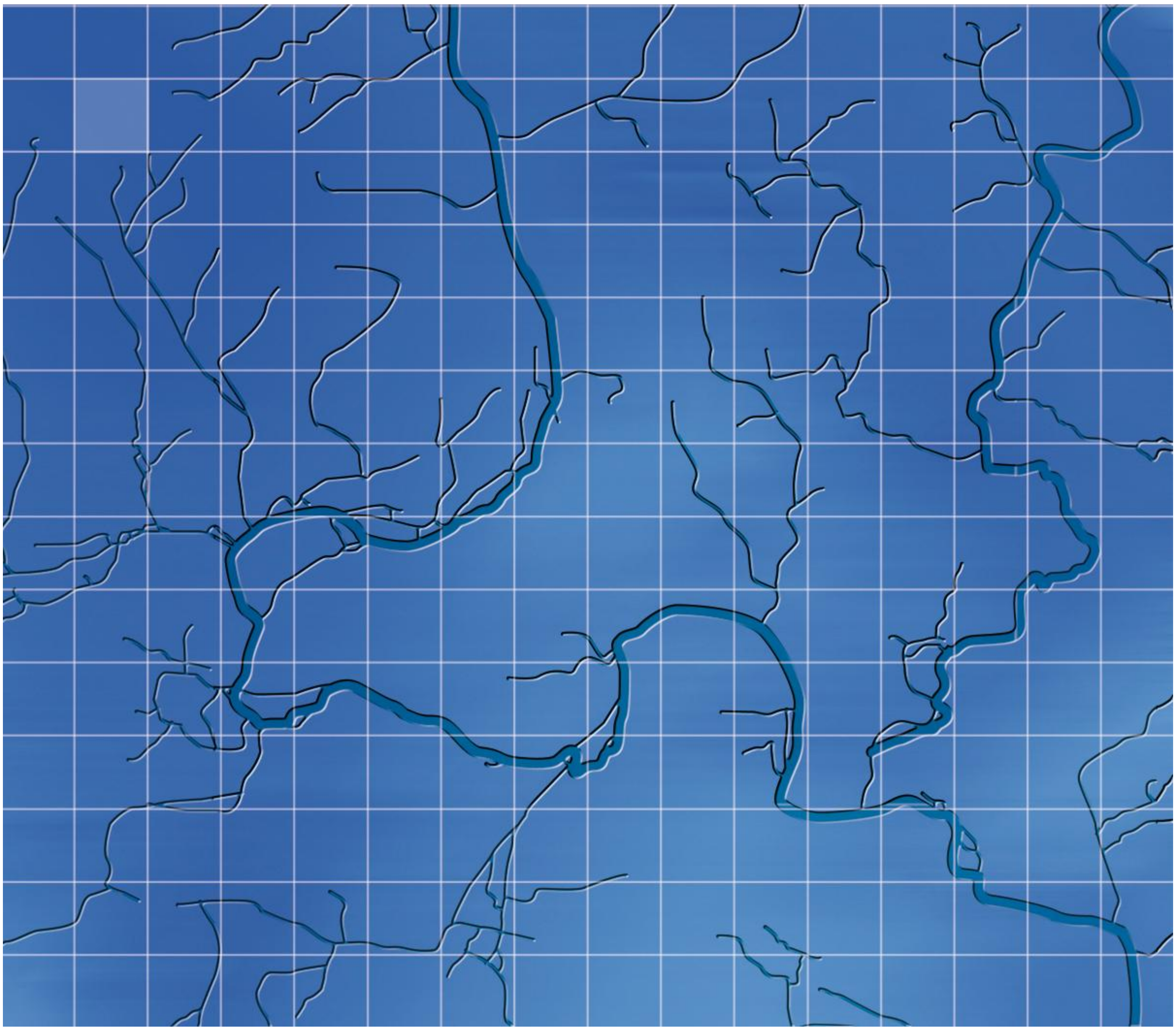
Oxford City Council

June 2025

Oxford City Water Cycle Study Scoping Report



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Oxford City Council Water Cycle Study Scoping Report

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1.2	19/06/2025	Draft	Daniel Hamilton (*Principal Consultant*)	Paul Blackman (*Director*)

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.

1 Introduction

1.1 Scope of Assessment

Wallingford HydroSolutions (WHS) has been commissioned by Oxford City Council to undertake a water cycle study scoping report. This will review emerging 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 Local Plan 2042 being developed by the council. The plan will allocate land for housing and employment development.

The project to date has consisted of a scoping study and preparation of this interim report for the council's regulation 18 consultation. This details infrastructural and environmental constraints in the study area in addition to any evidence gaps identified as a result of the study. The interim report will be updated and finalised to take account of any relevant feedback, particularly from key stakeholders such as the Environment Agency (EA) and Thames Water during the regulation 18 consultation. This will also take into account whether a further detailed study is needed.

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 Oxford City Council extent and amount of proposed development.
- Communicate with key stakeholders including the council, 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 and neighbouring local authorities. 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 the city, in addition to the development pressures in neighbouring authorities.

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 the city.
- 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 the city in the context of future development.
- Oxford Sewerage Treatment Work (STW) Catchment- To identify scale of development in Oxford City and neighbouring authorities draining to the STW in the future.
- EA Catchment Data Explorer[5]- To review Water Framework Directive (WFD) classifications and objectives for waterbodies falling within Oxford City.
- EA Thames River Basin Management Plan[6]- To help understand current and existing pressures on the water environment and mitigation measures.
- EA Abstraction Licenses[7] and Discharge Permits[8]- To gain spatial understanding of current discharges and abstractions to determine future management.

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[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 (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
[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 (2025) Abstractions licences *Abstraction Licences - Oxford.csv*
[8] EA (2025) Discharge Permits *Discharge Permits - Oxford.csv*

- 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.
- Thames Water DG5 sewer flooding data[11] – to determine risk of sewer flooding based on incidences of sewer flooding
- Proposed Local Plan Site Allocations[12]- To determine future development and localised demand. It should be noted that the allocations are provisional at this stage. Whilst the overall distribution of sites is likely to remain similar there is the potential for some sites to be withdrawn or to be added as the Local Plan 2042 emerges.
- Potential Windfall Sites[13]- To approximate future windfall development over the plan period.
- Oxford Local Plan 2036 (2020)[14]- To understand scale and distribution of development already planned in the city.

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 previous water cycle study for Oxford City[15], produced in 2018, has 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 the city 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 city through the adopted local plan, in addition to development being put forward in the emerging local plan and windfall development has all been determined through consultation with Oxford City council. This has been used to assess

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[9] EA (2025) *Flood Map for Planning – Flood Zones* https://environment.data.gov.uk/dataset/04532375-a198-476e-985e-0579a0a11b47

[10] EA (2025) *Risk of Flooding from Surface Water https://environment.data.gov.uk/dataset/b5aaa28d-6eb9-460e-8d6f-43caa71fbe0e*

[11] Thames Water (2023) Sewer flooding data for Oxfordshire *Oxfordshire CC SFHD data_Mar23.xlxs*

[12] Oxford City Council (2025) *Local Plan provisional site allocations* Oxford_sites.xlsx

[13] Oxford City Council (2025) *Windfall Sites* WINDFALL-HEA.004_HELAA_C_Sites_with_capacity_less_than_10_dwellings__March_2024_.pdf

[14] Oxford City Council (2025) *Oxford Local Plan 2016-2036* https://www.oxford.gov.uk/local-plan/local-plan-2016-2036

[15] Oxford City Council (2018) *Phase 1 Oxford City Water Cycle Scoping Study* WHS1587 - Oxford City Council Water Cycle Study_v1.1.pdf

future pressures on wastewater infrastructure and gain an idea of the amount of additional water demand.

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. The Oxford City Council administrative boundary is located within the Swindon and Oxfordshire Water Resource Zone (SWOX WRZ). The plan also considers the whole Thames Water network, which is vital for putting development in the city 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 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 the city in view of the development being brought forward as part of the Local Plan.

In the context of the assessment and liaison with Thames Water, the potential for higher water efficiency standards have been considered for the city. 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 the city. Subsequently, a high-level review has been undertaken, looking at the current abstraction strategy in the city 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 Oxford (Sandford) STW which treats wastewater for the whole of the city, DG5 sewer flooding records and RAG reports on wastewater sewer capacity throughout the city. 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 water cycle study has also been reviewed to see if there is any additional information that needs to be updated.

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. The Thames River Basin Management Plan has been reviewed to identify the current measures in place to maintain water quality across the city.

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 Oxford City 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 2042 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 the STW has been reviewed. This has involved a review of the existing discharge permit at the Oxford (Sandford) STW, and the information garnered from the assessment of infrastructural capacity to determine the likelihood of discharges increasing 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 Oxford City including one special area of conservation (SAC) in the form of the Oxford Meadows and 12 Sites of Special Scientific Interest (SSSIs). The potential impact of future development on these sites is considered.

The location of the Oxford (Sandford) STW in relation to developments is also discussed in the context of odour risk.

The findings of this chapter are likely to inform nature recovery and potential environmental improvements within the city.

3 Baseline Assessment

The study area and main watercourses across it are shown in Figure 1. The study area comprises the administrative area of Oxford City Council.

The EA has classified the area served by Thames Water (which includes Oxford City) as being in "serious water stress"[16]. Serious water stress is defined in the Water Industry (Prescribed Conditions) Regulations 1999[17] 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 in the city, flowing from the north near Wolvercote towards Sandford just south of the city. The largest tributary joining the Thames within the city is the River Cherwell, which flows from Northampton to join the Thames just downstream of the city centre.

In terms of the water quality and the condition of watercourses, the EA catchment data explorer shows that of the 4 measured catchments falling within the city, 3 of the catchments have an ecological status of Poor and 1 catchment is classed as Moderate. 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[18] average annual rainfall in the city is 681 mm (1991-2020). Rainfall is delivered relatively uniformly across the year with moderate increases in the winter months.

In terms of groundwater, British Geological Society (BGS) mapping shows that the majority of Oxford is underlain by the Oxford Clay, West Walton, Ampthill and Weymouth formations all of which are comprised of Mudstone. This includes Wolvercote, Summertown, Jericho, Cutteslowe, New Botley, Osney, Oxford City Centre, New Hinksey, St Clements, New Marston and Iffley. The general permeability of the bedrock in these areas is expected to be low to moderate with limited yields of groundwater.

Areas in south and east Oxford lie outside of the mudstone formations. This includes, Barton, Temple Cowley, Littlemore, Blackbird Leys and west Headington which are underlain by the Beckley Sand Member formation comprised of Sandstone. It also includes Cowley and East Headington which are underlain by the Wheatley Limestone member. Both of these formations are expected to have high permeability and are classed as secondary A aquifers by the BGS. These are defined as aquifers that can support local water supplies. As outlined in more detail in section 4, a large proportion of the city is supplied by larger groundwater sources from the chalk formations in South Oxfordshire and Berkshire.

