrush, Evenlode, Cherwell (within Oxford), Ock and Thame. The catchment area of the Thames thus increases significantly from 776 km^2 near Lechlade where it enters the Vale of White Horse to 6,613km^2 when it exits the study area in South Oxfordshire at Henley-on-Thames.

In terms of the water quality and the condition of watercourses, the EA catchment data explorer shows of the 46 measured catchments falling within the district, 4 of the catchments have an ecological status of Bad, 18 are classed as Poor, 22 are classed as Moderate and 1 catchment is classed as Good. All catchments were measured to have a Fail chemical status in 2019. This shows the water environment to be vulnerable at present (more detail is provided in section 5.3.2).

According to the Met Office[19] average annual rainfall is measured to be between 634-706 mm (1991-2020) based on data from the Benson, Oxford and Brize Norton weather stations. This is expected to reflect conditions across both districts, which is below the UK average for rainfall. Rainfall is delivered relatively uniformly across the year with moderate increases in the winter months.

In terms of groundwater, there is a wide range of geology. Mudstone and clay layers are prevalent in and around Oxford including in the northern parts of both districts. There is also a large band of mudstone in the form of the Gault formation which runs across both districts. For these substrates, drainage into the subsurface will be more impeded and the strata are generally likely to be unproductive. A small area of limestone is present in the north of the Vale of White Horse district close to the Abingdon-on-Thames area. Local evidence indicates that this is more permeable with high groundwater identified in the Marcham area likely contributing to pressure on Thames Water's foul drainage system in the village.

Chalk formations dominate the south of both districts. It is a highly permeable substrate which provides significant groundwater reserves. It has been designated as a principal aquifer by the EA, defined as a strategically important rock unit with high permeability and water storage capacity. As outlined in more detail in section 4, a large proportion of both districts are supplied by groundwater sources from these chalk formations.

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[17] Environment Agency (July 2021) Water Stressed Areas - Final Classification 2021. Version 1.0: www.gov.uk/government/publications/water-stressed-areas-2021-classification
[18] UK Statutory Instruments (1999) *The Water Industry (Prescribed Conditions) Regulations 1999* https://www.legislation.gov.uk/uksi/1999/3442/contents/made
[19] Met Office (2024) UK Climate Averages Benson (Oxfordshire) https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcpjxj1hq

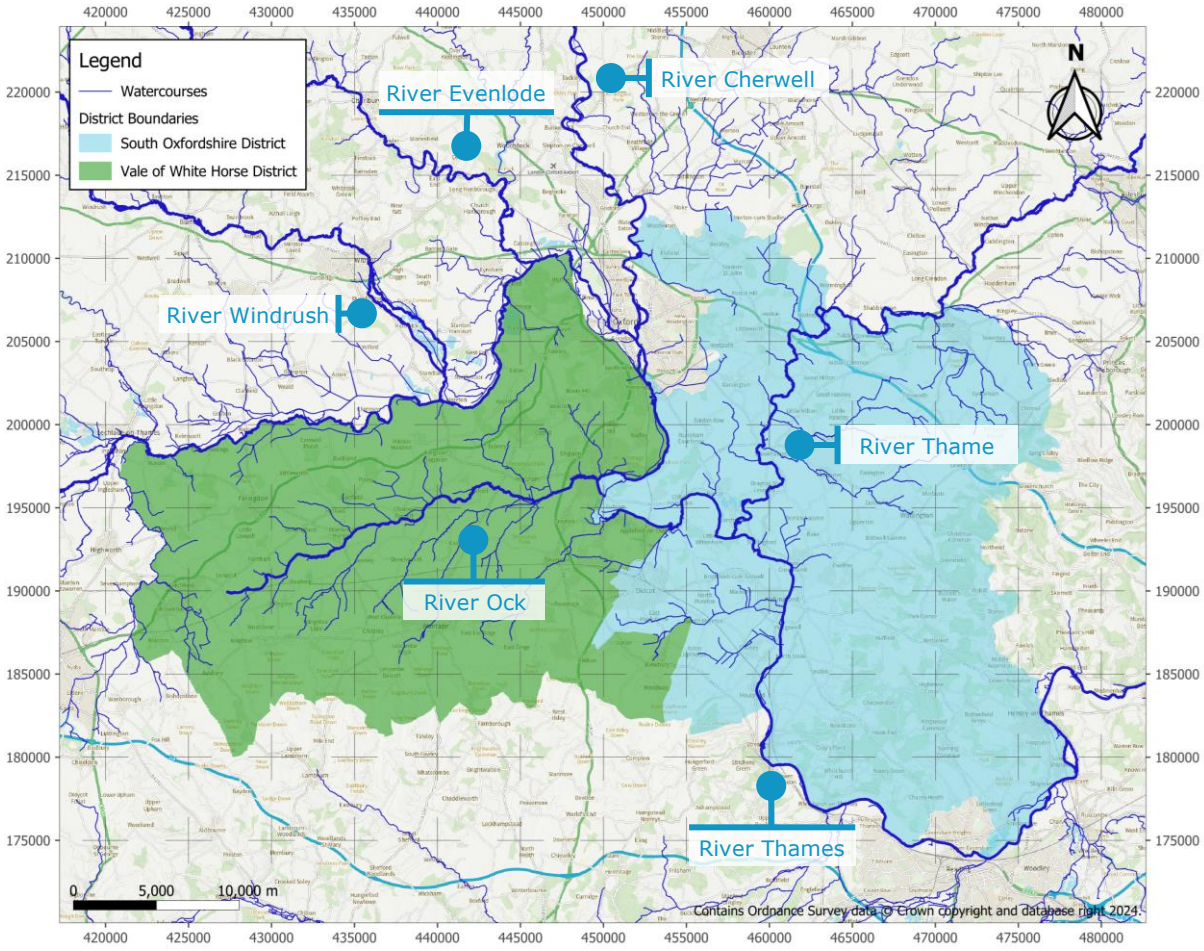

Figure 1- District Boundaries and Watercourses

4 Water Resources and Supply

4.1 Introduction

This section first assesses the current water resources supplying the South Oxfordshire and the Vale of White Horse district areas. Subsequently, the supply-demand position moving forward is reviewed against future development at the strategic and site level. This includes development identified in the JLP and made neighbourhood plans, in addition to estimates of windfall development. The assessment confirms whether there will be enough water resources available to sustainably manage the projected development levels in the study area.

The existing abstraction licenses and license strategies across the study area are also reviewed. Recommendations are then made on future demand and resource management in the study area. Any requirements for further work as part of a detailed report are also provided.

4.2 Water Company Planning

Thames Water is responsible for water supply across the South Oxfordshire and Vale of White Horse district areas. The water companies within England responsible for providing water supply and wastewater collection and treatment, are funded in 5-year planning periods. The money they have available to spend is determined by the Water Services Regulation Authority (OFWAT) in consultation with government, the EA and consumer organisations amongst others. The consultation process is known as the Price Review (PR). The latest price review was in 2024 (PR24) and determined how much money water companies have available to spend between 2025 and 2030 termed Asset Management Plan 8 (AMP8). 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 the water companies require detailed information on likely housing development well in advance. Table 1 outlines the lead time estimates provided by Thames Water.

Table 1- Thames Water estimate of infrastructure lead in times

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

4.3 Water Resource Zone

The entire Vale of White Horse district area falls within the SWOX WRZ. The majority of the South Oxfordshire district area also falls within the SWOX WRZ, with the exception of Henley-on-Thames and its surrounding area which falls within the Henley WRZ. Figure 2 shows the WRZs relative to each district area.

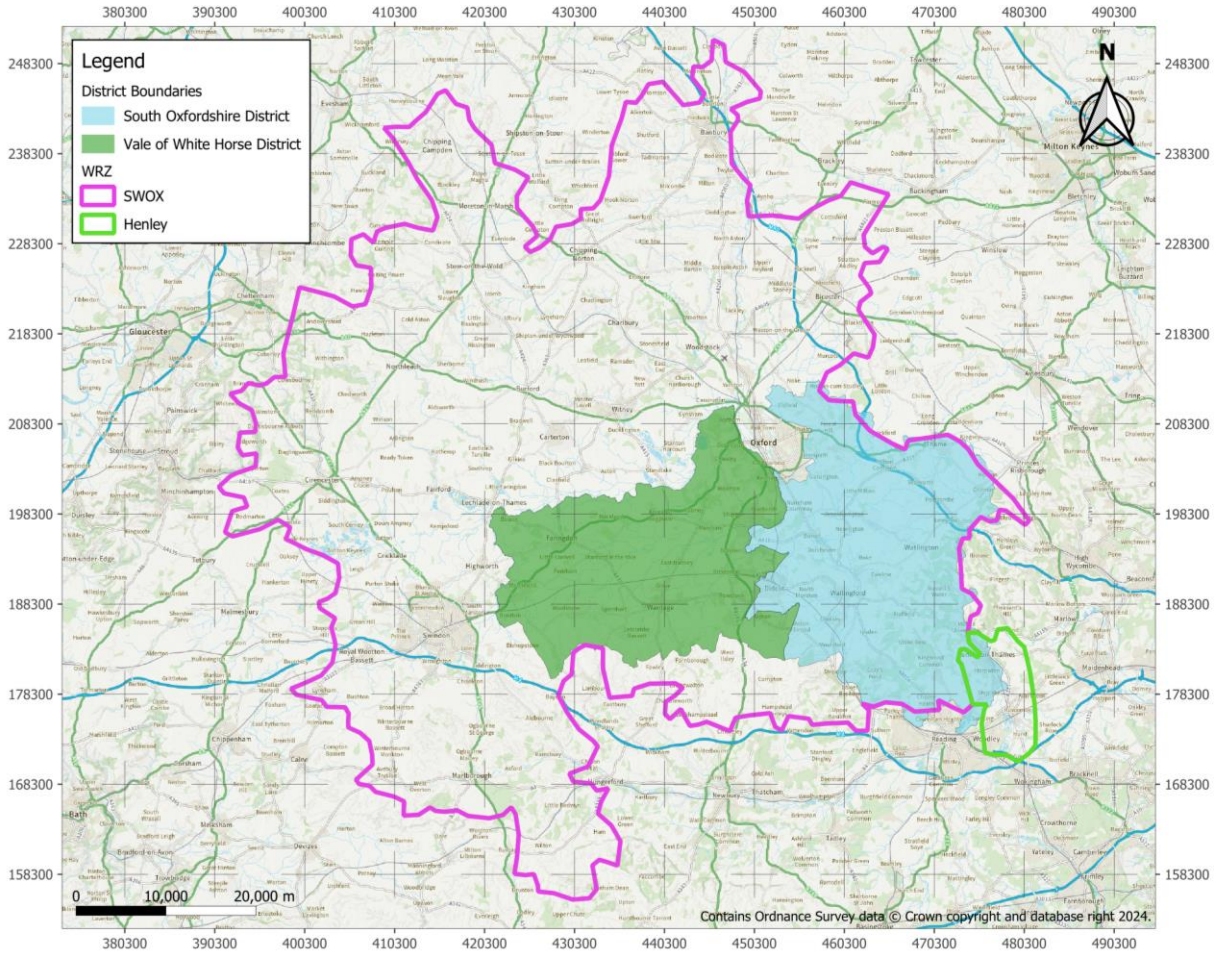

Figure 2- District Boundaries relative to Water Resource Zones

The SWOX WRZ is classified as a conjunctive use zone, in which approximately 60% of its supplies come from groundwater sources and 40% from surface water. The zone can be split into three 'sub-zones' which have major transfers between them, these are summarised as follows:

- South Oxfordshire (area stretching from Goring to Chinnor): Served by groundwater only from mainly chalk aquifer sources, it produces more water than needed for local demand.
- North Oxfordshire (Oxford, Banbury, Witney, Farringdon): Surface water only via abstraction from the Thames into Farmoor Reservoir. It produces more water than needed for local demand.
- Swindon & Cotswolds: Served by groundwater only mainly from Cotswolds Oolitic Limestone and Upper Kennet sources, it produces less water than needed for local demand.

It should be noted that whilst the South Oxfordshire 'sub-zone' produces more water than needed for local demand, in general a large proportion of its water is transferred northwards and westwards to meet water demand in other areas within the wider SWOX WRZ. The major transfers within the WRZ are shown in Figure 3.

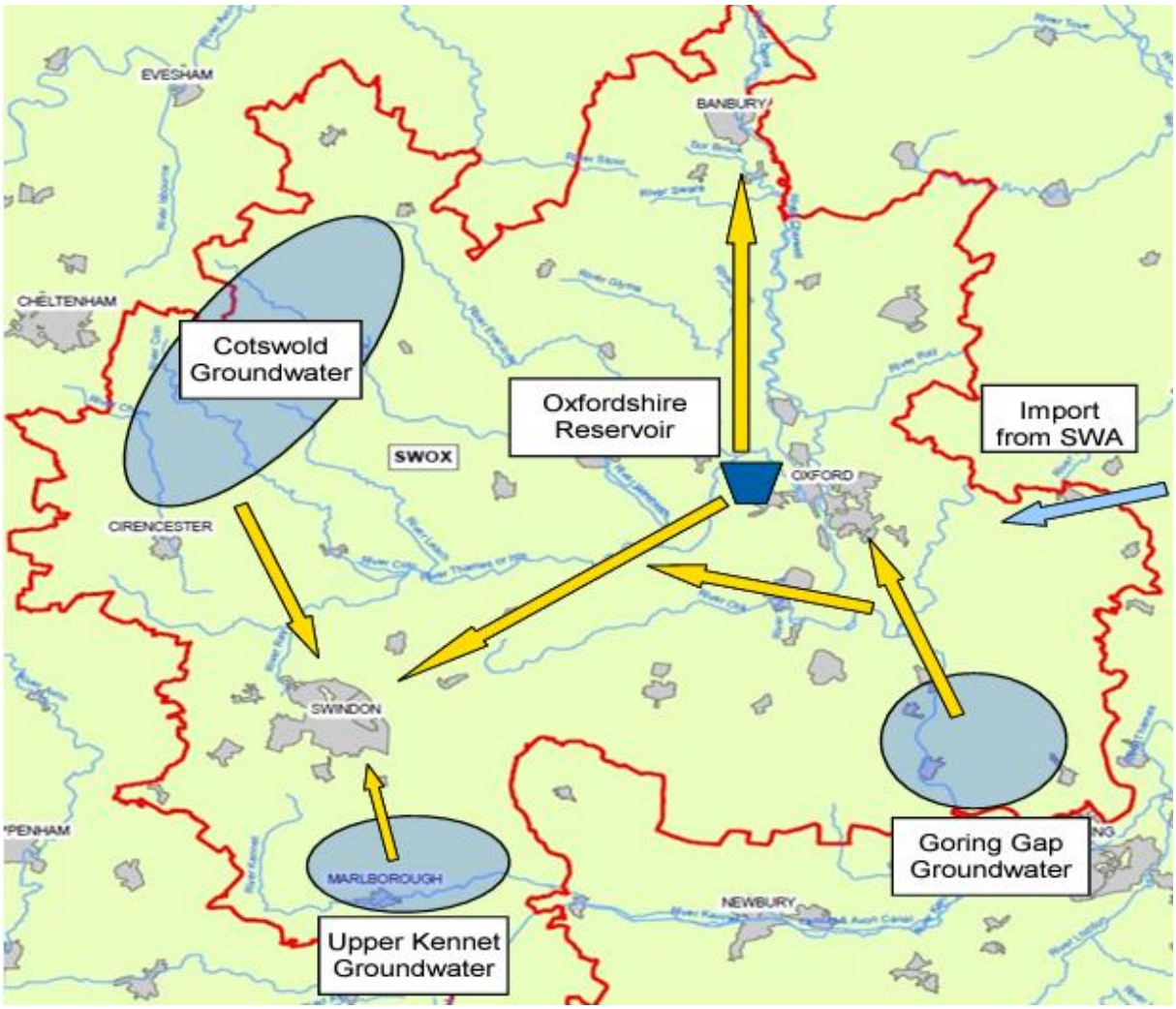

Figure 3- Principal Features of the SWOX WRZ (Source: Thames Water[20])

The water resources for the Henley WRZ are derived from three groundwater sources abstracting from the unconfined chalk of the Southwest Chilterns and the lower River Loddon catchment. The yields available are significant and are not deemed to be drought sensitive.

4.4 Population and Dwelling Forecast

Thames Water has assessed the impact of forecast population, household growth and non-household growth on water resources as part of their draft Water Resources Management Plan (WRMP) 2024. It sets out how they plan to provide a secure and sustainable supply of water for customers over the next 50 years (2025-2075). This scoping study has used the information from this latest WRMP to determine demand and delineate the potential impact of future development in both districts.

Population and dwelling forecasts are paramount in estimating future demand. Thames Water's population forecasts consider housing development, ageing population profiles and migration. The

[20] Thames Water (2023) *Revised Draft WRMP24 – Technical Appendix A: WRZ Integrity* https://www.thameswater.co.uk/media-library/home/about-us/regulation/water-resources/wrmp24-draft/technical-appendices/water-resource-zone-integrity.pdf

preferred population forecasts and dwelling figures are heavily based on local plans and also consider Office of National Statistics (ONS) trend-based projections. In addition to the central forecasts, Thames Water has also produced maximum and minimum scenarios in the production of demand forecasts for use in adaptive planning scenarios. Only the central forecasts (based on local plans) are considered for this study.

Thames Water, working with demographic analytics, calculated a range of population and dwelling growth forecasts across its supply area. Population and dwelling forecasts have been developed for each WRZ based on an aggregate of the findings for each local authority area. The values derived by Thames Water are used to inform future demand, which is subsequently used in determination of suitable resource options. The figures derived will be compared against the development proposed in the JLP to determine if the levels of growth are in excess of or below Thames Water's anticipated values.

According to the WRMP the base population (2021/22) in the SWOX area is 1,057,749. The South Oxfordshire area falling within the wider SWOX area has an estimated population of 137,459. This is based on the office of national statistics (ONS) 2022 mid-year estimate[21] of 151,845 for the entire district minus the estimated population falling within the Henley WRZ of 14,386. The Vale of White Horse District has a population of 142,355 based on the 2022 mid-year estimate. These values translate to approximately 26.5% of the total SWOX base population in total.

The central population forecasts for the SWOX area show an increase in population of 244,625 from the base year to 2041. In the absence of a breakdown for each local authority area, population growth is assumed to be uniform across the SWOX area. The population growth in South Oxfordshire and Vale of White Horse areas falling within SWOX are therefore expected to be 26.5% of 244,625 at 64,825.

According to the WRMP the base population (2021/22) in the Henley area is 50,333. The South Oxfordshire area falling within this area has an estimated population of 14,386, this includes the population of Henley-on-Thames and some small settlements around it. This value translates to approximately 28.6% of the total Henley base population in total.

The central population forecasts for the Henley area show an increase in population of 6,117 from the base year to 2041. Assuming population growth to be uniform, the population change in the South Oxfordshire area falling within the Henley WRZ is therefore expected to be 28.6% of 6,117 at 1,749.

Thames Water has also estimated dwelling numbers across the WRMP plan period (2025-2075). The base year shows 431,000 and 21,000 dwellings in the SWOX and Henley WRZs respectively. The projected increase in dwelling numbers by 2041 is 116,533 and 2,998 for each WRZ. Using the population proportions above, this translates to 120,021 dwellings in the base year across both districts with an increase of 31,719 dwellings by 2041. This again assumes uniform growth across the WRZs and that occupancy rate remains relatively stationary with respect to population change. Table 2 summarises the values estimated in terms of population and dwelling growth.

[21] ONS (2024) *Population estimates for England and Wales: mid-2022 https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/populationestimatesforenglandandwales/mid2022*

Table 2-Base and Projected (2041) Population and Dwelling Estimates based on Thames Water's WRMP

	SWOX WRZ	Henley WRZ	South Oxfordshire	Vale of White Horse	Combined (SO&VWH)
Base Population (2021/2022)	1,057,749	50,333	151,845	142,355	294,200
Projected Population (2041)	1,302,374	56,450	185,583	175,277	360,860
Base Dwelling (2021/2022)	431,000	21,000	62,016	58,005	120,021
Projected Dwellings (2041)	547,533	23,998	78,052	73,688	151,740

Comparing these figures with the JLP and made neighbourhood plans, shows the total number of dwellings being brought forward in the plans to be higher, with 38,577 dwellings currently proposed in the JLP compared to 31,719 dwellings based on Thames Water's plan-based forecasts. It is important to note that some site allocations will continue to build out beyond 2041. Based on past growth rates in both districts, there is forecast to be a further 6,392 dwellings arising from windfall development from present to 2041.

It is important to note that the majority of the proposed allocations in the JLP are being rolled forward from the existing adopted local plans for each district. The reason for the differences in dwelling numbers is thought to be partly due to Thames Water's plan-based forecasts for South Oxfordshire using local plan data accessed in March 2020. This was prior to the adoption of the South Oxfordshire Local Plan 2035 in December 2020 which included additional development allocations. The full list of site allocations for the JLP and windfall development figures are provided in Appendix 1.

