# Buckinghamshire Water Cycle Study - Stage 1

## Final Report

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Prepared for:

Buckinghamshire Council

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This report describes work commissioned by Buckinghamshire Council, by an instruction dated 21 December 2022. The Client's representatives for the contract were David Broadley, Aude Pantel and Trinidad Galindo of Buckinghamshire Council. Laura Thompson, James Fitton and Richard Pardoe of JBA Consulting carried out this work.

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## Abbreviations

AMP ..... Asset Management Plan

AONB ..... Area of Outstanding Natural Beauty

AW ..... Anglian Water

BC ..... Buckinghamshire Council

BNG ..... Biodiversity Net Gain

BOD ..... Biochemical Oxygen Demand

BREEAM ..... Building Research Establishment Environmental Assessment Methodology

CAPEX ..... Capital Expenditure

CFMP ..... Catchment Flood Management Plan

CfSH ..... Code for Sustainable Homes

CSO ..... Combined Sewer Overflow

DLUHC ..... Department for Levelling Up, Housing & Communities

DWF ..... Dry Weather Flow

DWI ..... Drinking Water Inspectorate

DWMP ..... Drainage and Wastewater Management Plan

EA ..... Environment Agency

EFI ..... Ecological Flow Indicator

EP ..... Environmental Permit

EU ..... European Union

FEH ..... Flood Estimation Handbook

FFT ..... Flow to Full Treatment

FWMA ..... Flood and Water Management Act

FZ ..... Flood Zone

GIS ..... Geographic Information Systems

HRA ..... Habitats Regulations Assessment

JBA ..... Jeremy Benn Associates

LLFA ..... Lead Local Flood Authority

LNRS ..... Local Nature Recovery Strategy

LPA ..... Local Planning Authority

l/p/d ..... Litres per person per day

Ml/d ..... Mega (Million) litres per day

MHCLG ..... Ministry of Housing Communities and Local Government (replaced by DLUHC)

NAV ..... New Appointment and Variations suppliers

NH4 ..... Ammonia

NMP ..... Nutrient Management Plan

NPPF ..... National Planning Policy Framework

NRN ..... Nature Recovery Network

OAN ..... Objectively Assessed Need

OfWAT ..... Water Service Regulation Authority

OPEX ..... Operational Expenditure

OS ..... Ordnance Survey

P ..... Phosphorous

RAG ..... Red / Amber / Green assessment

RBD ..... River Basin District

RBMP ..... River Basin Management Plan

RoFSW ..... Risk of Flooding from Surface Water (replaced uFMfSW)

RQP ..... River Quality Planning tool

SA ..... Sustainability Appraisals

SAC ..... Special Area of Conservation

SBP ..... Strategic Business Plan

SEA ..... Strategic Environmental Assessment

SfA ..... Sewers for Adoption

SFRA ..... Strategic Flood Risk Assessment

SHELAA ..... Strategic Housing and Economic Land Availability Assessment

SHMA ..... Strategic Housing Market Assessment

SPA ..... Special Protection Area

SPD ..... Supplementary Planning Document

SPZ ..... Source Protection Zone

SS ..... Suspended Solids

SSSI ..... Site of Special Scientific Interest

SU ..... Sewerage Undertaker

SuDS ..... Sustainable Drainage Systems

SWMP ..... Surface Water Management Plan

TW ..... Thames Water

UWWTD.....Urban Waste Water Treatment Directive
WaSC.....Water and Sewerage Company
WCS.....Water Cycle Study
WFD.....Water Framework Directive
WINEP .....Water Industry National Environment Programme
WRMP.....Water Resource Management Plan
WRZ.....Water Resource Zone
WTW .....Water Treatment Works
WwTW.....Wastewater Treatment Works

## Glossary

| Term | Description |
|---|---|
| Abstraction Point | The location where water is either taken or extracted from either a surface or groundwater waterbody. |
| Agricultural Management | The farming techniques and practices used to produce food and manage livestock. |
| Abstraction Licencing Strategy | The Abstraction Licencing Strategy sets out the Environment Agency's approach to managing new and existing abstraction and impoundments within their river management catchments. |
| Asset Management Plan (AMP) Period | Price limit periods in the water sector are sometimes known as Asset Management Plan (AMP) periods. The current period (2020-25) is commonly known as AMP 7 because it is the seventh price review period since privatisation of the water industry in 1989. AMP periods are five years in duration and begin on 1 April in the years ending in 0 or 5. Every five years the industry submits a Business Plan to OfWAT for a Price Review (PR). These plans set out the companies' operational expenditure (OPEX) and capital expenditure (CAPEX) required to maintain service standards, enhance service (for example where sewer flooding occurs), to accommodate growth and to meet environmental objectives defined by the Environment Agency. OfWAT assesses and compares the plans with the objective of ensuring what are effectively supply monopolies and operating efficiently. |
| Aquifer | An aquifer is a rock and/or sediment body that holds groundwater. |
| Chalk Stream | Chalk streams are rivers that flow across or are influenced by chalk bedrock. They are predominantly fed by underground chalk aquifers. |
| Dry Weather Flow | Dry weather flow is the average daily flow of wastewater to a waste water treatment works during a period without rain. |
| Effluent | Effluent discharge is the liquid waste produced from residential, commercial and industrial processes. |
| Environmental Flow Indicator | The Environmental Flow Indicator (EFI) is the proportion of natural flows that are required to support the environment of a waterbody. |
| Groundwater Body | A Groundwater Body is the management unit under the Water Framework Directive which represents a distinct body of groundwater with its own hydrogeological characteristics. |
| Lead Local Flood Authority | A county council or unitary authority which leads in managing local flood risks (i.e., risks of flooding from |

| Term | Description |
|---|---|
| | surface water, ground water and ordinary (smaller) watercourses). Their duties are outlined in the Flood and Water Management Act. |
| Natural Flood Management | Natural flood management is the use of natural processes to reduce the risk of flooding and coastal erosion. |
| Per Capita Consumption | The per capita consumption is the average volume of water used by one person in a day. It is defined as the sum of the measured household consumption of clean water and unmeasured household consumption of clean water divided by the total household population. This is often expressed in litres per person per day (l/p/d). |
| Permitted Headroom | The difference between the volume of treated wastewater a treatment works is allowed to discharge under its environmental permit, and volume it currently discharges. It can be used to estimate the number of properties that could be connected to a WwTW catchment before a flow permit is exceeded. |
| Sustainable Drainage Systems (SuDS) | Sustainable drainage systems are drainage solutions that provide a natural alternative to the direct channelling of surface water through an artificial networks of pipes and sewers to nearby watercourses. |
| Waterbodies | Water bodies constitute areas of water – both salt and fresh, large and small – which are distinct from one another in various ways.<br>All surface waters (including rivers, lakes, estuaries and stretches of coastal water) and groundwaters have been divided up into discrete units called water bodies. Water bodies are the basic unit that are used to assess the quality of the water environment and to set targets for environmental improvements. |
| Water Framework Directive (WFD) | The Water Framework Directive is a river basin management planning system which was implemented to help protect and improve the ecological health of the UK's rivers, lakes, estuaries and coastal and groundwaters. |

| Term | Description |
|---|---|
| Water Framework Directive Classification Status | Rivers, lakes, estuaries and coastal waters can be awarded one of five WFD statuses:<br>High<br>Good<br>Moderate<br>Poor<br>Bad<br>Groundwater can be awarded one of two statuses:<br>Good<br>Poor |
| Water Framework Directive – Reasons for not achieving good (RNAG) | Where a WFD element is classified as being at less than good status, a reason for the failure to meet the good status is attributed, including the sector deemed responsible or a pressure affecting a biological element. |
| Water Framework Directive objectives | The Water Framework Directive objectives are set out in Regulation 12 and Regulation 8 of the Water Environment Regulations 2017. |
| Water Industry National Environment Programme | The Water Industry National Environment Programme is the programme of work in which water companies in England must meet their obligations from environmental legislation and UK government policy. |
| Water Resource Management Plan (WRMP) | Water Resource Management Plans are statutory documents that all water companies must produce at least every five years. They set out how the water company intends to achieve a secure water supply for their customers while protecting and enhancing the environment. |
| Water Recycling Centres (WRC) | A wastewater treatment works receive flows from the sewerage system and treats it so it can be discharged back into a river. They may also be called Sewage Treatment Works (STWs) or Wastewater Treatment Works (WwTWs). |
| Water Resource Zone (WRZ) | A Water Resource Zone is an area in which the abstraction and distribution of water is self-contained and is used to meet demand within that area. |
| Wastewater Treatment Works (WwTW) | A wastewater treatment works receive flows from the sewerage system and treats it so it can be discharged back into a river. They may also be called Sewage Treatment Works (STWs) or Water Recycling Centres (WRCs). |

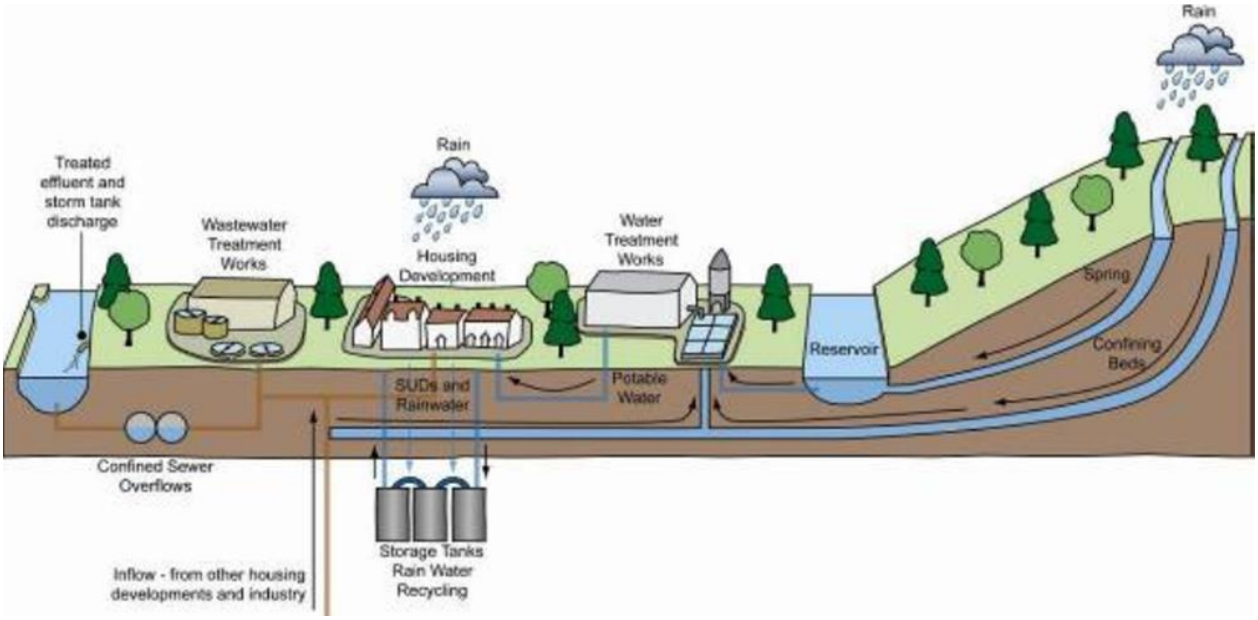
# Executive Summary

JBA Consulting was commissioned by Buckinghamshire Council (BC) to undertake a Water Cycle Study (WCS) for Buckinghamshire. The purpose of the WCS is to form part of a comprehensive and robust evidence base to inform the preparation of the emerging Local Plan for Buckinghamshire (LP4B), the first Local Plan for Buckinghamshire Council since it became a unitary authority in 2020. The LP4B is currently at the evidence gathering and engagement stage. Once finalised and adopted, the LP4B will replace the existing Local Plans for the former districts of Aylesbury Vale, Chiltern, South Bucks and Wycombe.

Unmitigated future development and climate change can adversely affect the environment and water infrastructure capability. A WCS will provide the required evidence, together with an agreed strategy to ensure that planned growth occurs within environmental constraints, with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable.

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. The allocation of large numbers of new homes in certain locations may result in the capacity of existing available infrastructure being exceeded, a situation that could potentially cause service failures to water and wastewater customers, adverse impacts to the environment, or high costs for the upgrade of water and wastewater assets being passed on to the bill payers.

In addition to increased housing demand, future climate change presents further challenges to the existing water infrastructure network, including increased intensive rainfall events and a higher frequency of drought events. Sustainable planning for water must now take this into account. The water cycle can be seen in the figure below and shows how the natural and artificial processes and systems interact to collect, store or transport water in the environment.




Source: Environment Agency – Water Cycle Study Guidance

This Stage 1 Scoping Study will assist Buckinghamshire Council to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. This has been achieved by identifying areas where there may be conflict between any proposed development, and the requirement to protect the environment (and the environmental legislative tests). Further work is recommended to be carried out within a Stage 2 Detailed Study.

The Water Cycle Study has been carried out in co-operation with the water companies, the Environment Agency (EA) whilst also using information from the neighbouring Local Planning Authorities (LPAs).

At the time of preparing the Stage 1 WCS, the identification of suitable and deliverable allocation sites for the Local Plan, as part of the Housing and Employment Land Availability Assessment (HELAA) was in progress, and therefore proposed were not yet available for assessment. Chapter 2 sets out the approach used to assess planned growth within Buckinghamshire and neighbouring Local Planning Authorities as part of the WCS.

Relevant environmental and water industry policy and legislation is presented in Section 3 to provide context for the following sections. The report is then divided into sections assessing the impact of growth on each topic in the water cycle.

**Water resources and supply**

Buckinghamshire receives its water from Affinity Water (AfW), Anglian Water (AW), and Thames Water (TW). In some of the water resource zones (WRZs) covering Buckinghamshire, the forecast percentage growth in the number of households is

lower than the expected growth during the Local Plan period. This should be investigated further in the Stage 2 WCS once the water companies latest Water Resource Management Plans (WRMP24) are published.