[16] Environment Agency (July 2021) Water Stressed Areas - Final Classification 2021. Version 1.0: www.gov.uk/government/publications/water-stressed-areas-2021-classification

[17] UK Statutory Instruments (1999) *The Water Industry (Prescribed Conditions) Regulations 1999* https://www.legislation.gov.uk/uksi/1999/3442/contents/made

[18] Met Office (2025) UK Climate Averages Oxford https://www.metoffice.gov.uk/research/climate/maps-and-data/location-specific-long-term-averages/gcpn7mp10

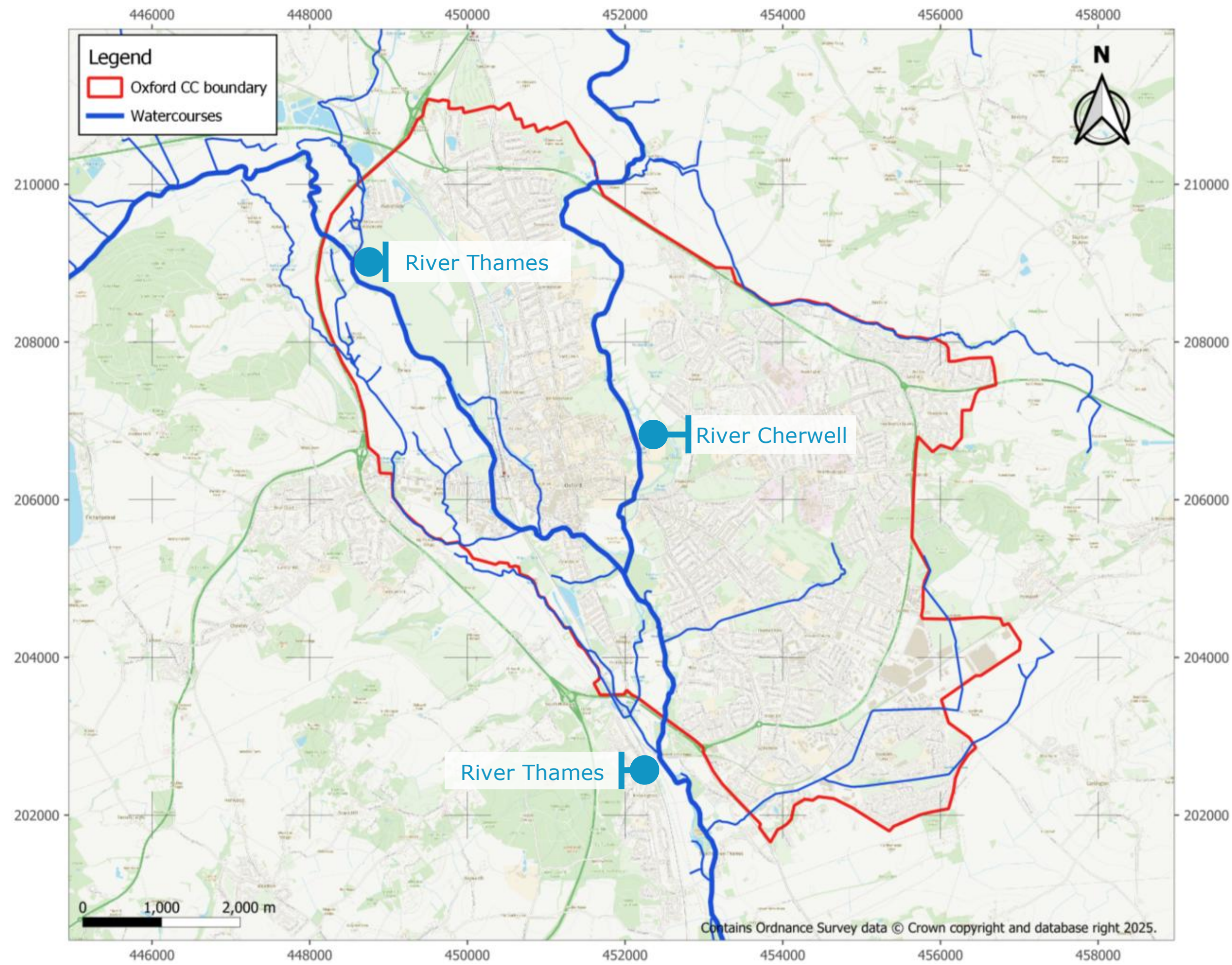

Figure 1- Oxford City Boundary and Watercourses

4 Water Resources and Supply

4.1 Introduction

This section first assesses the current water resources supplying the Oxford City administrative area. Subsequently, the supply-demand position moving forward is reviewed against future development at the strategic and site level. This includes development identified in the emerging local plan, the previously adopted local plan and 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 Oxford City. The water companies within England responsible for providing water supply and wastewater collection and treatment are funded in 5-year planning periods. The budget 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 during 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 area of Oxford City falls within the Swindon and Oxfordshire (SWOX) water resource zone (WRZ). Figure 2 shows the SWOX WRZ relative to Oxford City Council's administrative boundary.

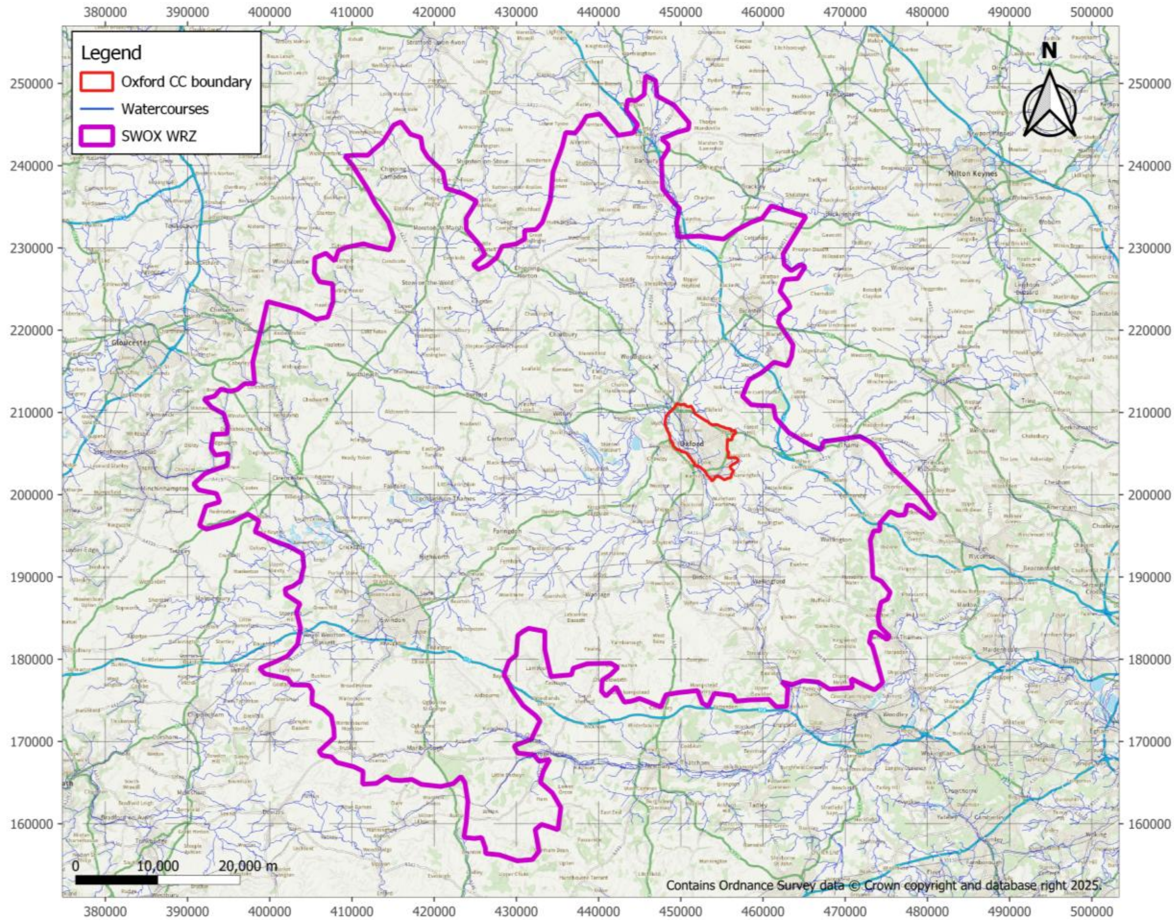

Figure 2- Oxford City Boundary relative to SWOX Water Resource Zones

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:

- North Oxfordshire (Oxford, Banbury, Witney, Farringdon): Surface water only via abstraction from the Thames into Farmoor Reservoir (Oxfordshire Reservoir). It produces more water than needed for local demand.
- South Oxfordshire (area stretching from Goring to Chinnor): Served by groundwater only from mainly chalk aquifer sources (Goring Gap groundwater), 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 both the North Oxfordshire and South Oxfordshire 'sub-zones' produce more water than needed for local demand, in general a large proportion of the water from these zones is transferred to meet water demand in other areas within the wider SWOX WRZ. The major transfers within the WRZ are shown in Figure 3.

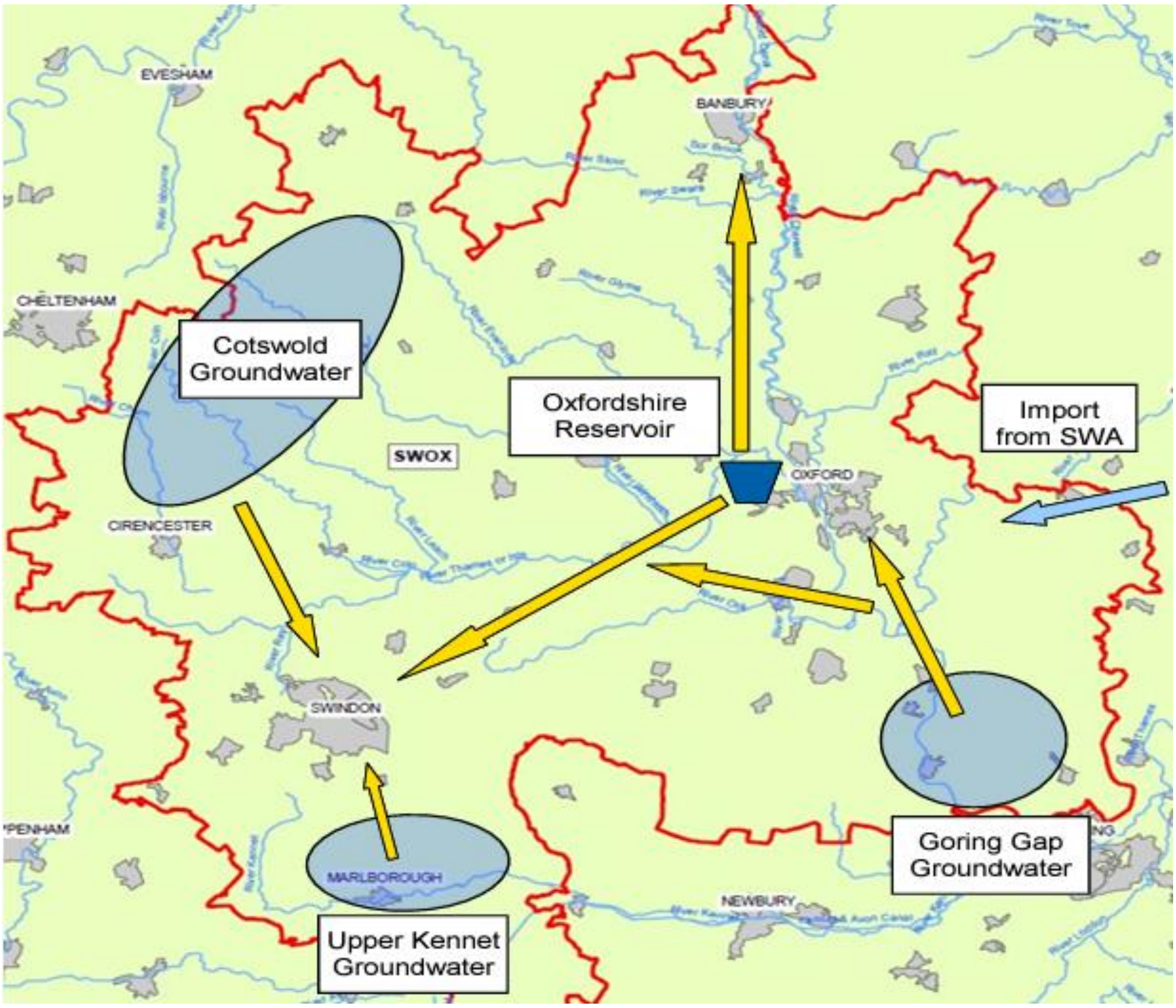

Figure 3- Principal Features of the SWOX WRZ (Source: Thames Water[19])

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 its 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 the city.

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

[19] 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

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 local plan 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 1,058,000. The Oxford City population in 2021 was 162,100[20]. This is based on the ONS 2021 census estimate[21] and is 15.32% of the total SWOX population.

The central housing plan population forecasts for the SWOX area show an increase in population of 249,000 from the base year to 2042 equivalent to 23.53%. 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 Oxford City is therefore assumed to be 23.53% at 38,150.