As mentioned, assumptions have been made in terms of uniform population growth across both WRZ and occupancy rate which increase uncertainty in the scaled down figures for each district. However, the differences to the JLP are noteworthy with the Thames Water forecast close to 20% lower in terms of dwelling numbers. This is made particularly important given that the AMP8 cycle is based on the Thames Water plan-based forecasts presented herein rather than the maximum scenario also produced by Thames Water.

4.5 Demand

Demand includes household use, non-household use, operational use (water used maintaining the network), water taken unbilled and leakage. The main driver on demand is population, however several other factors also play a role, including the effects of climate change, improvements in efficiency, and changes in household/non-household consumption.

In terms of per capita demand this is expected to fall moving forward with changes in behaviour and increases in water efficiency. Climate change is expected to offset this slightly with increasing demand due to hot and dry weather, in which customers are likely to use more water for activities such as garden watering. On the other hand, climate change is likely to lead to milder winters, which will reduce leakages caused by contraction in cold weather.

It should be noted in the demand scenarios presented, new demand management activity ceases at the end of AMP7 (2025). The measures introduced under AMP7 include the installation of meters, leakage reductions and household use reductions (due to public awareness and water efficiency savings). The Ml/d savings earmarked for these measures introduced under AMP7 will still have a continued effect, however additional measures introduced as part of AMP8 and beyond are not accounted for. This means that the consumption estimates are considered to be conservative with further reductions in consumption not forecast likely.

The WRMP has assessed demand using Dry Year Annual Average (DYAA) and Dry Year Critical Period (DYCP) forecasts. The DYAA is the annual average value of water demand over the course of a dry year. The DYCP forecast, describes the average daily demand during the peak week for water demand, rather than an annual average across the year.

For the DYAA forecast, despite a per capita reduction in consumption (due to AMP7 measures), total demand in the SWOX region is expected to increase from 280.26 Ml/d in 2025/26 (the start of AMP8) to 301.08 Ml/d by 2041. Total demand in the Henley region is expected to increase from 12.99 Ml/d in 2025/26 to 13.34 Ml/d by 2041. The increases in demand are largely driven by population growth increasing household demand, non-household consumption is forecast to fall with a small decrease in leakage too.

Based on the DYAA forecast total demand in the SWOX region is expected to increase from 340.67 Ml/d in 2025/26 to 363.72 Ml/d by 2041. Total demand in the Henley region is expected to increase from 18.77 Ml/d in 2025/26 to 19.23 Ml/d by 2041. These are roughly comparable to the changes in the DYAA forecast in terms of percentage increases. Table 3 provides a summary of the changes to DYAA and DYCP values from the beginning of AMP8 (2025/26) across the plan period up to 2041. Values are provided for the two WRZs with scaled down values also shown for both districts (based on population proportions).

Table 3-DYAA and DYCP Forecasts (2025-2041) based on Thames Water's WRMP

	SWOX WRZ	Henley WRZ	South Oxfordshire	Vale of White Horse	Combined (SO&VWH)
DYAA (2025/2026)	280.26	12.99	40.23	37.71	77.94
Projected DYAA (2041)	301.08	13.34	43.03	40.52	83.55
DYCP (2025/2026)	340.67	18.77	48.90	45.85	94.75
Projected DYCP (2041)	363.72	19.23	51.98	48.95	100.93

4.6 Supply

As part of the WRMP, Thames Water has determined the amount of water that is available for water supply, termed the Deployable Output (DO). They have also estimated and forecast the Water Available for Use (WAFU). The WAFU is the amount of water that water companies expect to be able to supply under the demand conditions set out in the levels of service. The key components of WAFU are the DO and water from neighbouring water companies' resources zones. It also takes into account climate change, the water lost through process, planned and unplanned events (outages) sustainability reductions and water transfers to other companies. Note, in their WRMP, when estimating WAFU, the DO values are estimated for a dry year pertaining to the 1 in 100-Year drought.

Looking to the future, water supplies are forecast to fall, the main cause being climate change. In the SWOX WRZ the water available for use (WAFU) in the 2025/26 is 304.77 Ml/d and 330.02 Ml/d under DYAA and DYCP conditions respectively. Based on the demand figures estimated and shown above, this shows the WAFU to exceed demand under DYAA conditions, however during peak week (DYCP) conditions, there is a shortfall of 10.65 Ml/d.

Based on graphs provided in the WRMP[22], in 2041, the forecasted WAFU is estimated to be 285 Ml/d and 310 Ml/d under DYAA and DYCP conditions respectively. Using the projected demand figures in Table 3 this points to a shortfall of 16.08 Ml/d under DYAA conditions and 53.72 under DYCP conditions.

In the Henley WRZ the water available for use (WAFU) in the 2025/26 is 20.40 Ml/d and 21.70 Ml/d under DYAA and DYCP conditions respectively. This shows the WAFU to exceed demand under both DYAA and DYCP conditions. Based on graphs provided in the WRMP[23], in 2041, the forecasted WAFU for Henley is estimated to remain the same at 20.40 Ml/d and 21.70 Ml/d under DYAA and DYCP conditions respectively. This remains above the projected demand figures listed in Table 3.

As mentioned, the Henley WRZ is supplied by three groundwater sources which are not deemed to be drought sensitive and are therefore more resilient to climate change. Figure 4 extracted from the WRMP shows the finding of Thames Water's climate change vulnerability assessment, which shows the Henley and SWOX areas as being at low and medium vulnerability respectively.

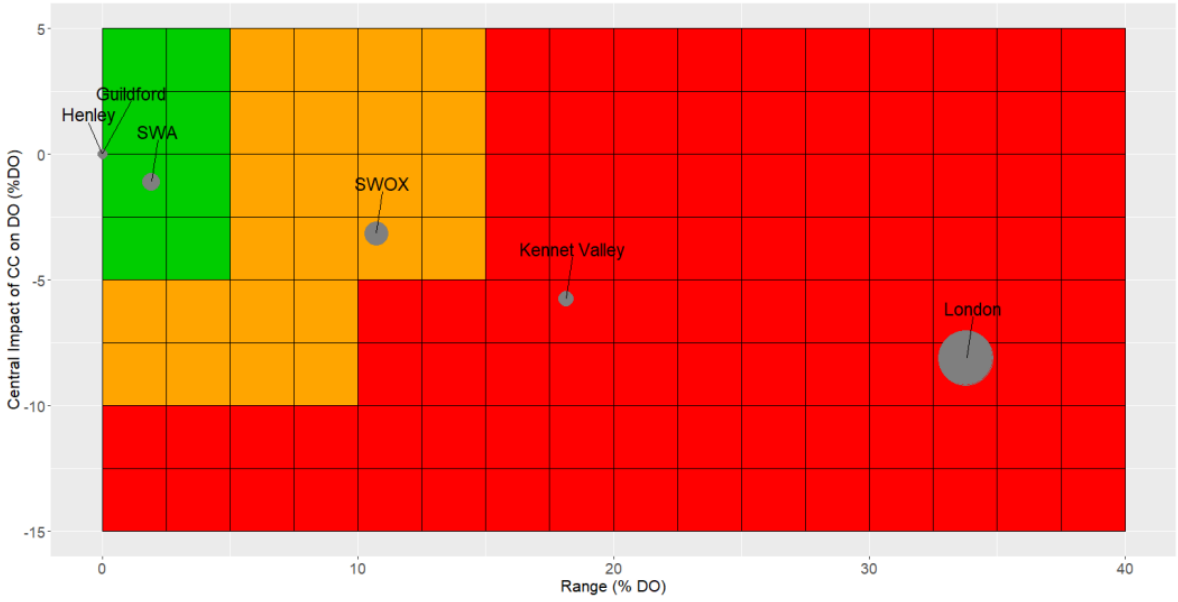

Figure 4- Thames Water Basic Vulnerability Assessment- Climate Change (Source: Thames Water[24])

[22] Thames Water (2024) Figures 4-16 p58 rdWRMP24+-+Section+4+-+Current+and+Future+Water+Supply.pdf (dn9cxogfaqr3n.cloudfront.net)
[23] Thames Water (2024) Figures 4-20 p60 rdWRMP24+-+Section+4+-+Current+and+Future+Water+Supply.pdf (dn9cxogfaqr3n.cloudfront.net)
[24] Thames Water (2023) *Section 4 – Current and Future Water Supply p36* https://dn9cxogfaqr3n.cloudfront.net/revised-draft/Technical+Report/rdWRMP24+-+Section+4+-+Current+and+Future+Water+Supply.pdf

Table 4 provides a summary of the changes to WAFU values from the beginning of AMP8 (2025/26) across the plan period up to 2041. Values are provided for the two WRZs with scaled down values also shown for both districts (based on population proportions).

Table 4-WAFU DYAA and DYCP Forecasts (2025-2041) based on Thames Water's WRMP

	SWOX WRZ	Henley WRZ	South Oxfordshire	Vale of White Horse	Combined (SO&VWH)
WAFU (Ml/d) DYAA (2025/2026)	304.77	20.40	45.44	41.02	86.46
Projected WAFU (Ml/d) DYAA (2041)	285	20.40	42.87	38.36	81.23
WAFU (Ml/d) DYCP (2025/2026)	330.02	21.70	49.09	44.42	93.51
Projected WAFU (Ml/d) DYCP (2041)	310	21.70	46.49	41.72	88.21

Table 5 provides a summary of the differences between WAFU and demand values from the beginning of AMP8 (2025/26) across the plan period up to 2041. It shows adequate supply for WAFU in 2025/2026 for all areas when considering DYAA conditions. Under DYCP conditions there is a small shortfall in the SWOX area and the Vale of White Horse, Henley shows significantly more supply with South Oxfordshire showing a marginal surplus. In the projected scenarios for 2041, all areas apart from Henley show a shortfall. South Oxfordshire shows less of a shortfall than the Vale of White Horse, partly due to it lying partially in the Henley WRZ.

Table 5-Projected differences in WAFU and Demand (DYAA and DYCP) based on Thames Water's WRMP

	SWOX WRZ	Henley WRZ	South Oxfordshire	Vale of White Horse	Combined (SO&VWH)
WAFU-Demand (Ml/d) DYAA (2025/2026)	24.51 (+8.75%)	7.41 (+57.04%)	5.21 (+12.95%)	3.31 (+8.78%)	8.52 (+10.93%)
Projected WAFU-Demand (Ml/d) DYAA (2041)	-16.08 (-5.34%)	7.06 (+52.92%)	-0.16 (-0.37%)	-2.16 (-5.33%)	-2.32 (-2.78%)
WAFU-Demand (Ml/d) DYCP (2025/2026)	-10.65 (-3.13%)	2.93 (+15.61%)	0.19 (+0.39%)	-1.43 (-3.12%)	-1.24 (-1.31%)
Projected WAFU-Demand (Ml/d) DYCP (2041)	-53.72 (14.77%)	2.47 (+12.84%)	-5.49 (-10.56%)	-7.23 (-14.77%)	-12.72 (-12.60%)

The current forecast indicates potential water shortages in the South Oxfordshire and Vale of White Horse districts under drought conditions. The growth in demand due to population growth and development outstrips any water demand management activity. Also, climate change affects the amount of water available to supply. The JLP is bringing forward a greater allocation of dwellings than currently forecasted by the WRMP so could exacerbate the shortfall predicted. However, as mentioned previously the majority of allocations are being rolled forward from the existing adopted local plans for each district, so the quantum of development assessed as part of these is unlikely to change significantly.

It should be noted that the values stated are based on several assumptions and are subject to uncertainty. Namely that the DYCP and DYAA figures can be scaled down based solely on population and that the trends in non-household demand and leakage for the WRZs will broadly match the trends in the two districts. Furthermore, for the demand scenarios presented, new demand management activity ceases at the end of AMP7 (2025) and the supply scenarios do not account for potential resource options, both of which are covered in section 4.7.

In any case the results do show that without corrective action, the supply for the districts could be less secure for all the scenarios tested. This means that there could be a greater probability that demand restrictions will be required in dry years.

4.7 Demand Management and Resource Options

When considering demand management options, Thames water have considered the three main components of water demand, which consist of:

- Household (HH) Consumption: water consumed by households
- Non-Household (NHH) Consumption: water consumed by businesses
- Leakage: water that leaks from water mains and customer supply pipes

Demand management is considered to be the best means to negate a water deficit in the short to medium term with resource options growing in importance in the longer term. Some of the primary measures include metering, household innovation, tariffs/incentives, government led demand reduction (e.g. water labelling and minimum standards) and media campaigns.

The WRMP has identified eight ambitions with respect to demand management:

- Reduce leakage by 50% (from 2017-18 levels) by 2050
- Maximise feasible Per Capita Consumption (PCC) reductions by 2050
- Smart meter all practicable connections by 2035
- Minimise un-meterable properties by 2040
- Wipe out most wastage by 2050
- Minimise impact on customer bills
- Minimise carbon cost
- Create deliverable, resilient and ambitious programme

The WRMP has projected future changes to consumption and leakage based on four different demand management programmes (Low, Medium, High, High +). Table 6 shows the projected changes in household PCC and how these relate to the national government's PCC target of 110 l/head/day by 2050 which was set as part of the Environmental Improvement Plan 2023[25]. For context, in the

[25] DEFRA (2023) Environmental Improvement Plan 2023
https://www.gov.uk/government/publications/environmental-improvement-plan

demand scenarios presented in section 4.5, the measured PCC in 2041 is approximately 133.31 l/head/day which translates to a total household consumption of 176.36 Ml/d for the SWOX area. Based on the target values below, the PCC would be approximately 119 l/head/day, an 11% reduction which would result in a fall of 18.93 Ml/d for total household consumption. Comparing this to Table 5, this has the potential to completely offset the shortfall estimated under DYAA conditions of 10.65 Ml/d and significantly reduce the shortfall under DYCP conditions of 53.72 Ml/d.

Table 6- PCC (l/head/d) projections extracted from Thames Water WRMP

Demand Programme	2024/25	2037/38	2049/50
Low	142.9	128.9	113.9
Medium	142.9	126.0	108.4
High	142.9	126.0	108.4
High+	142.9	124.4	106.9
Target			110.0

Note for new build dwellings, a water efficiency calculation is a legal requirement set out in Part G of the Building Regulations. These calculations are required for all new build dwellings, as well as conversions. Part G requires that a dwelling must not use more than 125 l/head/day. However, the Planning Practice Guidance (PPG)[26] states that where there is a clear local need, local planning authorities can set out local plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 l/head/day. The adopted local plans for the South Oxfordshire and the Vale of White Horse districts have already implemented the tighter standard of 110 l/head/day.

Currently, as mentioned the national government's PCC target is 110 l/head/day, however tighter standards may be sought going forward. Previous governments have consulted on introducing more ambitious requirements through the Building Regulations including Defra's 2021 Consultation on measures to reduce personal water use[27]. This discussed the potential to change the baseline standard of 125 l/head/day to 110 l/head/day, it also discussed a staged introduction of tighter standards down to 50 l/head/day. Furthermore, the Environmental Improvement Plan 2023 discusses how the building regulations should be periodically reviewed with a view to setting more ambitious statutory requirements in the future.

Given the issues of water stress in the districts and that the current development allocation in the JLP is close to 20% greater than Thames Water's property forecasts, adoption of lower standards (when enforceable) may be sought by the councils during the plan period. A number of public and private bodies have investigated the potential for tighter standards. In response to the EA's publication, *Meeting our Future Water Needs: a National Framework for Water Resources*[28] a road map is being developed by national government towards greater water efficiency in new developments and retrofits. The Future Homes Hub are providing input to the Roadmap by bringing

[26] Department for Levelling Up, Housing and Communities (2015) *Housing: optional technical standards* https://www.gov.uk/guidance/housing-optional-technical-standards

[27] DEFRA (2021) *Consultation on measures to reduce personal water use* https://assets.publishing.service.gov.uk/media/60dee0bdd3bf7f7c2b7f30b7/Summary_of_responses_for_the_consultation_on_measures_to_reduce_personal_water_use_.pdf

[28] EA (2020) *Meeting our future water needs: a national framework for water resources* https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

together industry stakeholders. It has published a report[29] which highlights the need for changes in future PCC standards, fittings, labelling, water reuse and water positivity to enable sustainable growth. In terms of PCC specifically, it has reviewed foreseeable changes in fittings and technology to set out a roadmap for future standards between 2025-2035. These are shown in Table 7, with different standards set depending on levels of water stress.

Table 7- Future Homes Hub Litres per person per day framework

Demand Programme	2025	2030	2035
Achieved through fittings approach	105 l/head/day	100 l/head/day	90 l/head/day
In water stressed areas	100 l/head/day	90 l/head/day	80 l/head/day
In seriously water stressed areas	90 l/head/day	To be determined	To be determined

RIBA has also developed in consultation with other professional UK construction bodies voluntary performance targets for water use[30] with regard to construction. The performance targets align with the future legislative horizon and set out challenging but achievable targets in order to have a realistic prospect of achieving net zero carbon for the whole UK building stock by 2050. In terms of water use it sets a standard of 95 l/head/day by 2025 and 75 l/head/day by 2030. BREEAM[31] does not set specific standards for PCC, however does set graded standards for individual water fittings which developers can use to reduce water consumption. The Future Homes Hub, RIBA and BREEAM standards are all voluntary standards at this stage that developers could choose to align with.

It should be noted that reducing PCC to tighter standards across the districts will likely require demand reduction actions from Thames Water in combination with government led policy changes. The districts have undertaken viability testing and found that moving to a standard of 100 l/head/day should not lead to significant additional costs, however moving to 90 l/head/day would do at present.

Table 8 shows the projected changes for non-household consumption as percentage reductions. Note currently Thames Water has no variable options for non-household use reduction. For non-household use, the differences between the Low/Medium and High/High+ programmes result from the differing levels of the Smarter Business Visit (SBV) option and innovation in general. Note, a SBV includes a free visit by qualified plumbers to install water saving devices and fix leaking utilities in non-households. This is seen as one of the most effective demand reduction programmes in non-households. For context SWOX had a non-household consumption of 54.1 Ml/d in 2021/22, assuming a linear fall from 2017/18 to 2049/50 target levels, this would result in an estimated non-household consumption of 49.1 Ml/d in 2041.

[29] Future Homes Hub (2024) *Water Ready- A report to inform HM Government's roadmap for water efficient new homes* https://irp.cdnwebsite.com/bdbb2d99/files/uploaded/Water%20Ready_A%20report%20to%20inform%20HM%20Government-s%20roadmap%20for%20water%20efficient%20new%20homes.pdf

[30] RIBA (2021) *RIBA 2030 Climate Challenge* https://www.architecture.com/-/media/files/Climate-action/RIBA-2030-Climate-Challenge.pdf?srsltid=AfmBOopW1CKKCWUCJ76wMu2194M2EVKmfsT9sCZT-NoSvN8rClGvzGv1

[31] BREEAM (2024) *BREEAM Standards* https://breeam.com/standards

Table 8- Demand programme business use reductions from 2019/20 levels

Demand Programme	2024/25	2037/38	2049/50
Low/Medium	12.7%	7.9%	5.3%
High/High +	12.7%	16.0%	20.7%
Target		9%	15%

The PCC targets set for residential dwellings do not apply for non-household development. However, non-household development should be encouraged to demonstrate the installation of water efficient products where possible. SBVs and water efficiency labelling can help in this regard, however government actions to set exemplar standards for non-households will likely be required to regulate non-household developments more closely.

Table 9 shows the projected changes for leakage as percentage reductions. Note there is no variation around Low, Medium, and High programmes for leakage. This results from the expectation that Thames Water hit their leakage target for 2049/50, resulting in the value constraining each programme. High+ presents an accelerated leakage profile, with a target of near 50% reduction by 2037/38. This programme heavily relies on expensive leakage innovation and mains rehabilitation policies. For context SWOX had a reported leakage of 68.5 Ml/d in 2021/22, assuming a linear fall from 2017/18 to 2049/50 for the target levels, this would result in an estimated leakage of 48.5 Ml/d in 2041.

Table 9- Demand programme leakage reductions from 2017/18 levels

Demand Programme	2024/25	2026/27	2031/32	2037/38	2049/2050
Low/Medium/High	25.2%	32.8%	40.3%	45.0%	52.5%
High+	25.2%	33.2%	42.1%	49.6%	57.8%
Target		20%	30%	37%	50%

In terms of resource options, the latest WRMP has identified a number of potential resource options following a screening process which was primarily based on stakeholder engagement and scenario testing. The main options proposed include a new reservoir near Abingdon-on-Thames in Vale of White Horse. The reservoir would be filled from the River Thames in the winter. When river levels fall or demand increases, water would be released from the reservoir back into the river for re-abstraction downstream. It should be noted that the Vale of White Horse District Council currently oppose this proposal.