The Water Industry National Environment Programme (WINEP) is a set of actions that the EA have requested all 20 water companies operating in England to complete in a particular Asset Management Period (AMP) as part of their environmental commitments. A number of investigations are planned or underway to ensure that abstraction of water from both groundwater and rivers is not leading to unsustainable reductions in flow, particularly in chalk streams. Development and population growth can increase abstraction, and so BC has an opportunity to contribute to these actions indirectly by pursuing policies that promote water efficiency in new development. In addition, work by water companies on environmental improvement provides a baseline against which to assess the environmental capacity and opportunity for enhancement via the Local Nature Recovery Strategy and Biodiversity Net Gain from developments.

It is widely recognised that the climate is changing and in response Buckinghamshire Council is working with local communities to tackle the impact of climate change in Buckinghamshire by aiming to reach net zero carbon emissions by 2050, as part of the Bucks Climate Challenge. Progress against this goal can be found here. Climate change is predicted to increase pressure on water resources, increasing the potential for a supply-demand deficit in the future, and making environmental damage from over abstraction of water resources more likely. Furthermore, the delivery of water and wastewater services and the heating of water in the home require high energy inputs, and therefore contribute directly to emissions of greenhouse gases. Improvements in water efficiency therefore directly contribute to a reduction energy use and carbon emissions.

It is important therefore that new development does not result in an unsustainable increase in water abstraction. This can be done in a number of ways from reducing the water demand from new houses through to achieving “water neutrality” in a region by offsetting a new developments water demand by improving efficiency in existing buildings.

There is sufficient evidence to recommend the optional 110 litres per person per day design standard allowed under Building Regulations. This should be supported by an equivalent non-household water efficiency target.

Defra has signalled their intention to review the water efficiency standards for new homes, including consideration of a new national 105l/p/d standard and 100l/p/d where there is a clear local need. Anglian Water is working with the Environment Agency and Natural England on an updated Water Efficiency Protocol, which will support local councils in going beyond the 110 litres per person per day policy.

Water resources are under significant pressure in the UK, and the direction of travel in water resources planning is to reduce per capita consumption in new build development below the optional building regulations standard of 110 l/p/d. Currently this approach is not adequately supported in building regulations and the NPPF and policies requiring water efficiency standards less than 100l/p/d may only be supported at Local Plan inspection in exceptional circumstances, such as a direct link between water abstraction and damage to a Special Area of Conservation. Until this changes, LPAs should encourage developers to go further than building regulations. This is supported by Thames Water's, Anglian Water's and Affinity Water's incentives for water efficient design in new builds outlined in Section 4.5 of the study, where significant incentives are offered to reduce design consumption below 110l/p/d. Developers should be encouraged to achieve at least the Tier 2 incentive.

Four chalk stream catchments are present in Buckinghamshire. A chalk stream is broadly defined as a river that derives most of its flow from chalk-fed groundwater, stores of underground water that are replenished when it rains. England is home to 85 per cent of the world's chalk streams. Chalk streams are an important and rare habitat and are particularly sensitive to abstraction of water. Opportunities should be taken within the Local Plan to define policies to protect these important river ecosystems.

Given the evidence of pressures on the environment, particularly rare chalk streams, and on public water supply, and the EA's classification of the wider region as an area of serious water stress, it is recommended that the Council considers a domestic water efficiency target of 100l/p/d for all new homes and works with the water suppliers to incentivise even lower consumption.

**Wastewater network and treatment**

Anglian Water (AW) and Thames Water (TW) provide wastewater services for Buckinghamshire. Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of storm overflow operation. Early engagement with developers, Thames Water and Anglian Water is required, and further modelling of the network may be required in the Stage 2 WCS and at the planning application stage. Furthermore, in the Thames Water and Anglian Water networks, there are areas where the current network is a combined sewer system, and further separation of foul and surface water may be required, as well as suitably designed SuDS.

Early engagement between developers, Buckinghamshire Council and Thames Water and Anglian Water is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.

A headroom assessment was carried out comparing the current flow from each WwTW, making allowance for growth already planned, with the permit limit. This provides an estimate of the spare capacity in wastewater treatment infrastructure in Buckinghamshire.

Some of the WwTWs in the study area are expected to be close to or exceeding their permit during the Local Plan period. An increase in the permit limit, and / or upgrades to treatment capacity may be required at these WwTWs in order to accommodate further growth.

It is widely recognised that the water industry in the UK faces significant challenges to meet the expectations of customers, regulators and government and confront the challenges of climate change mitigation and a growing population. At the same time, the industry is committed to becoming net zero by 2030. Consideration should be given to using capacity in existing permits where possible as this provides a lower carbon cost than upgrading capacity at existing WwTW or building new treatment works, as this helps to avoid or defer investment in carbon-intensive new infrastructure. The work on the Local Plan will take this into account where possible as part of its wider growth strategy and assessment of site allocations.

There are a number of poorly performing storm tank overflows at WwTWs in Buckinghamshire. Growth within these catchments could result in an increase in the operations of these overflows contributing to a worsening of water quality in the area. Action should be taken by the water companies to address these overflows prior to an increase in wastewater demand being generated by new development.

New development proposed within the Thames Water and Anglian Water's WwTW odour buffer zones are recommended to undergo an odour assessment, to establish the likelihood of odour annoyance and establish adequate odour buffers as necessary.

**Water quality and environmental impact**

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area in which they serve can lead to a negative impact on the quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourses. Where the scale of development is such that a deterioration is predicted, a variation to the Environmental Permit (EP) may be required for the WwTW to improve the quality of the final effluent, so that the increased pollution load will not result in a deterioration in the water quality of the watercourse. This is known as "no deterioration" or "load standstill". The need to

meet river quality targets is also taken into consideration when setting or varying a permit.

At this stage of the Local Plan process, a sensitivity analysis was appropriate, and carried out using the EA's SIMCAT water quality modelling tool. Three scenarios were tested, one based on the Local Housing Need (LHN) figure, and a 15% buffer above and below this figure. The response in water quality at each WwTW in the study area was investigated. Where water quality downstream of a WwTW deteriorates by 10% or more in response to the increase in effluent flow, the sewer catchment can be said to be "more sensitive" to changes in effluent flow, and therefore growth.

The modelling results suggest that rivers with Buckinghamshire may be highly sensitive to changes in wastewater discharge for Ammonia and Phosphate and moderately sensitive for Biochemical Oxygen Demand (BOD).

There is therefore a potential for an unmitigated increase in wastewater from growth during the Local Plan period to cause a deterioration in water quality in the receiving watercourses and this must be carefully considered. Alongside no deterioration in class, a significant deterioration in water quality (over 10%) within a WFD classification is not acceptable under the Water Framework Directive.

Detailed water quality modelling to test impact of proposed allocations is recommended in a Stage 2 WCS.

A screening exercise was undertaken to identify designated sites such as Sites of Special Scientific Interest (SSSIs) that could be impacted by a deterioration in water quality. These will be analysed further in Stage 2 as part of the detailed modelling study.

Development sites within the study area could be sources of diffuse pollution from surface runoff. SuDS are currently required on all major development sites. Their design should consider both water quantity and water quality and site level investigations should be undertaken to define the most appropriate SuDS types for each specific development. Buckinghamshire Council should be consulted at an early stage of development to ensure that SuDS are implemented and designed in response to site characteristics and policy factors.

It should be noted that Schedule 3 of the Flood and Water Management Act is due to be implemented in England, which will make SuDS mandatory. It is also expected to establish Buckinghamshire Council as a SuDS Approving Body (SAB), responsible for the approval and adoption of SuDS. The SAB approval of SuDS designs will form a separate process to the planning system.

# 1 Introduction

## 1.1 Terms of reference

JBA Consulting was commissioned by Buckinghamshire Council (BC) to undertake a Water Cycle Study (WCS) to support their draft Local Plan (Regulation 18). This will provide an assessment of the impact of the growth options on water infrastructure and the water environment.

The purpose of the WCS is to form part of a comprehensive and robust evidence base to inform the preparation of the new Local Plan, which will set out where and how development will take place during the plan period, which is expected to be at least 15 years in length and will be used to inform decisions on the location of future development.

Unmitigated future development and climate change can adversely affect the environment and water infrastructure capability. A WCS will provide the required evidence, together with a strategy to ensure that planned growth occurs within environmental constraints, with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable.

## 1.2 Structure of report

The requirements and objectives of the WCS are set out in the section below. Planned growth in and around Buckinghamshire is characterised in Section 2 of the report, before relevant environmental and water industry policy and legislation is presented in Section 3 to provide context for the following assessment. The report is then divided into sections assessing the impact of growth on each topic in the water cycle study.

## 1.3 The Water Cycle

Planning Practice Guidance on Water Supply, Wastewater and Water Quality[1] describes a water cycle study as:

*"a voluntary study that helps organisations work together to plan for sustainable growth. It uses water and planning evidence and the expertise of partners to understand environmental and infrastructure capacity. It can identify joined up and cost-effective solutions, that are resilient to climate change for the lifetime of the development.*

1 Planning Practice Guidance: Water supply, wastewater and water quality, Department for Communities and Local Government (2014). Accessed online at: http://planningguidance.planningportal.gov.uk/blog/guidance/ on: 08/02/2023.

*The study provides evidence for Local Plans and sustainability appraisals and is ideally done at an early stage of plan-making. Local authorities (or groups of local authorities) usually lead water cycle studies, as a chief aim is to provide evidence for sound Local Plans, but other partners often include the Environment Agency and water companies."*

The Environment Agency's guidance on WCS[2] recommends a phased approach, which is being followed:

- Stage 1: Scoping study, identifies if the water infrastructure capacity could constrain growth and if there are any gaps in the evidence you need to make this assessment. The scoping study will identify:
  - The area and amount of proposed development;
  - the existing evidence;
  - main partners to work with; and
  - evidence gaps and constraints on growth.
- Stage 2: Detailed study, to provide the evidence to inform an integrated water management strategy. It will identify the water and flood management infrastructure that will mitigate the risks from too little or too much water. It will also identify what you need to do to protect and enhance the water environment.

As a WCS is not a mandatory document, Local Planning Authorities are advised to prioritise the stages of the WCS to integrate with their Local Plan programme. Figure 1.1 below shows the main elements that compromise the Water Cycle.

The natural water cycle describes the continuous transfers of water around the planet, from atmosphere to surface and back via evaporation, transpiration and precipitation, and the various flows and storage processes that occur. The artificial water cycle looks at the availability of water resources for human consumption, its treatment and supply to homes and business, its use and consequently the generation of wastewater. It then looks at how wastewater is taken away, treated, and finally what happens when it is returned to the environment.

2 Water Cycle Study Guidance, Environment Agency (2021). Accessed online at: https://www.gov.uk/guidance/water-cycle-studies on: 08/02/2023.

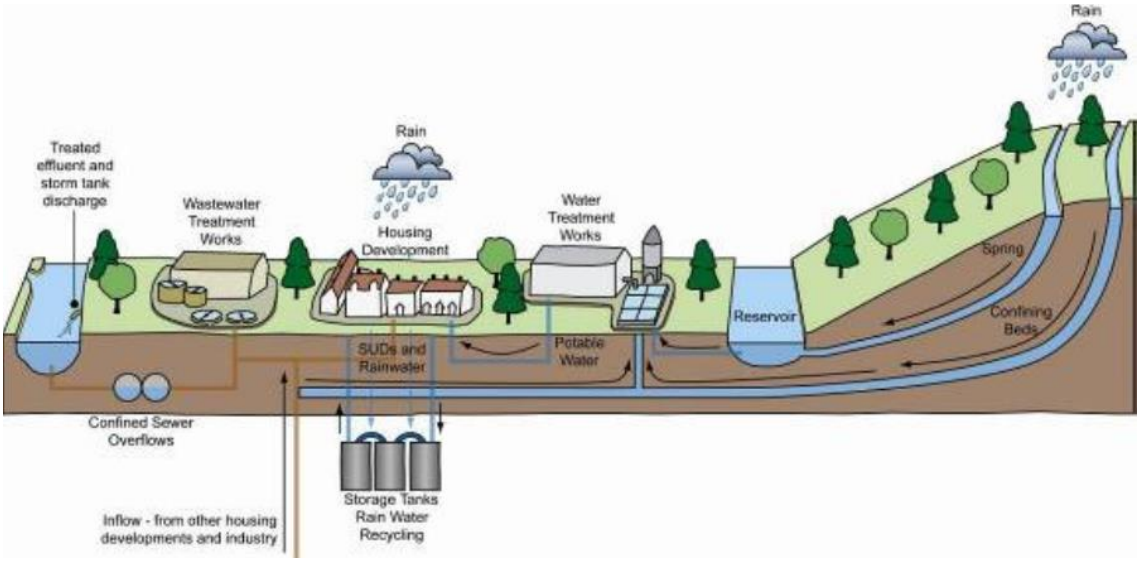



Figure 1.1 The Water Cycle

## 1.4 Impacts of Development on the Water Cycle

New homes require the provision of clean water, safe disposal of wastewater and limitation of flood risk. It is possible that allocating large numbers of new homes at some locations may result in the capacity of the existing available infrastructure being exceeded. This situation could potentially lead to service failures to water and wastewater customers, have adverse impacts on the environment or cause the high cost of upgrading water and wastewater assets being passed on to bill payers. Climate change presents further challenges such as increased intensity and frequency of rainfall and a higher frequency of drought events that can be expected to put greater pressure on the existing infrastructure. Development, when planned correctly, can also offer opportunities to reduce flood risk to existing properties and increase community resilience, contribute to nature recovery, and allow a collaborative approach to infrastructure.