Thames Water has also estimated dwelling numbers across the WRMP plan period (2025-2075). The base year shows 431,000 in the SWOX WRZ. The projected increase in dwelling numbers by 2042 is 119,533 (27.73%) for the WRZ. Using the population proportion above (15.32%), this translates to 66,029 dwellings in the base year across the city with an increase of 18,312 dwellings (27.73%) by 2042. 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.

Table 2-Base and Projected (2042) Population and Dwelling Estimates based on Thames Water's WRMP

	SWOX WRZ	Oxford City
Base Population (2021/2022)	1,058,000	162,100
Projected Population (2042)	1,307,000	200,250
Base Dwelling (2021/2022)	431,000	66,029
Projected Dwellings (2042)	550,553	84,341

Comparing these figures with the development estimated by Oxford City Council, shows the scaled down Thames Water figures to be higher. At the time of writing, Oxford City Council has provided the number of dwellings expected to be delivered in the city up to 2042. This value totals 10,836 dwellings and is a capacity figure based on their Housing and Economic Land Availability Assessment (HELAA) 2023. It includes the local plan allocations, adopted local plan allocations and an allowance for windfall development. An additional 10% non-implementation buffer is added to account for additional capacity becoming available. It should be noted that this value is subject to change, a more conservative number has been utilised to inform scoping and help accommodate any shift in exact capacity as work on the Local Plan continues.

[20] Oxford City Council (2025) *Oxford's population statistics* https://www.oxford.gov.uk/population-statistics/oxfordspopulation#:~:text=Oxford%20is%20a%20dynamic%20international,the%20population%20of%20the%20city

[21] ONS (2022) *How the population changed in Oxford: Census 2021 https://www.ons.gov.uk/visualisations/censuspopulationchange/E07000178/*

As mentioned, for the scaled down Thames Water figures assumptions have been made in terms of uniform population growth across the WRZ and occupancy rate. However, the differences to the local plan are noteworthy with the Thames Water's scaled down forecast close to 70% higher in terms of dwelling numbers.

It is important to note that assessing the city in isolation may not be reflective of future water availability, given that the availability of water in Oxford City will also be shaped by pressures in the SWOX WRZ and wider Thames Water supply area as a whole. Surpluses in one location could be used to address shortages elsewhere.

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 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. A shortfall in DYAA would suggest a longer-term water shortage across the year, whereas a shortfall in DYCP would suggest a water shortage when demand is high.

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 304.40 Ml/d by 2042. 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 367.39 Ml/d by 2042. 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 2042. Values are provided for the SWOX WRZ with scaled down values also shown for Oxford City (based on population proportion of 15.32%).

Table 3-DYAA and DYCP Forecasts (2025-2042) based on Thames Water's WRMP

	SWOX WRZ	Oxford City
DYAA (2025/2026)	280.26	42.94
Projected DYAA (2042)	304.40	46.64
DYCP (2025/2026)	340.67	52.19
Projected DYCP (2042)	367.39	56.29

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). It has 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 2042, the forecasted WAFU is estimated to be 280 Ml/d and 304 Ml/d under DYAA and DYCP conditions respectively. Using the projected demand figures in Table 3 this points to a shortfall of 24.40 Ml/d under DYAA conditions and 63.39 Ml/d under DYCP conditions.

Figure 4 extracted from the WRMP shows the findings of Thames Water's climate change vulnerability assessment, which shows the SWOX area as being at medium vulnerability.

[22] Thames Water (2024) Figures 4-16 p58 rdWRMP24+-+Section+4+-+Current+and+Future+Water+Supply.pdf (dn9cxogfaqr3n.cloudfront.net)

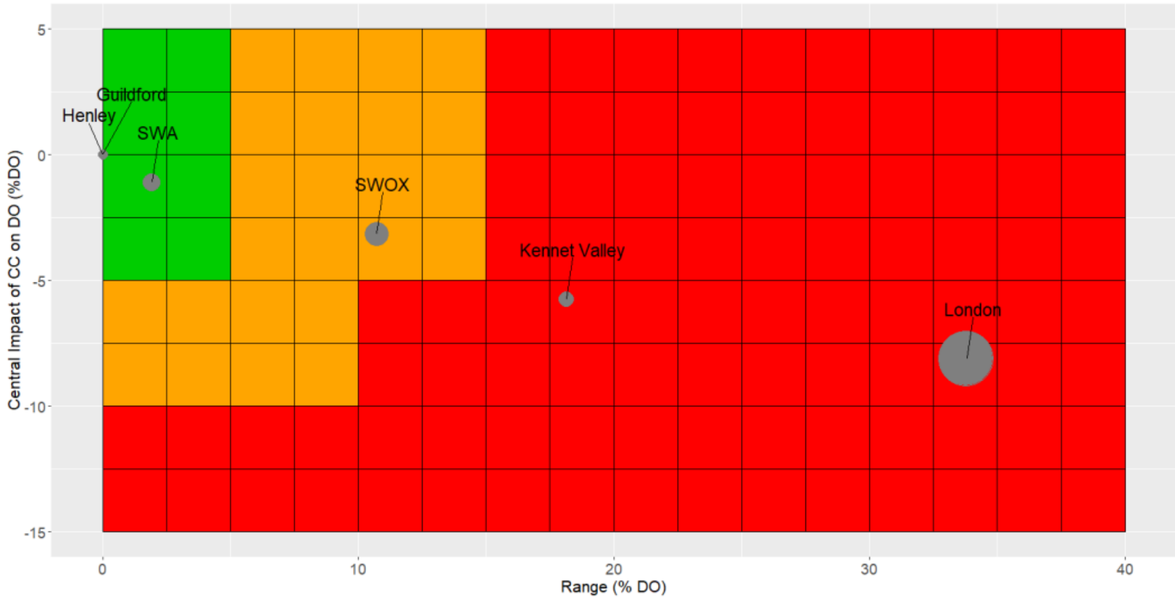

Figure 4- Thames Water Basic Vulnerability Assessment- Climate Change (Source: Thames Water[23])

Table 4 provides a summary of the changes to WAFU values from the beginning of AMP8 (2025/26) across the plan period up to 2042. Values are provided for the SWOX WRZ with scaled down values also shown for Oxford City (based on population proportion of 15.32%). Percentage differences between WAFU and demand values from the beginning of AMP8 (2025/26) across the plan period up to 2042 are also presented to show where a potential surplus or shortfall is present.

Table 4-WAFU DYAA and DYCP Forecasts (2025-2042) based on Thames Water's WRMP

	SWOX WRZ	Oxford City	Demand Surplus for SWOX (%)
WAFU (Ml/d) DYAA (2025/2026)	304.77	46.69	24.51 (+8.73)
Projected WAFU (Ml/d) DYAA (2042)	280*	42.90	-24.40 (-8.02)
WAFU (Ml/d) DYCP (2025/2026)	330.02	50.56	-10.65 (-3.12)
Projected WAFU (Ml/d) DYCP (2042)	304*	46.57	-63.39 (-17.27)

**estimated from graphical data*

The current forecast indicates potential water shortages in the SWOX WRZ under drought conditions. Population growth and climate change are considered the two main drivers of water shortages, increasing demand and reducing supply respectively.

It should be noted that the values stated for Oxford 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 WRZ will broadly match the trends in the city. It is perhaps more likely in Oxford that the shortfalls will be reduced given that the number of dwellings earmarked by Oxford City Council is significantly less than the scaled down

[23] 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

figures estimated from the WRMP. However, this must be balanced against the fact that water will need to be transferred across the WRZ and potentially the wider Thames Water supply area to augment resources in areas where shortages are greater.

Despite some uncertainty, in general, the results do show that without corrective action, the supply for the SWOX WRZ and to Oxford City could be less secure in the future. This means that there could be a greater probability that demand restrictions will be required in dry years.

The demand scenarios presented to date assume that new demand management activity ceases at the end of AMP7 (2025). The supply scenarios also do not take account of potential resource options which are covered along with future demand management options in section 4.7 below.

4.7 Demand Management and Resource Options

4.7.1 Thames Water Demand Ambitions

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 +).

4.7.2 Water Efficiency

Table 5 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[24]. For context, in the demand scenarios presented in section 4.5, the measured PCC in 2042 is approximately 133.40 l/head/day which translates to a total household consumption of 183 Ml/d for the SWOX area. Based on the target values below, the PCC would be approximately 120 l/head/day under the Medium and High Demand Programmes, an approximate 10% reduction that would result in a fall of 18.20 Ml/d for total household consumption. Comparing this to Table 4, this has the potential to almost completely offset the shortfall estimated under DYAA conditions of 24.40 Ml/d and significantly reduce the shortfall under DYCP conditions of 63.39 Ml/d.

Table 5- 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

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

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)[25] 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 plan 2036 for Oxford has already implemented the tighter standard of 110 l/head/day for new developments (Policy RE1).

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[26]. 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 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*[27] a road map is being developed by national government towards greater water efficiency in new developments and retrofits. The Future Homes Hub is providing input to the Roadmap by bringing together industry stakeholders. It has published a report[28] 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 6, with different standards set depending on levels of water stress.

Table 6- 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

Royal Institute of British Architects (RIBA) has also developed in consultation with other professional UK construction bodies voluntary performance targets for water use[29] with regard to construction. The performance targets align with the future legislative horizon and set out challenging but

[25] Department for Levelling Up, Housing and Communities (2015) *Housing: optional technical standards* https://www.gov.uk/guidance/housing-optional-technical-standards
[26] 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
[27] 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
[28] 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
[29] RIBA (2021) *RIBA 2030 Climate Challenge* https://www.architecture.com/-/media/files/Climate-action/RIBA-2030-Climate-Challenge.pdf?srsltid=AfmBOopW1CKKCWUCJ76wMu2194M2EVKmfsT9sCZT-NoSvN8rClGvzGv1

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[30] 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 city will likely require demand reduction actions from Thames Water in combination with government led policy changes. Currently local authorities are not permitted to demand tighter limits beyond 110 l/head/day.

4.7.3 Non-Household Consumption

Table 7 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 2019/20 to 2049/50 target levels, this would result in an estimated non-household consumption in 2042 of 51.5 Ml/d for the Low/Medium programme and 48.2 Ml/d for the High/High + programme.

Table 7- Demand programme business use reductions from 2019/20 levels

Demand Programme	2024/25	2037/38	2049/50
Low/Medium	6.91%	6.63%	11.25%
High/High +	6.91%	12.54%	17.15%
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.

4.7.4 Leakage

Table 8 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 in 2042 of 43.0 Ml/d for the Low/Medium/High programme and 39.2 Ml/d for the High + programme.

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

Table 8- 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%

4.7.5 Resource Options

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.

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[31]. This is close to the end of the local plan period; however, it could offer some security to the city if in 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 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 9 summarises the feasible list of resource options for the SWOX WRZ.

[31] 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

Table 9-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.

4.7.6 Drought Permits

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.

4.7.7 Summary of Demand and Supply Options

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 between 45.1 Ml/d and 53.3 Ml/d in the SWOX area by 2042 based on the low and High+ demand programmes respectively. 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.

Furthermore, in the longer-term supply options are likely to be necessary. 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 Oxford City in isolation.

4.8 Site Specific Assessments (RAG reports)

The analysis undertaken to this point has focused on current and future water availability in the SWOX WRZ with this scaled down to Oxford City. 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 50 sites that are proposed for allocation in the local plan. It should be noted that these 50 sites are provisional at this stage, whilst the overall distribution of sites is likely to remain similar there is the potential for some sites to be withdrawn or be added as the Local Plan 2042 emerges.

In total 43 of the sites are residential and 7 are for employment. Thames Water assessed these sites against the existing capacity of the clean water, wastewater networks and downstream STW, 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 clean water are listed below:

- Green – Based on the information provided Thames Water do not envisage infrastructure concerns in relation to development.
- Amber – Based on the information provided modelling may be required to understand the impact of development.
- Red – Based on the information provided, modelling will be required, and it is anticipated that upgrades to network will be necessary

Across all of the sites, 10 of the sites are scored red, 22 are scored as amber and 18 as green. Larger development allocations tended to score red whereas smaller sites scored amber and green.

For the sites scored amber or red, the water network capacity in the surrounding area may be unable to support the demand anticipated from the development and a further modelling assessment is likely required. 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 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 1.