Thames Water intend to submit a development consent order (DCO) in 2026, seeking permission to construct and maintain the new reservoir. If granted, construction is forecast to begin in 2029 with the reservoir planned to begin operating in 2040. Supply to the Thames Water supply area could be increased by up to 271 Ml/d, some of the supply would also be provided to other water companies. In terms of the SWOX WRZ specifically, it is expected that supplies could be bolstered by up to 48 Ml/d after 2050 for the more extreme future scenarios[32]. This is close to the end of the JLP period; however, it could offer some security to both districts if n place.

Other reservoir options in Chinnor, South Oxfordshire and Marsh Gibbon, Buckinghamshire are also being explored by Thames Water. These reservoirs would also serve a number of WRZs across the

[32] Thames Water (20) South East Strategic Reservoir Option (SESRO) Technical Supporting Document B7 https://www.thameswater.co.uk/media-library/home/about-us/regulation/regional-water-resources/south-east-strategic-reservoir/gate-2-reports/B-7---SESRO-SEA.pdf

Thames Water supply area. Estimates suggest that Chinnor could provide an additional 66 Ml/d to the overall supply area, with Marsh Gibbon up to 149 Ml/d.

Raw water transfers could also supply a significant amount of additional yield. A raw water transfer from the River Severn in Deerhurst, Gloucestershire to Culham, South Oxfordshire could potentially supply 107 Ml/d of additional yield to the Thames Water supply area. A transfer from the Oxford Canal could also provide up to 15Ml/d to the SWOX WRZ specifically.

A further yield of 11.1 Ml/d could be found from groundwater abstractions, internal inter-zonal transfers, and the removal of pumping constraints.

Whilst these supply options offer large increases in yield, they are subject to significant lead times, with the majority forming part of Thames Water's long-term plan (2045-2099). Table 10 summarises the feasible list of resource options for the SWOX WRZ. Note, given the surplus of water within the Henley WRZ further resource options have not been explored.

Table 10-Feasible Resource Options for SWOX WRZ

Option Type	Name	Output (Ml/d)	Commentary
Raw Water Transfer (conveyance)	Severn Thames Transfer	107	107 Ml/d is the mid range option. A lower range and upper range option of 80 Ml/d and 134 Ml/d are also being explored. The transfer would serve the entire Thames Water supply area.
	Oxford Canal Transfer	15	
New Reservoir	Abingdon-on-Thames Reservoir	185	The output value stated is for a 100Mm^3 reservoir. Sizes from 75-150 Mm^3 are being considered providing between 149-271 Ml/d in terms of output. The reservoir would serve the SWOX, London and SWA WRZs. It would also help provide supply to other water companies.
	Chinnor Reservoir	66	The reservoir would serve the SWOX, London and SWA WRZs.
	Marsh Gibbon Reservoir	103	The output value stated is for a 50 Mm^3 reservoir. Sizes from 30-75 Mm^3 are being considered providing between 66-149 Ml/d in terms of output. The reservoir would serve the SWOX, London and SWA WRZs.
Groundwater	Moulsford 1	2	
	Woods Farm	2.4	
Removal of Constraints to Deployable Outputs	Ashton Keynes borehole pumps	2	
Internal Inter-Zonal Transfer	Henley to SWOX	2.4	Option to transfer 5 Ml/d also considered feasible.
	Kennet Valley to SWOX	2.3	Option to transfer 4.5 Ml/d also considered feasible.

In addition to the supply options outlined above, the WRMP has also identified a number of drought permit options. Drought permits are options that enable water companies to abstract more water than permitted by their abstraction licenses. These options are only available in drought situations and require the water company to demonstrate that there has been an exceptional shortage of rainfall. For the SWOX WRZ, the drought permit for Gatehampton has the potential to offer an additional yield of 3.5 Ml/d. For the Henley WRZ, the drought permit for Sheeplands/Harpsden has the potential to offer an additional yield of 5.6 Ml/d.

Unlike the supply options, the demand options are able to deliver from the first year of implementation due to shorter lead times. Whilst the yield from such measures are typically less than those found for the supply options, they still offer significant savings. Based on a review of the figures estimated in the WRMP, reductions in consumption and leakage could yield approximately 43.9 Ml/d in the SWOX area by 2041 based on the target estimates. This should be sufficient to significantly offset some of the deficits measured in the development scenarios tested by Thames Water. However, it should be noted that there remains an element of risk around the expectation on the public and on the government to assist in the demand reductions set.

The current dwelling numbers in the JLP are being rolled forward from existing adopted local plans, but do exceed those in Thames Water's WRMP. It should also be noted that the JLP trajectories for housing growth are not uniform to 2041. There is a projected peak in South Oxfordshire around 2031/2032 of approximately 1,500 homes a year, which then falls to between 1200-1400 up until 2041. For the Vale of White Horse, the number of dwellings per year is expected to be between 1000-1200 homes between 2021 and 2033, which then falls to between 600-700 up until 2041. This could bring additional pressures in the first half of the plan period which further highlights the need for Thames Water's demand management and resource options reductions to take effect. It may also necessitate the need for new interventions from the district councils such as stricter water use standards.

4.8 Site Specific Assessments (RAG reports)

The analysis undertaken to this point has focused on current and future water availability in the SWOX and Henley WRZs and this has been scaled down to the South Oxfordshire and Vale of White Horse districts. However, even if sufficient water may be available in the short to medium term, the infrastructural capacity needs to be in place to ensure that water can be transferred to new developments.

To help assess existing capacity Thames Water was provided with a list of 135 sites that are either proposed for allocation in the JLP or allocated for development in made neighbourhood plans. A list is provided in Appendix 1 detailing each site. In total 101 of the sites are residential, 27 are for employment and 7 are mixed use. Thames Water assessed these sites against the existing capacity of the clean water and wastewater networks, and generated a series of RAG (red, amber, green) reports which scored each site based on the available capacity and the requirement for local upgrades. For clean water, each development is 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. The RAG categories for clean water are listed below:

- Green – no capacity constraints, with the development site's net dwelling increase within the DMA.
- Amber – medium risk to the network, modelling required to ascertain. Sites within a Source Protection Zone (SPZ) will automatically be classed as amber.
- Red - The proposed level of development will require a Development Impact Assessment as the net property equivalent increase is above the agreed upon DMA upper threshold for growth.

For employment allocations which do not have dwellings and therefore a stated number of dwellings, Thames Water were not able to provide a RAG category based on the DMA threshold. In these cases, we have identified the score for nearby residential allocations located in the same DMA and where appropriate applied the same status to the employment allocation. Where no other site is served by the same infrastructure or where there is significant uncertainty no score is assigned.

In terms of the sites with dwelling numbers provided, 53 of the sites are scored red, 5 are scored as amber and 47 as green. The sites with the largest dwelling numbers tend to score red whereas those with lower dwelling numbers score amber and green. For the sites without dwelling numbers, 13 are scored as red (inferred), 5 are scored as amber (inferred) and 12 are not assigned a score due to insufficient information.

For the sites scored amber or red, the water network capacity in the surrounding area will be unable to support the demand anticipated from the development. In these locations local upgrades to the existing water network infrastructure will be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work with Thames Water early on in the planning process to understand what infrastructure is required, in addition to where, when and how it will be delivered. Any development needs to consider the lead times detailed in Table 1.

Figure 5 and Figure 6 shows the location of each of the sites, and their water supply score (RAG) following Thames Water's assessment. Thames Water's original RAG reports for both water supply and wastewater are provided in Appendix 2 with a summary of Thames Water's comments on each site also listed.

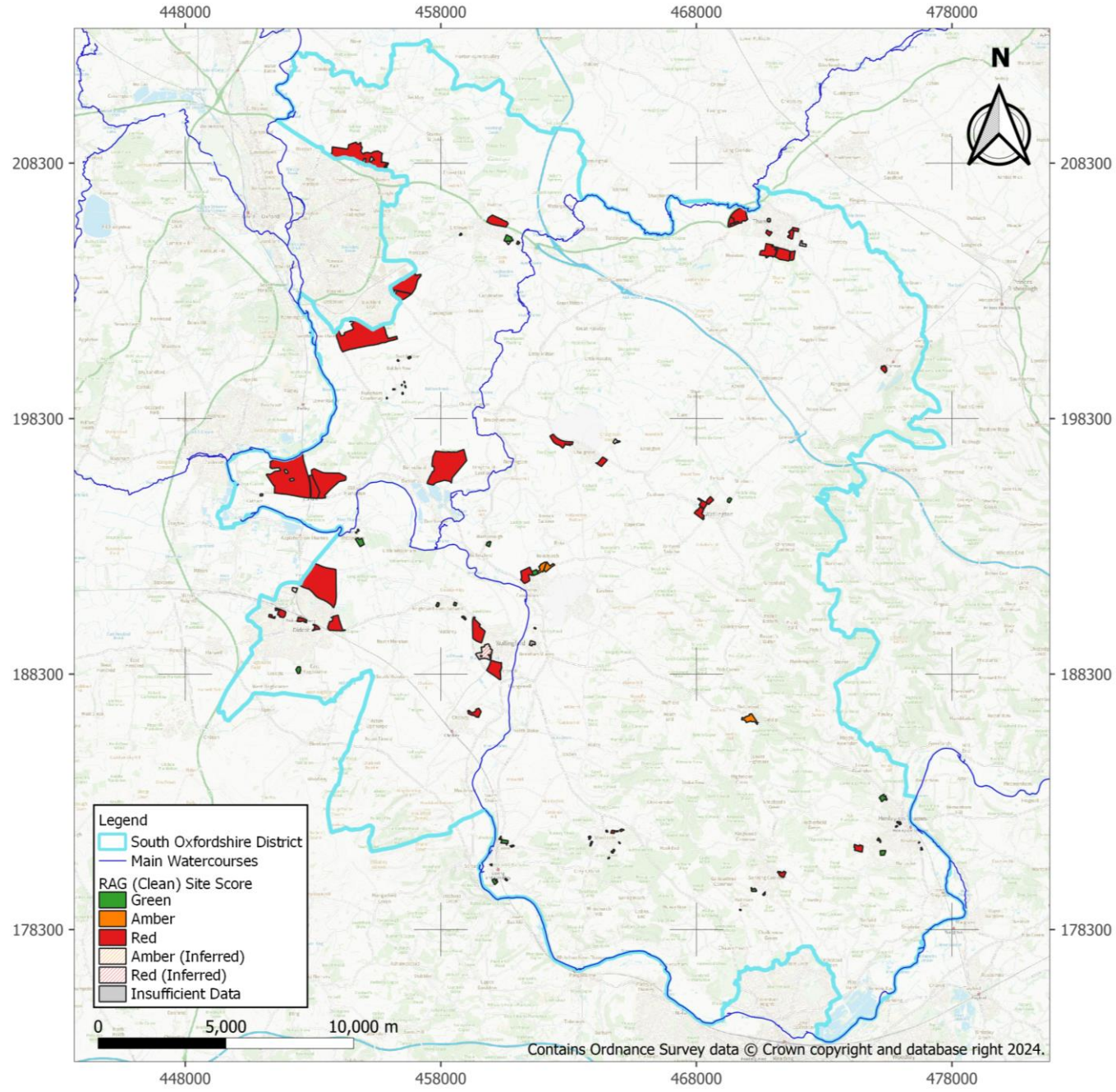

Figure 5- RAG Assessments for South Oxfordshire District

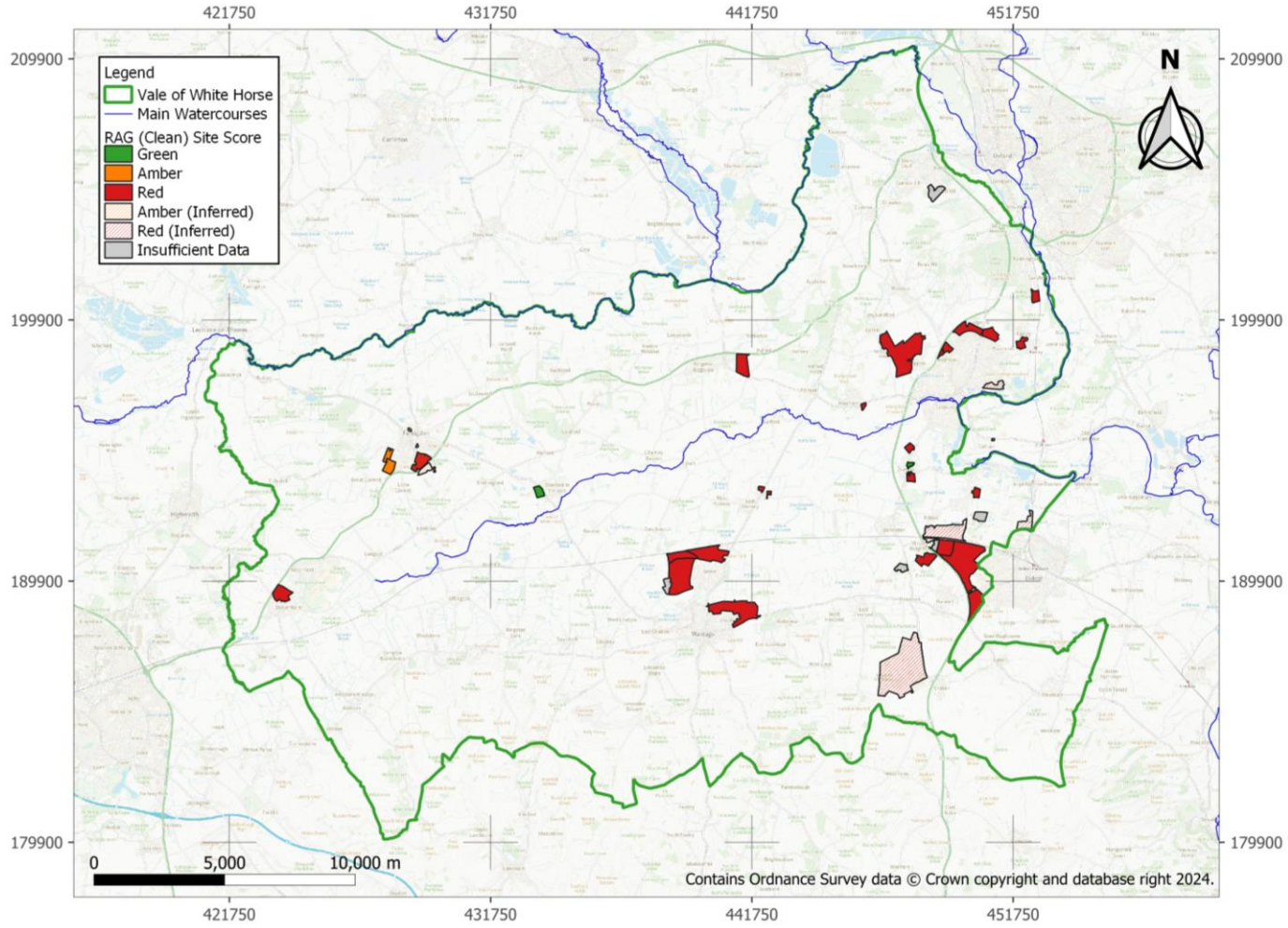

Figure 6- RAG Assessments for Vale of White Horse District

4.9 Abstraction Licenses

A data request was sent to the EA to establish the existing water abstraction licenses currently in use in South Oxfordshire and the Vale of White Horse. Currently there are a total of 59 abstraction licenses in place including 2 area abstractions, 47 point abstractions and 10 reach abstractions; 32 of these come from groundwater sources with the remaining 27 coming from surface water sources. Table 11 summarises the volumes abstracted for each abstraction type and Figure 7 maps all of the abstractions scaled by annual abstraction volume. Based on the figures provided it is estimated that on average 13.46 Ml/d is abstracted, although this figure will vary seasonally. Appendix 3 provides the full abstraction records provided by the EA.

Table 11- Abstraction License Details

License Type	Maximum Daily Abstraction (m^3)	Total Annual Abstraction (Ml)
Area	1370	133.2
Point	31963	4612.9
Reach	4452	171.7

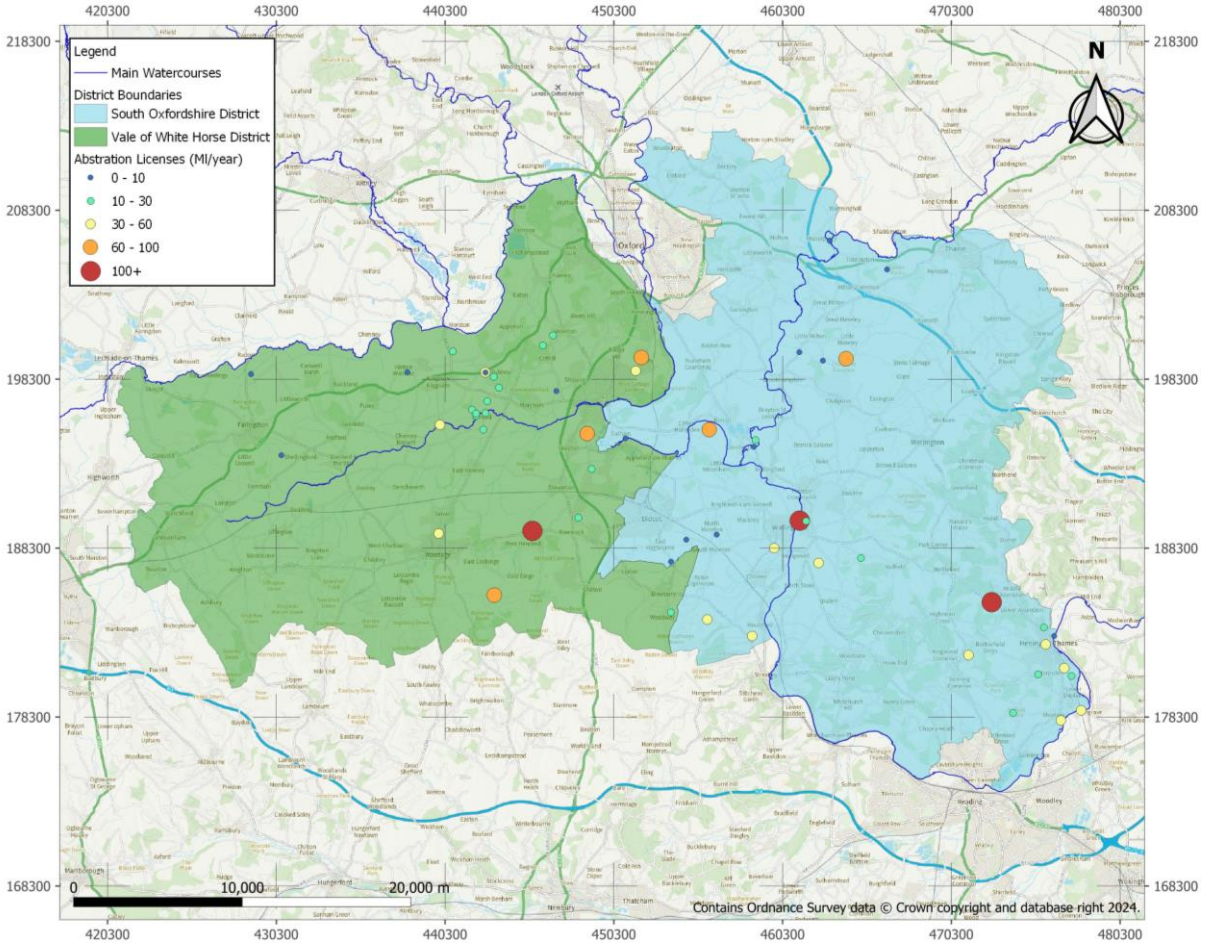

Figure 7- Location of abstraction licenses in both districts scaled to annual abstraction volume

Based on the Thames Abstraction License Strategy[33] the Lower River Thames which encompasses the majority of both districts is classed as 'water not available for licensing' up to the Q30 flow. The Q30 is the flow that will be equalled or exceeded for at least 30% of the time it is typically equivalent to the mean flow.

However, the strategy states that there is no evidence to show that managing the Thames to the highly restrictive Q30 hands off flow (HoF) identified in the resource assessment will benefit the river and its ecology. Evidence shows that the current management of abstraction in the Lower Thames is not preventing it from reaching 'Good Ecological Potential (GEP)' and the EA recognise that they have a duty to ensure abstraction meets the needs of people, businesses and the environment.

The bespoke strategy devised allows abstractions of less than 2 Ml/d to take place when flows recorded on the River Thames at Kingston are above Q50 (based on daily mean flows over the preceding 5 days). For all abstractions above 2 Ml/d, a hands-off flow (HoF) of between the Q50 and Q30 is applied based on the perceived level of risk in the area. The abstraction strategy also highlights that more stringent requirements may also be required in protected areas. It specifically lists the Little Wittenham SAC in South Oxfordshire.

Groundwater licences that do not have a direct impact upon river flow and will not contribute to the deterioration of groundwater quantitative status may be permitted without the same restrictions. In these cases, restrictions will be determined on a case-by-case basis and applications will be subject to the normal licence determination process.