## 1.5 Objectives

This Stage 1 scoping report is written to support the Buckinghamshire Local Plan Review. The overall objective of the WCS is to understand the environmental and physical constraints of development and identify opportunities for more sustainable planning and improvements that may be required to achieve the required level of development.

This WCS will consider the following issues:

- Water resources, demand, and supply.
- Wastewater infrastructure and treatment.
- Water quality and environmental impact.

## 1.6 Study Area

Buckinghamshire Council covers an area of approximately 1565 $km^2$ encompassing Buckingham, Aylesbury, High Wycombe, Amersham and many towns and villages. The area has a number of major road and rail networks, with connections to London in the south east, Milton Keynes to the north and Oxford to the west.

The study area has a population of 553,100 (based on the 2021 census data).

Several Environment Agency (EA) designated main rivers flow through Buckinghamshire, including the River Great Ouse, River Chess, River Misbourne, River Wye, Hamble Brook, River Ray and River Thame.

The Grand Union Canal passes through Iver in the south and through Aylesbury Vale in the centre of the local plan area towards Milton Keynes and includes arms to Aylesbury and Wendover.

Water supply services are provided by Thames Water, Anglian Water and Affinity Water. Leep Networks and Independent Water Networks are New Appointment and Variations (NAV) suppliers of water services to some recent developments in the centre of Buckinghamshire.

## 1.7 Authorities responsible for Water Resource and Wastewater Management in Buckinghamshire

Within Buckinghamshire there are a number of authorities and regulators responsible or involved in supplying, managing, and overseeing water supply, wastewater and the environment. The table below explains the responsibilities of various bodies within the local plan area.

Table 1.1 Responsibilities of authorities within Buckinghamshire

| Authority Name | Key Responsibilities of Different Authorities |
|---|---|
| Environment Agency | The EA are the environmental regulator in the UK with responsibilities for water quality, flood risk and administering licences for water abstraction.<br>They are a statutory consultee for many development plan documents and for some planning applications. They advise on environmental and infrastructure capacity issues across the water cycle. |
| Natural England | Natural England are the Government's advisors on the natural environment, which they have a responsibility to protect and enhance. In a WCS they may provide information on the conservation objectives, and guidance on, the protection of designated sites. |
| Thames Water | Thames Water is the water supplier for the central and southern areas within Buckinghamshire. Thames Water has a statutory duty under the Water Industry Act to maintain an efficient and economical system of water supply within its area and supply households with a reliable and sufficient supply of water.<br>Thames Water is also the sewerage undertaker for the centre and south of Buckinghamshire. Sewerage undertakers have a duty under the Water Industry Act to provide, improve and extend a system of public sewers (for both domestic and trade flows) so as to cleanse and maintain those sewers (and any lateral drain) to ensure that the area that they serve is effectually drained. There is also a duty to make provision for the emptying of those sewers, normally through sewage treatment works or where appropriate through discharges direct to watercourses.<br>Note: The boundaries of water supply and of waste water areas served by water companies are not the same. |

| Authority Name | Key Responsibilities of Different Authorities |
|---|---|
| Anglian Water | Anglian Water is the water supplier for the north of Buckinghamshire. As the water supplier for this part of Buckinghamshire, Anglian Water have the same responsibilities as Thames Water to maintain an efficient and economical system of water supply.<br>Anglian Water is also the sewerage undertaker for the north of the Buckinghamshire. As the sewerage undertaker for this part of Buckinghamshire, Anglian Water have the same responsibilities as Thames Water to provide, improve and extend a system of public sewers (for both domestic and trade flows) and to make provision for the emptying of those sewers.<br>Note: The boundaries of water supply and of waste water areas served by water companies are not the same. |
| Affinity Water | Affinity Water is the water supplier for the south east of Buckinghamshire. As the water supplier for this part of Buckinghamshire, Affinity Water have the same responsibilities as Thames Water to maintain an efficient and economical system of water supply. |
| New Appointment and Variations (NAV) suppliers | Limited companies providing water and/or wastewater services, primarily to new developments. The "wholesale supplier" remains the local supplier of water and/or wastewater services in that area. NAVs were introduced with the intention of providing competition in the monopolistic water market. Leep Networks and Independent Water Networks are two NAVs known to be operating within Buckinghamshire. |
| Retail suppliers to non-household customers | Businesses and other non-household customers are supplied via non-household water and wastewater service retailers. The "wholesale supplier" remains the local supplier of water and/or wastewater services in that area. Retail suppliers were introduced with the intention of providing competition in the monopolistic water market. |

## 1.8 Record of Engagement

### 1.8.1 Overview

Preparation of a WCS requires significant engagement with stakeholders, within the Local Planning Authority area, with water and wastewater utilities, with the Environment Agency, and where there may be cross-boundary issues, with neighbouring local authorities. This section forms a record of engagement for the WCS. Further engagement will take place if necessary, as the Local Plan progresses.

### 1.8.2 Engagement

The preparation of this WCS was supported by the following engagement:

**Inception meeting**

| Engaged Parties | Details |
|---|---|
| Buckinghamshire Council (LPA) | Scope of works and data collection requirements. |

**Neighbouring authorities**

| Engaged Parties | Details |
|---|---|
| All 11 neighbouring Local Planning Authorities | Request and receipt of site allocation and commitment data |

**Collaboration with Water Companies and Risk Management Authorities**

| Engaged Parties | Details |
|---|---|
| Buckinghamshire Council (LPA, LLFA)<br>Bedford Group of Drainage Boards<br>Thames Water<br>Anglian Water<br>Environment Agency | Scope of works and data collection requirements. |

# 2 Future Growth in Buckinghamshire

## 2.1 Growth in Buckinghamshire

Buckinghamshire Council's new Local Plan is currently expected to be adopted in 2027/28. The plan period is 2023 to 2045. The plan will direct future growth and associated infrastructure across the area, and will include new housing and employment requirements for Buckinghamshire. Spatial growth options for Buckinghamshire have not yet been defined, and therefore to inform a growth scenario within the Stage 1 WCS, several assumptions have been made about where and when development might occur.

## 2.2 Development sites in Buckinghamshire

### 2.2.1 Present day baseline (as of March 2023)

Across the plan area there are 45,164 homes already in the planning system (either with planning permission, or allocated in adopted local plans of the legacy Local Planning Authority areas of Aylesbury Vale, Chiltern, South Bucks and Wycombe), expected to be built by 2033. A further 3,840 homes are already committed and expected to be built between 2033 and 2040, of which 73% of these are located in the former Vale of Aylesbury area.

Neighbourhood Plan allocations without permission are assumed to commence completions in 2027/28 and build out at up to 25 homes per year. For commitments beyond the plan period, Buckinghamshire Council has projected forward the build out rate at 2032/33 until the allocation is complete. One site, the Princes Risborough Expansion, is not forecast to be complete until 2043/44.

### 2.2.2 Interim growth scenario and assumptions

While further work is carried out to determine the housing requirement for the emerging Local Plan, it has been assumed for the purpose of the Stage 1 WCS that the current Local Housing Need (LHN) figure for Buckinghamshire can be used as a proxy for the housing requirement in the emerging Local Plan. The plan period for the emerging Local Plan that the evidence base is being asked to cover is 2023/2024 to 2044/2045. Using the government's standard methodology as a starting point, and calculating it on a former district area basis, the total Local Housing Need for the plan area has been identified as an interim figure as 2,920 homes per year[3], which is a greater housing requirement than it is possible to deliver through existing housing commitments. Buckinghamshire Council has calculated the deficit in homes in the

3 The housing need figure is yet to be fixed and the figure used in this study should be considered as indicative only.

LHN forecast scenario, and therefore the additional allocations required under this scenario. The allocations have been apportioned to the legacy Local Planning Authority areas (Aylesbury Vale, Chiltern, South Bucks and Wycombe) based on the distribution of existing commitments, with all new allocations assumed to be delivered after the adoption of the emerging Local Plan in 2027/2028.

The following scenarios are tested within the WCS:

- Present-day baseline - includes residential and employment completions and commitments as of 31st March 2023, and site allocations from the former district authority Local Plans between 2013 - 2033.
- Interim growth scenario - estimate of allocations required based on the deficit in homes between the LHN figure for the plan area of 2,920 homes, and existing housing commitments.
- +15% growth compared to interim growth scenario.
- -15% growth compared to interim growth scenario.

Employment growth in general makes up a smaller proportion of water demand than residential and the baseline employment forecast has been maintained in the interim growth scenario.

## 2.3 Development sites in Buckinghamshire

### 2.3.1 Completions and commitments within Buckinghamshire

Buckinghamshire Council have provided their completions and commitments for the Plan area. The housing and employment completions and commitments have been summarised by the former district authority boundaries (Aylesbury Vale, Chiltern, South Bucks and Wycombe) in Table 2.1 and Table 2.2 below. A map of these areas is shown in Figure 2.1.

Table 2.1 Housing completions and commitments within Buckinghamshire

| Legacy Area | Total completions and commitments 2013-2033 | Total commitments post 2033 |
|---|---|---|
| Aylesbury Vale | 36,771 | 2,790 |
| Chiltern | 894 | 0 |
| South Bucks | 604 | 0 |
| Wycombe | 6,895 | 1,050 |

Table 2.2 Employment completions and commitments within Buckinghamshire

| Legacy Area | Total completions and commitments (area sq. m) 2013-2033 |
|---|---|
| Aylesbury Vale | 240,056 |

| Legacy Area | Total completions and commitments (area sq. m) 2013-2033 |
|---|---|
| Chiltern | 2,193 |
| South Bucks | 11,105 |
| Wycombe | 848,245 |

### 2.3.2 Interim growth scenario for Buckinghamshire

Buckinghamshire Council has provided an interim growth scenario for the plan area, based on the methodology set out in Section 2.2.1. The approach is the best available at the time of preparing the assessment, as details of the actual location and scale of allocations are not currently available. It is anticipated that further work determining the housing requirement for Buckinghamshire and assessing sites for the emerging Local Plan will supersede this interim growth scenario.

Table 2.3 Indicative broad distribution of new homes within interim growth scenario throughout plan period (2023/2024 - 2044/2045)

| Legacy Area | Total predicted allocated new homes |
|---|---|
| Aylesbury Vale | 42,777 |
| Chiltern | 1,702 |
| South Bucks | 2,412 |
| Wycombe | 17,385 |
| Total | **64,276** |

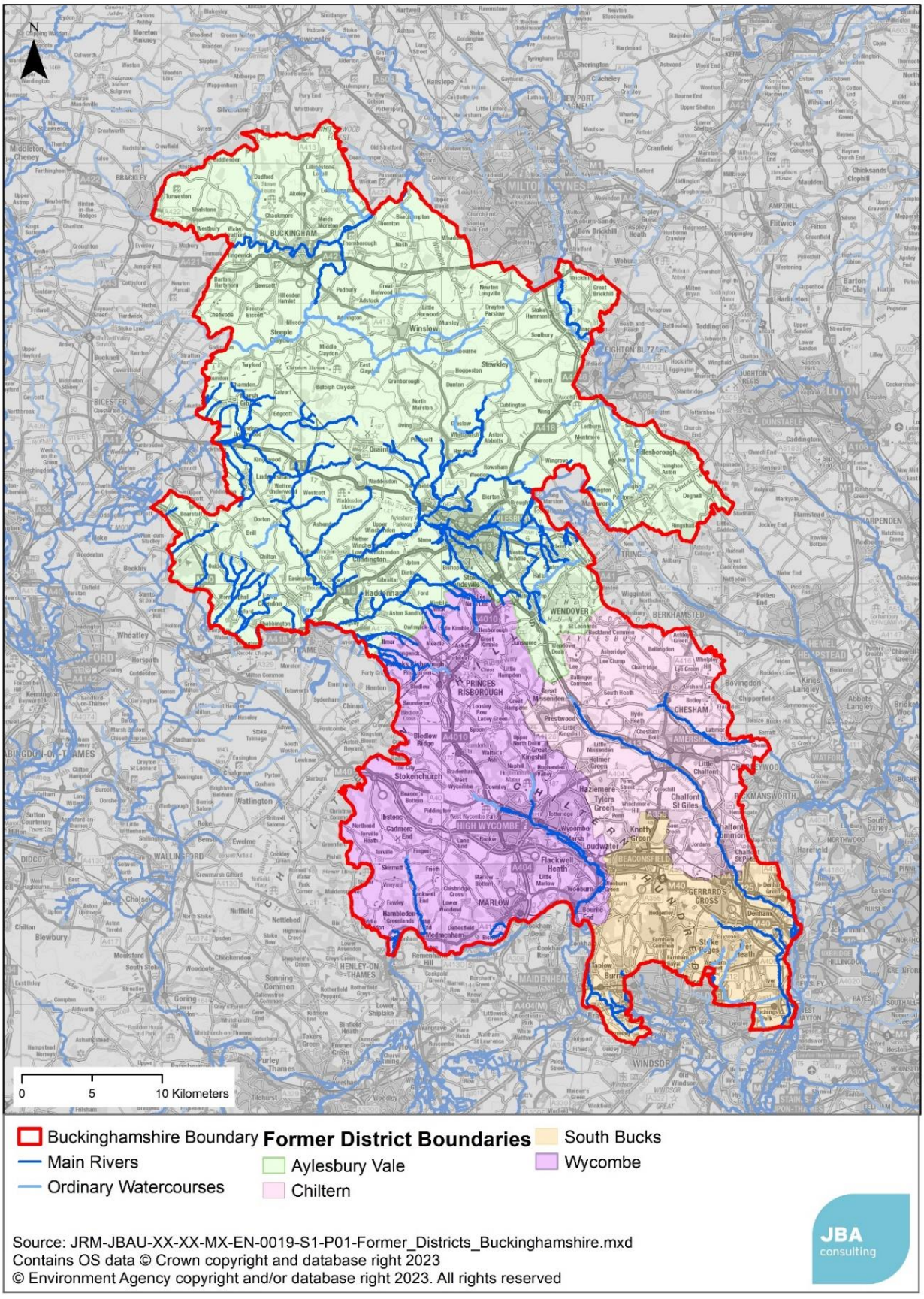



Figure 2.1 Former district boundaries in Buckinghamshire

## 2.4 Windfall

Windfall sites are sites that are not specifically allocated in the Local Plan or neighbourhood plans. Local Plans usually provide an allowance to cover this circumstance, consistent with the National Planning Policy Framework (NPPF). For the purpose of the Stage 1 report, windfall sites were distributed between WwTWs based on the proportion of the commitments at each WwTW. This may be revised in Stage 2. The windfall allowance of 303 homes per year across Buckinghamshire was advised by BC as an estimate to inform the WCS. This may be different in the published Local Plan and may change as a result of subsequent monitoring.