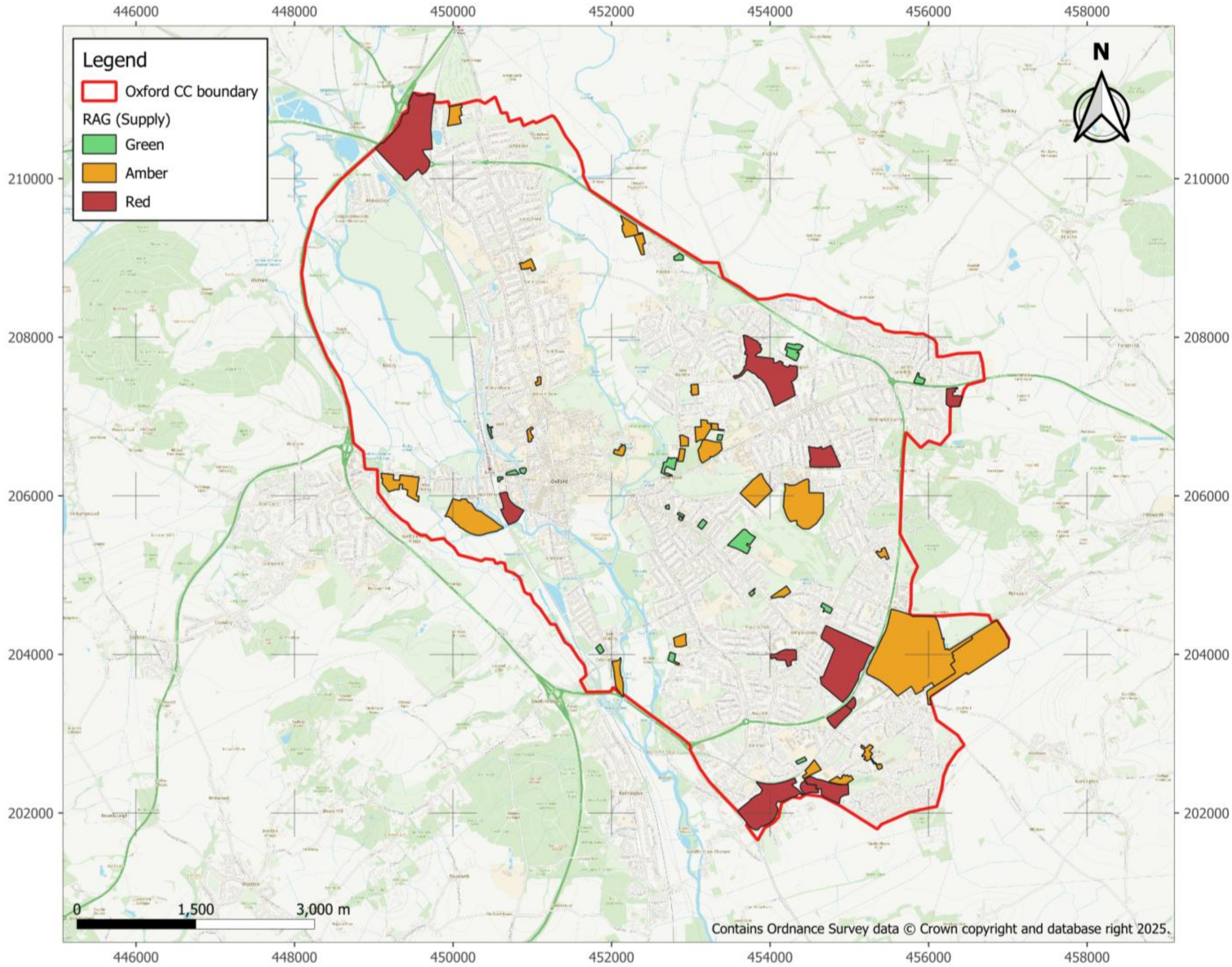

Figure 5- RAG Assessments (Water supply) for site allocations within Oxford City

4.9 Abstraction Licenses

A data request was sent to the EA to establish the existing water abstraction licenses currently in use in Oxford City. Currently there are a total of 6 abstraction licenses in place, all of which are point abstractions. In total 5 of the abstractions come from surface water with one abstraction coming from groundwater sources. Table 10 provides more information about the abstractions including the license holder and their uses. Figure 6 maps the location of the abstractions. Appendix 2 provides the full abstraction records provided by the EA.

Table 10- Abstraction License Details

Licence Holder	Use	NGR	Source of supply
Worcester College	Industrial and Commercial	SP508064	Thames Surface Water
C Gee & Partners	Agriculture	SP496073	Thames Groundwater
Environment Agency	Industrial and Commercial	SP5032405814	Thames Surface Water
W H Munsey Ltd	Production Of Energy	SP5036705904	Thames Surface Water
West Oxford Community Renewables Ltd	Production Of Energy	SP5030705915	Thames Surface Water
Environment Agency	Industrial and Commercial	SP5032805808	Thames Surface Water

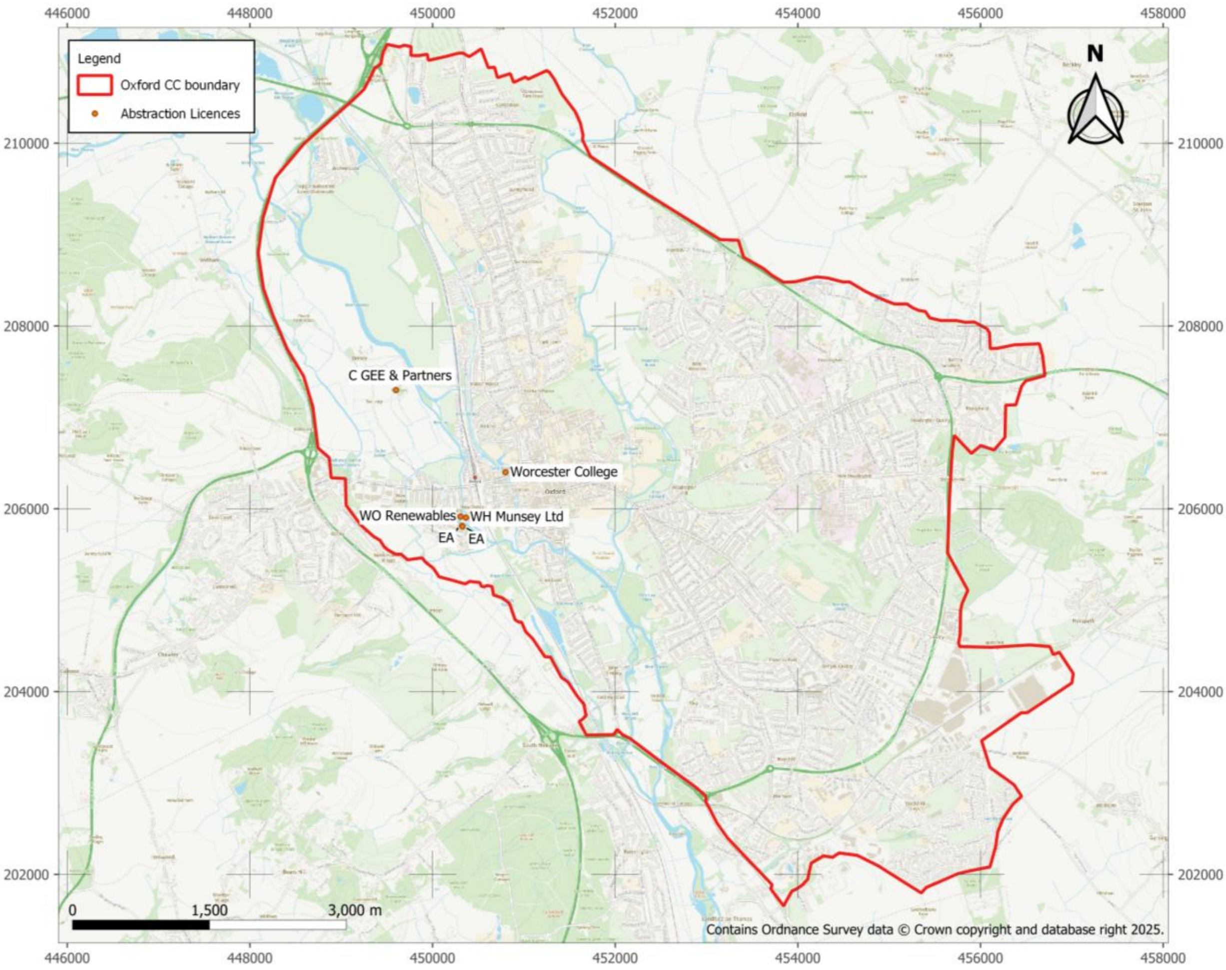

Figure 6- Location of abstraction licenses in Oxford City scaled to annual abstraction volume

Based on the Thames Abstraction License Strategy[32] the Lower River Thames which encompasses the majority of the city 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.

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.

The majority of abstraction licenses across the city are for industrial, commercial, agricultural and energy purposes. However, further abstraction for water supply may be required going forward. This will depend on the availability of water sources, development and climate pressures not only in the city 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 and future abstractions may need to be managed and reduced where possible through better management practices. DEFRA's water abstraction plan[33] 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.

[32] EA (2019) *Thames Abstraction License Strategy* https://assets.publishing.service.gov.uk/media/5de4ebc940f0b650c268495f/Thames-Abstraction-Licensing-Strategy.pdf

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

4.10 Summary

Based on the DYAA and DYCP forecasts in Thames Water's latest WRMP there could be shortfalls in water up to 2042 and beyond.

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 city in isolation.

In terms of infrastructural capacity, based on the RAG reports provided by Thames Water constraints do exist for a number of sites. This means that upgrades will be required across the city to ensure that water supply infrastructure is in place to accommodate the development being brought forward as part of the local plan. 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 in the city are currently used for industrial, commercial, agricultural and energy purposes. 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 city but across the wider Thames Water supply area. It will also be influenced by the implementation of Thames Water's WRMP.

The assessment for the city provides an understanding of water resource pressures in the city 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 WRZ based on population and dwellings fully translate to the Oxford City area
- The full scope of water network upgrades remain unclear until development allocations come forward and more detailed modelling is carried out by Thames Water.

To address the first evidence gap, further technical work would be required in order to refine population estimates and derive specific deficits for the city considering the quantum of development proposed in the local plan. However, this should be captured in future updates to Thames Water's WRMP which will make use of more recent local plan data including the local plan 2042. Furthermore, assessing Oxford City in isolation may not be reflective of future water availability, given that the availability of water in Oxford will also be shaped by pressures in the SWOX WRZ and wider Thames Water supply area as a whole. In terms of the second evidence gap, 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.

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 Oxford City 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) looking at current and future capacity covering a minimum of 25 years, 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[34], and as part of this produced a long-term Strategic Plan for Oxfordshire, Swindon, Wiltshire, Gloucestershire and Warwickshire[35]. 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 the city 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 city specifically is generally moderate to poor (see section 5.3.2 for more detail on watercourse classifications).

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[34] Thames Water (2023) *Drainage and Wastewater Management Plan (DWMP)* https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management/our-dwmp

[35] 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 Oxford (Sandford) STW catchment which serves the city 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 Sewage 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 water cycle study, Thames Water were consulted on the current and future planned capacity of the Oxford (Sandford) STW which serves the city.

In recent years Oxford (Sandford) STW has faced a number of issues. 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. The STW has also been in a position of having to 'catch up' because its FFT was considered too small for the population it serves.

A plan was needed to deliver outstanding AMP7 (2020-2025) obligations, show evidence of coming back into compliance and meet the demands of development outlined in local plans that propose development within the Oxford (Sandford) STW catchment.

Some progress has been made in this regard, Thames Water do have a scheme underway which is expected to be completed by 2027. The first phase of this scheme has been delivered and includes an increase in the inlet capacity to receive a greater daily flow. Thames Water has stated that the increase in capacity provides the additional capacity required to treat domestic sewage from both the projected increase in non-residential development and the projected increase in the number of new houses driven by Local Plan trajectories provided by Oxford City Council, Cherwell District Council and South and Vale District Councils, which according to Thames Water totals 9,534 new domestic properties between 2025 – 2031, and 10,902 between 2032-2041. Further phases will look to build resilience at the STW, they should include further flow improvements and the introduction of a new treatment process later this year. The improvements to up to 2027 should collectively reduce spills to the surrounding water environment and improve effluent quality.