In terms of the existing abstractions, the abstraction strategy identifies four areas where there are further specific actions to address unsustainable abstraction. One of these, Assessment Point 3 (AP3) in the Thames basin, is located at Dys Lock and Weir near Dorchester in South Oxfordshire. Waterbodies upstream of AP3 are failing to achieve good ecological status. Thames Water have investigated the impacts of their abstraction at Farmoor and identified public water supply to be contributing to the failure. The abstraction strategy mentions that options to restore habitat and ecology in the catchments upstream of AP3 are being considered and implemented.

Note, the Kennet and Vale of White Horse Abstraction License Strategy[34] covers a small part of the Vale of White Horse district. It is also based on flows recorded at the River Thames at Kingston and has the same restrictions in place. The strategy identifies one area within the Vale of White Horse district where further actions are being implemented; this is for AP3 in the Kennet and Vale of White Horse area, which is located on the River Ock. Water bodies upstream of AP3 are impacted in part by public water supply abstractions. Thames Water have carried out an investigation and identified their abstractions at Childrey Warren and Manor Road to be impacting these water bodies. Following this investigation, the Childrey Warren source is planned for closure, and habitat enhancement works will be carried out to reduce the impacts of abstraction.

The majority of abstraction licenses across the districts are for agricultural purposes. However, further abstraction for water supply may be required going forward. This will depend on development and climate pressures not only in the districts but across the wider Thames Water supply area. It will also be influenced by the implementation of Thames Water's WRMP. In this regard, existing

[33] EA (2019) *Thames Abstraction License Strategy*
https://assets.publishing.service.gov.uk/media/5de4ebc940f0b650c268495f/Thames-Abstraction-Licensing-Strategy.pdf
[34] EA (2019) *Kennet and Vale of White Horse License Strategy*
https://assets.publishing.service.gov.uk/media/5cb70475e5274a4f43fa5077/Kennet-and-Vale-of-White-Horse-Abstraction-Licensing-Strategy.pdf

abstractions may need to be reduced through better management practices. DEFRA's water abstraction plan[35] lists the following measures to reduce abstraction:

- Introducing controls on more licences to better protect the environment, particularly at low flows.
- Capping licences to prevent increased abstraction damaging the environment.
- Fine tuning the use of surface water and groundwater sources to make the best use of water when it is available while protecting the environment.
- Supporting rapid water trading where it is needed most to allow abstractors to share access to water quickly.
- Allowing some winter abstractors to take water at the highest flows in the summer to boost the use of stored water.
- Sharing real-time information on river flows and forecast changes to help abstractors plan their water use.
- Managing water discharges to benefit abstractors downstream who depend on them.

4.10 Summary

Based on the DYAA and DYCP forecasts in Thames Water's latest WRMP there could be shortfalls in water up to 2041 and beyond. This suggests that water shortage for both district council areas is a real concern moving forward. Without corrective action, the supply for both districts could be less secure which will mean a greater probability that demand restrictions will be required in dry years.

The WRMP has identified demand management through a combination of leakage reduction, smart metering and the promotion of water efficiency as the best means to negate a water deficit in the short to medium term. This should be sufficient to offset some of the deficits estimated, however supply options are likely to be necessary, especially in the longer term. In this regard, Thames Water is exploring a number of options for its supply area including a new reservoir near Abingdon-on-Thames, raw water transfers and groundwater abstractions. These have the potential to offset the deficits estimated, however will require significant lead in times and are proposed to serve the Thames Water supply area rather than the districts in isolation.

In terms of infrastructural capacity, based on the RAG reports provided by Thames Water significant barriers currently exist for a number of sites. This means that upgrades will be required across both districts to ensure that water supply infrastructure is in place to accommodate the development being brought forward as part of the JLP. Typically, these upgrades would have a lead time of 1-3 years. In this regard, the developer is encouraged to work with Thames Water early on in the planning process to understand what infrastructure is required, in addition to where, when and how it will be delivered.

Abstractions across both districts predominantly come from agriculture, overall, their impact on water resources is thought to be small. However, further abstraction for water supply may be required going forward. This will depend on development and climate pressures not only in the districts but across the wider Thames Water supply area. It will also be influenced by the implementation of Thames Water's WRMP.

[35] DEFRA (2021) *Water abstraction plan* https://www.gov.uk/government/publications/water-abstraction-plan-2017/

The assessment for the districts undertaken provides an understanding of water resource pressures in both districts in the context of future development and climate change. However, it is important to note that the findings are caveated on the basis of several assumptions. The main evidence gaps are identified as:

- Whether the demand and supply changes forecasted for the SWOX and Henley WRZs based on population and dwellings fully translate to the South Oxfordshire and Vale of White Horse districts.
- The effects on water resources of the development (above Thames Water's current projections) proposed in the JLP on water demand.
- Given the scale of water network upgrades required, it is unclear whether all upgrades can be funded and delivered in time for each development site.

It is important to note that the JLP is not proposing significantly more development above what is already set out in existing adopted local plans for each district. However, Thames Water's current WRMP seems to project lower dwelling numbers for the JLP plan period. The differences in numbers is thought to be partly due to Thames Water's plan-based forecasts for South Oxfordshire using local plan data accessed in March 2020, prior to the adoption of the South Oxfordshire Local Plan 2035 which took place in December 2020. It may also be related to the approach used in this scoping study to estimate population and dwelling numbers for the districts from the WRMP. The estimates have been scaled using ONS population data combined with the figures provided in the WRMP for the SWOX and Henley WRZs. The approach provides a means of assessing the results of the WRMP in the context of the study area however it is subject to uncertainty. This said, the results do firmly point to water shortages being a real issue for the councils without corrective action.

To provide more confidence in the assessment and fill the evidence gaps identified, further technical work would be required in order to refine population estimates and derive specific deficits for both districts considering the quantum of development proposed in the JLP. Population projections could be refined looking at past growth trends and the level of development planned in the districts based on the JLP. Thames Water are best placed to assess the impact of these population changes on supply and demand, which will require an in-depth understanding of how each WRZ operates and access to the models used in development of the WRMP. The deliverability of upgrades to the water network would also require further technical input from Thames Water as sites are brought forward through the planning process.

In view of the above, a water cycle study detailed report is not required to assess water resource and supply, however following adoption of the JLP, further technical work by Thames Water could be useful in better understanding current and future pressures across the districts. It should be partly captured in future updates to Thames Water's WRMP which will make use of more recent local plan data including the JLP.

5 Wastewater Infrastructure, Water Quality and Environmental Capacity

5.1 Introduction

This section assesses the infrastructural capacity of the wastewater system and environmental capacity of the receiving water environment. The infrastructural capacity is defined as the ability of the wastewater system to collect, transfer and treat wastewater from homes and businesses. The environmental capacity is defined as the water quality needed to protect aquatic wildlife and the environment. The latter is associated with the water quality targets required to protect waterbodies and the associated STW and storm discharge environmental permits in place to achieve this. Both are assessed against the proposed development in South Oxfordshire and the Vale of White Horse to determine whether there will be a detrimental impact on water quality, and whether new wastewater infrastructure can be delivered accordingly.

5.2 Infrastructural Capacity

5.2.1 Drainage and Wastewater Management Plan & Catchment Strategic Plan

Water and sewerage companies must produce Drainage and Wastewater Management Plans (DWMPs) (they must cover a minimum of 25 years) looking at current and future capacity, pressures, and risks to their networks such as climate change and population growth. DWMPs must detail how companies will manage these pressures and risks through their business plans and how they will work with other risk management authorities and/or drainage asset owners.

Thames Water published their DWMP in 2023[36], and as part of this produced a long-term Strategic Plan for Oxfordshire, Swindon, Wiltshire, Gloucestershire and Warwickshire[37]. The DWMP process is iterative and will be repeated every 5 years, with the next version due in 2028. The current DWMP has three main goals:

- Stop internal and external property sewer flooding- up to a 1 in 50-year storm event.
- Eliminate harm from storm overflows - no more than an average of 10 discharges per annum by 2045 at overflow locations and no adverse ecological impact.
- Enhancing resilience at sewage treatment works - to ensure 100% permit compliance and protect river water quality.

The area covered by the DWMP includes both districts and encompasses the upper reaches of the River Thames and its tributaries. The region mostly has separate sewer systems that convey wastewater and surface water from homes and businesses. However, combined sewers still make up a significant proportion of the sewer network and many of the separate systems ultimately drain into combined sewers. Rainfall runoff from roofs is often collected by soakaways. Surface water sewers and highway drainage discharge directly into nearby watercourses. The river water quality status in this region and within the two districts specifically is generally moderate to poor (see section 5.3.2 for more detail on watercourse classifications).

[36] Thames Water (2023) *Drainage and Wastewater Management Plan (DWMP)* https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management/our-dwmp
[37] Thames Water (2023) *Oxfordshire, Swindon, Wiltshire, Gloucestershire and Warwickshire Catchment Strategic Plan* https://www.thameswater.co.uk/media-library/home/about-us/regulation/drainage-and-wastewater/oxfordshire-swindon-wiltshire-gloucestershire-warwickshire-catchment-strategic-plan.pdf

The DWMP's initial risk-based screening found that 77% of catchments were vulnerable to the risks associated with development and climate change and warranted long-term planning. The analysis has also identified significant risks of pollution and sewer collapses in the area. If no actions are taken over the next 25 years, properties at risk of flooding internally (up to a 1 in 50-year storm) are forecast to increase from 5% in 2020 to 7% in 2050. In terms of storm overflows, there would be a 36% increase in the number of overflows per annum from 2020-2050 and for STWs, the number of water quality compliance failures would increase from 24% in 2020 up to 37% in 2050.

To prevent these outcomes, Thames Water have identified the following options:

- Sewer lining and manhole sealing - Undertaking a programme of sewer lining and manhole sealing to reduce areas of high infiltration risk that lead to unwanted flows in sewerage systems.
- Network improvements - Managing the impact of surface water on the sewerage system, through the identification of network improvements to address deficiencies in the sewerage network capacity.
- Individual property level protection - Providing vulnerable homes with active and passive sewer flood protection measures.
- Existing inter-catchment transfers - Optimise existing connections between catchments and STWs, to transfer flows in stressed areas to catchments with available capacity.
- Surface water management - Surface water separation and the installation of features to collect, store and/or infiltrate surface water from buildings and impermeable areas.
- Treatment process technologies **-** Implementation of a range of different technologies identified to enhance the performance of the STWs. This will include the use of more intensive wastewater treatment processes which have the capacity to meet future demands.

The widespread implementation of these measures could be vital in ensuring sufficient infrastructural and environmental capacity going forward. The strategic plan produced as part of the DWMP has specifically identified the Appleton and Oxford STW catchments which serve the two districts for future improvement due to issues with capacity, overflows and sewer flooding. In these catchments the measures outlined above will be prioritised.

5.2.2 Sewerage Treatment Works

Discharges from STWs are controlled by discharge consents set by the EA, which detail the flow rate and effluent quality that the STW must meet to achieve water quality targets. The Dry Weather Flow (DWF) is a key parameter in this regard, it is the flow that may be discharged in dry weather (i.e. flow which occurs in the absence of any runoff from rainfall, snow melt or other sources). The DWF permit specifies the allowable discharge flow rate and required effluent quality of the flow.

The flow to full treatment (FFT) is also important it measures how much wastewater a treatment works is able to treat at any time. Where the FFT level is exceeded, water may need to be diverted to storm tanks (if available). Water will typically be held in these tanks until the storm passes. The contents of these storm tanks can then be returned to be treated by the works. Where a storm is prolonged or sustained, then often the environmental permit will allow the water company to release the extra incoming rainwater and diluted wastewater into the environment, normally after partial treatment. If a water company is diverting this rain and wastewater to storm tanks or the environment before reaching the works' FFT level, they could be breaking the conditions of their environmental permit.

Population growth could increase the amount of treated sewage being discharged to the receiving water environment. If population increase causes effluent flows to increase above the consented

flow, then there will be a risk of failing to meet water quality objectives. To mitigate against this, the treatment capacity at STWs may need to be increased to yield a higher FFT. Current DWF permits may also need to be renegotiated.

In developing the JLP and water cycle study, the EA and Thames Water were consulted on the proposed allocations in the context of the current and future planned capacity of the STWs serving both districts. This consultation has highlighted a number of issues with the current capacity of STWs. The text below provides a summary of the main issues faced at key STWs serving the study area where development allocations are proposed. Appendix 4 provides the consultation comments in full.

Abingdon: The EA believe that Abingdon STW is close to using the capacity within its DWF permit. If foul drainage flows from proposed allocation AS10 (Land at Dalton Barracks Garden Village, Shippon) go to Abingdon STW (Appleton STW catchment area also falls within their site areas), it is likely that Thames Water will need to apply for a new permit. Application for the permits should occur well in advance of development occurring. Abingdon is currently a low spilling site, however an increase in storm overflows due to development would be unacceptable.

Appleton: Appleton STW has a requirement under AMP7 to increase FFT, however the EA understands this scheme has been delayed. No additional flows should connect to Appleton STW until the AMP7 scheme is completed. Appleton STW is a frequent spilling site and has been part of the Storm Overflow Assessment Framework (SOAF) to identify causes for the frequent spilling, the environmental impact and to propose solutions to reduce storm overflows.

The EA believe that Appleton STW may also be close to, or already exceeding, its DWF permit. An assessment is required to determine the remaining capacity at the STW. If the flows from site AS10 (Land at Dalton Barracks Garden Village, Shippon) go to Appleton STW, it is likely that Thames Water will need to apply for a new permit.

Benson: A AMP7 Flow to Full Treatment (FFT) scheme has recently been completed at Benson. Benson STW has sufficient storm tanks for the population served, but this capacity will be eroded if they are not updated in line with development. The EA believes that Benson STW is approaching its DWF capacity and may need to apply for a new permit in the future, more information is required to confirm this.

Culham: The DWF permit at Culham has quite a bit of capacity (relative to its size), but the development in the JLP discharging to Culham STW is quite large compared to the size of the STW, especially considering sites AS2 (Land adjacent to Culham Science Centre), AS11 (Culham Science Centre) & AS1 (Land at Berinsfield Garden Village). Culham is currently a low spilling site, however there is a risk that additional development may lead to increased instances of storm overflows impacting the receiving environment. A headroom capacity assessment is required to ensure that the DWF permit is not exceeded and to give Thames Water adequate time to ensure any new permits are in place in advance of flow exceeding their permitted limits.

Didcot: There is a large amount of development planned within Didcot STW catchment. The majority of this has planning permission already. This is with the exception of one site allocation in the JLP, AS9 (North west of Valley Park) which is a proposal for 800 dwellings. Didcot STW is a site of concern for the EA. It is a high spilling site and exceeded its DWF in 2020 and 2021 on the basis of flow rate and phosphate. Thames Water are required to approach the EA to apply for a new DWF permit that covers growth up to an appropriate design horizon. Until a new permit is in place, the EA will not be able to support any further development within this STW catchment which may affect the development of AS9 (North west of Valley Park) and any potential windfall sites within the STW catchment.

The issues largely relate to phosphate discharging into the Moor Ditch and Ladygrove Ditch which have seen a deterioration in their WFD Phosphate status from Moderate in 2019 to Poor in 2022. New development will not be deemed acceptable if it leads to a deterioration of any WFD status.

Oxford: Upgrades are due to be delivered by March 2025 at Oxford STW. These are required to allow the STW to 'catch up' because the FFT is considered too small for the population it currently serves. A FFT figure has not been agreed between the EA and Thames Water, and it is expected that the scheme will not be delivered by March 2025. This means the site is at risk of further non-compliance. This may lead to wastewater flow from within the catchment not being passed forward for treatment and the risk of prolonged storm overflows. 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. Given the issues mentioned, any additional flows discharging to Oxford STW present a significant environmental risk. According to the EA, Thames Water need to develop a plan to deliver the AMP7 obligations in a timely manner, show evidence of coming back into compliance, and plan appropriately into the future to meet the demands of development outlined in the JLP and other local Plans that propose development within the Oxford STW catchment. The site allocations which would drain to the Oxford STW in the JLP include AS3 (Land south of Grenoble Road), AS4 (Land at Northfield) and AS5 (Land at Bayswater Brook). Oxford City Council who have the most potential development draining to the works, have prepared a statement of common ground[38] with the EA and Thames Water in support of their emerging 2040 local plan, which sets out how all parties will work together to satisfactorily resolve the issues in a timely manner.

The text above points to significant issues with regard to development in some of the STW catchment areas, especially for allocations being brought forward early in the plan period. This is particularly the case with regard to the Didcot and Oxford STWs, where the EA would not currently support additional development.

Infiltration of groundwater and windfall development could also be significant in some STW catchments potentially compounding some of the issues above if sewer networks are not properly maintained and upgraded as required. The windfall development estimates provided in Appendix 1 show the highest levels of potential additional development in the Abingdon (995 dwellings by end of plan period), Benson (394 dwellings), Oxford (528 dwellings), Didcot (227 dwellings) and Wantage (627 dwellings) STW catchments. This is expected as these STWs serve the largest urban centres in the districts.

In terms of groundwater infiltration, it can result in large volumes of groundwater infiltrating into the sewage network and increasing water volumes reaching STWs. This extra volume causes a STW to have to process higher volumes of effluent during periods of high groundwater levels. In Oxfordshire specifically, in response to stage 1 of Oxfordshire Infrastructure Strategy (OxIS)[39] the EA have recommended that a study is conducted to identify the networks effected by groundwater infiltration and that this infrastructure is considered for upgrades as a priority. Thames Water are best placed to take a lead on this study.

[38] Oxford City Council (2024) *Statement of Common Ground between Oxford City Council, the Environment Agency and Thames Water Submission Draft (Regulation 19) Oxford Local Plan 2040 March 2024* https://www.oxford.gov.uk/downloads/file/3154/com-011-socg-with-environment-agency-and-thames-water
[39] City Science (2021) *Oxfordshire Infrastructure Strategy (OxIS)* https://mycouncil.oxfordshire.gov.uk/documents/s59528/OxIS%20Stage%201%20Chapter%201.pdf

5.2.3 Combined Sewer Overflows (CSOs)

Many parts of England have a combined sewage system which transports both clean rainwater and wastewater. During heavy rainfall the capacity of these pipes can be exceeded, which means possible inundation of STWs and backing up of network infrastructure. Combined sewer overflows (CSOs) were developed as overflow valves to reduce the risk of sewage backing up during heavy rainfall. These overflows discharge diluted untreated sewage during heavy rainfall. CSOs discharge to watercourses in both districts.

The EA work closely with water companies to ensure CSOs are closely monitored to identify where the system is not operating as it should. The Environment Act 2021[40] introduced new requirements, stipulating that storm overflow discharges in England must be reported, including their location and the duration of any spill.

The national government's Storm Overflows Discharge Reduction Plan[41] sets targets for regulators and water companies to prioritise improving the water environment. This ties into some of the aims set out in Thames Water's DWMP (see section 5.2.1). The reduction plan states that by 2040, water companies should have: improved 87% of overflows discharging into high-priority sites and 60% of all overflows. By 2050 all overflows should be improved. Note, for a CSO to be considered as improved, it must meet the following criteria:

- It must be demonstrated that discharges from the CSOs have no local adverse ecological impact.
- The CSO will not be permitted to discharge above an average of 10 rainfall events per year.
- The CSO has screening controls that avoid pollution by limiting discharge of persistent inorganic material. Disinfection may be required in some cases to reduce harmful pathogens.
- The CSO spills no more than 2 times per season when upstream of a designated bathing water.

In terms of the above, there is currently a bathing water at Wallingford and potential for others within both districts in the future. The requirements above apply to CSOs at STWs and network CSOs.

Thames Water were contacted to obtain data on CSO monitoring within the two districts. The CSOs monitored in the previous year (2023) across both districts are summarised in Table 12. Appendix 5 provides the full dataset which includes further information on spills outside of the study area, spill durations and figures for previous years dating back to 2018. The data shows CSO spills to be most prevalent in the Abingdon STW catchment, however it should be noted that currently not all STW catchments are monitored. As outlined in section 5.2.2 there are a number of high-spilling STW catchments in the area, and further development has the potential to increase risks unless infrastructural capacity is in place.