## 2.5 Growth outside Buckinghamshire

### 2.5.1 General approach

Where growth within a neighbouring Local Planning Authority (LPA) area may be served by infrastructure within or shared with Buckinghamshire, the LPA were contacted as part of a Duty to Cooperate request to provide information on:

- The latest growth forecast (housing and employment) for the local plan area.
- Details of future growth within the catchments of WwTW which serve part of their council area and Buckinghamshire.

The neighbouring authorities to Buckinghamshire are shown in Figure 2.2.

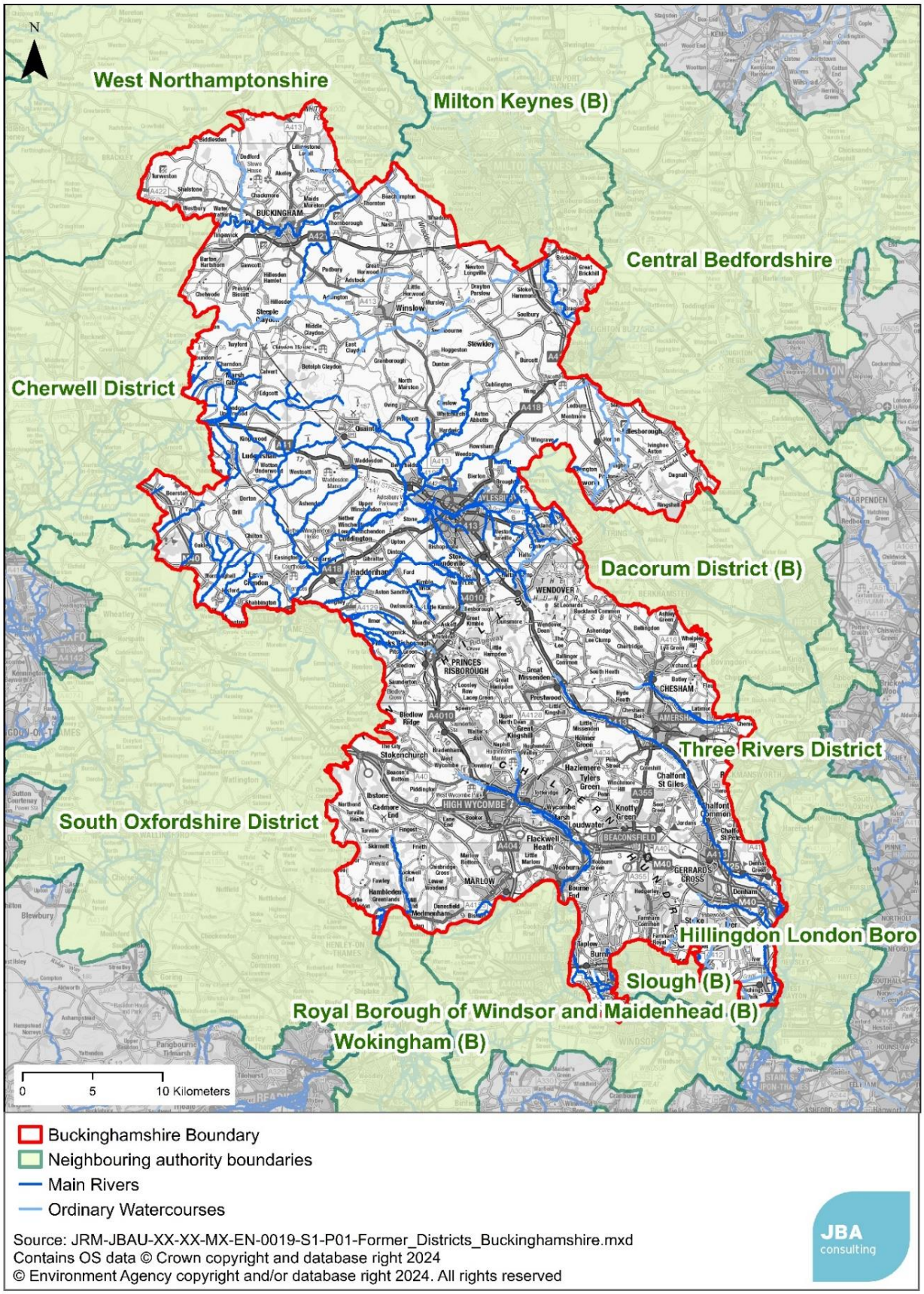



Figure 2.2 Neighbouring authorities to Buckinghamshire

### 2.5.2 Central Bedfordshire Council

Growth within Central Bedfordshire has been taken from the allocations data supplied by Central Bedfordshire Council for the Milton Keynes Integrated Water Management Strategy undertaken by JBA in 2023. These sites would be served by Cotton Valley, Stanbridgeford and Leighton Linslade WwTWs (Anglian Water) which are shared with Buckinghamshire.

Table 2.4 Summary of growth in the Central Bedfordshire area served by infrastructure shared with Buckinghamshire.

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^2$) | Period |
|---|---|---|---|
| Cotton Valley | 5,021 | 300,000 | 2015-2035 |
| Stanbridgeford | 639 | 21,400 | 2015-2035 |
| Leighton Linslade | 3,399 | 145,210 | 2015-2035 |

### 2.5.3 Cherwell District Council

Growth within Cherwell has been taken from the completions and allocations data supplied by Cherwell District Council for the Cherwell Water Cycle Study undertaken by JBA in 2022. These sites would be served by Bicester WwTW (Thames Water) which is shared with Buckinghamshire.

Table 2.5 Summary of growth in the Cherwell area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^{2)}$ | Period |
|---|---|---|---|
| Bicester | 1,984 | 55,713 | 2011-2031 |

### 2.5.4 Dacorum Borough Council

The Dacorum planning team has provided information on allocations. No details of committed sites in Dacorum were available for use within the assessment. There are no sites within Dacorum Borough Council that would be served by a Thames WwTWs that also serves Buckinghamshire.

### 2.5.5 Hillingdon Council

The Hillingdon planning team has provided information on allocations and completions up to 2026. These sites would be served by the Mogden WwTW (Thames Water) which is shared with Buckinghamshire.

Table 2.6 Summary of growth in the Hillingdon area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^{2)}$ | Period |
|---|---|---|---|
| Mogden | 831 | None identified | 2021-2026 |

### 2.5.6 Royal Borough of Windsor and Maidenhead

The Royal Borough of Windsor and Maidenhead planning team has provided information on housing and employment allocations. These sites would be served by the Slough WwTW (Thames Water) which is shared with Buckinghamshire.

Table 2.7 Summary of growth in the Windsor and Maidenhead area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^{2)}$ | Period |
|---|---|---|---|
| Slough | 100 (Site ref AL40 in RBWM Local Plan) | None identified | 2013 – 2033 |

### 2.5.7 Milton Keynes City Council

Growth within Milton Keynes has been taken from the commitments and allocations data supplied by Milton Keynes Council for the Milton Keynes Integrated Water Management Strategy undertaken by JBA in 2023. These sites would be served by the Cotton Valley WwTW (Anglian Water) which is shared with Buckinghamshire.

Table 2.8 Summary of growth in the Milton Keynes area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^{2)}$ | Period |
|---|---|---|---|
| Cotton Valley | 26,148 | 910,400 | 2016-2031 |

### 2.5.8 Slough Borough Council

The Slough planning team has provided information on housing commitments up to April 2022. These sites would be served by the Slough WwTW (Thames Water) which is shared with Buckinghamshire.

Table 2.9 Summary of growth in the Slough area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^2$) | Period |
|---|---|---|---|
| Slough | 13,099 | None identified | 2006-2026 |

### 2.5.9 South Oxfordshire District Council

The South Oxfordshire planning team has provided information on their commitments and allocations. There are no Thames Water WwTWs within South Oxfordshire that also serve Buckinghamshire.

### 2.5.10 Three Rivers District Council

Growth within Three Rivers District has been taken from the preferred options sites provided to JBA. These sites would be served by the Maple Lodge WwTW (Thames Water) which is shared with Buckinghamshire. Several employment sites were identified in the preferred options, although proposed floorspace was not available at this stage. No details of committed sites in Three Rivers District were available for use within the assessment.

Table 2.10 Summary of growth in the Three Rivers area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^2$) | Period |
|---|---|---|---|
| Maple Lodge | 1,915 | Data not available | 2020-2038 |

### 2.5.11 West Northamptonshire Council

The West Northamptonshire planning team has provided information on housing and employment allocations. These sites would be served by the Brackley WwTW (Anglian Water) which is shared with Buckinghamshire.

Table 2.11 Summary of growth in the West Northamptonshire area served by infrastructure shared with Buckinghamshire

| WwTW | Proposed number of dwellings | Potential Employment Space ($m^2$) | Period |
|---|---|---|---|
| Brackley | 1,435 | 123,638 | 2021-2041 |

### 2.5.12 Wokingham Borough Council

Growth within Wokingham has been taken from the commitments data supplied by Wokingham Borough Council for the Wokingham Stage 2 WCS undertaken by JBA. There are no Thames Water WwTWs within Wokingham that also serve Buckinghamshire.

# 3 Policy and legislation

## 3.1 Introduction

The following sections introduce several national, regional, and local policies that must be considered by the LPA, water companies and developers during the planning stage. Key extracts from these policies are presented as well as links to the full text. Whilst care has been taken to ensure that the information presented in this report was up to date at the time of writing, policy and guidance can change rapidly and the reader should ensure that the most up to date information is sought.

## 3.2 Plan-making

The National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2023)[4] was originally published in 2012, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

Local Plans are the primary mechanism by which plan-led spatial planning is implemented in England. Local Plans must be prepared by Local Planning Authorities (LPAs) and include:

- Strategic policies which set out the "overall strategy for the pattern, scale and design duality of places", including for the provision of infrastructure, transportation and community facilities.
- Non-strategic policies, which "set out more detailed policies for specific areas, neighbourhoods or types of development. This can include allocating sites, the provision of infrastructure and community facilities at a local level."

Under the Localism Act (HM Government, 2011) new rights were provided to allow local communities to come together and shape the development and growth of their area by preparing Neighbourhood Development Plans, or Neighbourhood Development Orders, where the ambition of the neighbourhood is aligned with strategic needs and priorities for the area. Neighbourhood Plans can make non-strategic policies, aligned to the strategic policies of the Local Plan. As neighbourhoods draw up their proposals, Local Planning Authorities are required to provide technical advice and support to communities.

4 National Planning Policy Framework, Department for Communities and Local Government (2012)

## 3.3 Water and the Planning System

### 3.3.1 National Planning Policy Framework and water

The NPPF provides guidance to planning authorities to take account of flood risk and water and wastewater infrastructure delivery in their Local Plans. Key paragraphs include:

- Paragraph 34: “Plans should set out the contributions expected from development. This should include setting out the levels and types of affordable housing provision required, along with other infrastructure (such as that needed for education, health, transport, flood and water management, green and digital infrastructure). Such policies should not undermine the deliverability of the plan.”
- Paragraph 158: “Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply...”
- Paragraph 180(e): “…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans”.

### 3.3.2 Planning Practice Guidance overview

Planning Practice Guidance (PPG) was originally issued in 2014 by the Department for Communities and Local Government, with the intention of providing guidance on the application of the NPPF. The individual guidance documents are updated periodically. The following guidance documents are particularly relevant to a WCS:

- Water Supply, Wastewater and Water Quality (HM Government, 2019)
- Housing - Optional Technical Standards (HM Government, 2015a)

### 3.3.3 PPG - Water Supply, Wastewater and Water Quality

Two key passages from the PPG (Para 002) provide an overview of what needs to be considered plan-making authorities, and provide a basis for the work contained in a WCS or IWMS:

"Early discussions between strategic policy-making authorities and water and sewerage companies can help to ensure that proposed growth and environmental objectives are reflected in company business plans. Growth that requires new water supply should also be reflected in companies' long-term water resources management plans. This will ensure that the necessary infrastructure is funded through the water industry's price review."

"Strategic policy-making authorities will also need to consider the objectives in the government's 25 Year Environment Plan to reduce the damaging abstraction of water from rivers and groundwater, and to reach or exceed objectives for rivers, lakes, coastal and ground waters that are specially protected."

A summary of the advice for plan-makers and for planning applications is contained below but it is recommended that the full text is reviewed.

**Plan-making considerations - Infrastructure (Para 005)**

- Identification of suitable sites for new or enhanced infrastructure, including the location of existing and proposed development.
- Consider whether new development is appropriate near to water and wastewater infrastructure (for example due to odour concerns).
- Phasing new development so that water and wastewater infrastructure will be in place when needed. Infrastructure should also be in place before any environmental effects occur on designated sites of importance for biodiversity.