Subsequent upgrades are also set to be delivered for 2031. These are focused on improving the quality of the final effluent further, with a reduction in Phosphorus being a key element. Alongside this Thames Water are also finalising plans for a major upgrade at Oxford (Sandford) STW, costing more than £435m. This will provide a significant increase in treatment capacity, larger storm tanks and a higher quality of treated effluent discharging to the river. This work is planned to be delivered during AMP9 (2030-2035).

The future upgrades at Oxford (Sandford) STW should allow for the development proposed in the local plan to be accommodated at the STW. However, it should be noted that many of the upgrades are yet to be fully realised, and it is unclear what the changes in discharge volume will be at the STW. Development, particularly early in the plan period, needs to take this into account to ensure it is phased correctly to avoid any exceedance in infrastructural capacity and/or environmental capacity.

It is also important to note that infiltration of groundwater could be significant in the Oxford (Sandford) STW catchment if sewer networks are not properly maintained and upgraded as required. Infiltration 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)[36] the EA has recommended that a study is

[36] City Science (2021) *Oxfordshire Infrastructure Strategy (OxIS)* https://mycouncil.oxfordshire.gov.uk/documents/s59528/OxIS%20Stage%201%20Chapter%201.pdf

conducted to identify the networks effected by groundwater infiltration and that this infrastructure is considered for upgrades as a priority. Thames Water is best placed to take a lead on this study.

5.2.3 Combined Sewer Overflows (CSOs)

Many parts of England have a combined sewerage 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 the city.

The EA works 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[37] 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[38] 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 (including both CSOs at STWs and network CSOs) 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.

Thames Water was contacted to obtain data on CSO monitoring within Oxford City. The CSOs monitored in the last seven years (2018-2025) across the city are summarised in Table 11. Appendix 3 provides the full dataset, which includes further information on spill durations and dates. Further development has the potential to increase risks unless infrastructural capacity is in place. The improvements planned for the Oxford (Sandford) STW should reduce this risk however it is likely that development will need to be phased appropriately to allow these upgrades to take effect. It is also Thames Water's responsibility to continue to monitor CSOs and take appropriate action.

Table 11- CSOs monitored in study area

Name	NGR	Period of Record	Average Spills per year	Average Spill duration per year (hrs)
Littlemore (Heyford Hill Lane)	SP529024	2019-2024	41.2	56.1
North Hinkey Lane (The Willows)	SP491058	2019-2025	32.8	280.5
Oxford (Sandford) STW	SP543019	2018-2025	61.8	1317.3

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

5.2.4 Site Specific Assessments (RAG reports)

To help assess existing infrastructural capacity, Thames Water was provided with a list of 50 sites that are proposed for allocation in the local plan. Thames Water assessed these against the existing capacity of the clean water (see section 4.8), wastewater networks and downstream STW 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 the wastewater network are the same as those listed in section 4.8 for clean water. For the STW assessment the following categories apply:

- Green – Based on the information provided Thames Water does not envisage infrastructure concerns in relation to the capacity at the STW
- Amber – Thames Water is aware of capacity concerns at the STW and a scheme is planned to accommodate future growth
- Red – There are concerns about the capacity at the STW to accommodate future growth

For the STW assessment all sites drain to the same STW, Oxford (Sandford) STW. As a result, all sites scored amber. This reflects that whilst capacity concerns are present at Oxford (Sandford) STW, an interim scheme in 2027 and a full upgrade in 2031 are earmarked to address these.

For the wastewater network, 40 sites are scored green, 6 are scored as amber and 4 are scored red. For the sites scored amber or red, the water network capacity in the surrounding area may be unable to support the demand anticipated from the development and a further modelling assessment is likely required. In these locations, local upgrades to the existing sewerage 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 7 shows the location of each of the sites and their wastewater network score (RAG), following Thames Water's assessment. Thames Water's original RAG reports for both water supply and wastewater are provided in Appendix 1.

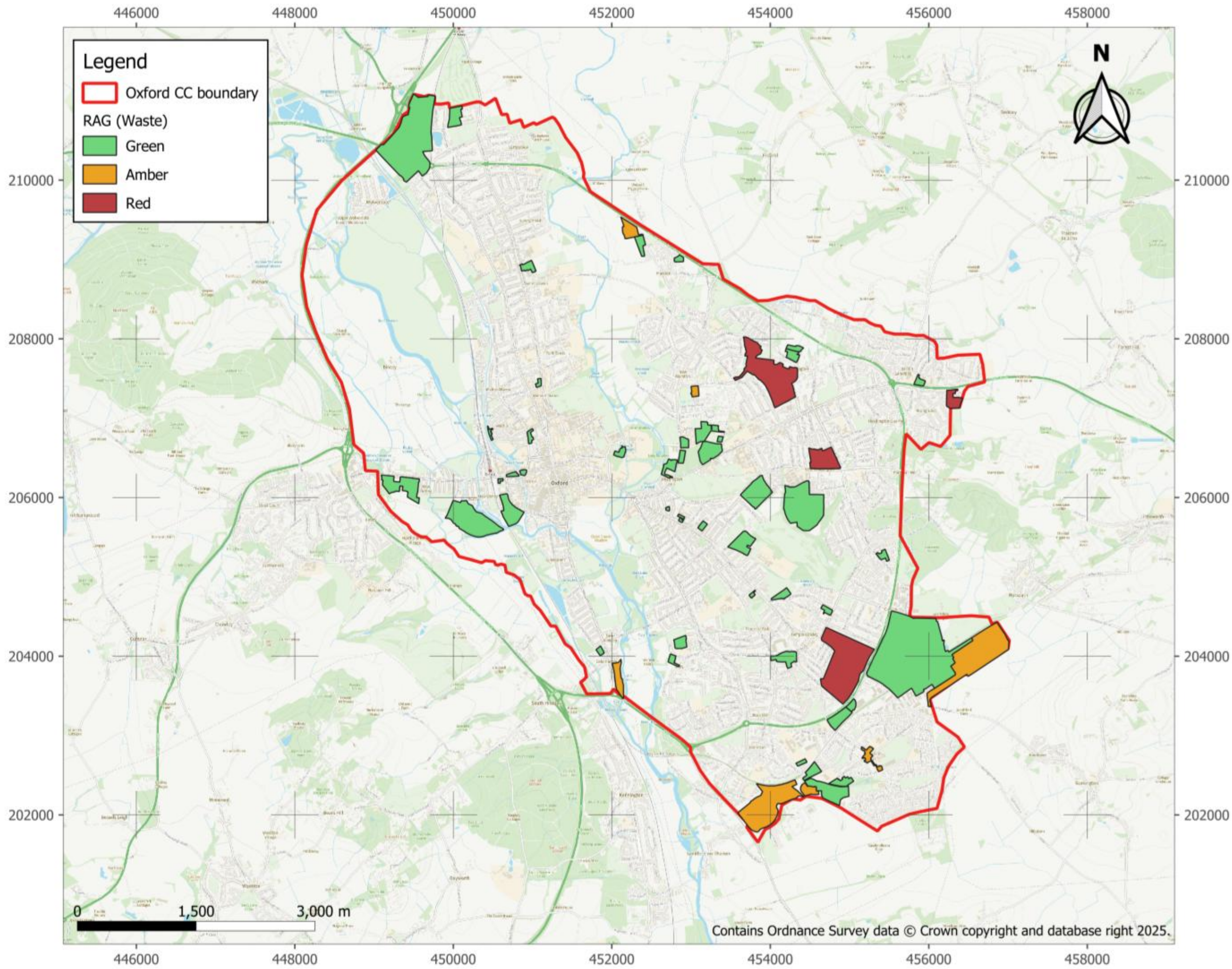

Figure 7- RAG Assessments (Wastewater) for site allocations within Oxford City

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)[39] transposed into law by the Water Environment Regulations 2017 in England and Wales[40] 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 12 gives a description of each of the status classes.

Table 12- 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
- 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

[39] European Commission, *Water Framework Directive (2000)*, http://ec.europa.eu/environment/water/water-framework/index_en.html
[40] 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

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 13 summarises some of the key measures relevant to the study area.

Table 13- 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
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 solutions through PR24 process and the agriculture sector	EA
	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

5.3.2 Surface Water

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

The ecological status of WFD catchments can be classified as *Bad, Poor, Moderate, Good* and *High*. For the chemical status, WFD 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 understand their environmental capacity. Figure 8 shows the WFD catchments within the city.

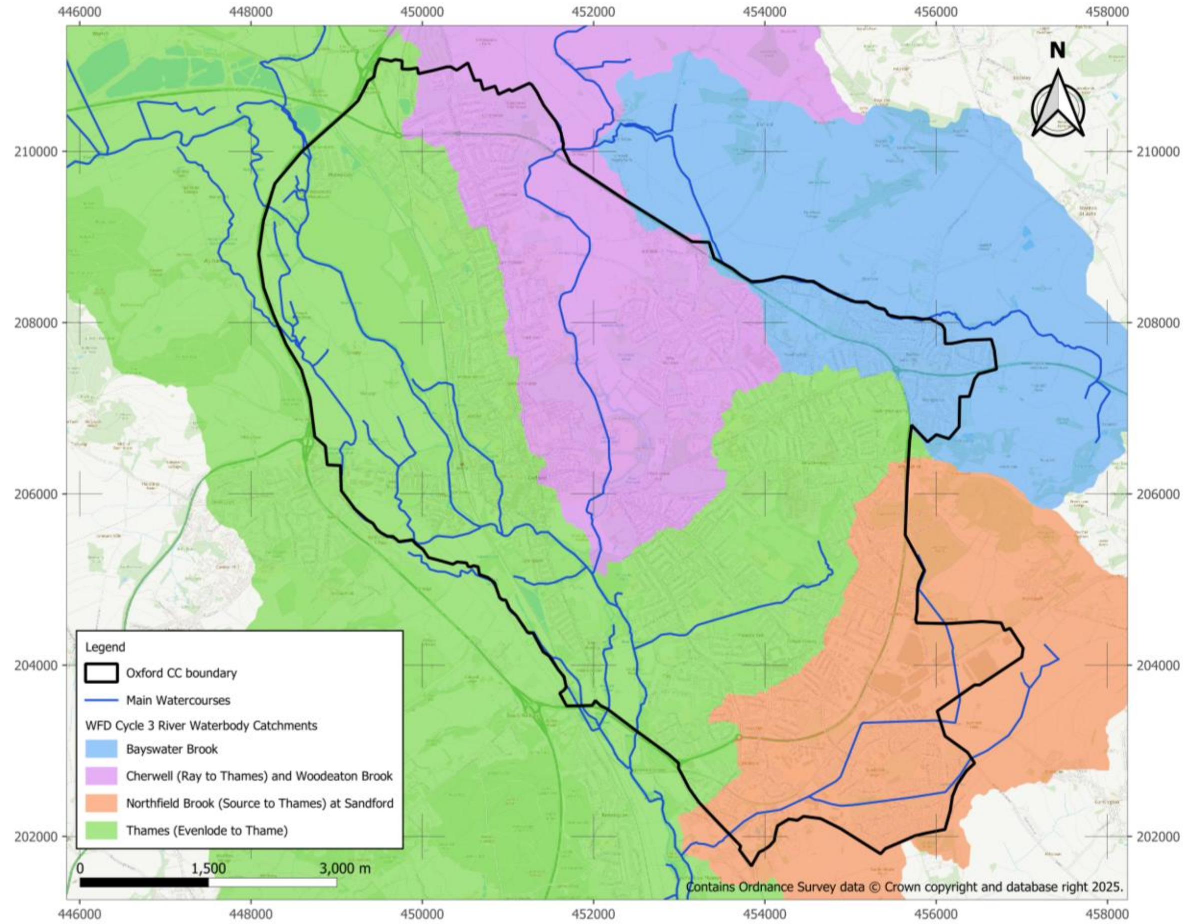

Figure 8- WFD Cycle 3 River Waterbody Catchments

Table 14 shows the ecological and chemical status of the four WFD catchments which fall within the city. In total, 3 of the catchments are classed as *Poor*, and 1 is classed as *Moderate*. 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 the assessments undertaken for previous WFD cycles. 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. Those being impacted by the water industry could be more sensitive to future development given its potential impact on increasing pollutant loads.