[40] Parliament of the United Kingdom (2021) *The Environment Act 2021* https://www.legislation.gov.uk/ukpga/2021/30/contents
[41] UK Government (2023) *Storm overflows discharge reduction plan* https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

Table 12- CSOs monitored in study area

Name	Eastings	Northings	WFD Waterbody	Years of Record	Average spill count per year
Abingdon STW	449330	195090	Thames (Evenlode to Thame)	4 (installed 2019)	29.4
Cassington (New)	446600	210100	Thames (Evenlode to Thame)	4 (installed 2019)	17
Dorchester WWTW	458010	193700	Thame (Scotsgrove Brook to Thames)	5 (installed 2018)	2.6
Friday Street, Henley	476300	182700	Thames (Reading to Cookham)	5 (installed 2018)	6.5
Goring WTW	460200	182901	Thames Wallingford to Caversham	5 (installed 2018)	0.17
Littlemore Low Level	452500	202900	Thames (Evenlode to Thame)	4 (installed 2019)	4.2
Stanford in the Vale STW	434420	192910	Ock (to Cherbury Brook)	3 (installed 2020)	2.75

5.2.4 Site Specific Assessments (RAG reports)

To help assess existing infrastructural capacity, Thames Water were provided with a list of 135 sites proposed for development in the districts. These sites are either JLP allocations or made neighbourhood plan allocations for residential and/or employment uses. Thames Water assessed these against the existing capacity of the clean water (see section 4.8) and wastewater networks, and generated a series of RAG (red, amber, green) reports which scored each site based on the available capacity and the requirement for local upgrades. The RAG categories for wastewater are summarised as follows:

- Green – Site represents no capacity constraints to the network, assuming a single point of discharge, with no additional surface water drainage to the network. No constraints with the STW.
- Amber – Site represents medium network risk to the network and/or some constraints with the STW or Sewerage Pumping Station (SPS).
- Red - High risk to the network and/or capacity constraints at the STW.

Thames Water were not able to do a full assessment where dwelling numbers were not provided, which was the case for the employment allocations. In these cases, WHS have identified the score for nearby residential allocations served by the same infrastructure and where appropriate applied the same status to the employment allocation. Where no other site is served by the same infrastructure or where there is significant uncertainty, no score is assigned.

In terms of the sites with dwelling numbers provided, 68 are scored as amber and 41 as green. For the employment allocations which do not have dwelling numbers, 13 are scored as amber (inferred), 7 are scored as green (inferred) and 6 are not assigned a score given that no nearby residential allocations are served by the same infrastructure. This includes SON009 (Kidby's Yard), WOC016 (Old Coal Yard, Greenmore), WOC017 (Land west of Church Farmhouse), JT1i (Former Esso Research Centre), JT1c (Milton Interchange) and JT1h Didcot Quarter.

For sites scored amber, network upgrades may be required and there may be some constraints at the STW discharged to. Thames Water's original RAG reports for both water supply and wastewater are provided in Appendix 2 which provide a summary of Thames Water's comments for many of the sites. They suggest that for some of the sites the upgrades required are already planned for delivery during AMP8 (2025-2030).

In some cases, upgrades are not yet planned. In these cases, the developer is encouraged to work with Thames Water early on in the planning process to understand what infrastructure is required, in addition to where, when and how it will be delivered. Any development needs to consider the lead times detailed in Table 1.

In addition to local upgrades, a number of STWs have planned capacity improvements earmarked for AMP8. As outlined in section 5.2.2, in some locations upgrades set for AMP7 are yet to be completed, these are essential to allow significant development to take place. This could delay some of the allocations being brought forward, especially those being considered early in the plan period in STW catchments which are already close to capacity.

Figure 8 and Figure 9 show the location of each of the sites and their wastewater supply score (RAG), following Thames Water's assessment.

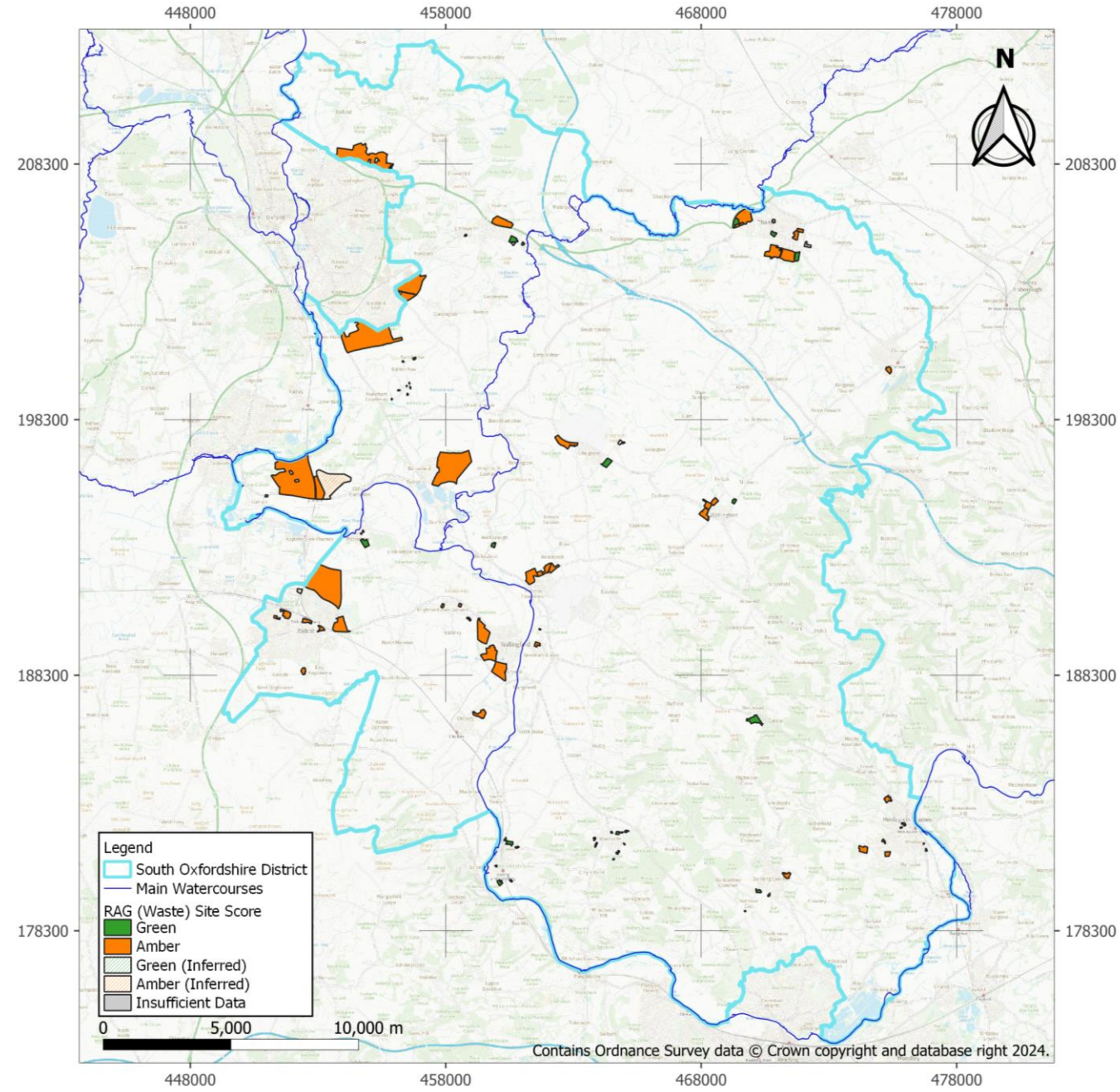

Figure 8- RAG Assessments (Wastewater) for site allocations within the South Oxfordshire District

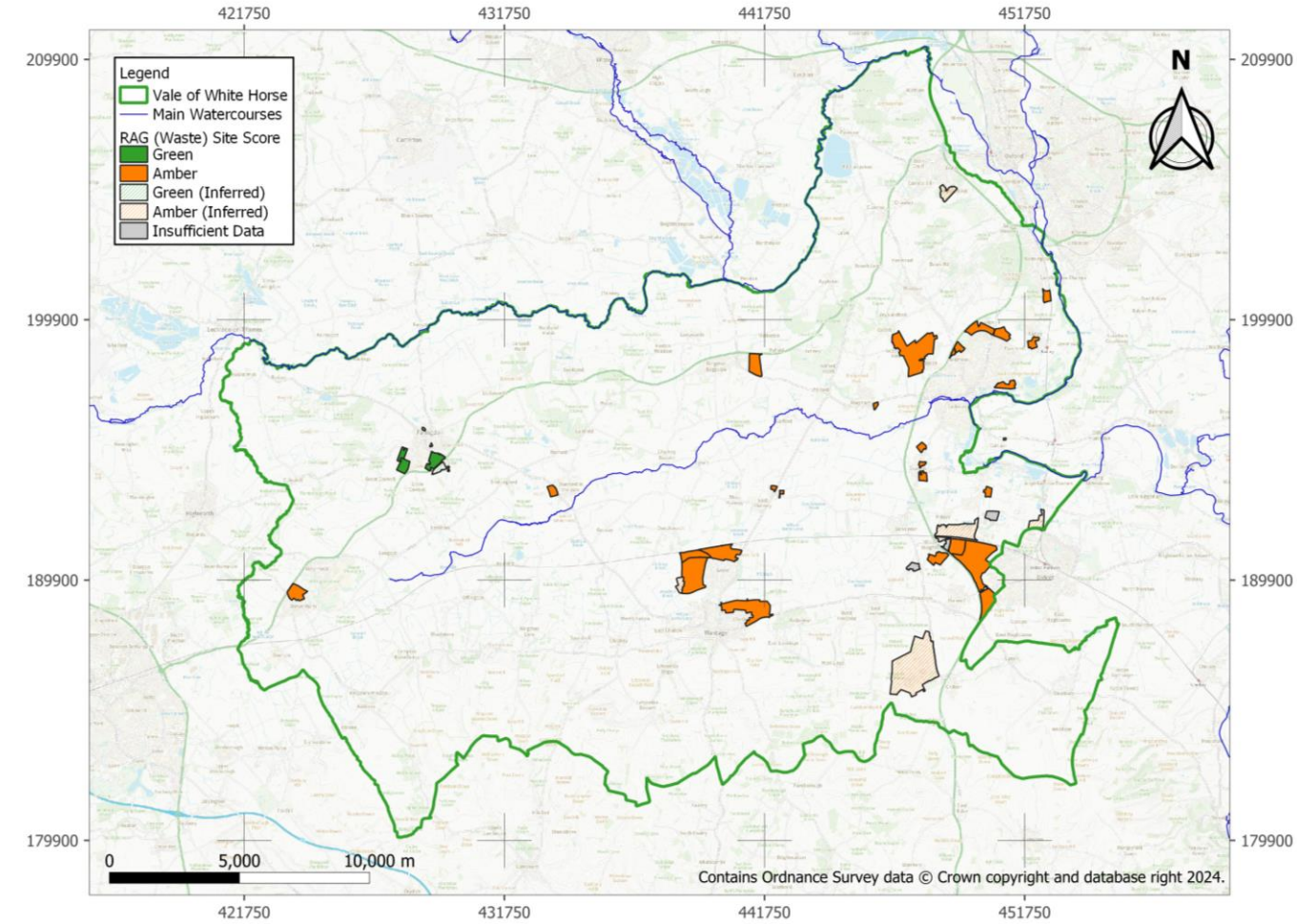

Figure 9- RAG Assessments (Wastewater) for site allocations within the Vale of White Horse

5.3 Environmental Capacity

5.3.1 Thames river basin management plan

The Thames River Basin Management Plan (RBMP) was initially published by DEFRA and the EA in 2015 and updated in 2022. The purpose of the RBMP is to provide a framework for protecting and enhancing the water environment. To achieve this, and because water and land resources are closely linked, it also informs decisions on land use planning.

The RBMP covers the following areas which relate to management of land and water:

- Baseline classification of water bodies
- Statutory objectives for protected areas
- Statutory objectives for water bodies
- Challenges for the water environment
- Summary programme of measures to achieve statutory objectives

The Water Framework Directive (WFD)[42] transposed into law by the Water Environment Regulations 2017 in England and Wales[43] provides most of the legislative basis for the RBMP. Water bodies are assessed based on the WFD indicator, which measures the health of the water environment and assigns them a status. The assessment is based on a range of quality elements relating to the biology and chemical quality of surface waters. Table 13 gives a description of each of the status classes.

Table 13- Definition of ecological status in Water Framework Directive

Status	Definition
High	Near natural conditions. No restriction on the beneficial uses of the water body. 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 water body. 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 water body. 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 water body. 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 water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

These status classes feed into the overall environmental objectives of the WFD and the associated RBMP. The environmental objectives are

- To prevent deterioration of the status of surface waters and groundwater
- To achieve objectives and standards for protected areas
- To aim to achieve good status for all water bodies

[42] European Commission, *Water Framework Directive (2000)*, http://ec.europa.eu/environment/water/water-framework/index_en.html
[43] Parliament of the United Kingdom (2017) *The Water Environment (Water Framework Directive) (England & Wales) Regulations (2017)* https://www.legislation.gov.uk/uksi/2017/407/contents

- To reverse any significant and sustained upward trends in pollutant concentrations in groundwater
- The cessation of discharges, emissions and priority hazardous substances into surface waters
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants

The RBMP outlines the measures potentially needed to achieve these statutory objectives and the regulators/operators responsible. These measures are/will be essential in maintaining environmental capacity in response to increased housing and population growth. Table 14 summarises some of the key measures relevant to the study area. A full list of the measures for the Thames River basin is provided in Appendix 6.

Table 14- Key measures summarised from Thames RBMP

Category	Description	Key Stakeholders
Advice Schemes	Advice to farmers on environmental improvements and nutrient management	NFU
Education, targeted information	Aquatic Biosecurity Campaigns- Slowing spread of invasive species via public awareness	GB Non Native Species Secretariat
	Behaviour campaigns on water use	EA and TW
Financial incentives	Environment Management capital programme including diffuse pollution control initiatives	EA
	EA Flood and Coastal Risk Management capital programme- includes river restoration	EA
	England Woodland Creation Offer- Tree planting to improve water quality	Forestry Commission
	Green recovery challenge fund- various environmental improvement projects	Defra
	Environment Land Management Schemes- Various environmental improvements by land managers	Defra
	Water Environment Improvement Fund- Local habitat improvement schemes and pollution control initiatives	EA
	Letcombe Brook Habitat enhancement	Letcombe Brook project
	Ock Arable Project - Engage with farmers across the catchment to tackle pollution	Freshwater Habitats Trust
	River Thame Restoration- includes fish passage	River Thame Conservation Trust
Guidance/Process	Water Leaders Group to act as advocates for restoration of natural processes within freshwater catchments	EA
	Water Environment Transformation (WET) Programme - to support wider implementation of nature-based solution through PR24 process and the agriculture sector	
	Drainage Wastewater Management Plans to inform measures identified by Water Industry in Price Review24	EA and TW
Non-regulatory	Nature Recovery Network- Various actions to protect, improve, expand, and connect habitats including water and water-dependent environments	Natural England
Partnerships	Catchment partnership led projects and measures related to multiple funding streams and outcomes for water quality, quantity, habitat and flood risk reduction	EA and TW
Regulatory	Water Industry National Environment Programme schemes - Habitat improvements and farm nutrient management plans	EA and TW
	Sustainable abstraction improvements through changes to abstraction licences, licence conditions and non-licence changes at specific sites	EA and TW
	Sewage treatment improvements by changes to licence conditions at specific sites	EA and TW
Research	Water Leaders Group developing shared guidance and case studies for integrating investment in and across catchments	EA
Various	Implementation of the Water Resources Catchment Based Approach (CaBA) Chalk Stream Restoration Group (CSRG) chalk strategy	EA and TW

In addition and in support to the RBMP, River Catchment Partnerships play a key role in certain areas within both districts. This includes the South Chilterns, Ock and Thame. These are collaborative bodies which take an interest over these catchments, developing catchment plans that outlines their goals and action plans for improving the freshwater environment. The Letcombe Brook project and River Thame Conservation Trust play a similar role in looking to improve the ecological status in specific river catchments.

5.3.2 Surface Water

The EA's catchment data explorer was used to extract information about the water environment for several catchments in the Oxford area. The dataset provides information on the ecological and chemical status of catchments throughout the UK.

Aforementioned, the ecological status of catchments can be classified as *Bad, Poor, Moderate, Good* and *High*. For the chemical status, catchments are classed as either as a *Fail* or *Good*. For this study the classifications are used to assess the existing pressures on specific catchments in the study area and get an idea of their environmental capacity. Figure 10 shows the WFD management catchments which intersect the districts.

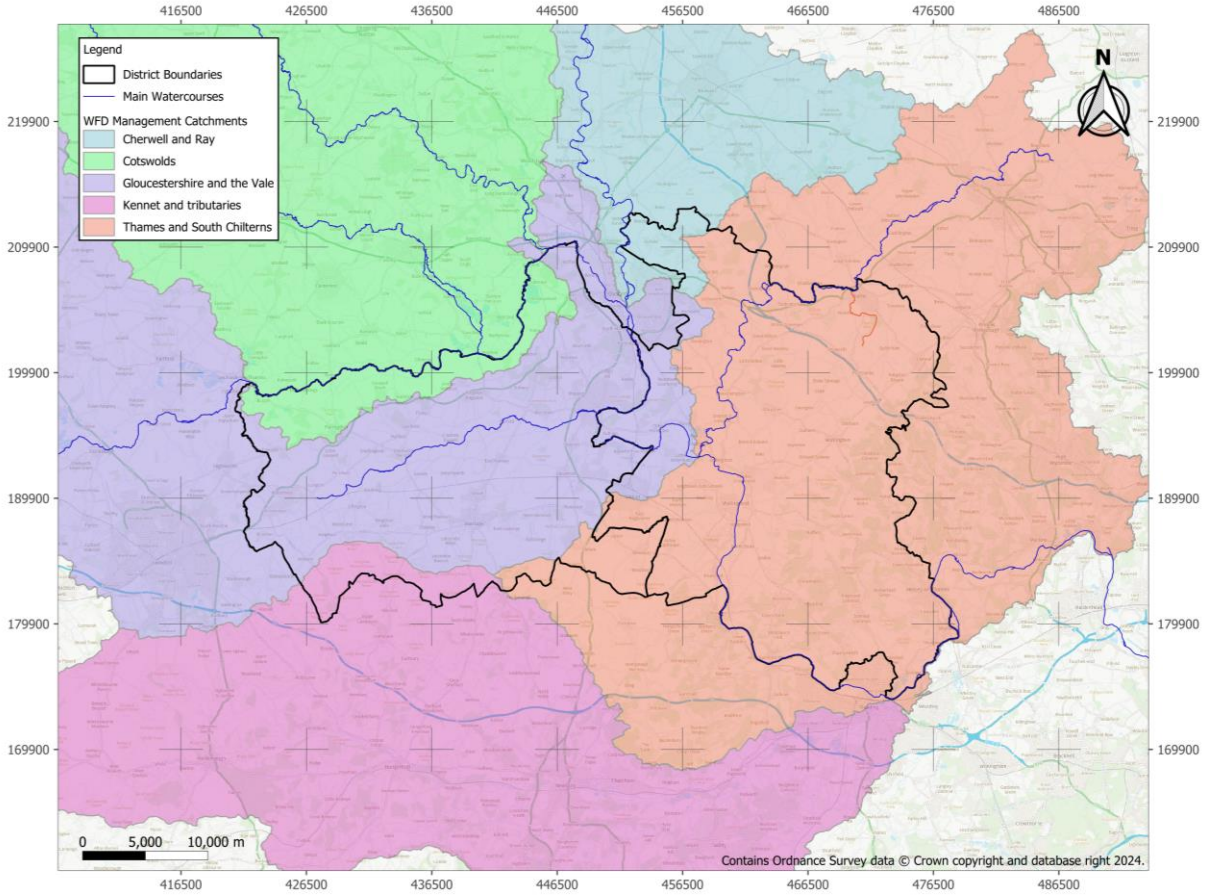

Figure 10- Surface Water WFD Management Catchments intersecting districts

Table 15 shows the ecological and chemical status of the 45 WFD waterbodies which fall within the districts. In total, 4 of the catchments are classed as *Bad*, 18 are classed as *Poor*, 22 are classed as *Moderate* and 1 catchment is classed as *Good.* All catchments were measured to have a *Fail* chemical status in 2019. For the 2019 assessment of chemical status, the EA changed some methods and

increased their evidence base. Due to these changes, all water bodies now fail chemical status. This is largely due to the introduction of thresholds for newly introduced substances. The assessment is not comparable to previous year's assessments. The table also lists where the water industry has been identified as a reason for the watercourse not achieving good status, based on its effect on a specific metric used to determine ecological and chemical classifications. In many of these cases the water industry is not the only reason listed with agriculture, transport and waste management often also being cited as reasons for not achieving good status. Where, the water industry is not identified as a reason, the waterbody failures lie outside of the scope of this study. Those being impacted by the water industry could be more sensitive to future development given its potential impact on increasing pollutant loads.