**Plan-making considerations - Water quality (Para 006)**

- How to help protect and enhance local surface water and groundwater in ways that allow new development to proceed and avoids costly assessment at the planning application stage.
- The type or location of new development where an assessment of the potential impacts on water bodies may be required.
- Whether measures to improve water quality, (e.g., SuDS schemes) can be used to address water quality in addition to flood risk.

**Plan-making considerations - Wastewater (Para 007)**

- The sufficiency and capacity of wastewater infrastructure.
- The circumstances where wastewater from new development would not be expected to drain to a public sewer (such as via a package treatment sewage treatment works or septic tank).
- The capacity of the environment to receive effluent from development without preventing statutory objectives being met.

Early engagement with the LPA, the EA, and relevant water and sewerage companies can help establish whether any particular water and wastewater issues need to be considered.

**Considerations for planning applications - Water supply (Para 016)**

Water supply planning would normally be addressed through the LPA's strategic policies and reflected in the water companies WRMPs. Water supply is therefore unlikely to be a consideration for most planning applications. However, some exceptions might include:

- Large developments not identified in plans that are likely to require a large volume of water; and/or
- significant works required to connect the water supply; and/or
- where a plan requires enhanced water efficiency in new development as part of a strategy to manage water demand locally.

**Considerations for planning applications - Water quality (Para 016)**

Water quality is only likely to be a significant planning concern where a proposal would:

- Involve physical modifications to a water body such as flood storage areas, channel diversions and dredging, removing natural barriers, construction of new locks, new culverts, major bridges, new barrages or dams, new weirs, and removal of existing weirs; and/or
- indirectly affect water bodies, for example:
  - As a result of new development such as the redevelopment of land that may be affected by contamination, mineral workings, water and wastewater treatment, waste management facilities and transport scheme including culverts and bridges.
  - Result in runoff into surface water sewers that drain directly, or via a combined sewer, into sensitive waterbodies e.g., waterbodies with a local, national or international habitat designation.
  - Through a lack of adequate infrastructure to deal with wastewater.
  - Through a local of adequate infrastructure to deal with wastewater where development occurs in an area where there is strategic water quality plan e.g., a nutrient management plan, River Basin Management Plan, Water Cycle Study, Diffuse Water Pollution plan or sewerage undertakers' drainage strategy which set out strategies to manage water quality locally and help deliver new development.

### 3.3.4 PPG - Housing - Optional Technical Standards

This guidance advises planning authorities on how to gather evidence to set optional requirements, including for water efficiency. It states that “all new homes already must meet the mandatory national standard set out in the Building Regulations (of 125 litres /person /day). 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 litres/person/day. Planning authorities are advised to consult with the EA and water companies to determine where there is a clear local need, and also to consider the impact of setting this optional standard on housing viability.

The evidence for adopting the optional requirements is outlined in Section 4.4. Viability is reviewed in Section 3.4.4.

## 3.4 Water and design

### 3.4.1 Building Regulations

The Building Regulations (2010) Part G was amended in early 2015 to require that all new dwellings must ensure that the potential water consumption must not exceed 125 litres/person/day, or 110 litres/person/day where required under planning conditions (HM Government, 2016) (see 3.3.4).

The Environmental Improvement Plan (discussed in 3.7.2) contains a commitment to consider a new standard for new homes in England of 105 litres per person per day (l/p/d) and 100 l/p/d where there is a clear local need, such as in areas of serious water stress. Whilst this new standard is only under consideration, it demonstrates the direction of travel for water efficiency standards, and it is highly likely that this or a similar standard will be adopted.

### 3.4.2 Building Research Establishment

The Building Research Establishment (BRE) publish an internationally recognised environmental assessment methodology for assessing, rating, and certifying the sustainability of a range of buildings.

New homes are most appropriately covered by the Home Quality Mark (BRE, 2023a), and commercial, leisure, educational facilities and mixed-use buildings by the Building Research Establishment Environmental Assessment Methodology (BREEAM) UK New Construction Standard (BRE, BREEAM, 2018b).

Using independent, licensed assessors, BREEAM/HQM assesses criteria covering a range of issues in categories that evaluate energy and water use, health and wellbeing, pollution, transport, materials, waste, ecology, and management processes.

In the Homes Quality Mark, 400 credits are available across 11 categories and lead to a star rating. 18 credits are available for water efficiency and water recycling. A greater number of credits are awarded for homes using water efficient fittings (with the highest score achieving 100l/p/d or less), and further credits are awarded for the percentage of water used in toilet flushing that is either sourced from rainwater or from grey water.

The BREEAM New Construction Standard awards credits across nine categories, four of which are related to water: water consumption, water monitoring, leak detection and water efficient equipment. This leads to a percentage score and a rating from “Pass” to “Outstanding”.

Through the Local Plan, the Council has the opportunity to seek BREEAM or HQM status for all new, residential, and non-residential buildings.

### 3.4.3 Energy and Water

18% of the UK's domestic energy usage is for water heating (Department for Energy Security and Net Zero, 2022). If less water was being used within the home, for instance through more water efficient showers, less water would need to be heated, and overall domestic energy usage would be reduced.

The Government is currently analysing the results of a 2019 consultation on a Future Homes Standard that will involve changes to Part L (conservation of fuel and power) of the Building Regulations for new dwellings. Whilst there is no direct mention of water efficiency in this consultation, there is an important link between water use and energy use, and therefore between water use and the whole-life carbon cost of developments.

### 3.4.4 Viability

The evidence for the costs of meeting the optional 110l/p/d water efficiency target in new homes indicate that the costs are minimal:

- A 2014 study into the cost of implementing sustainability measures in housing found that meeting a standard of 110 litres per person per day would cost only £12 (at 2023 prices) for a four-bedroom house (EC Harris, 2014).
- The Committee on Climate Change report - UK Housing: Fit for the Future - stated that the cost of "requiring all homes in England to be built to 110 l/p/d is possible under Part G of regulations and would be no additional cost."(Committee on Climate Change, 2019)
- Heating water accounts for 18% of energy used in the home (Department for Energy Security and Net Zero, 2022) This would cost a 2-3 person, 3-bed household an average of £352 per year in energy at 2023 costs (British Gas, 2023). Water efficiency is therefore not only viable but of positive economic benefit to both private homeowners and tenants.

There is less evidence available on the costs of going below 110l/p/d. The Sussex North Water Neutrality Strategy (JBA Consulting, 2022) found that the additional cost to meet 85l/p/d using water efficient fittings would be between £349 and £431 per dwelling, or £1,049 to £1,531 where white-goods appliances would not otherwise have been installed in the dwelling (2022 prices).

## 3.5 The Water Industry

### 3.5.1 The Water Industry in England

Water and sewerage services in England and Wales are provided by eleven Water and Sewerage Companies (WaSCs) and six 'water-only' companies. The central legislation relating to the industry is the Water Industry Act 1991. The companies operate as regulated monopolies within their supply regions, although very large water

users and developments are able to obtain water and/or wastewater services from alternative suppliers - known as inset agreements.

The Water Act 2014 aims to reform the water industry to make it more innovative and to increase resilience to droughts and floods. Key measures could influence the future provision of water and wastewater services include:

- Non-domestic customers are able to switch their water supplier and/or sewerage undertaker (from April 2017);
- new businesses will be able to enter the market to supply these services;
- measures to promote a national water supply network; and
- enabling developers to make connections to water and sewerage systems.

The water industry is primarily regulated by three regulatory bodies:

- **Economic regulation:** Office of Water Services (Ofwat) are the economic regulator. They have a statutory duty to protect the interests of consumers, ensuring water companies carry out their functions (customer service standards, environmental rules, drinking water standards etc) and can finance them. Part of this role is setting the limits on pricing of water and sewerage services.
- **Environmental regulation:** The Environment Agency are the environmental regulator. They are responsible for monitoring the impact of the water industry (as well as others) on the environment and issuing permits for abstraction of water and discharge of wastewater.
- **Drinking water regulation:** Finally, the Drinking Water Inspectorate (DWI) implement standards for drinking water and can take enforcement measures against water companies if those standards are not met.

### 3.5.2 Planning and Funding of the water industry

The water industry works on a five-year cycle called the Asset Management Plan period or AMP periods. Every five years a water company submits a Business Plan to Ofwat for a Price Review. These plans set out the companies' operational expenditure (OPEX) and capital expenditure (CAPEX) required to maintain service standards, enhance service (for example where sewer flooding occurs), to accommodate growth and to meet environmental objectives defined by the Environment Agency. Ofwat assesses and compares the plans with the objective of ensuring what are effectively supply monopolies are operating efficiently, and that the company is meeting its obligations. It then sets the allowable price increase for consumers based on the retail prices index, the business plan, and taking into consideration affordability for consumers. The current AMP period is AMP 7 (2020-2025), and the price of water for this period was set by Ofwat late in 2019 in a process referred to as Price Review 19 (PR19). The new price came into effect in April 2020. The next price review will be 2024 (PR24) and will set prices from 2025 to 2030. This system gives stability in

pricing. Within this price review process there may also be incentives and penalties on the water company for exceeding or failing to meet targets.

When considering investment requirements to accommodate growing demand, water companies are required to ensure a high degree of certainty that additional assets will be required before funding them. Longer term growth is, however, considered by the companies in their internal asset planning processes and in their 25-year Strategic Direction Statements and Water Resource Management Plans (WRMPs).

The Water Industry National Environment Programme (WINEP) is a set of actions that are defined by the EA and given to all water companies operating in England for completion during a particular AMP period. The aim of the programme is to support the objectives in the Water Framework regulations. Examples of typical actions could include investigations into the sustainability of an abstraction, a reduction in an abstraction to support river flows, or new permit limits at a wastewater treatment works.

Water and wastewater infrastructure requires significant lead-times to plan, obtain planning and other permissions, finance and construct. The time required to provide new or upgraded infrastructure to serve a development or a larger spatial plan is highly locally specific. The following is provided as an indicative guide to lead-times.

Table 3.1: Indicative lead-times (years) for new infrastructure to serve development

| Scale of development | Water supply | Water resources | Wastewater network | Wastewater treatment |
|---|---|---|---|---|
| Minor | 1 | N/A | 1 | N/A |
| Major | 1-3 | 5-10 | 1-5 | 3-5 |
| Strategic / Plan | 3-5 | 10-20 | 5-10 | 5-10 |

### 3.5.3 Planning for Water

**Water resource management plans**

Water Resource Management Plans (WRMPs) are 25-year strategies that water companies are required to prepare, with updates every five years. In reality, water companies prepare internal updates more regularly. WRMPs are required to assess:

- Future demand (due to population and economic growth).
- Future water availability (including the impact of sustainability reductions).
- Demand management and supply-side measures (e.g., water efficiency and leakage reduction, water transfers and new resource development).
- How the company will address changes to abstraction licences.
- How the impacts of climate change will be mitigated.
- Where necessary, they set out the requirements for developing additional water resources to meet growing demand and describe how the balance between water supply and demand will be balanced over the period 2015 to 2040.
- Using cost-effective demand management, transfer, trading and resource development schemes to meet growth in demand from new development and to restore abstraction to sustainable levels.
- In the medium to long term, ensuring that sufficient water continues to be available for growth and that the supply systems are flexible enough to adapt to climate change.

The Thames Water, Anglian Water and Affinity Water WRMPs cover Buckinghamshire and are reviewed for the study area in Section 4.2.

**Drought Plan**

Linked to the WRMP is a water company's drought plan. This is a requirement under the Water Industry Act 1991 (as amended by the water Act 2003). A water company must state how it will maintain a secure water supply and protect the environment during dry weather and drought. The plan will contain:

- Drought triggers - these are points where a water company will take action to manage supply and demand. They are based on monitoring of rainfall levels, river flows, groundwater levels and reservoir stocks.

- Demand management actions - how a water company will reduce demand for water during a drought. Actions that save water before taking more water from the environment must be prioritised. These could include:
    - reducing leakage;
    - carrying out water efficiency campaigns with customers;
    - reducing mains pressure; and
    - restricting water use, for example through temporary use bans which limit hosepipe and sprinkler use.
- Supply management actions - how a water company will maintain water supply during a drought. Actions that have the least effect on the environment must be prioritised. This could include:
    - carrying out engineering work to improve its supply;
    - transferring water in bulk from other water companies;
    - using drought permits and drought orders to abstract more water;
    - using desalination - permanent or temporary plants; and
    - using tankers to supply customers with water directly.
- Extreme drought management actions - the actions it could take in an extreme drought. These could delay the need to use emergency restrictions standpipes and rota cuts.
- Communicating during a drought - a water company must set out how it will communicate in a clear and timely way during a drought with customers, partners or other stakeholders.
- Environmental assessment, monitoring and mitigation. A drought plan must include:
    - an environmental assessment;
    - an environmental monitoring plan for each supply management action; and
    - details of mitigation measures the company plans to take for each supply management action.
- End of a drought - a water company must explain how it will identify when a drought is over or ending and the actions it will take during this stage, communicate this information to customers, and review its performance.

**Regional water resource planning**

Water resource planning is taking an increasingly regional focus, recognising the need for collaboration between water companies and sectors in order to address the challenges of climate change, increasing demand for water and protecting the water environment. Five regional groupings having been formed, including the Water Resources East (WRE) and Water Resources South East (WRSE) groups which cover Buckinghamshire Council. Advisory groups consisting of their regulators (Environment Agency and Ofwat) and Defra regularly attend meetings of WRE and WRSE.

WRSE published a draft regional water resource plan in 2023, and WRE will finalise their plan for publication in 2023. These plans in turn will inform the next round of company WRMPs to be published in 2024. As part of this process, WRE and WRSE have published initial water resource position statements which set out the water resources challenges and opportunities within the region.