Table 14- Ecological and Chemical Status of Surface Waterbodies in the study area

Waterbody Name	Ecological	Chemical	Reasons for not achieving good status (RNAG)
Cherwell (Ray to Thames) and Woodeaton Brook	Poor	Fail	Water industry listed as RNAG for macrophytes and phosphate. Urbanisation, agriculture and invasive species are listed as other RNAGs.
Bayswater Brook	Poor*	Fail	Water industry not listed. RNAG listed as agriculture.
Northfield Brook (Source to Thames) at Sandford	Moderate	Fail	Water industry listed as RNAG for macrophytes, invertebrates and phosphate. Urbanisation, drought and invasive species are listed as other RNAGs.
Thames (Evenlode to Thame)	Poor	Fail	Water industry listed as RNAG for phosphate and Tributyltin Compounds. Poor nutrient management and invasive species are listed as other RNAGs.

*Classification from 2019, no classification available for 2022

Listed below in Table 15 are the site allocations located within each WFD catchment, some sites fall across more than one catchment. Figure 9 maps the ecological classification for each WFD catchment overlain by the site allocations. It should be noted that the site allocations presented are provisional at this stage, whilst the overall distribution of sites is likely to remain similar there is the potential for some sites to be withdrawn or be added as the Local Plan 2042 emerges.

Table 15- Site Allocations within each WFD catchment

Waterbody Name	Site Allocations
Cherwell (Ray to Thames) and Woodeaton Brook	• Diamond Place and Ewert House • Hill View Farm • Land West of Mill Lane • Marston Paddock • Rectory Centre • John Radcliffe Hospital Site • Land Off Manor Place, Rectory Centre • Land Surrounding St Clement's Church • Headington Hill Hall and Clive Booth SV • 1 Pullens Lane, Government Buildings & Harcourt House • Oxford University Press Sports Ground, Jordan Hill • Oxford Brookes Marston Road Campus • Union Street CP and 159-161 Cowley Road • Government Buildings & Harcourt House
Bayswater Brook	• John Radcliffe Hospital Site • Ruskin Field • Ruskin College Campus, Dunstan Road • Thornhill Park, London Road • Bayards Hill Primary School Playing Fields
Northfield Brook (Source to Thames) at Sandford	• Unipart Group • Slade House • MINI Plant Oxford • Kassam Stadium and Ozone Leisure Complex • Oxford Science Park (Whole Site) • ARC Business Park (Whole Site) • Knights Road • Overflow Carpark at Kassam Stadium Site • Sandy Lane Recreation Ground • Edge of Playing Field Oxford Academy • Blackbird Leys Central Area
Thames (Evenlode to Thame)	• Redbridge Paddock • John Radcliffe Hospital Site • Manzil Resource Centre • Jesus and Lincoln College Sports Ground • Canalside Land, Jericho • Botley Road Retail Park • West Wellington Square • Oxpens • Osney Mead (Whole Site) • Warneford Hospital

	• Nuffield Orthopaedic Centre • Churchill Hospital Site • Cowley Centre (Templars Square) • Northern Gateway • Bertie Place Recreation Ground • Banbury Road University Sites (Parcel B) • Crescent Hall, Crescent Road • Cowley Marsh Depot, Marsh Lane • Land at Meadow Lane • Former Iffley Mead Playing Field • 474 Cowley Road • Nuffield Sites

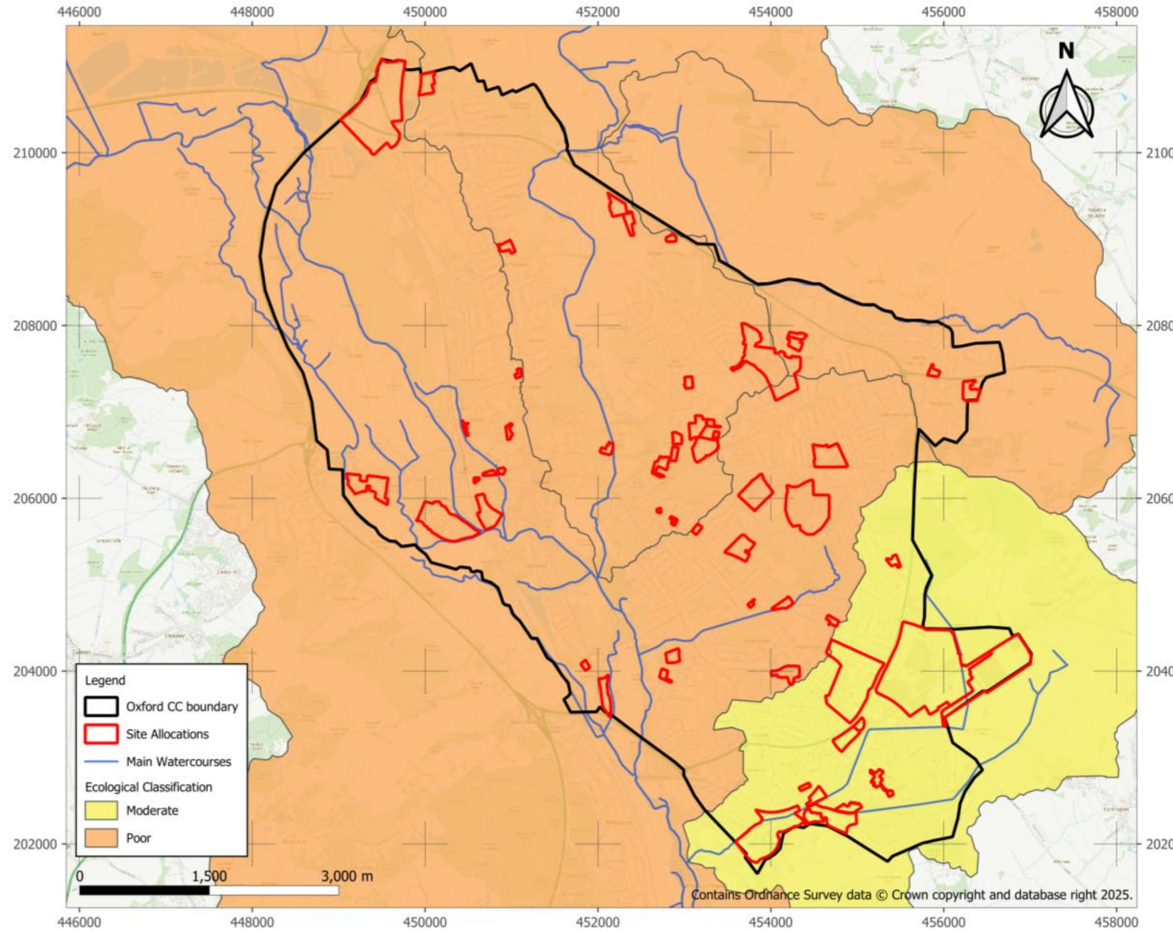

Figure 9- WFD Catchments Ecological Classification

The current status of watercourses within the city 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 significant limit to growth, especially where other reasons (i.e. agriculture, invasive species) are playing a large role in the watercourse not achieving good status.

The findings do highlight the need for the STW upgrades earmarked in section 5.2.2 to be implemented in a timely manner. When implemented, these should improve the headroom available to allow some development to take place without compromising water quality.

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 the city. 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 10 only the Headington Corallian groundwater body intersects the Oxford City boundary, with the Shrivenham groundwater body lying just outside. 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.

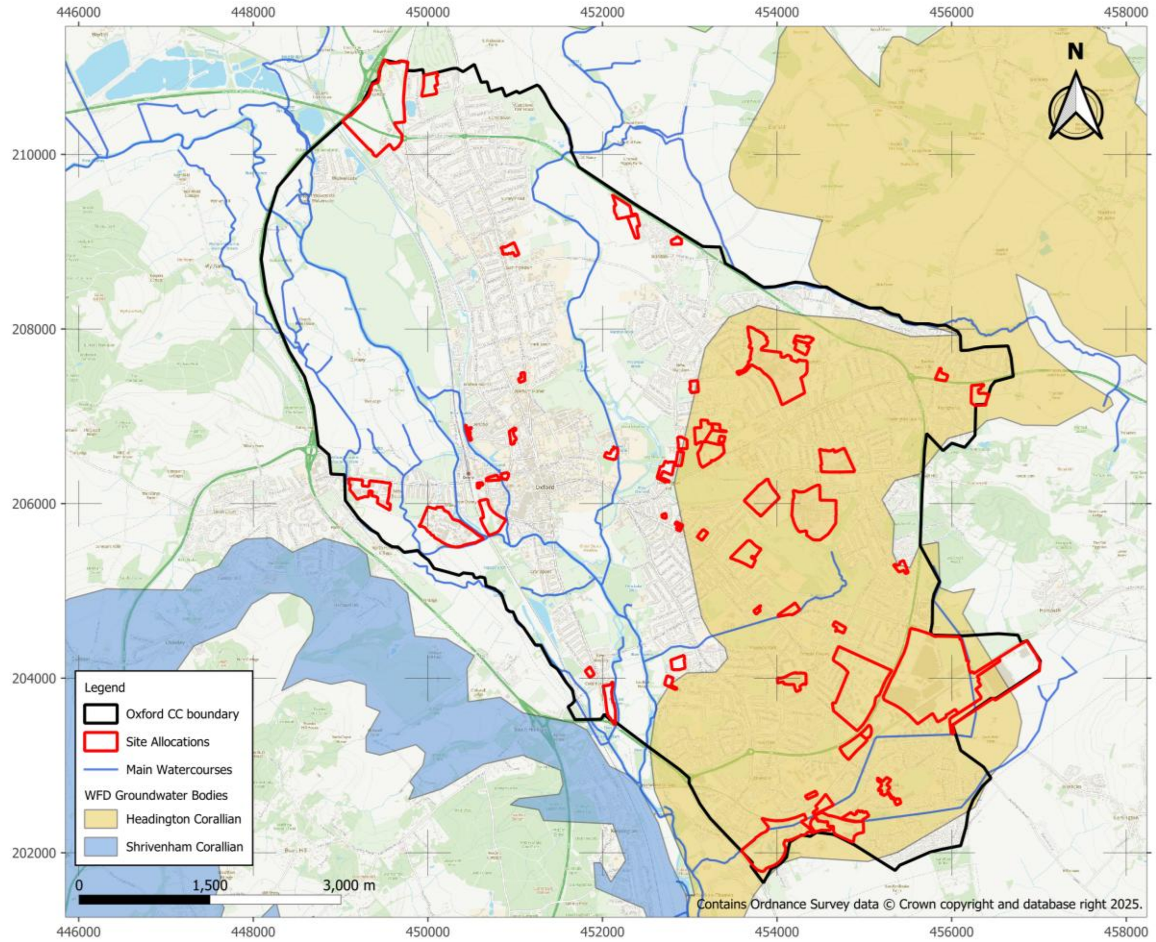

Figure 10- WFD Groundwater Catchments intersecting the city

The WFD groundwater classification for the Headington Corallian groundwater catchment is *Poor.* This is due to its chemical status, as its quantitative status is *Good.* Whilst the quantitative classification is *Good,* abstractions could potentially increase to meet future demand and offset shortages in surface water supplies as a result of climate change. This in turn could have a detrimental impact on quantitative status if not properly managed.

5.4 Summary

The sewer network in the city currently manages the demand of over 162,100 people. This is set to increase over the plan period and it is essential that there is sufficient infrastructural and environmental capacity to safeguard against issues such as ecological damage and sewer flooding.

The Oxford (Sandford) STW serving the city is the most important infrastructural asset with respect to future development in the city.

On a site-specific basis, local upgrades to the existing wastewater infrastructure network are likely required at some of the sites in the local plan, to ensure sufficient capacity is brought forward ahead of the occupation of development. The capacity of the existing sewer network and downstream STW could present barriers to development progressing, particularly early in the plan period. However, it should be noted that a significant infrastructure upgrade is underway and planned for Oxford (Sandford) STW which should mean it has capacity for future development.