Table 15- Ecological and Chemical Status of Surface Waterbodies in the study area

Waterbody Name	Ecological	Chemical	Reasons for not achieving good status (water industry)
Baldon Brook (South of Oxford)	Moderate	Fail	
Bayswater Brook	Poor*	Fail	
Berrick Stream and Lady Brook	Poor*	Fail	
Chalgrove Brook	Moderate	Fail	Water industry listed as reason for deterioration in invetebrates and phosphate
Cherwell (Ray to Thames) and Woodeaton Brook	Poor*	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Childrey and Woodhill Brooks	Moderate	Fail	
Childrey Brook and Norbrook at Common Barn	Poor	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Chinor Brook and Sydenham Brook	Moderate*	Fail	
Cholsey Brook and tributaries	Moderate	Fail	Water industry listed as reason for deterioration in invertebrates
Cole (Acorn Bridge to Bower Bridge)	Poor	Fail	Water industry listed as reason for deterioration in phosphate
Cole (Bower Bridge to Thames) including Coleshill	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Cow Common Brook and Portobello Ditch	Poor*	Fail	
Cuttle Brook	Moderate*	Fail	Water industry listed as reason for deterioration in hydrological regime
Ewelme Stream (Source to Thames)	Moderate	Fail	
Filchhampstead Brook at Farmoor	Bad	Fail	Water industry listed as reason for deterioration in macrophytes
Frilford and Marcham Brook	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Ginge Brook and Mill Brook	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Hamble Brook	Poor*	Fail	
Haseley Brook	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Holton Brook and tributaries	Bad	Fail	Water industry listed as reason for deterioration in macrophytes, invertebrates and phosphate
Kingsey Cuttle Brook and tributaries at Thame	Poor	Fail	Water industry listed as reason for deterioration in invertebrates and phosphate
Lambourn (Source to Newbury)	Moderate	Fail	
Latchford Brook at Tetsworth	Poor	Fail	Water industry listed as reason for deterioration in macrophytes and phosphate
Lenta Brook, East of Swindon	Poor*	Fail	
Letcombe Brook	Poor	Fail	
Lewknor Brook	Moderate*	Fail	Water industry listed as reason for deterioration in phosphate
Mill Brook and Bradfords Brook system, Wallingford	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes
Moor Ditch and Ladygrove Ditch	Poor	Fail	Water industry listed as reason for deterioration in macrophytes, invertebrates and phosphate

Northfield Brook (Source to Thames) at Sandford	Moderate	Fail	Water industry listed as reason for deterioration in macrophytes, invertebrates and phosphate
Ock (to Cherbury Brook)	Moderate	Fail	Water industry listed as reason for deterioration in phosphate
Ock and tributaries (Land Brook confluence to Thames)	Poor	Fail	Water industry listed as reason for deterioration in phosphate
Oxon Ray (upstream A41 to Cherwell) including Otmoor	Bad	Fail	Water industry listed as reason for deterioration in fish, dissolved oxygen, macrophytes and phosphate
Pang	Poor	Fail	Water industry listed as reason for deterioration in dissolved oxygen and hydrological regime
Sandford Brook (source to Ock)	Poor*	Fail	
Scotsgrove Brook (upstream Kingsey Cuttle Brook)	Moderate	Fail	Water industry listed as reason for deterioration in dissolved oxygen, macrophytes and phosphate
Stutfield Brook (source to Ock)	Moderate	Fail	Water industry listed as reason for deterioration in phosphate
Thame (Scotsgrove Brook to Thames)	Moderate	Fail	Water industry listed as reason for deterioration in phosphate
Thames (Evenlode to Thame)	Poor	Fail	Water industry listed as reason for deterioration in phosphate and Tributyltin Compounds
Thames (Leach to Evenlode)	Poor	Fail	Water industry listed as reason for deterioration in fish and phosphate
Thames (Reading to Cookham)	Moderate	Fail	Water industry listed as reason for deterioration in phosphate
Thames Wallingford to Caversham	Moderate	Fail	Water industry listed as reason for deterioration in phosphate
Tuckmill Brook and tributaries	Poor	Fail	Water industry listed as reason for deterioration in phosphate and macrophytes
Wadley Stream (Source to Thames at Duxford)	Bad	Fail	Water industry listed as reason for deterioration in dissolved oxygen and phosphate
Waterloo Ditch (East of Coleshill)	Good	Fail	
Wye (Source to High Wycombe fire station)	Moderate	Fail	Water industry listed as reason for deterioration in fish

*Classification from 2019, no classification available for 2022

Listed below in Table 16 are the WFD catchments which, based upon a review of the location of allocations in the JLP and made neighbourhood plans are determined to contain the greatest quantum of development relative to their size. Once more, it should be noted that the majority of the proposed allocations are being rolled forward from the existing adopted local plans for each district. All of the WFD catchments identified currently have an ecological classification of *Poor*, with the exception of the Northfield Brook which is classified as *Moderate*. Figure 11 maps the ecological classification for each WFD catchment overlain by the site allocations.

Table 16- WFD Catchments with greatest quantum of development

Waterbody Name	Site Allocations
Moor Ditch and Ladygrove Ditch	• AS6 (Rich's Sidings and Broadway, Didcot), AS7 (Didcot Gateway, Didcot) and AS9 (NW of Valley Park, Didcot) • HOU2a (Ladygrove East, Didcot), HOU2b (Didcot Northeast), HOU2e (Vauxhall Barracks), HOU2i (Milton Heights) and HOU2s (Valley Park) • JT1a (Southmead Industrial Estate), JT1m (Milton Park), JT1g (Didcot A) JT1h (Didcot Quarter), JTi (Former Esso Research Centre) and JTc (Milton Interchange)
Thames (Evenlode to Thame)	• AS2 (Land Adjacent to Culham Science Centre), AS11 (Culham Science Centre) and AS15 (Oxford Brookes Harcourt Hill Campus) • HOU2o (North of Abingdon-on-Thames), HOU2j (NW Radley), HOU2k (South of Kennington) and HOU2w (NW of Abingdon-on-Thames). • DRT001 (South of the High Street), DRT002 (North of Barrow Road) and DRT003 (Manor Farm) • BAL007 (20-MB) and BAL008 (21-MB) • LOW001 (Long Wittenham Community Hub), LOW002 (Long Wittenham School Site) and LOW003 (Long Wittenham Village Hall Site) • CUL001(Former Waggon and Horses) • JT1f (Abingdon Science Park)
Ock and Tributaries	• AS10 (Land at Dalton Barracks Garden Village) • HOU2w(NW of Abingdon-on-Thames)
Letcombe Brook	• HOU2q (Monks Farm, North Grove), HOU2r (Grove Airfield) HOU2v (Crab Hill, NE Wantage and SE Grove) and HOU2x (North of East Hanney) • AS8 (NW of Grove) • JT1b (Grove Technology Park)
Northfield Brook (Source to Thames)	• AS3 (Land South of Grenoble Road, Edge of Oxford) and AS4(Land at Northfield, Edge of Oxford)

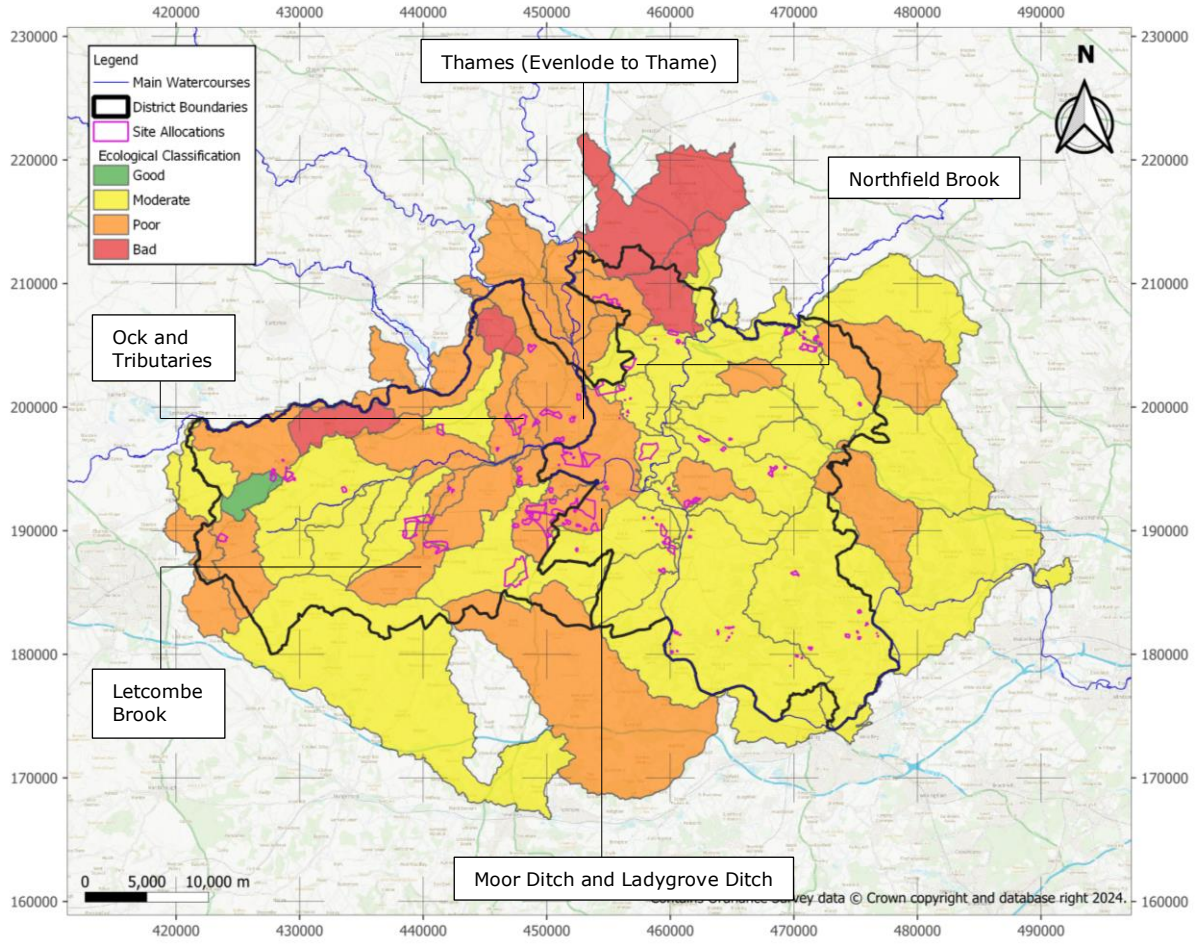

Figure 11- WFD Catchments Ecological Classification

The current status of watercourses within the districts shows them to be potentially vulnerable, with limited environmental capacity especially likely in catchments with failures in nutrient status (e.g. Phosphate, Biochemical Oxygen Demand etc). It should be noted that not all the failures or deterioration necessarily impose a limit to growth. In some cases, they may be due to physical modifications, barriers to fish and drought amongst other factors.

In any case, the findings further highlight the need for the STW upgrades earmarked in section 5.2.2. When implemented, these should improve the headroom available to allow some development to take place without compromising water quality. However there remains some uncertainty on the amount of headroom currently available at some of the STWs and how the development being brought forward in the districts may impact this.

As well as the additional wastewater draining to STWs, development can also affect surface water flow routes and water quality through direct runoff to waterbodies. This has the potential to impact upon the ecology of the watercourses running through districts. In this regard, the use of SuDS and associated flow control should be encouraged to ensure development does not affect or has minimal impact on water quality or flow regimes (more detail on SuDS is provided in section 6.4).

5.3.3 Groundwater

The EA catchment data explorer was also used to assess the status of groundwater bodies. As shown in Figure 12 a total of 9 ground waterbodies intersect the two districts. Groundwater bodies are measured against a quantitative status and a chemical status. Good quantitative status can be achieved by ensuring that the available groundwater resource is not reduced by the long-term annual average rate of abstraction. In addition, impacts on surface water linked with groundwater or groundwater-dependent terrestrial ecosystems should be avoided, as should saline intrusions.

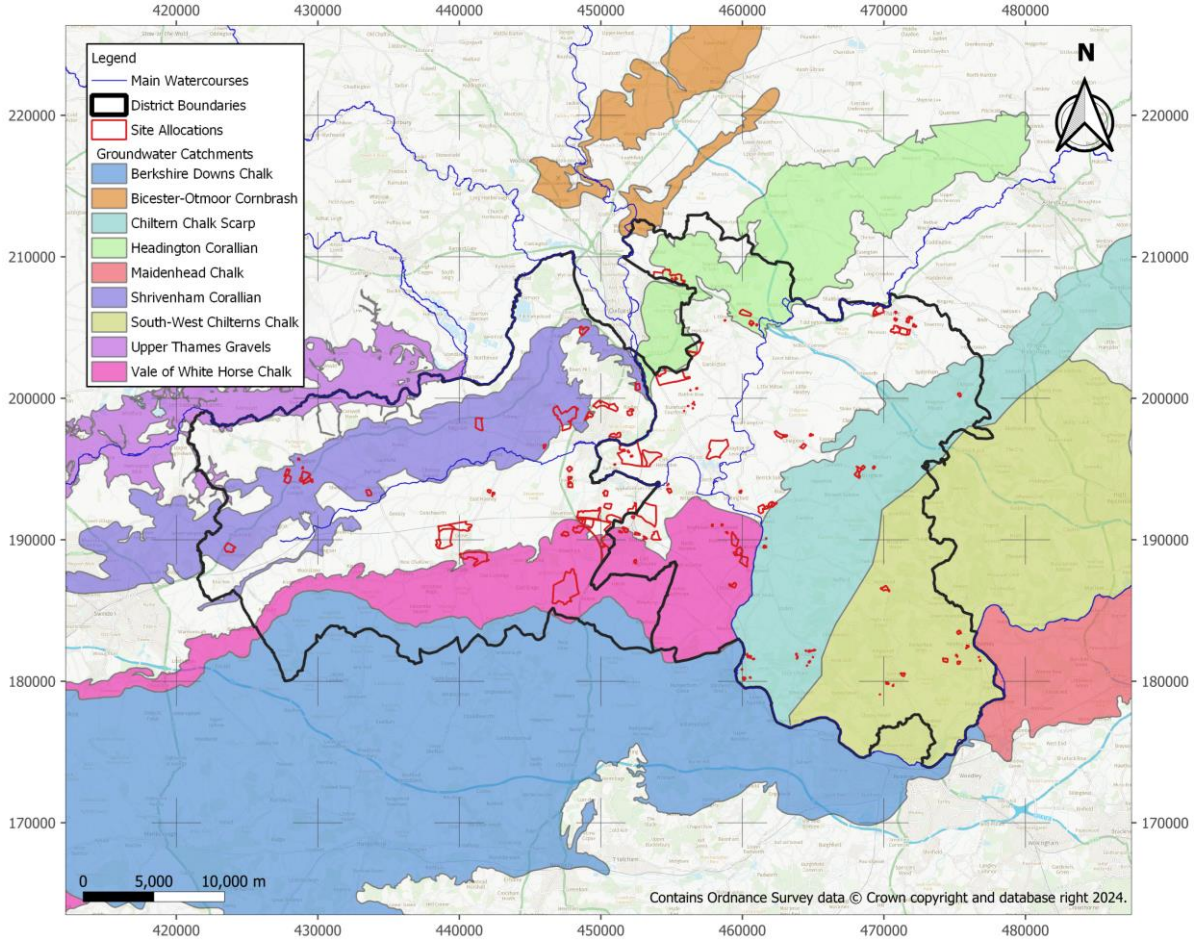

Figure 12- WFD Groundwater Catchments intersecting districts

Table 17 shows the WFD groundwater classifications for the 9 WFD groundwater catchments identified. In total, 7 have a *Poor* overall status and 2 have *Good* status. This is thought to be mostly caused by a *Poor* chemical status with Quantitative status generally *Good* across the catchments.

Table 17- Overall, Quantitative and Chemical Status of Groundwater Waterbodies in the study area

Waterbody Name	Overall	Quantitative	Chemical
Berkshire Downs Chalk	Poor	Poor	Poor
Bicester-Otmoor Cornbrash	Poor	Good	Poor
Chiltern Chalk Scarp	Poor	Good	Poor
Headington Corallian	Poor	Good	Poor
Maidenhead Chalk	Poor	Good	Poor
Shirivenham Corallian	Good	Good	Good
South-West Chilterns Chalk	Good	Good	Good
Upper Thames Gravels	Poor	Good	Poor
Vale of White Horse Chalk	Poor	Good	Poor

The catchments where development allocations are most prevalent are the Shivenham Corallian and the Vale of White Horse Chalk. It is also known that Thames Water abstracts water from a number of these waterbodies for water supply across the SWOX and Henley WRZs. Whilst quantitative classifications are *Good,* abstractions could potentially increase to meet future demand and to offset shortages in surface water supplies as a result of climate change.

5.4 Summary

The sewer network in both districts currently manages the demand of over 290,000 people. This is set to increase significantly as a result of population growth, and it is essential that there is sufficient infrastructural and environmental capacity to safeguard against issues such as ecological damage and sewer flooding.

The STWs serving the districts are the most important infrastructural asset with respect to future development in the districts. As highlighted in section 5.2.2, there are delays in the upgrades earmarked for AMP7 at some of the STWs and uncertainty regarding the headroom available at a number of other STWs.

On a site-specific basis, local upgrades to the existing wastewater infrastructure network are likely required for the majority of sites in the JLP, to ensure sufficient capacity is brought forward ahead of the occupation of development. The capacity of the existing sewer network and STWs could present barriers to development progressing, particularly early in the plan period.

In terms of environmental capacity, the EA's catchment data explorer suggests that most of the watercourses in the study area have *Poor* ecological status and *Fail* with regard to chemical status. This suggests that overall, they are vulnerable at present. Further assessment is needed however to understand which watercourses are being impacted most by the water industry and which will be most vulnerable to future growth.

Future upgrades to the sewer network alongside measures identified in the Thames River Basin Management Plan and Thames Water's DWMP could help in reducing impacts but will take time to take effect. It is vital that the correct measures are followed by several stakeholders, including developers, the EA, local authorities and Thames Water, to ensure that the current statuses of the watercourses improve.

The assessment undertaken in this scoping study presents an overview of environmental capacity and infrastructural capacity for the study area. However, it is limited in its scope and there remains some uncertainty over the impacts of development. This includes uncertainty on the following issues:

- Infrastructural capacity within some of the STW catchments
- The potential for development to cause further deterioration in some of WFD catchments identified.
- Appropriate mitigation measures to safeguard environmental and infrastructural capacity.

To address these evidence gaps a water cycle study detailed report is recommended. The EA and Thames Water have been consulted on the scope of this study, and it is likely to include the following:

- An assessment of water quality impacts, using the latest version of the EA's SIMCAT model. This will include an assessment of growth against the WFD status for watercourses discharged to. All STWs that may be impacted by growth will be considered, with particular attention paid to the Didcot STW, Oxford STW, Abingdon STW, Wantage STW and Benson STW. The assessment of water quality impact will consider nitrates, in addition to biochemical oxygen demand (BOD), ammonia and phosphates.

- A headroom capacity assessment will be undertaken at all STWs that may be impacted by growth. Particular attention will be paid to the Appleton STW, Benson STW and Culham STW which have been flagged by the EA previously. The assessment will determine whether the STWs have sufficient headroom to manage the future growth proposed over the lifespan of the local plan.
- Based on these assessments, the detailed report will identify whether Thames Water will need to apply to the EA to amend existing environmental permits to allow for future development. The implications of these amendments on water quality will also be assessed.
- If it is identified that there is a risk of deterioration and insufficient environmental capacity, the study will assess the potential of improved treatment or alternative discharge locations through liaison with Thames Water and the EA. As part of this assessment FFT, storm tanks and amendments to DWF permits will be considered. Consideration will also be given to whether these options can be funded and delivered to align with development.

It should be noted that the detailed report will primarily be used to better understand which watercourses are being impacted most by the water industry and which will be most vulnerable to future growth. It will only be used as a guide to assess upgrades required to the sewer network and the scope of future mitigation. Further technical work will be required by Thames Water in collaboration with the EA to fully determine the design of any required upgrades and the full conditions within any future permit applications. Furthermore, in the wider context of Oxfordshire the EA have recommended that a study is conducted to identify the networks affected by groundwater infiltration and that this infrastructure is considered for upgrades as a priority. The scope of this lies beyond a water cycle study detailed report and Thames Water are considered best placed to take a lead on this study.

6 Flood Risk

6.1 Introduction

This section includes a high-level review of the flood risk relevant to this study across both districts, and its relationship with the development proposed. How flood risk might be managed moving forward, is also addressed.

6.2 Overview of Flood Risk relevant to WCS

The River Thames is the main watercourse across both districts. Significant tributaries join the Thames within the districts, including the Windrush, Evenlode, Ock and Thame. Fluvial flood risk is present along these main rivers (which are the responsibility of the EA) and ordinary watercourses (which are the responsibility of the Oxfordshire County Council acting as the Lead Local Flood Authority (LLFA) and riparian owners). Of existing properties within South Oxfordshire, approximately 6% are within Flood Zone 2 and 3% are within Flood Zone 3. For the Vale of White Horse, approximately 6% are within Flood Zone 2 and 4% are within Flood Zone 3.

Surface water flood risk also effects many locations across both districts, including the settlements of Abingdon-on-Thames, Appleton, Faringdon, Wantage and Wheatley amongst others. Flooding of land from surface water runoff is usually caused by intense rainfall and usually occurs in lower lying areas often where the drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage and sewer flooding.

Sewer flooding often occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Groundwater flooding which is relatively common in the hard rock aquifers across both districts, can also contribute to sewer flooding through groundwater infiltration, where groundwater finds its way into the sewer system. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system.