### 3.5.4 Planning for Wastewater

**21st Century Drainage**

The UK Water Industry Research (UKWIR) “21st Century Drainage” programme has brought together water companies, governments, regulators, local authorities, academics, and environmental groups to consider how planning can help to address the challenges of managing drainage in the future. These challenges include climate change, population growth, urban creep and meeting the Water Framework Directive.

The group recognised that great progress has been made by the water industry in its drainage and wastewater planning over the last few decades, but that, in the future, there needs to be greater transparency and consistency of long-term planning. The Drainage and Wastewater Management Plan (DWMP) framework (Water UK, 2018) sets out how the industry intends to approach these goals. Companies were required to published finalised DWMPs in 2023 to inform their business plans for the 2024 Price Review.

**Drainage and Wastewater Management Plans (DWMPs)**

DWMPs are consistently structured plans delivered at three spatial scales; company-wide, regional groupings and individual wastewater catchments. The framework defines drainage to include all organisations and all assets which have a role to play in drainage, although, as the plans will be water company led, it does not seek to address broader surface water management within catchments.

LPAs and LLFAs are recognised as key stakeholders and are invited to join, alongside other stakeholders, the Strategic Planning Groups (SPGs) organised broadly along river basin district catchments.

DWMPs aim to provide more transparent and consistent information on sewer flooding risks and the capacity of sewerage networks and treatment works, and this should be taken into account in SFRAs, Water Cycle Studies, as well as in site-specific FRAs and Drainage Strategies.

Thames Water released their final DWMP in May 2023[5], and Anglian Water released their final DWMP in June 2022[6]. The latest information about the DWMPs can be found on their websites.

### 3.5.5 Developer Contributions and connection charges

A significant part of water company business is the interface with developers to facilitate connection to the public water supply and sewerage systems, through their developer services functions. Developments with planning permission have a right to connect to the public water and sewerage systems (where this is for domestic use), however, there is no guarantee that the capacity exists to serve a development.

Developers may requisition a water supply connection or sewerage system or self-build the assets and offer these for adoption by the water company or sewerage undertaker. Self-build and adoption are usually practiced for assets within the site boundary, whereas requisitions are normally used where an extension of upgrading the infrastructure requires construction on third party land. The cost of requisitions is shared between the water company and developer as defined in the Water Industry Act 1991.

The above arrangements are third party transactions because the Town and Country Planning Act Section 106 agreements and Community Infrastructure Levy agreements may not be used to obtain funding for water or wastewater infrastructure.

OfWAT, the water industry's economic regulator, published revised rules covering how water and wastewater companies may charge customers for new connections (OfWAT, 2020). These rules have applied to all companies in England since April 2018. The key changes include:

- More charges will be fixed and published on water company websites. This will provide greater transparency to developers and will also allow alternative connection providers to offer competitive quotations more easily.
- There will be a fixed infrastructure charge for water and one for wastewater.
- The costs of network reinforcement will no longer be charged directly to the developer in their connection charges. Instead, the combined costs of all of the works required on a company's networks, over a five-year rolling period, will be covered by the infrastructure charges paid for all new connections.
- The definition of network reinforcement has changed and will now apply only to works required as a direct consequence of the increased demand

5 Drainage and Wastewater Management Plan, Thames Water. Accessed online at: https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management#csplans on 08/11/2023.

6 Drainage and Wastewater Management Plan, Anglian Water. Accessed online at: https://www.anglianwater.co.uk/about-us/our-strategies-and-plans/drainage-and-wastewater-management-plan/ on: 08/11/2023

due to a development. Where the water company has not been notified of a specific development, for example when developing long-term strategic growth schemes, the expenditure cannot be recovered through infrastructure charges.

Anglian Water, Affinity Water and Thames Water publish their charging arrangements annually (hyperlinks available on relevant water companies name). These include incentives to encourage good design by developers.

### 3.5.6 Water companies and the planning system

Water companies are currently not statutory consultees to planning applications, although they do monitor planning applications and respond to potentially significant applications, or where requested to do so by the LPA. Defra are intending to consult on making water companies statutory consultees for some applications (Department for Environment, Food & Rural Affairs, 2023).

Where a water company is concerned that a new development may impact upon their service to customers or the environment (for example by causing foul sewer flooding or pollution) they may request the LPA to impose a Grampian condition, whereby the planning permission cannot be implemented until a third-party secures the necessary upgrading or contributions.

Defra has issued National Policy Statements (NPSs) on Nationally Significant Infrastructure Projects (NSIPs) for wastewater (Department of Environment, Food & Rural Affairs, 2012) and water (Department of Environment, Food & Rural Affairs, 2023), to be used as the primary basis when considering applications for Development Consent Orders (DCOs).

## 3.6 Flood Risk and Surface Water

### 3.6.1 Flood and Water Management Act 2010

The Flood and Water Management Act (FWMA) aims to improve both flood risk management and the way water resources are managed (HM Government, 2010).

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by LAs and other key partners. The integration and synergy of strategies and plans at national, regional, and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

Schedule 3 of the Act has not been enacted in England, but this is expected to be implemented in 2024. The enactment of schedule 3 will have the following implications for the planning process:

- Designation of local authorities as SuDS Approval Bodies (SAB) which have a duty to adopt new drainage systems.
- The cessation of the automatic right for new developments to connect to the existing sewer system.
- Developers must ensure that drainage systems are built as per the approved drainage plan that complied with mandatory national standards.

### 3.6.2 Local Flood Risk Management Strategy (LFRMS)

Local Flood Risk Management Strategies set out how Lead Local Flood Authorities such as Buckinghamshire Council will manage local flood risk i.e., from surface water runoff, groundwater and ordinary watercourses, for which they have a responsibility as LLFA. It also sets out the work that other Risk Management Authorities are doing to manage flood risk across the unitary authority area.

The Buckinghamshire Local Flood Risk Management Strategy[7] was published in 2017, when the LLFA sat within the County Council, and was updated in 2023. The objectives for the 2023 strategy are:

- Develop and promote better understanding of flood risk from all sources, now and in the future,
- Work in partnership to build the resilience of our communities to flood risk and climate change,
- Support climate-resilient placemaking,
- Manage flood risk through nature-based solutions and adaptive pathways; and
- Improve innovation, skills and resourcing in flood risk management.

### 3.6.3 Strategic Flood Risk Assessment (SFRA)

All LPAs are required, under NPPF, to prepare a SFRA, which forms a key part of the evidence base for their Local Plan. The SFRA must consider flood risks from all sources, collating up-to-date flood risk data and in some cases developing new flood risk modelling. The SFRA is used to inform the Sequential Test, by which Local Plan allocations should be sequentially selected to direct development towards areas of lower flood risk, taking into consideration the vulnerability to flooding of the proposed land use. A Level 1 SFRA has been prepared for Buckinghamshire in 2023, to form part of the evidence base for the emerging LP4B. The document replaces the

7 Buckinghamshire Council (2017) Buckinghamshire Local Flood Risk Management Strategy. Available at: Facsimile (buckinghamshire-gov-uk.s3.amazonaws.com)

document replaces the Level 1 SFRAs published by the former Aylesbury Vale, Chiltern, South Bucks and Wycombe District Councils.

### 3.6.4 Surface Water Management Plan

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location and establish a long-term action plan to manage surface water. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. Within Buckinghamshire, Surface Water Management Plans have been developed for Chesham and High Wycombe, Marlow and Buckingham.

### 3.6.5 Sustainable Drainage Systems

From April 2015, Local Planning Authorities (LPA) have been given the responsibility for ensuring that sustainable drainage is implemented on developments of ten or more homes or other forms of major development through the planning system. Under the new arrangements, the key policy and standards relating to the application of SuDS to new developments are:

- The National Planning Policy Framework, which requires that development in areas already at risk of flooding should give priority to sustainable drainage systems.
- The House of Commons written statement (Pickles, 2014) setting out governments intentions that LPAs should “ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate” and “clear arrangements in place for ongoing maintenance over the lifetime of the development.” This requirement is also now incorporated in the 2019 update of the NPPF (paragraph 165). In practice, this has been implemented by making Lead Local Flood Authorities (LLFAs) statutory consultees on the drainage arrangements of major developments.
- The Defra non-statutory technical standards for sustainable drainage systems (HM Government, 2015c). These set out the government’s high-level requirements for managing peak flows and runoff volumes, flood risk from drainage systems and the structural integrity and construction of SuDS. This very short document is not a design manual and makes no reference to the other benefits of SuDS, for example water quality, habitat, and amenity.

Buckinghamshire Council are the LLFA and play a key role in ensuring that the proposed drainage schemes for all new developments comply with technical standards and policies in relation to SuDS. The “Sustainable Drainage Systems

(SuDS): guidance for developers"[8] contains guidance for the design and application of SuDS in the county. Further information on surface water drainage can be found on the Buckinghamshire Council website.

An updated version of the CIRIA SuDS Manual was published in 2015. The guidance covers the planning, design, construction and maintenance of SuDS for effective implementation within both new and existing developments. The guidance is relevant for a range of roles with the level of technical detail increasing throughout the manual. The guidance does not include detailed information on planning requirements, SuDS approval and adoption processes and standards, as these vary by region and should be checked early in the planning process. The manual itself can be found here.

CIRIA also publish "Guidance on the Construction of SuDS" (C768), which contains detailed guidance on all aspects of SuDS construction, with specific information on each SuDS component available as a downloadable chapter. The downloadable chapter is available here.

Thames Water provides guidance on their website through their Surface Water Management Programme available here. Applications for projects should be made through their website.

Anglian Water offers a SuDS scheme for communities, with further details available here.

### 3.6.6 Design and Construction Guidance

The Design and Construction Guidance (DCG), part of a new Codes for Adoption covering the adoption of new water and wastewater infrastructure by water companies, contains details of the water sector's approach to the adoption of SuDS, which meet the legal definition of a sewer. This replaces the formerly voluntary Sewers for Adoption The new guidance came into force in April 2020 and compliance by water companies in England is mandatory.

The previous standards, up to and including Sewers for Adoption Version 7, included a narrow definition of sewers to mean below-ground systems comprising of gravity sewers and manholes, pumping stations and rising mains. This essentially excluded the adoption of SuDS by water companies, except for below-ground storage comprising of oversized pipes or chambers.

The new guidance provides a mechanism for water companies to secure the adoption of a wide range of SuDS components which are now compliant with the legal definition of a sewer. There are however several non- adoptable components such as green

8 Sustainable Drainage Systems (SuDS): guidance for developers (2022). Accessed online at: Sustainable Drainage Systems (SuDS): guidance for developers (buckinghamshire.gov.uk) on: 07/02/2023

roofs, pervious pavements, and filter strips. These components may still form part of a drainage design so long as they remain upstream of the adoptable components.

The Design and Construction Guidance states that the drainage layout of a new development should be considered at the earliest stages of design. It is hoped that the new guidance will lead to better managed and more integrated surface water systems which incorporate amenity, biodiversity, and water quality benefits.

## 3.7 Environmental Protection and Biodiversity

### 3.7.1 The Environment Act 2021

The Environment Act (HM Government, 2021) came into UK law in November 2021 with the aim of protecting and enhancing the environment. The Act has objectives to improve air and water quality, biodiversity, waste reduction and resource efficiency. The implementation of the policies within the Environment Act has begun and legally binding environmental targets are being developed. This will be enforced by the newly created Office for Environmental Protection (OEP, more information available here).

The Environment Act (Part 5) contains policies concerning improvements to the water environment. These policies have the following aims:

- Effective collaboration between water companies through statutory water management plans.
- Minimise the damage that water abstraction may cause on environment.
- Modernise the process for modifying water and sewerage company licence conditions.

Further to this, there is specific legislation regarding storm overflows aiming to reduce the discharge of untreated sewage into waterways. This plan includes requirements for water companies to:

- report on the discharges from storm overflows;
- monitor the quality of water potentially affected by discharges;
- progressively reduce the harm caused by storm overflows; and
- report on elimination of discharges from storm overflows.

### 3.7.2 25-year Environment Plan

The Environmental Improvement Plan (EIP) is the first revision of the 25-year environment plan (25YEP) published in 2018. It contains ten goals which are shown in Figure 3.1. The full text of the EIP can be found here. Government must review and revise the plan, if needed, every five years to ensure continued progress against the ten 25YEP goals.

Of particular importance to a WCS is Goal 3 - Clean and plentiful water.