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 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. This interim report will be updated and finalised to take account of any relevant feedback, particularly from key stakeholders such as the Environment Agency (EA) and Thames Water during the regulation 18 consultation. This will also take into account whether a further detailed study is needed with regards to wastewater infrastructure, water quality and environmental capacity.

6 Flood Risk

6.1 Introduction

This section includes a high-level review of the flood risk relevant to this study across Oxford City, 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 and the River Cherwell are the main watercourses within Oxford City. Their confluence is located southeast of the city centre. Other watercourses that confluence with the Thames in Oxford City include Boundary Brook, Northfield Brook, Littlemore Brook, Seacourt Stream, and Bulstake Stream. Fluvial flood risk is present along 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).

Surface water flood risk also effects many locations across the city, including the areas of Temple Cowley, New Headington, New Marston, and Cutteslowe 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 more common in the hard rock aquifers in the east of the city, 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 270 incidents in the four postcode areas within Oxford City since records began in 1989 with the privatisation of the water industry. The total number of recorded incidents has been aggregated for each of the postcode areas intersecting the city. These are shown in Figure 11. Generally, these show that most incidents occur in the west of the city. However, there are more urban areas included within the postcode areas outside the city boundary to the west than the east. Extrapolating to 2042, a large amount of the development proposed in Oxford is for the two eastern postcode areas.

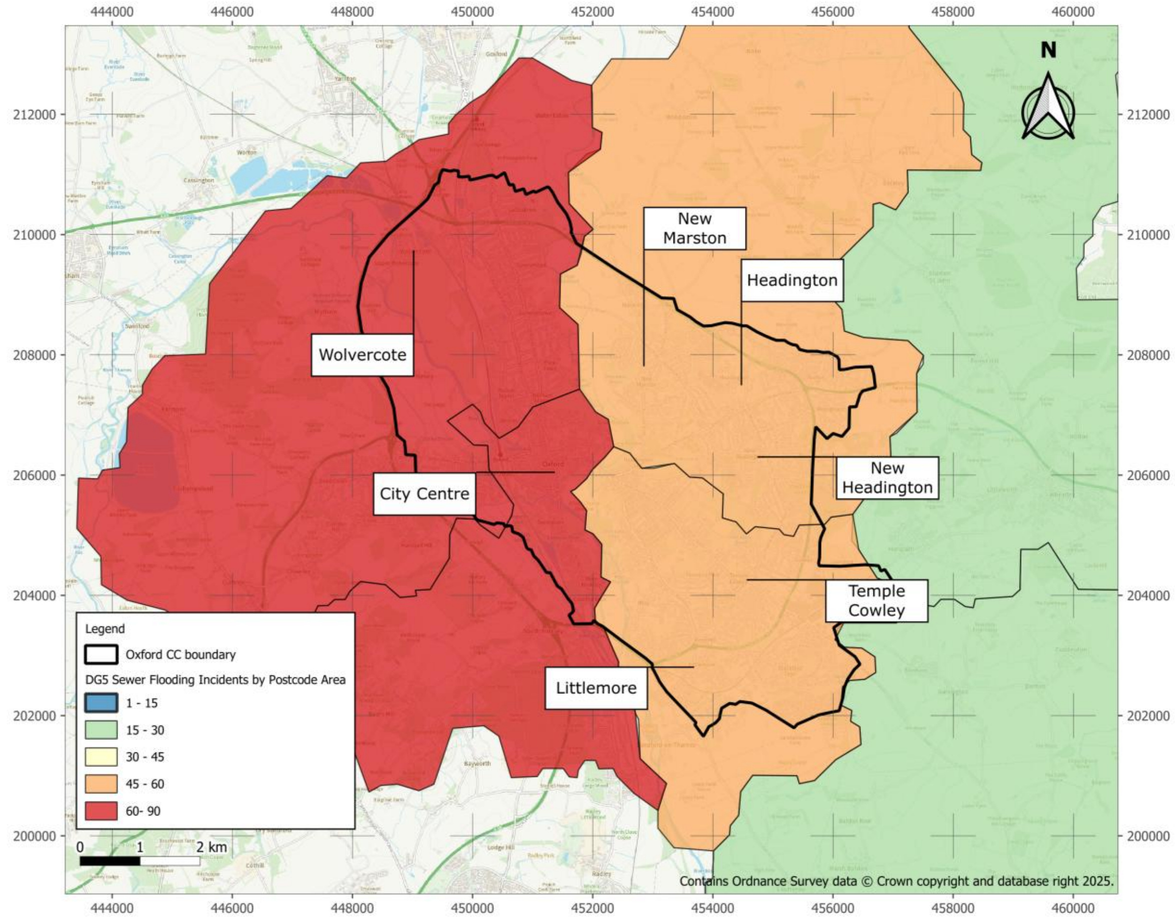

Figure 11 - DG5 Sewer Flooding Records for Postcode Areas

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.

Specifically, 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, development 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.

Extrapolating to 2042, a total of 16 sites being brought forward in the Local Plan fall partially within Flood Zone 3 and have the potential to compromise floodplain storage. These sites include 474 Cowley Road; Bertie Place Recreation Ground; Botley Road Retail Park; Canalside Land, Jericho; Cowley Marsh Depot, Marsh Lane; Kassam Stadium and Ozone Leisure Complex; Knights Road; Land at Meadow Lane; Land Off Manor Place; Land surrounding St Clement's Church; Nuffield Sites; Osney Mead; Overflow carpark at Kassam Stadium site; Oxford Science Park; Oxpens; and Redbridge Paddock. At most of 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. However, for the sites west of the city centre, a larger proportion of them are located within Flood Zone 3.

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, the discharge permit for the Oxford (Sandford) STW was obtained from the EA. It states 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[41] software which can be used to estimate annual flow statistics for catchments across the UK was then used to estimate the annual Q1 flow (the flow exceeded for 1% of the year) at the Oxford (Sandford) STW outfall location. The Q1 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 16 shows the Q1 flow compared to the permitted flow. The analysis shows that the permitted flow significantly exceeds the estimated Q1 flow for the Pottery Stream. However, the Pottery Stream is a very small watercourse that confluences with Littlemore Brook shortly downstream of the STW discharge location. The estimated Q1 flow for Littlemore Brook downstream of the confluence is 754 l/s, slightly higher than the permitted flow. The Littlemore Brook later discharges into the River Thames, where the permitted flow will likely become negligible. However, the analysis does suggest that caution should be applied when the EA come to setting the maximum flow volume in the future especially with regards to local flood risk along the Pottery Stream and Littlemore Brook.

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

Table 16- Sewage Treatment Work Q1 flows against permitted flows

STW Name	Watercourse	DWF Permit (m^3/day)	DWF Permit(l/s)	Estimated Q1 at Outfall (l/s)
Oxford	Pottery Stream	50985	590	113

Development across the city 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. For the majority of the sites (see section 5.2.4), Thames Water does not currently envisage any infrastructure concerns based on the information provided to date. This is with the exception of some of the larger allocations in the east of the city where future infrastructure upgrades will likely be required to accommodate growth. It should be noted that windfall sites and urban creep present a further risk, especially if their impact is not captured in the planning process for future sewer upgrades.

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

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)[42] a sequential approach will be taken in the Local Plan 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 requires that 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.

In terms of the Local Plan, whilst development will be sited outside of floodplain areas where possible and often upon previously developed land, 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 Local Plan. To 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 Systems (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 SuDS 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. They also help maintain and improve water quality. The non-statutory guidance[43] 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[44] on SuDS and drainage requirements within the county. Major developments (more than 10 dwellings) within Oxfordshire

[42] Ministry of Housing, Communities and Local Government (2023) *National Planning Policy Framework* https://www.gov.uk/government/publications/national-planning-policy-framework--2
[43] 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
[44] 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

should meet these standards. Note, the majority of sites being brought forward in the local plan are located on previously developed land (brownfield sites), the local standards stipulate that for brownfield sites a betterment on existing runoff rates and volumes should be sought to meet the equivalent greenfield runoff rate (rural land use). A 10% allowance for urban creep in new development sites is also stipulated 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 in the city, in addition to limiting significant increases in discharges from the Oxford (Sandford) STW. 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 are within normal range.

As part of its DWMP, Thames Water is taking a 'SuDS-first' approach when prioritising options to manage flood risk. Stating further that it will work in collaboration with partners to increase the amount of SuDS delivered across the Thames Valley. When considering sites in the Local Plan 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 (typically by the EA, LLFA or local authorities), 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.

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 increased 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 the city. 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 Local Plan will include a more detailed assessment of the fluvial and surface water flood risk constraints at each of the development sites.

7 Other Environmental Constraints

7.1 Protected Sites

Further environmental constraints arise mainly from the protected status of sites across the city.

There is one large Special Area of Conservation (SAC) within the city, Oxford Meadows. 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 12 shows the location of SACs across the city and in the surrounding area.

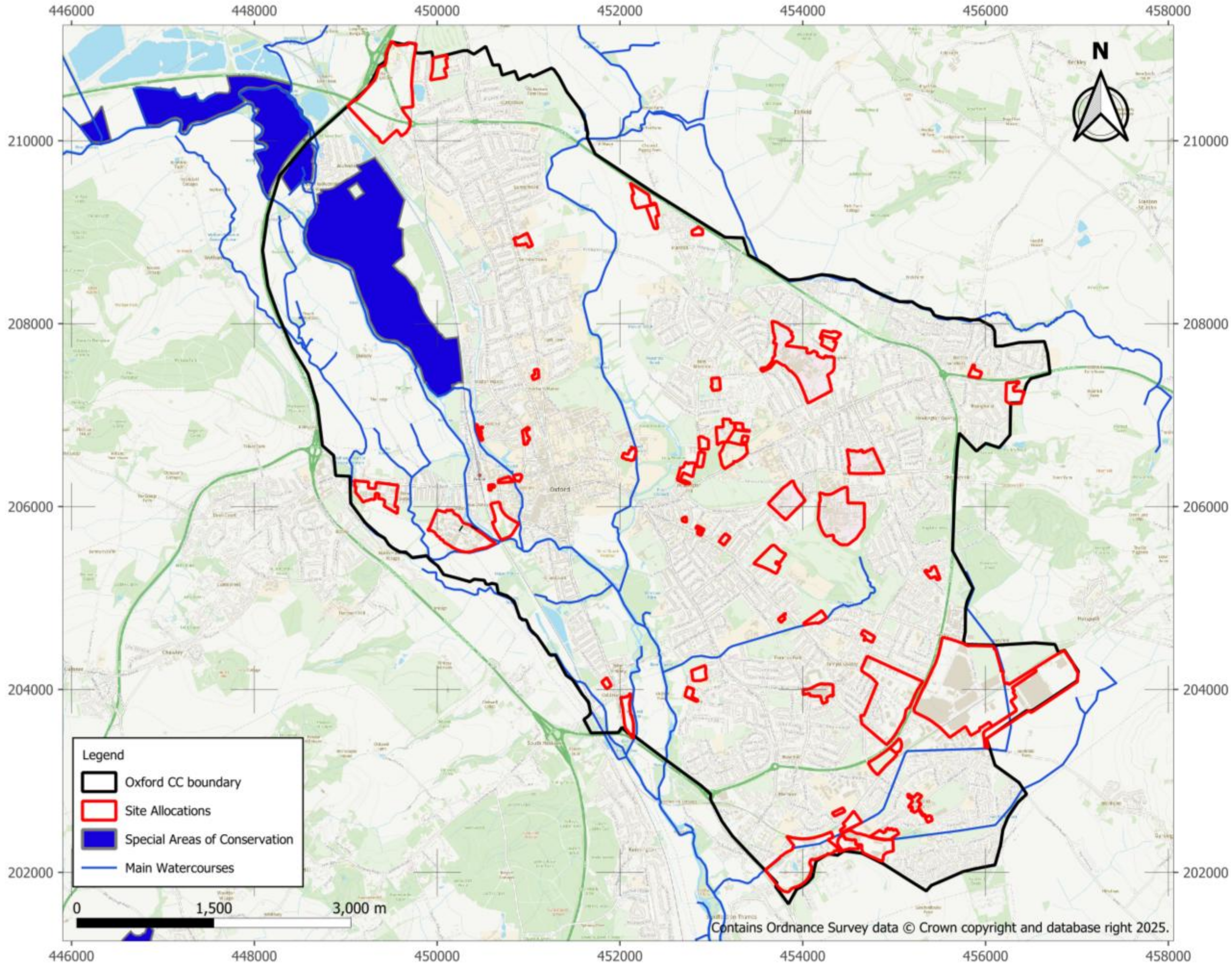

Figure 12- SACs across the city and in the surrounding area

There are 12 Sites of Special Scientific Interest (SSSI) within the city, with many SSSIs 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 that 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 for certain activities. Figure 13 shows the location of SSSIs across both the city and surrounding area.