The Thames Water DG5 sewer flooding register is available at the 5-digit postcode level and has been obtained to further assess the spatial distribution of sewer flooding. In total there have been 223 incidents in the Vale of White Horse and 293 incidents in South Oxfordshire since records began in 1989 with privatisation of the water industry. The total number of recorded incidents has been aggregated for each of the postcode areas intersecting the districts. These are shown in Figure 13. Generally, these show the most incidents to occur in urban areas along the boundary of the two districts, including Abingdon-on-Thames, Didcot, Kennington and Wallingford. Extrapolating to 2041, a large amount of development is proposed for the Abingdon-on-Thames postcode area in addition to open land to its west near Shippon and Kingston Bagpuize. There are also a significant proportion of development allocations located in the Didcot and Wallingford postcode areas.

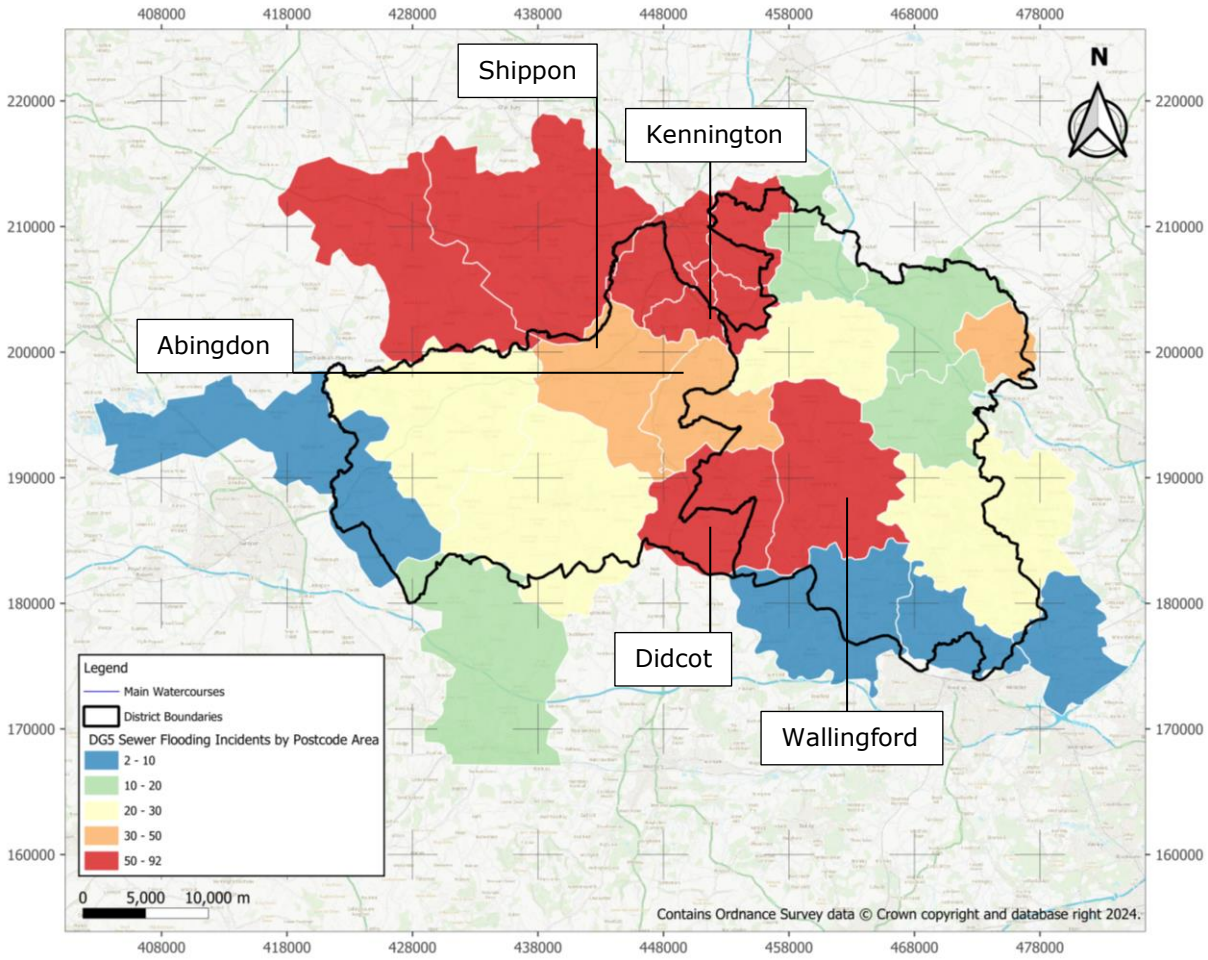

Figure 13- DG5 Sewer Flooding Records for Postcode Areas intersecting districts

6.3 Impacts of Development on Flood Risk

Development if not properly managed has the potential to impact a wide range of flood mechanisms, including those identified in section 6.2. Land use change influences the characteristics of how rainwater runs off land into local water networks such as drains, streams and rivers. Localised changes in land use can alter the pre-existing baseline behaviour of an individual area, and when this occurs collectively over multiple areas within a catchment, it can cause a change in flooding characteristics for the area. As such, this may incur detrimental impacts downstream on a catchment-wide scale. Instances in which this can occur can be seen in the development of previously rural land, which increases the amount of impermeable surfaces.

Many of the site allocations in the JLP will be developed upon greenfield land. If insufficient measures are taken, the replacement of rural land use with impermeable surfaces will increase the volume and rates of surface water runoff following rainfall. When instances of this happen repeatedly across a catchment, this can result in a catchment experiencing shorter amounts of time between rainfall events and peak flood levels, resulting in greater magnitude floods and making effective flood response more difficult. This can impact both fluvial flood risk and surface water flood risk. Windfall sites and urban creep could also contribute to these forms of flood risk by the same mechanism.

In addition, the development of greenfield land may result in the loss of floodplain area causing reduced floodplain storage capacity which could have a detrimental impact on fluvial flood risk on immediately neighbouring land, as well as downstream. Instances of practices that may cause this, include changes in a buildings footprint which could reduce flood storage area, whilst the raising of land levels above the existing floodplain may interfere with storage and floodwater conveyance. The impacts of this are managed through

Extrapolating to 2041, a total of 24 sites being brought forward in the JLP and made neighbourhood plans fall partially within Flood Zone 3 and have the potential to compromise floodplain storage. Sites in the JLP include AS1 (Land at Berinsfield Garden Village), AS2 (Land Adjacent to Culham Science Centre), AS3 (Land South of Grenoble Rd), AS4 (Land at Northfield), AS5 (Land at Bayswater Brook), AS9 (North West of Valley Park), AS10 (Land at Dalton Barracks Garden Village), HOU2b (Didcot Northeast), HOU2o (North of Abingdon-on-Thames), HOU2q (Monks Farm, North Grove) and HOU2s (Valley Park). At these sites the vast majority of the site area lies outside of floodplain areas, so it should be possible to locate development outside of areas at flood risk. In terms of the neighbourhood plan sites WHE22 (Littleworth Rd Industrial Estate), WHE15 (Miss Tomb's Field), BEN004 (Land to north and NE of the Sands), CHA001 (Land to the East of Chalgrove), CHA002 (Land to the west of Marley Lane), THA004 (Reserve Site C), THA006 (Site F), THA007 (Thame Site C), THA010 (Site D), WAL001 (Wallingford Site C), WAL002 (Site E) and WAL003 (Land between Britwell Rd & Cuxham Rd) have been identified, again for the most of these sites the majority of their areas lie outside of the floodplain.

An indirect impact of development on fluvial flood risk which is relevant to this study, is increasing discharges from STWs as a result of changes to current discharge permits. Generally, this is not considered to be a significant contributor to flood risk given that the flows discharged from STWs tend to be many orders of magnitude smaller than the flood flows in the watercourses they discharge to. To approximate the level of risk within the study area, discharge permits for STWs across the study area were obtained from the EA; these are provided in Appendix 7. These state the maximum volume of flow that can be discharged over the course of a day (m^3/day). Subsequently, this was converted to a value in litres per second (l/s). The Qube[44] software which can be used to estimate annual flow statistics for catchments across the UK was then used to estimate the annual Q5 flow (the flow exceeded for 5% of the year) at the outfall locations for major STWs across both districts. Provisionally, major STWs defined as having a maximum volume of flow exceeding 750 m^3/day were assessed. The Q5 flow was chosen as it represents high flows, however it should be noted that it is often many times smaller than significant flood flows such as the 2-year, 30-year and 100-year flows.

Table 18 shows the Q5 flows estimated against the permitted flows. The analysis shows that in general the estimated Q5 flow significantly exceed the permitted flows. However, there are cases including at Benson STW, Chinnor STW, Henley STW, Thame STW and Watlington STW where the permitted flow is very close or exceeds the Q5. In many of these cases the watercourses discharged to is very small and runs through rural land before joining a larger main river where the discharged flow becomes negligible. Despite this, it does suggest that caution should be applied at these STWs when setting the maximum flow volumes in the future. As mentioned in section 5.2.2, Benson STW specifically is approaching its DWF capacity and may need to apply for a new permit in the future.

It should be noted that the assessment is subject to uncertainty given the lack of gauged data along the watercourses assessed.

[44] Qube (2024) https://qube.hydrosolutions.co.uk/

Table 18- Ecological and Chemical Status of Surface Waterbodies in the study area

STW Name	Watercourse	DWF Permit (m^3/day)	DWF Permit(l/s)	Estimated Q5 at Outfall (l/s)
Abingdon	River Thames	8335	96	91200
Appleton	Marcham Brook	1368	16	138
Benson	Howbery Ditch	2157	25	10
Chalgrove	Warpsgrave Ditch	1231	14	91
Chinnor	Henton Stream	2125	25	20
Cholsey	Cholsey Brook	3200	37	310
Culham	Unnamed tributary to Thames	889	10	57
Didcot	Moor Ditch	11476	133	236
Drayton	Ginge Brook	1672	19	657
Faringdon	Faringdon Brook	2812	33	113
Goring	Unnamed Watercourse	1289	15	212
Henley	Unnamed Watercourse	2950	34	12
South Moreham	Mill Brook	862	10	478
Thame	Lashlake Stream	2792	32	6
Wantage	Letcombe Brook	6250	72	449
Watlington	Pyrton Stream	2000	23	19

Development across both districts could also contribute to sewer flooding. As more land drains to the sewer network, its capacity will need to increase to ensure that it is not overloaded and surcharges. The allocations in the JLP present some level of risk in this regard, as shown in sections 4.8 and 5.2.4 as there are many sites where the sewer network is close to capacity. Windfall sites and urban creep present a further risk, especially if their impact is not captured in the planning process for future sewer upgrades.

6.4 Mitigation Options

Flood risk is a key factor in spatial planning. Government policy seeks to ensure that all developments are safe with respect to flooding, and that floodplains are used for their natural purposes. As mentioned, development on a floodplain is both at risk from flooding and also has the potential to reduce the ability of the river corridor to convey and store flood waters without suitable mitigation measures. This means that if development is not adequately controlled, there will be a detrimental effect on third party flood risk, with the floodplain's capacity reduced and water displaced elsewhere.

Through application of the National Planning Policy Framework (NPPF)[45] a sequential approach will be taken in the JLP to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites in areas with a lower probability of flooding. If following this exercise, sites still need to be allocated in at risk areas, an exception test is typically required, which will look to ensure the development is safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The proposed policies and site concept plans being prepared for the JLP sites do not allow any development in Flood Zone 2 and Flood Zone 3 except for general and essential infrastructure (e.g. utilities for electrical supply).

In terms of the JLP, whilst development will largely be sited outside of floodplain areas where possible, it still has the potential to exacerbate flood risk due to increased runoff from hard impermeable surfaces. There will be a change in land use in some areas as a result of the JLP. To

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

accommodate such a change, it is likely that mitigation options will need to be implemented at a number of sites in order to facilitate development, ensuring development is both safe and does not increase third party flood risk elsewhere. Options to be considered include:

- Increase floodplain storage/provide compensatory storage should the development require any ground raising above measured/modelled flood levels.
- Sustainable Drainage System (SuDS) guidelines to achieve no net increase in runoff as a result of the development proposals (obligatory for most development sites).
- Possibility of developer contributions to fund local improvement schemes elsewhere.
- Flood resilient and resistant building design.
- Flood incident management (flood warning) and emergency planning.
- Opportunities for integrated urban drainage schemes at locations where there is mutual benefit in relation to reducing overall flood risk to new and existing developments.

SuDS in particular are seen as key in ensuring development does not lead to increased runoff rates and volumes. SuDS are designed to manage stormwater locally (as close to its source as possible), to mimic natural drainage and encourage its infiltration, attenuation and passive treatment. The non-statutory guidance[46] for SuDS published by DEFRA (2015), sets out the technical Standards for SuDS systems in England. Oxfordshire County Council acting as the LLFA also sets out local standards and guidance[47] on SuDS and drainage requirements within the county. Major developments (more than 10 dwellings) within Oxfordshire should meet these standards. Note, the local standards stipulate a 10% allowance for urban creep in new development sites to safeguard against drainage schemes becoming non-compliant.

In managing stormwater locally through infiltration and attenuation, SuDS also has the potential to reduce the amount of surface water runoff entering sewer systems and thereby sewer flood risk overall. SuDS also has the potential to treat and enhance water quality. Both of these facets will be key in managing the infrastructural and environmental capacity available across both districts, in addition to limiting significant increases in discharges from STWs. In terms of the latter, upgrades to STWs including the provision of new storm tanks could allow for more water to be stored at STW for subsequent treatment and discharge when water levels downstream are within normal range.

As part of their DWMP, Thames Water are taking a 'SuDS-first' approach when prioritising options to manage flood risk. Stating further, that they will work in collaboration with partners to increase the amount of SuDS delivered across the Thames Valley. When considering sites in the JLP, neighbourhood plans and windfall sites, any developer is encouraged to work with Thames Water early in the planning process to understand what infrastructure is required, in addition to where, when and how it will be delivered. Urban creep and climate change will also need to be considered in any liaison to ensure the infrastructure upgrades implemented are resilient going forward. During the plan period, mitigation may also be implemented at the catchment wide scale, encompassing natural flood risk management (NFM), river engineering, wide scale sewer network upgrades, rural land management, urban design and defence infrastructure. These measures have the potential to reduce flood risk for new and existing development.

[46] Department for Environmental, Food and Rural Affairs (2015) *Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

[47] Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire, OCC. 2021. Available from: https://www.oxfordshirefloodtoolkit.com/wp-content/uploads/2022/01/LOCAL-STANDARDS-AND-GUIDANCE-FOR-SURFACE-WATER-DRAINAGE-ON-MAJOR-DEVELOPMENT-IN-OXFORDSHIRE-Jan-22-2.pdf

6.5 Summary

Both the impact of development on flood risk, and the impact of flood risk on development can be reduced by following the sequential and exception tests outlined in the NPPF and ensuring that development in the study area follows SuDS guidelines.

At the site-specific level, SuDS should be implemented at all of the sites. Ground raising and compensatory storage may also be required where sites are at flood risk. Furthermore, ensuring local sewer upgrades are in place prior to development will safeguard against pronounced surface water and sewer flood risk. In line with NPPF, it is also recommended that where possible development should seek to reduce flood risk overall. Methods to reduce flood risk at sites and downstream may include creating flood storage areas, establishing wetland features, promoting vegetation growth and the use of NFM practices. Alongside these site scale measures; catchment scale measures may help reduce flood risk in a number of areas throughout the districts. A reduction in flood risk could also be supported by a direct financial contribution from developers to wider flood risk management infrastructure through section 106 agreements or a community infrastructure levy.

The assessment of flood risk undertaken to date is high level. The specific upgrades required to the sewer network in response to development are likely to require further technical work by Thames Water in collaboration with developers. The SFRA supporting the JLP will include a more detailed assessment of the fluvial and surface water flood risk constraints at each of the development sites. In terms of the risk posed by increases in discharge volumes from STWs, the additional work proposed for the water cycle study detailed report on infrastructural capacity in section 5.4 should give a clearer idea on the potential changes for DWF permits required at key STW sites. The findings of which should give a clearer idea on likely changes to the volumes draining from STWs to accommodate future development. Further liaison will also be undertaken with the EA and Thames Water to establish how the discharge volumes have been estimated and whether they have concerns at any specific STWs.

7 Other Environmental Constraints

7.1 Protected Sites

Further environmental constraints come mainly from the protected status of numerous sites across both districts.

Firstly, there are 6 Special Areas of Conservation (SAC) within the districts. SACs are strictly protected sites designated under the European Union's Habitats Directive. Any developments that are close to or within the boundary of a SAC, may require a Habitat Regulations Assessment (HRA) if they could have an adverse effect on the site. An initial screening stage would be required, followed by an appropriate assessment if needed. The HRA process is focused on protecting the qualifying features of designated sites.

Where it is considered that an adverse effect on the integrity of the SAC is likely, and no alternatives are available, the project can only go ahead if there are imperative reasons of over-riding public interest and if the appropriate compensatory measures can be secured. Planning authorities can also insist that developments carried out without necessary planning permission are removed. Figure 14 shows the location of SACs across both districts and in the surrounding area.

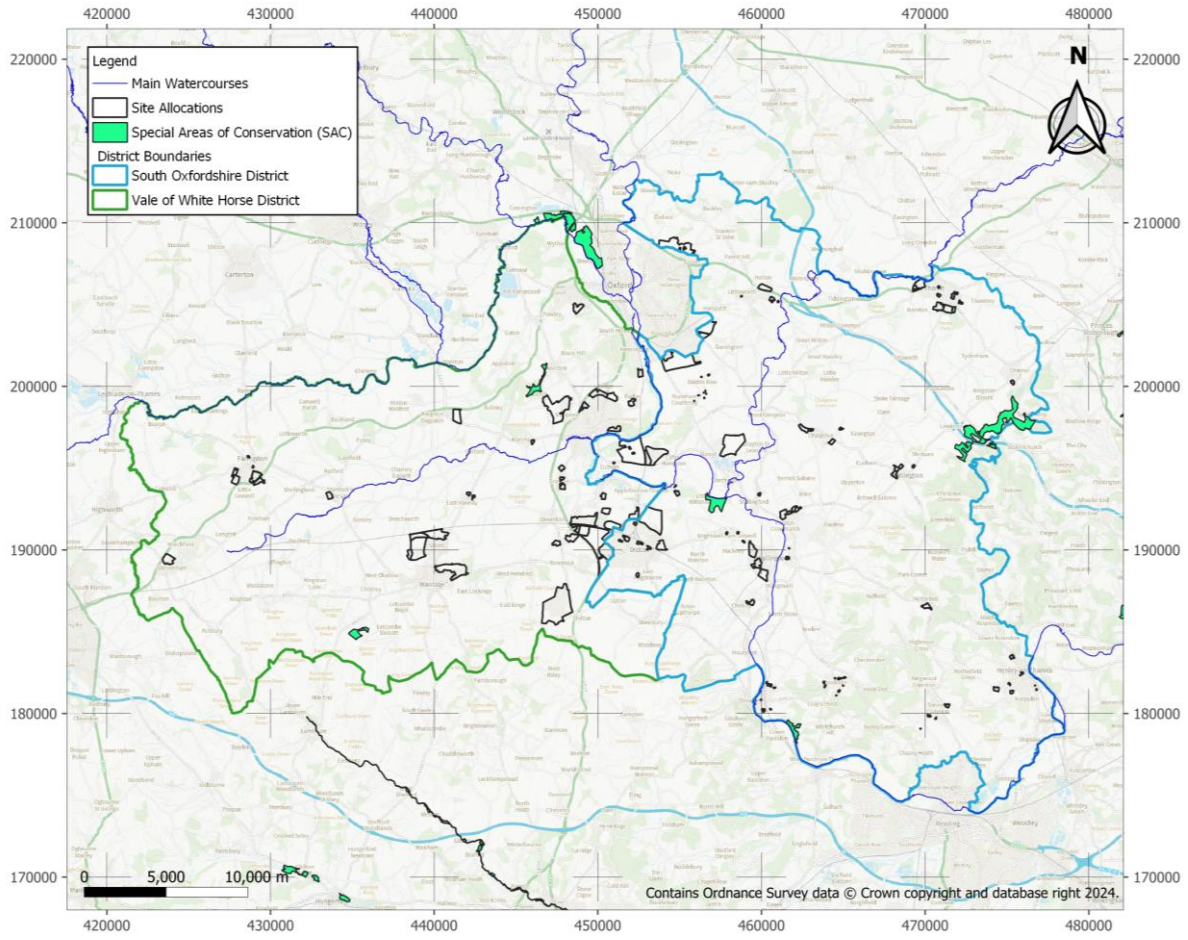

Figure 14- SACs across both districts and in the surrounding area

There are 60 Sites of Special Scientific Interest (SSSI) within the districts (38 in South Oxfordshire and 22 in Vale of White Horse), with many SSSI also located in the surrounding area. A SSSI is a formal 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).