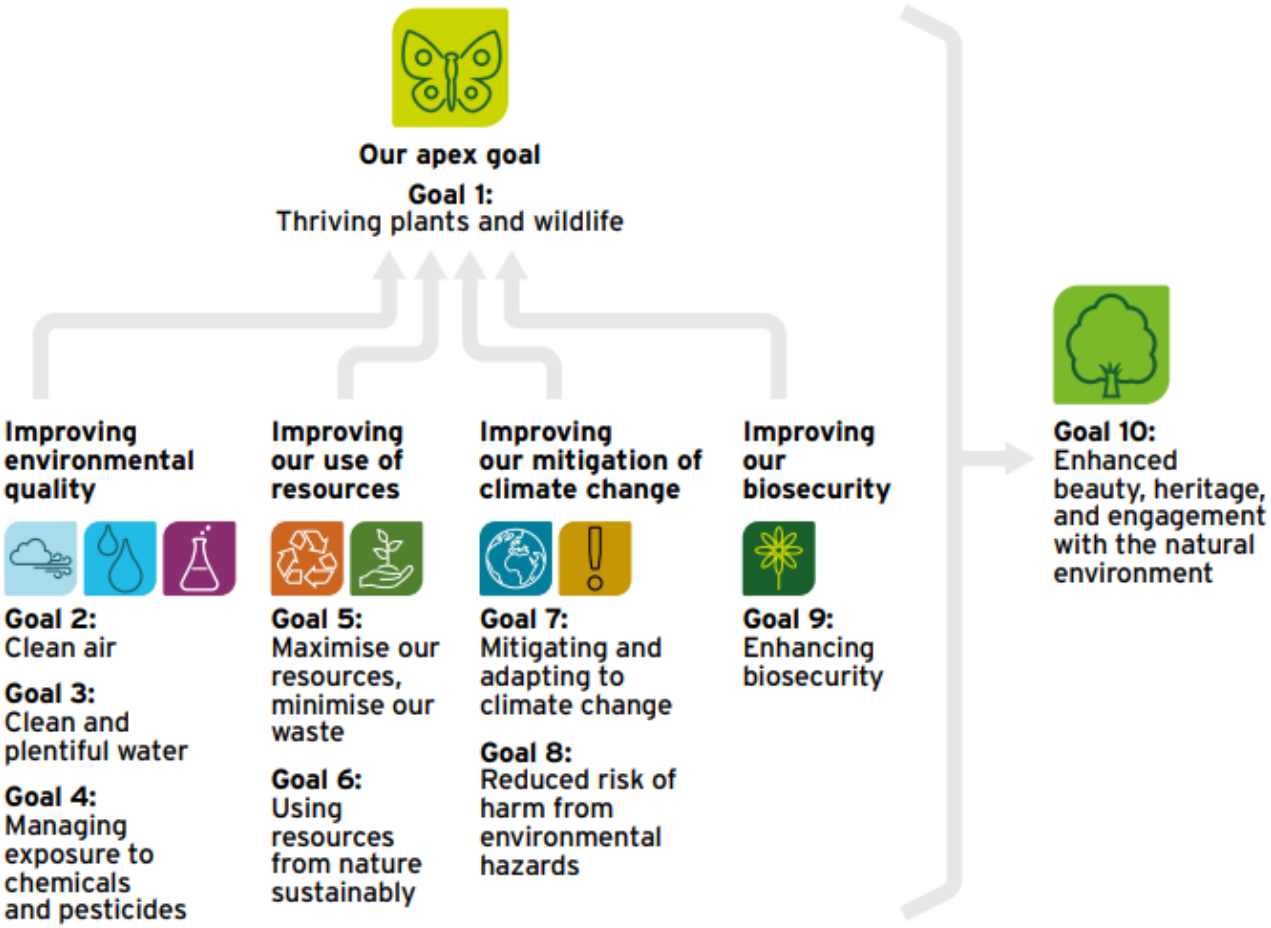



Figure 3.1 The 10 Environmental Improvement Plan goals

Under Goal 3 - Clean and plentiful water, there are eight sets of targets and commitments relating to different aspects of the water environment:

- Reduce nitrogen, phosphorus, and sediment pollution from agriculture into the water environment by at least 40% by 2038, compared to a 2018 baseline, with an interim target of 10% by 31 January 2028, and 15% in catchment containing protected sites in unfavourable condition due to nutrient pollution by 2028.
- Reduce phosphorus loadings from treated wastewater by 50% by 2028 and 80% by 2038 against a 2020 baseline.
- Halve the length of rivers polluted by harmful metals from abandoned mines by 2038, against a baseline of around 1,500km (approximately 930 miles).
- Reduce the use of public water supply in England per head of population by 20% from the 2019-20 baseline, 2038, with interim targets of 9% by 2027 and 14% by 2032, and to reduce leakage by 20% 2027 and 30% by 2032.
- Restore 75% of our water bodies to good ecological status.

- Require water companies to have eliminated all adverse ecological impact from sewage discharges at all sensitive sites by 2035, and at all overflows by 2050.
- Target a level of resilience to drought so that emergency measures are needed only once in 500-years.

To deliver these goals, the EIP outlines action across these areas:

- Improving wastewater infrastructure and water company environmental performance.
- Reducing pressures on the water environment from agriculture.
- Enabling the sustainable use of water for people, business and the environment
- Tackling pressures from chemicals and pollutants.
- Restoring natural function and iconic water landscapes.
- Joined-up management of the water system.

Progress towards delivering the EIP will be monitored annually.

### 3.7.3 Defra Plan for Water

Defra's Plan for Water (Department for Environment, Food & Rural Affairs, 2023) provides further detail on the actions towards achieving Goal 3 of the EIP23. It promotes an integrated approach to water management as the foundation of the plan. Whilst many of the actions contained within the Plan for Water are outside of the responsibilities of areas of influence of the LPAs, the following summarises those actions that LPAs should have regard to:

- Require standardised sustainable drainage systems (SuDS) in new housing developments in 2024, subject to final decisions on scope, threshold, and process following consultation in 2023.
- Designate all chalk catchments as water stressed and high priority under the sewer overflows reduction plan, driving action to improve water management.
- The plan reflects the predicted 4 billion litre per day (4,000 ml/d) gap between supply and demand across England and contains measures to both boost supply and reduce demand. Of interest to LPAs is the plan to reduce demand which will address half of the gap.
- A key component in reducing demand for water is improving water efficiency and there is a target under the Environment Act to reduce the use of public water supply in England per head of population by 20% by 2038.A road map on water efficiency in new developments and retrofits has been developed with ten actions to improve water efficiency:
    - **Action 1** - Implement schedule 3 to the Flood and Water Management Act 2010. The 2024 consultation will consider

rainwater harvesting in developing the statutory SuDS National Technical Standards.

- **Action 2** - Review the Water Supply (Water Fittings) Regulations 1999, the Water Supply (Water Quality) Regulations 2016 and/or any other relevant legislation to address wasteful product issues with toilets and enable new water efficient technologies.
- **Action 3** – Develop clear guidance on 'water positive' or 'net zero water' developments and roles for developers and water companies.
- **Action 4** – Review water efficiency options in planning, building regulations and through voluntary schemes for non-household buildings.
- **Action 5** – Work with Ofwat to ensure the water industry can play a central role in retrofitting water efficient products in households, businesses, charities and the public sector.
- **Action 6** – Work across government to integrate water efficiency into energy efficiency advice and retrofit programmes.
- **Action 7** - Review the Building Regulations 2010, and the water efficiency, water reuse and drainage standards including considering a new standard for new homes in England of 105l/p/d and 100 l/p/d where there is a clear local need.
- **Action 8** –Mandatory water efficiency labelling scheme.
- **Action 9** – Investigate dual pipe systems (rainwater harvesting) and water reuse options for new housing development as part of the review of the planning framework.
- **Action 10** – Enable innovative water efficiency approaches in buildings, including technologies and approaches to funding and maintenance.

### 3.7.4 Biodiversity Net Gain

Biodiversity net gain (BNG) is designed to contribute to the recovery of nature while developing land. The principle is that the natural environment is in measurably better state after development than it was before. The Environment Act 2021 requires all planning permissions granted in England (except for small sites) to achieve 10% BNG from January 2024. This will be required on small sites from April 2024.

Defra publishes a biodiversity metric tool, the latest version of which must be used for calculating the BNG deriving from a proposed development.

### 3.7.5 Local Nature Recovery Strategy

The Environment Act (HM Government, 2021) also established a duty to prepare, by March 2025, Local Nature Recovery Strategies (LNRS), recognising that England is one of the most nature-depleted countries in the world. Buckinghamshire Council is

the authority responsible for preparing the LNRS In the study area. They are tasked with working with local partners to agree priorities for nature recover and identify "practical, achievable proposals" (Department for Environment Food & Rural Affairs, 2023) to address these priorities. The LNRS should also co-ordinate with neighbouring strategies to form a national Nature Recovery Network.

There is a close linkage with BNG, as developments proposing to create, enhance or recover habitat in locations mapped by the LNRS receive a higher value in the biodiversity metric calculator than in other locations.

### 3.7.6 Storm Overflow Reduction Plan

The Environment Act placed a legal duty on water companies to progressively reduce the adverse impacts of discharges from storm overflows. The storm overflow reduction plan (Department for Environment, Food & Rural Affairs, 2023) sets the following targets:

- By 2035, water companies will have: improved all overflows discharging into or near every designated bating water; and improved 75% of overflows discharging to high priority sites.
- By 2050, no storm overflows will be permitted to operate outside of unusually heavy rainfall or to cause any adverse ecological harm.

There is also an expectation that water companies ensure their infrastructure keeps pace with increasing external pressures, such as urban growth and climate change, without these pressures leading to greater numbers of discharges.

### 3.7.7 The Water Framework Directive (WFD) and Water Environment Regulations

**Introduction**

The European Union Water Framework Directive (WFD) 2000 is currently transposed into English and Welsh law by the Water Environment Regulations (HM Government, 2017). They apply to all waterbodies (watercourses, canals, lakes, estuaries and coastal waters), with the objective of meeting Good Ecological Status (GES) or, where heavily modified, Good Ecological Potential (GEP) To meet GES or GEP, a water body must achieve a good or high score for all elements - in the case of surface water, these are biological, physico-chemical, specific pollutants and hydromorphology (Figure 3.2). UK policy remains to meet GES or GEP for all waterbodies by 2027.

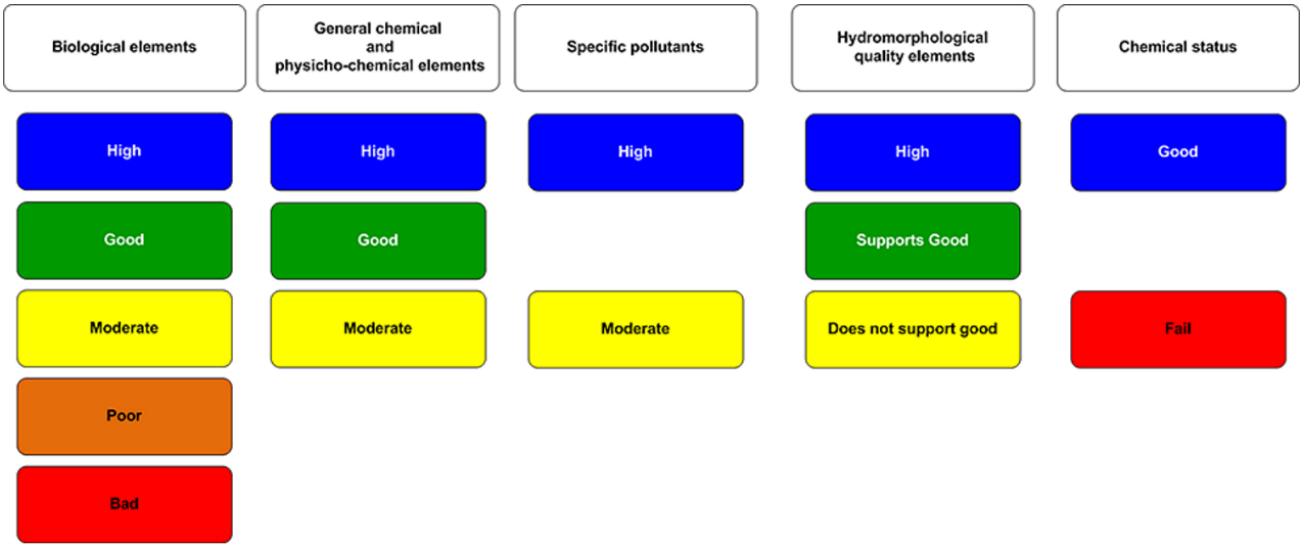



Figure 3.2: Status classification for surface water (Environment Agency, 2023a)

Chemical Status is separately assessed. The Water Framework Directive and the EA recognise a group of ubiquitous chemicals which are persistent, bioaccumulative or toxic (uPBT), and without which over 90% of England's waterbodies would achieve Good Chemical Status. Mercury, PFOS and PBDE are the most ubiquitous causes of failures. Due to the persistent nature of these chemicals, the date for getting all waterbodies to Good Chemical Status is set for 2063.

**River Basin Management Plans**

River Basin Management Plans (RBMP) are required under the WFD and document the baseline classification of each waterbody in the plan area, the objectives, and a programme of measures to achieve those objectives. Buckinghamshire falls within the Thames RBD[9] and the Anglian RBD[10]. The third cycle RBMPs were published in 2022. A primary WFD objective is to ensure 'no deterioration' in environmental status, therefore all water bodies must meet the class limits for their status class as declared in the Anglian and Thames River Basin Management Plan. Another equally important objective requires all water bodies to achieve good ecological status. Future development needs to be planned carefully so that it helps towards achieving the WFD and does not result in further pressure on the water environment and compromise

9 River Thames River Basin Management Plan 2021-2027, Environment Agency, (2022). Accessed online at: https://www.gov.uk/guidance/thames-river-basin-district-river-basin-management-plan-updated-2022 on: 08/02/2023

10 Anglian River Basin Management Plan 2021-2027, Environment Agency, (2022). Accessed online at: https://www.gov.uk/guidance/anglian-river-basin-district-river-basin-management-plan-updated-2022 on: 08/02/2023

WFD objectives. The WFD objectives as outlined in the updated RBMPs are summarised below:

- Preventing deterioration of the status of surface waters and groundwater.
- Achieving objectives and standards for protected areas.
- Aiming to achieve good status for all water bodies.
- Reversing any significant and sustained upward trends in pollutant concentrations in groundwater.
- Cessation of discharges, emissions and losses of priority hazardous substances into surface waters.
- Progressively reducing the pollution of groundwater and preventing or limiting the entry of pollutants.
- Local Planning Authorities (LPAs) must have regard to the Water Framework Directive as implemented in the RBMPs. It is of primary importance when assessing the impact of additional wastewater flows on local river quality.
- Alongside the RBMP documents, the data behind them can be explored further using the Catchment Data Explorer (Environment Agency, 2023a) and map viewer (Environment Agency, 2023b).

**Protected Area Objectives**

The Water Environment Regulations specify that areas requiring special protection under other EC Directives, and waters used for the abstraction of drinking water, are identified as protected areas. These areas have their own objectives and standards.