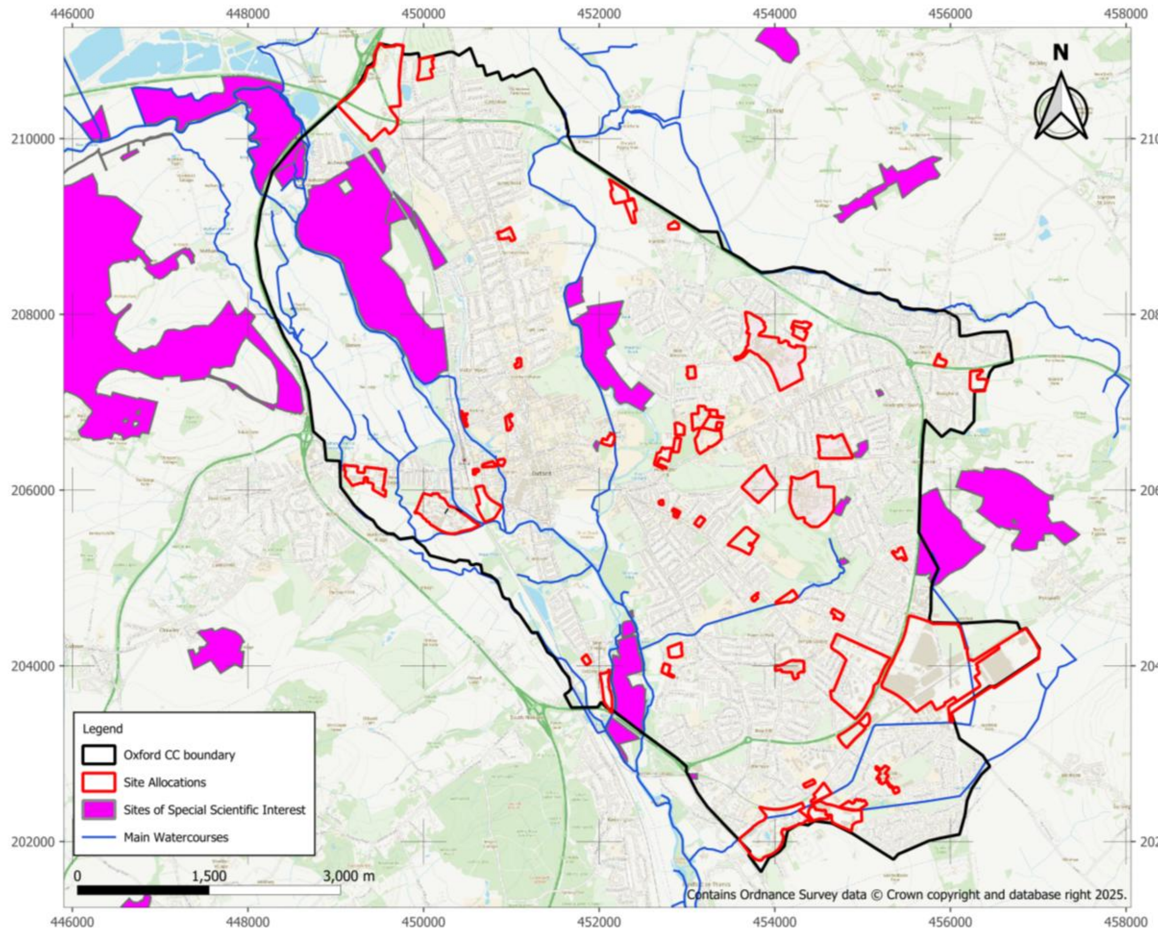

Figure 13- SSSIs across the city and surrounding area

Often protected sites play a key function in terms of water quality which is vital for maintaining the environmental capacity across the city. 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 has published guidance[45] for new and 'change of use' developments proposed near STWs and large pumping stations. Thames Water aims to ensure all proposed developments near its wastewater sites are risk assessed and, where necessary, that developers fund any mitigation needed to enable them to build there.

Developers should contact Thames Water to discuss any encroachment close to STWs prior to 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 Local Plan, Figure 14 shows the proposed site locations relative to the Oxford (Sandford) STW with an 800m buffer shown.

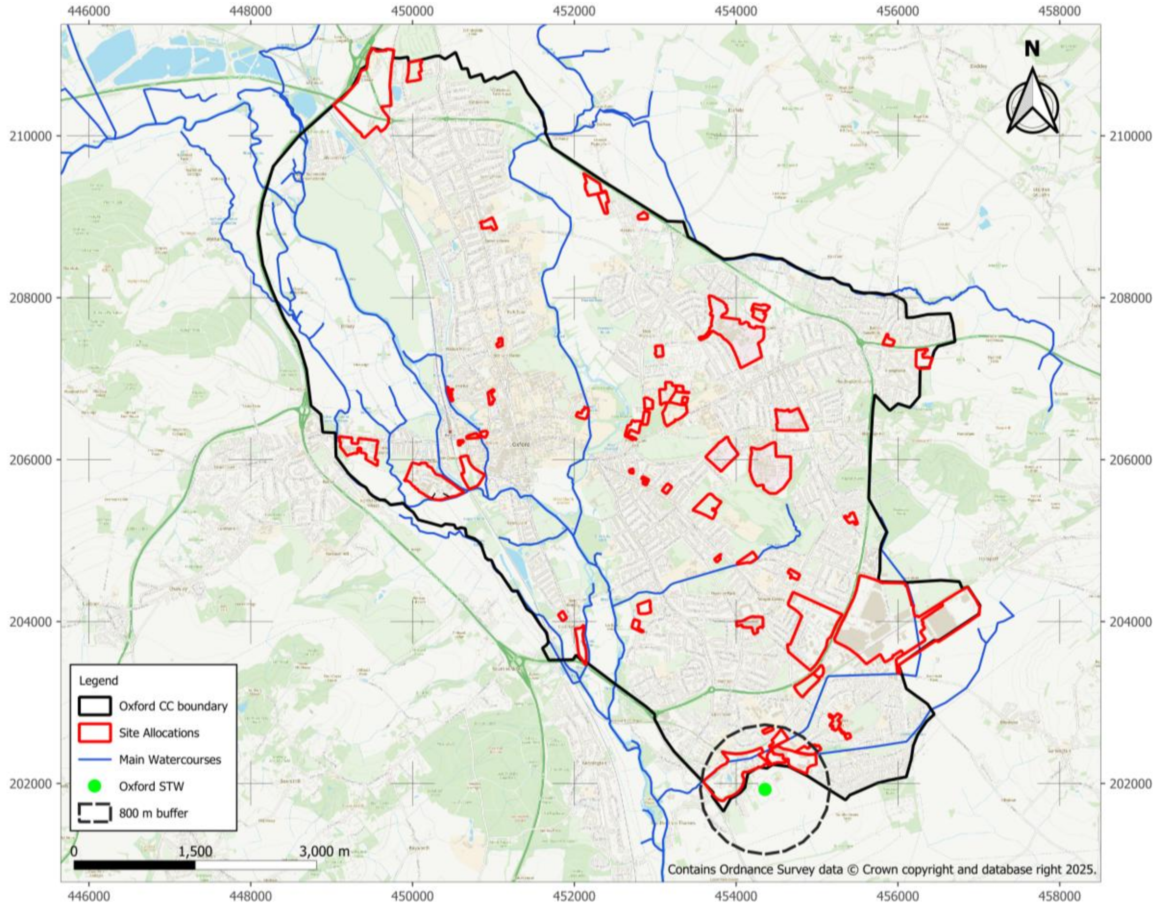

Figure 14- STW with 800m buffer relative to site allocations

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45 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

It has been estimated that 5 sites identified in the Local Plan fall within 800m of Oxford (Sandford) STW. These sites are Knight's Road, Kassam Stadium and Ozone Leisure Complex, Overflow carpark at Kassam Stadium site, Edge of Playing fields Oxford Academy, and Oxford Science Park (Whole Site).

At these sites odour risk could be a concern and 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 undertakes risk assessments in phases – by desktop and then sample surveys. If this shows the development is at odour risk based on their assessment criteria, it 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 city includes a number of protected sites and designated habitats which may present constraints to development in certain areas. 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. 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 small number of the sites proposed in the Local Plan could encroach on land close to Oxford (Sandford) STW. For these sites, 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.

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 2042 and beyond. Without corrective action, the supply for to the city could be less secure which will mean a greater probability that demand restrictions will be required in dry years.
- 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 has 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.
- New interventions from the city council such as stricter water use standards may also be required during the plan period, if permissible under government policy and legislation.
- Thames Water has assessed the local 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 50 sites, 10 sites have been scored red. This means that based on the information provided, modelling will be required, and it is anticipated that upgrades to the network will be necessary
- In total 22 sites have been scored amber. At these sites, based on the information provided modelling may be required to understand the impact of development.
- In total 18 sites have been scored green. At these sites, based on the information provided Thames Water does not envisage infrastructure concerns in relation to development.
- The majority of abstraction licenses across the city are for industrial, commercial, agricultural and energy purposes. Overall, their impact on water resources is thought to be small. However, further abstraction for water supply may be required going forward.
- Further technical work could be undertaken in order to derive specific deficits for the city considering the quantum of development proposed in the local plan. However, water resources are managed on the scale of the SWOX WRZ and the development being proposed in the local plan 2042 should be captured in future updates to Thames Water's WRMP.
- The deliverability of upgrades to the water network will require further technical input from Thames Water as sites are brought forward through the planning process.

Wastewater Infrastructure, Water Quality and Environmental Capacity

- The Oxford (Sandford) STW serving the city is the most important infrastructural asset in the city. There are several planned upgrades to the STW due to take place in AMP8 (2025-2030) and AMP9 (2030-2035). These should provide sufficient capacity for growth up to 2042.
- Thames Water has 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 50 sites, 4 sites have been scored red. This means that based on the information provided, modelling will be required, and it is anticipated that upgrades to the network will be necessary
- In total 6 sites have been scored amber. At these sites, based on the information provided modelling may be required to understand the impact of development.
- In total 40 sites have been scored green. At these sites, based on the information provided Thames Water does not envisage infrastructure concerns in relation to development.
- Thames Water has also generated a series of RAG (red, amber, green) reports which scored each site based on the capacity of the downstream STW. As all sites drain to the same STW, Oxford (Sandford) STW, they were all scored amber. This reflects that Thames Water is aware of capacity concerns at the STW and a scheme is planned to accommodate future growth
- 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 potentially 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 this regard but will take time.

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.
- In terms of the risk posed by increases in discharge volumes from the Oxford (Sandford) STW, these are not thought to have a widespread impact however they could have an effect on local flood risk. This should be considered when the EA come to setting future flow permits.
- The SFRA supporting the local plan will include a more detailed assessment of the fluvial and surface water flood risk constraints at each of the development sites.

Other Environmental Constraints

- The city includes 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.
- 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, some of the sites proposed in the local plan could encroach on land close to Oxford (Sandford) STW. 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 should be sufficient to address the evidence gaps identified in this scoping study without the need for further assessment.

The project to date has consisted of a scoping study and preparation of this interim report for the council’s regulation 18 consultation. The interim report will be updated and finalised to take account of any relevant feedback, particularly from key stakeholders such as the Environment Agency (EA) and Thames Water during the regulation 18 consultation. This will also take into account whether a further detailed study is needed.

Appendix 1 – Thames Water RAG Reports

Appendix 2 – EA Abstraction Licenses

Appendix 3 – Thames Water CSO Monitoring Data