Local planning authorities are required to have policies in their development plans which protect SSSIs. They are also required to consult the appropriate conservation body over planning applications which might affect the special interest of a SSSI. The landowners of SSSIs are also required to obtain consent from the relevant nature conservation body if they want to permit potentially damaging activities. Figure 15 shows the location of SSSIs across both districts and surrounding area.

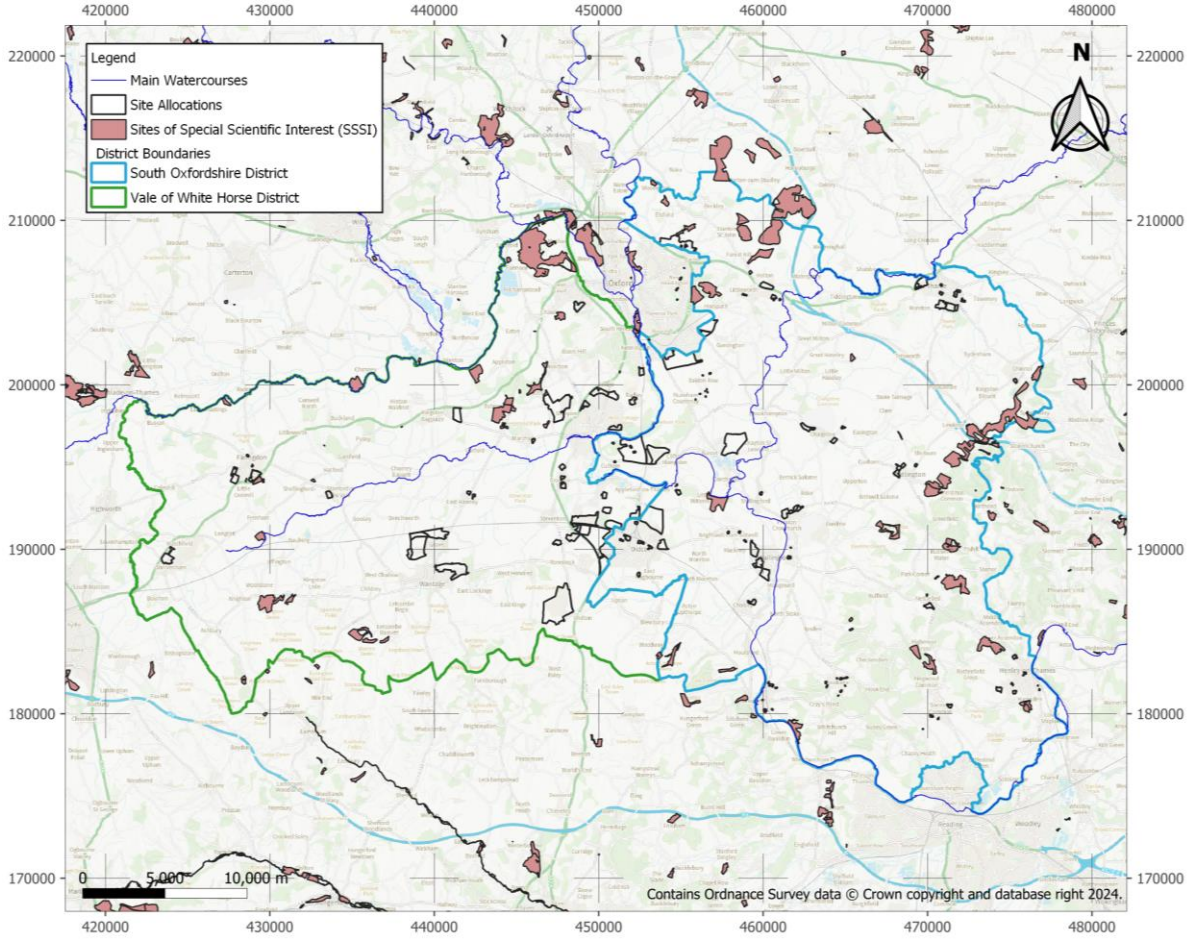

Figure 15- SSSIs across both districts and surrounding area

The Fresh Water Habitats Trust have raised specific comments in relation to protected sites within the districts, with particular attention paid to Alkaline Fens. These fens are identified as an Irreplaceable Habitats in the NPPF and play a key role in terms of biodiversity, carbon storage, water quality and flood risk. Protected Fen sites include the Cothill Fen SAC, the Parsonage Moor SSSI complex and Barrow Farm Fen SSSI. Local wildlife sites in Hinksey Heights, Chilswell Valley and Raleigh Park also support Fen habitats.

Two sites, AS15 (Harcourt Hill Campus) and AS10 (Land at Dalton Barracks) possibly present a heightened risk given their proximity to the some of these protected sites. AS15 is located within the

catchment of the Raleigh Park Fen complex and could replace large areas of open green space which allow water to percolate into the ground supporting the Fen habitat. AS10 is in close proximity to Cothill Fen SAC, Parsonage Moor SSI, Dry Sandford SSSI, Barrow Farm Fen SSSI and Frilford Heath SSSI. Development again potentially poses a risk to these sites due to a change in land use and a potential increase in recreational activity due to increases in local population.

In response to these concerns, it is understood that the councils have commissioned a separate Lowland Fen study to support the JLP. This will identify and map lowland fens' hydrological catchments and will consider potential risks from development within these catchments.

In their planning consultation responses, Natural England have also raised a number of concerns at protected sites. The River Lambourn SAC lies outside of the study area within West Berkshirei, but part of its catchment falls within the Vale of White Horse. Natural England has issued nutrient neutrality advice for the River Lambourn Special Area of Conservation (SAC) which stipulates that when considering a plan or project that may give rise to additional nutrients within the catchment, a HRA should be undertaken.

Natural England have also highlighted concerns regarding sites AS3 (Land South of Grenoble Road), AS4 (Land at Northfield) and AS5 (Land at Bayswater Brook) given their close proximity to a number of SSSI including the Brasenose Wood and Shotover Hill SSSI, Lye Valley SSSI, New Marston Meadows SSSI, Iffley Meadows SSSI and Sydlings Copse and College Pond SSSI. These sites are located within the Oxford City administrative boundary but in some cases their catchments extend into areas where development is proposed. Furthermore, the development sites are expected to cause an increase in local population which could in turn increase visitor numbers to the SSSIs leading to recreational impacts. The same recreational issues have been highlighted for Site AS10 (Land at Dalton Barracks Garden Village) which lies in close proximity to the Cothill Fen SAC. It is understood that the councils have commissioned a HRA to support the JLP. This will consider the impact of development on designated sites.

Often protected sites play a key function in terms of water quality which is vital for maintaining the environmental capacity across both districts. If development is not properly managed, it could lead to a deterioration in water quality or changes in the flow regime at protected sites. Care needs to be taken both during and after construction to ensure that runoff from development sites is adequately treated before entering the local drainage network. This will in turn safeguard environmental capacity and allow for further development to be delivered sustainably.

7.2 Odour Risk

STWs and other wastewater sites, like pumping stations and storm tanks, can sometimes be odour sources. They were originally built a significant distance away from urbanised areas; however, population growth means these once remote sites are now potential locations for development. Thames Water have published guidance[48] for new and 'change of use' developments proposed near STWs and large pumping stations.

Thames Water aim to ensure all proposed developments near their wastewater sites are risk assessed and, where necessary, that developers fund any mitigation needed to enable them to build there.

[48] Thames Water (2020) *Risk of Odour Encroachment* https://www.thameswater.co.uk/media-library/home/developers/larger-scale-developments/planning/water-and-wastewater-capacity/odour-encroachment-guidance.pdf

Developers should contact Thames Water to discuss any encroachment close to STWs prior to their submitting a planning application. In general, Thames Water will look closely at any proposals within either 800 metres of a STWs or 15 metres of a large sewage pumping station. The degree of odour complaint levels at the wastewater site will also be considered. This initial screening will then recommend whether further modelling work is needed.

In terms of the sites being brought forward in the JLP, Figure 16 shows the proposed site locations relative to each STWs (with an 800m buffer added).

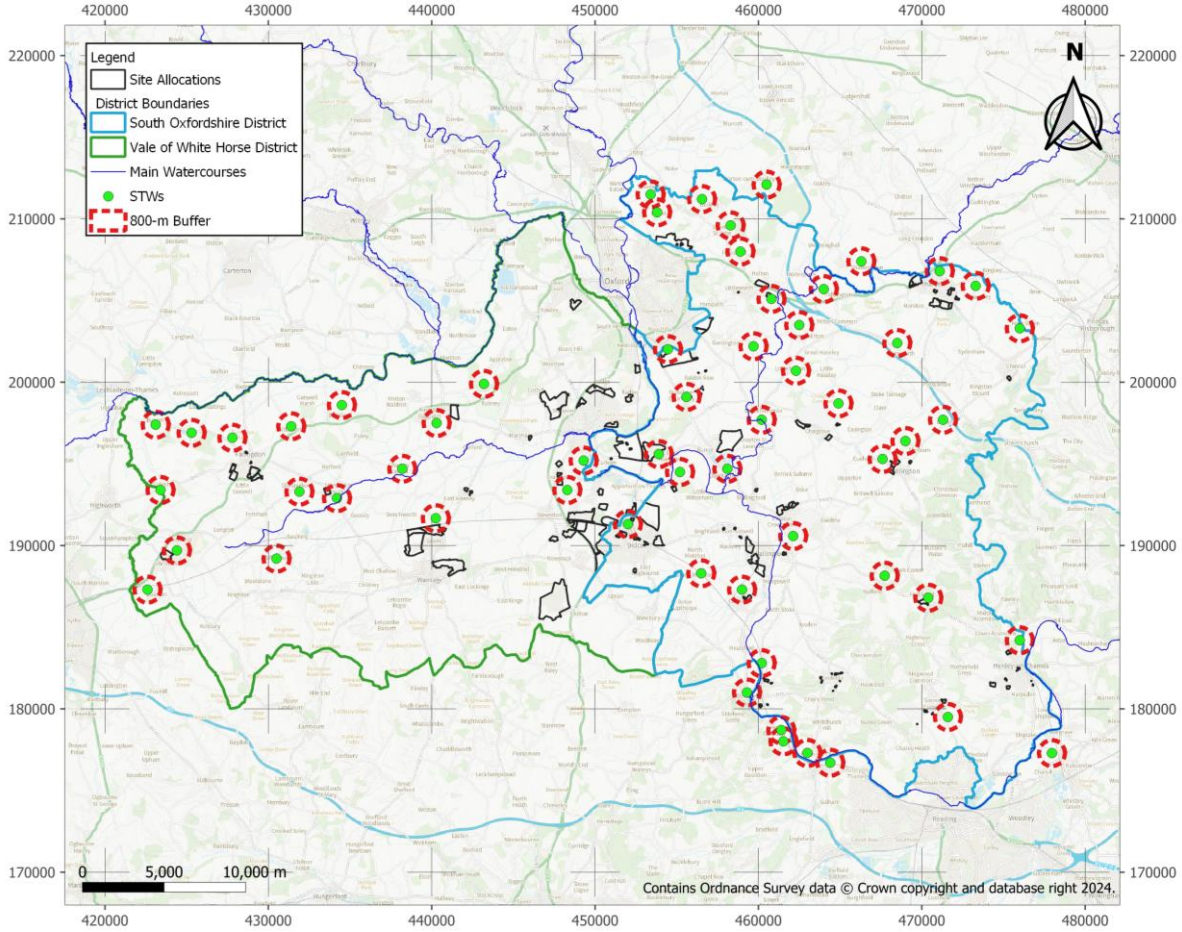

Figure 16- STWs with 800m buffer relative to site allocations

It has been estimated that 24 sites identified in the JLP or made neighbourhood plans fall within 800m of a Thames Water STW. Table 19 lists the sites falling within 800m of specific STWs.

Table 19- Sites within 800m of STWs

STW Name	Sites
Benson	CRW001 (Land at Howbery Park, Benson Lane, Crowmarsh Gifford)
Cholsey	CHO001 (Land west of Wallingford Rd)
Culham	AS2 (Land at Berinsfield Garden Village) & AS11 (Culham Science Park)
Didcot	HOU2b (Didcot North East), HOU2e (Vauxhall Barracks), JT1a (Southmead Industrial Estate), JT1g (Didcot A) & JTl (Didcot Technology Park)
Drayton	DRT001 (South of the High Street)
Long Wittenham	LOW002 (Long Wittenham School Site)
Nettlebed	HOU2f (Joyce Grove, Nettlebed)
Nuneham Courtney	BAL007 (20-MB) & BAL008 (21-MB)
Shrivenham	HOU2l (North of Shrivenham)
Streatley	GOR003 (Thames Court)
Thame	THA009 (Cattle Market)
Wantage	HOU2q (Monks Farm, North Grove)
Watlington	WAT002 (Land Off Cuxham Road and Willow Close) & WAT003 (Land between Britwell Road and Cuxham Road)
Wheatley	HOU2d (Land on Wheatley Campus, Oxford Brookes), WHE15 (Miss Tomb's Field), WHE16 (The Bungalows Site) & WHE17 (Mobb's Land)

At these sites odour risk could be a concern, and it should be assessed before the planning application stage. This will enable issues to be identified and resolved where possible, meaning fewer delays at the planning and construction stages. Typically, Thames Water undertake risk assessments in phases – by desktop and then sample surveys. If this shows the development is at odour risk based on their assessment criteria, they will object to the development. The developer must then submit an odour modelling assessment, in consultation with Thames Water. This assessment should typically consist of a full sample survey including source measurements at all relevant sources by olfactometry, followed by dispersion modelling. The odour assessment should be submitted to the local planning authority in support of the developer's planning application.

Where mitigation is required, the developer must fund this. It can be costly to reduce and treat odour. Measures include increased maintenance of plant and equipment, covers for tanks, the use of enclosure and venting and end of pipe treatments (i.e. dilute, disperse or abatement).

7.3 Summary

The districts include a number of protected sites and designated habitats which present constraints to development in certain areas. Conversely, ensuring these areas continue to serve their function will help maintain environmental capacity which is vital for allowing development to continue sustainably into the future.

At this stage, this scoping study has identified the main environmental constraints with respect to protected sites. More technical work and consultation will be required to understand the potential impacts of development on protected sites through the JLP Habitats Regulations Assessment and the Lowland Fen Study . Subsequently, further work at the planning application stage including Environmental Impact Assessments (EIAs) and HRAs may be required to determine impacts on specific SACs and SSSIs and any required mitigation.

In terms of odour risk, a number of sites proposed in the JLP could encroach on land close to STWs. For the sites identified where odour risk could be a concern, developers should contact Thames Water prior to submitting a planning application. This will enable issues to be identified and resolved at an early stage where possible, meaning fewer delays at the planning and construction stages.

The assessments outlined above should be sufficient to address the evidence gaps identified in this scoping study without the need for further assessment as part of a water cycle study detailed report.

8 Conclusions & Recommendations

The conclusions and recommendations from this study are as follows:

Water Resources and Supply

- Based on the forecasts in Thames Water's latest WRMP there could be shortfalls in water supply up to 2041 and beyond. Without corrective action, the supply for both districts could be less secure which will mean a greater probability that demand restrictions will be required in dry years.
- The JLP and adopted local plans are bringing forward a greater allocation of dwellings than currently forecasted by the WRMP, so could exacerbate the shortfalls predicted.
- The WRMP has identified and forecasted the effects of several design management options on household consumption, non-household consumption and leakage. The options should be sufficient to offset some of the deficits in the development scenarios tested by Thames Water.
- Thames Water have also identified several resource options including new reservoirs, raw water transfers and groundwater abstractions. These supply options offer large increases in yield, however, are subject to significant lead times.
- The demand options are able to deliver from the first year of implementation due to shorter lead times and will be important early in the plan period. However, the current dwelling numbers in the JLP and adopted local plans exceed those in Thames Water's WRMP which could increase the need for supply options.
- New interventions from the district councils such as stricter water use standards may also be required during the plan period.
- Thames Water have assessed the JLP and neighbourhood plan site allocations against the existing capacity of the clean water network, and generated a series of RAG (red, amber, green) reports which scored each site based on the available capacity and the requirement for local upgrades.
- Of the 135 sites allocated for development across the JLP and made neighbourhood plans, 66 sites have been scored red or inferred as red. This means that the proposed level of development will require a Development Impact Assessment, as the net dwelling equivalent increase is above the agreed upon DMA upper threshold for growth.
- In total 10 sites have been scored amber or inferred as amber. These present a medium risk to the network with modelling required to ascertain their impact.
- In total 47 sites have been scored green. For these sites, no capacity constraints exist, with the development site's net dwelling increase within the DMA. For the 12 remaining sites no score was assigned due to insufficient information.
- Abstractions across both districts predominantly come from agriculture; overall, their impact on water resources is thought to be small. However, considering the scale of development proposed in the JLP and adopted local plans, further abstractions for water supply may be required going forward.
- A water cycle study detailed report is not required to assess water resource and supply, however following adoption of the JLP further technical work by Thames Water could be helpful in deriving specific deficits for both districts considering the latest development allocations. This in part may be captured in the next iteration of the WRMP which should include the quantum of development earmarked in the JLP.
- The deliverability of upgrades to the water network would also require further technical input from Thames Water as sites are brought forward through the planning process.

Wastewater Infrastructure, Water Quality and Environmental Capacity

- The STWs serving the districts are the most important infrastructural asset with respect to future development in the districts. There are delays in the upgrades earmarked for AMP7 at some of the STWs and uncertainty regarding the headroom available at a number of other STWs.
- Thames Water have assessed the site allocations against the existing capacity of the wastewater network, and generated a series of RAG (red, amber, green) reports which scored each site based on the available capacity and the requirement for local upgrades.
- Of the 135 sites allocated for development in the emerging JLP, adopted local plans and made neighbourhood plans, 81 sites have been scored amber or inferred as amber. These sites represent a medium risk to the network.
- In total 48 sites have been scored green or inferred as green. At these sites there should be no capacity constraints. For the remaining 6 sites no score was assigned due to insufficient information.
- In terms of environmental capacity, the EA's catchment data explorer suggests that most of the watercourses in the study area have *Poor* ecological status and *Fail* with regard to chemical status. This suggests that overall, they are vulnerable at present, potentially to future growth.
- Future upgrades to the sewer network alongside measures identified in the Thames River Basin Management Plan and Thames Water's DWMP could help in this regard but will take time.
- Further work is required as part of a water cycle study detailed report to understand the infrastructural and environmental capacity within some parts of the districts, enabling mitigation measures to be identified. This will include modelling and headroom assessments at the STWs potentially impacted by growth.

Flood Risk

- Development has the potential to impact on a wide range of flood mechanisms including fluvial, surface water and sewer flooding.
- Both the impact of development on flood risk and the impact of flood risk on development can be reduced by following the sequential and exception tests outlined in the NPPF and ensuring that development in the study area follows SuDS guidelines.
- At the site-specific level, SuDS should be implemented at all of the sites. Ground raising, and compensatory storage may also be required where sites are at flood risk.
- Ensuring local sewer upgrades are in place prior to the occupation of development will safeguard against pronounced surface water and sewer flood risk.
- The assessment of flood risk undertaken to date is high level. The specific upgrades required to the sewer network in response to development are likely to require further technical work by Thames Water in collaboration with developers.
- The SFRA supporting the JLP will include a more detailed assessment of the fluvial and surface water flood risk constraints at each of the development sites.
- In terms of the risk posed by increases in discharge volumes from STWs, the additional work proposed for the detailed report on infrastructural capacity should give a clearer indication of the potential changes for DWF permits required at key STW sites.
- The EA and Thames Water will also be contacted as part of the production of water cycle study detailed report to establish how the current discharge volumes have been estimated and whether they have concerns at any specific STWs.

Other Environmental Constraints

- The districts include a number of protected sites and designated habitats which present constraints to development in certain areas.
- At this stage, this study has identified the main environmental constraints with respect to protected sites. More technical work and consultation will be required to elucidate the potential impacts of development on protected sites through the JLP Habitats Regulations Assessment and the Lowland Fen Study.
- Further work at the planning application stage including Environmental Impact Assessments (EIAs) and HRAs may be required to determine impacts on specific SACs and SSSIs and any required mitigation.
- In terms of odour risk, a number of sites proposed in the JLP could encroach on land close to STWs. For the sites identified where odour risk could be a concern, developers should contact Thames Water prior to submitting a planning application.
- The assessments outlined above for other environmental constraints should be sufficient to address the evidence gaps identified in this study without the need for further assessment as part of a water cycle study detailed report.

Appendix 1 – Site Allocations & Windfall Development

Appendix 2 – Thames Water RAG Reports

Appendix 3 – EA Abstraction Licenses

Appendix 4 – Stakeholder Consultation Comments

Appendix 5 – Thames Water Combined Sewer Overflows Data

Appendix 6 – Thames River Basin Management Plans Measures

Appendix 7 – EA Discharge Permits