Some areas may require special protection under more than one piece of EU-derived legislation or may have additional (surface water and/or groundwater) objectives. In these cases, all the objectives and standards must be met.

The types of protected areas are:

- Areas designated for the abstraction of water for human consumption (Drinking Water Protected Areas);
- areas designated for the protection of economically significant aquatic species (Freshwater Fish and Shellfish);
- bodies of water designated as recreational waters, including Bathing Waters;
- nutrient-sensitive areas, including areas identified as Nitrate Vulnerable Zones under the Nitrates Directive or areas designated as sensitive under Urban Waste Water Treatment Regulations; and
- areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection including relevant Natura 2000 sites.

### 3.7.8 Conservation of Habitats Regulations 2017 (as amended)

The Conservation of Habitats and Species Regulations 2010 (commonly referred to as the Habitats Regulations) consolidated the Conservation (Natural Habitats, &c.) Regulations 1994, and transposed the EU Habitats Directive in England and Wales which was aimed at protecting plants, animals and habitats that make up the natural environment. The regulations were further amended in 2017.

The Habitats Regulations define the requirement for a Habitats Regulations Assessment (HRA) to be carried out. The purpose of this is to determine if a plan or project may affect the protected features of a "habitats site". These include:

- A special area of conservation (SAC)
- Candidate SAC.
- A site of Community Importance.
- A site hosting a priority natural habitat type or priority species protected in accordance with Article 5(4) of the Habitats Directive.
- A Special Protection Area (SPA).
- A potential SPA.
- Ramsar sites
- Potential Ramsar sites
- Any relevant Marine Sites.

All plans and projects (including planning applications) which are not directly connected with, or necessary for the conservation management of a habitat site require consideration of whether the plan or project is likely to have significant effects on that site.

This is referred to as the "Habitats Regulations Assessment screening" and should take into account the potential effects of both the plan/project itself and in combination with other plans or projects.

Part 6 of the conservation of Habitats and Species Regulations 2017 states that where the potential for likely significant effects cannot be excluded, a competent authority must make an appropriate assessment of the implications of the plan or project for that site, in view of the site's conservation objectives.

The competent authority may agree to the plan or project only after having ruled out adverse effects on the integrity of the habitats site.

If adverse effects cannot be rules out, and where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons of over-riding public interest and if the necessary compensatory measures can be secured.

The "People over Wind" ECJ ruling (C-323/17) clarifies that when making screening decisions for the purposes of deciding whether an appropriate assessment is required, competent authorities cannot take into account any mitigation measures. This must be part of the appropriate assessment itself.

Whilst this study is not designed to undertake a full screening of likely significant effects on relevant protected sites, any development conforming to the policies derived from it must undertake project level HRAs, where necessary.

The implementation of the Conservation of Habitats Regulations have had particular significant implications in two areas related to water and planning:

- Nutrient Neutrality. Natural England (NE) has identified a number of catchment areas where Habitats Sites are in unfavourable condition due to eutrophication (an excess of the nutrients phosphorous and/or nitrogen in water). NE have advised that developments in these catchments must demonstrate that they do not cause harm, and that one way to do this is to introduce mitigation measures in the catchment area which offset the additional nutrients emitted as a result of the development, an approach known as nutrient neutrality. There are no parts of the study area which are currently within a nutrient neutrality catchment area, however NE may designate additional areas in the future.
- Water Neutrality. Natural England (NE) has issued a position statement that it cannot be concluded with sufficient certainty that groundwater abstractions in the Arun Valley, West Sussex are causing no adverse effect on Habitats Sites. NE have advised that developments in Sussex North Water Resource Zone must demonstrate that they do not cause harm, and that one way to do this is to introduce mitigation measures in the zone which offset the additional water consumed as a result of the development, an approach known as water neutrality. There are no parts of the study area which are currently within a water neutrality zone, however NE may designate additional areas in the future.

Both nutrient and water neutrality designations have resulted in significant impacts on the granting of planning permission in the designated areas.

### 3.7.9 Wildlife and Countryside Act

Sites of Special Scientific Interest (SSSI) are designated and legally protected under the Wildlife and Countryside Act 1981, Section 28G places a duty to take reasonable steps, consistent with the proper exercise of the authority's functions, to "further to the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest." (HM Government, 1981).

The Government's 25-year Environment Plan has a target of "restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term." In line with this, and the Wildlife and Countryside Act 1981, Local Authorities should look put forward options that contribute to conservation or restoration of favourable condition, and at the very least must not

introduce policies that hinder the restoration of favourable condition by increasing existing issues.

A site is said to be in “favourable condition” when the designated feature(s) within a unit are being adequately conserved and the results from monitoring demonstrate that the feature(s) in the unit are meeting all the mandatory site-specific monitoring targets set out in the favourable condition targets (FCT).

### 3.7.10 Ramsar

The Convention on Wetlands of International Importance, more commonly known as the Ramsar convention, aims to protect important wetland sites. Member counties commit to:

- Wise use of all their wetlands.
- Designating sites for the Ramsar list of “Wetlands of International Importance” (Ramsar Sites) and their conservation.
- Cooperating on transboundary wetlands and other shared interests.
- “Wise use” of wetlands is defined under the convention as “the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development”. (Ramsar Convention Secretariat, 2010)
- In the UK, Ramsar Sites are designated by the Joint Nature Conservation Committee (JNCC).

In general, the designation of UK Ramsar sites is underpinned through prior notification of these areas as Sites of Special Scientific Interest (SSSIs). Additionally, the NPPF states that Ramsar sites should be given the same protection in the planning process as sites designated under the EU Habitats Directive.

### 3.7.11 Bathing Water Regulations

The Bathing Water Directive was first published in 2006 and are currently transposed into English and Welsh law through the Bathing Water Regulations 2013. The aims of the directive are the protection of public health whilst bathing, standardisation of publicly available water quality information and to improve management practices at bathing waters.

The UK has over 600 designated bathing waters defined as areas of inshore waters designated for public swimming, these areas are typically characterised by large numbers of swimmers and visitors per year. The Environment Agency are required to monitor water quality at these sites regularly (usually weekly) throughout the Bathing Water season, between 15th May and 30th September.

Water quality standards are based on the incidence of potentially harmful bacteria, E. coli and intestinal enterococci and are categorised as ‘excellent’, ‘good’, ‘sufficient’ or

‘poor’ on the basis of bacteria levels. Sites are rated annually and on a short-term basis in response to any temporary pollution incidents.

Achieving compliance with the Bathing Water Directive has driven some £2.5bn of investment by UK water companies since the early 1990s to reduce the impact of sewerage systems and treated wastewater discharges. Measures have included storage and surface water management to reduce storm overflow spills, moving or extending effluent outfalls and improving wastewater treatment, including ultra-violet (UV) treatment of final effluent.

In contrast to some other European nations, the UK has not previously designated stretches of river as bathing waters, however five new inland bathing waters have been designated since 2021, and across England there are numerous campaigns by NGOs and members of the public to designate other stretches of river. Defra has published guidance on applying for bathing water status, including a requirement for at least 100 bathers per day during the season (Department for the Environment, Food and Rural Affairs, 2023).

### 3.7.12 Environmental Permitting Regulations

Environmental permitting is a process used to manage and regulate activities which may cause harm to the environment. The Environmental Permitting Regulations (HM Government, 2016) were introduced in order to streamline a wide-ranging number of environmental permitting laws under one set of regulations. These include permits for emissions to air, water and land, and cover a range of industrial sectors and waste management streams.

Of particular relevance to this study are the regulations for permitting sewage effluent discharges to surface waters and groundwaters, known as water discharge activities (Environment Agency, 2022).

- The regulations are used to permit discharges from water company and private wastewater treatment works, and for sewer overflows.
- The Environment Agency will usually object to applications for a new private Package Treatment Plan (PTP) or septic tank where it is feasible to connect the development to a public sewerage system. A general rule of 30m per dwelling is used to define a reasonable distance from the site boundary to a public sewer. Hence a development of 10 homes should connect to a public sewer within 300m of the boundary, unless there are significant barriers, such as a river or motorway.
- Where an existing or new development treats its own wastewater, a PTP must be installed if the discharge is directly to surface water. Where the discharge is to ground, a PTP or septic tank may be used, but must be connected to a suitably designed drainage field.

### 3.7.13 Groundwater protection

Under the regulations, the EA have published a set of position statements on protecting groundwater from various activities (Environment Agency, 2018). The position statements that are relevant to this study with regard to discharges to groundwaters, include surface water drainage and the use of SuDS, discharges from contaminated surfaces (e.g., lorry parks) and from treated sewage effluent.

The EA also maintain a set of maps of Source Protection Zones (SPZs) to help identify high risk areas within which pollution prevention measures should be implemented. The SPZs show the risk of contamination to public water supplies from activities that may cause pollution in the area, the closer the activity, the greater the risk:

- **Zone 1 (Inner protection zone)** This zone is designed to protect against the transmission of toxic chemicals and water-borne disease. It indicates the area in which pollution can travel to the borehole within 50 days from any point within the zone and applies at and below the water table. There is also a minimum 50 metre protection radius around the borehole.
- **Zone 2 (Outer protection zone)** This zone indicates the area in which pollution takes up to 400 days to travel to the borehole, or 25% of the total catchment area, whichever area is the largest. This is the minimum length of time the Environment Agency think pollutants need to become diluted or reduce in strength by the time they reach the borehole.
- **Zone 3 (Total catchment)** This is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.
- **Zone of special interest** This is defined on occasions, usually where local conditions mean that industrial sites and other polluters could affect the groundwater source even though they are outside the normal catchment.

## 3.8 Summary of key new and emerging policy and legislation

The policy and legislation covering the water environment, water and wastewater services and planning is wide and frequently changing. The new and emerging policy and legislation below have been identified as particularly important for consideration in the development of the Local Plan:

- Schedule 3 of the Flood and Water Management Act is expected to be enacted in England in 2024. This will designate Lead Local Flood Authorities as SuDS Approval Bodies (SABs) with a duty to adopt new SuDS and removing the automatic right to connect to public sewers.
- Defra has signalled their intention, with the Plan for Water, to review the water efficiency standards for new homes, including consideration of a new national 105l/p/d standard and 100l/p/d where there is a clear local need.
- All development sites will be expected to demonstrate at least a 10% net-gain in biodiversity from 2024.

- The designation of specific catchments in England as requiring to demonstrate Nutrient Neutrality under the Conservation of Habitats Regulations has led to significant limitations to development in these areas, as well as the development of offsetting schemes to enable nutrient-neutral development. In 2023 the government unsuccessfully attempted to remove development restrictions in these areas, suggesting this is an area of policy that may be subject to future change.
- Similarly, the availability of water resources, and the impact of new water demand on the environment, has led to restrictions on granting planning permission in Sussex North WRZ and a requirement to demonstrate water-neutral development in Cambridge Water WRZ. It is anticipated that LPAs will be increasingly required to demonstrate that there will be sufficient water resources to supply development without causing further harm to the environment through the life of their Local Plans.

# 4 Water Resources

## 4.1 Introduction

### 4.1.1 Objectives

The aim of the water resources assessment is to ensure that sufficient water is available in the region to serve the proposed level of growth, and that it can be abstracted without a detrimental impact on the environment, both during the plan period and into the future. The report characterises the study area, identifying the key surface water and groundwater bodies, and local geology. It highlights the pressures on water resources in the region, identifies existing constraints on abstraction and provides evidence for adopting tighter water efficiency targets.

### 4.1.2 Surface Waters

Figure 4.1 shows the main watercourses within the study area, which are summarised below:

The River Great Ouse lies within the north of Buckinghamshire, flowing in an easterly direction across the width of the northern Aylesbury Vale area of Buckinghamshire. The main tributary is Padbury Brook. Within the centre of Buckinghamshire, the River Ray and River Thame flow in a westerly direction.

Within the south of Buckinghamshire, a number of main rivers flow southwards, namely the River Wye, River Chess, River Misbourne and Hamble Brook. The River Colne runs alongside the south eastern boundary of Buckinghamshire.

### 4.1.3 Chalk streams

A chalk stream is broadly defined as a river that derives most of its flow from chalk-fed groundwater, stores of underground water that are replenished when it rains. England is home to 85 per cent of the world’s chalk streams. Chalk streams are an important and rare habitat and opportunities should be taken within the Local Plan to define policies to protect these river ecosystems.

The location of these rivers is shown in Figure 4.2 below. The chalk streams shown in this map have been identified by the recently published Natural England chalk stream mapping. The dataset uses 1:50,000 Biodiversity Action Plan (BAP) chalk river data, BGS geology, the World Wide Fund for Nature (WWF) report "The State of England’s Chalk Streams" and stakeholder knowledge to produce an updated chalk river network for England. Watercourses with a 'high certainty' of designation as chalk streams have been included in Figure 4.2. The nationally defined Natural England dataset may not include all chalk streams within Buckinghamshire, and therefore coverage of chalk streams within Buckinghamshire will be reviewed in the Stage 2 WCS. This will

consider any local designations, which are currently being assessed by conservation groups in Buckinghamshire.

It is understood that further work is being co-ordinated by the Chilterns Conservation Board to identify and map some possible additional chalk streams on the northern scarp slope of the Chilterns. If available, these should be mapped in a Stage 2 WCS.

Most of the flow within these streams derives from underground chalk aquifers rather than surface water runoff resulting in stable base flows. The chalk also has a filtering effect resulting in nutrient-poor and very clear water. Because their water sources are so pure, any agricultural or urban pollution can severely disrupt the ecology of a chalk stream, as can changes in flow.

The health of a chalk stream depends on three things - water quantity, water quality and physical habitat quality (has the stream been modified / constrained and are invasive species present).

Further discussion on how Local Plan policy can contribute to the protection of chalk streams should be included in the Stage 2 WCS.

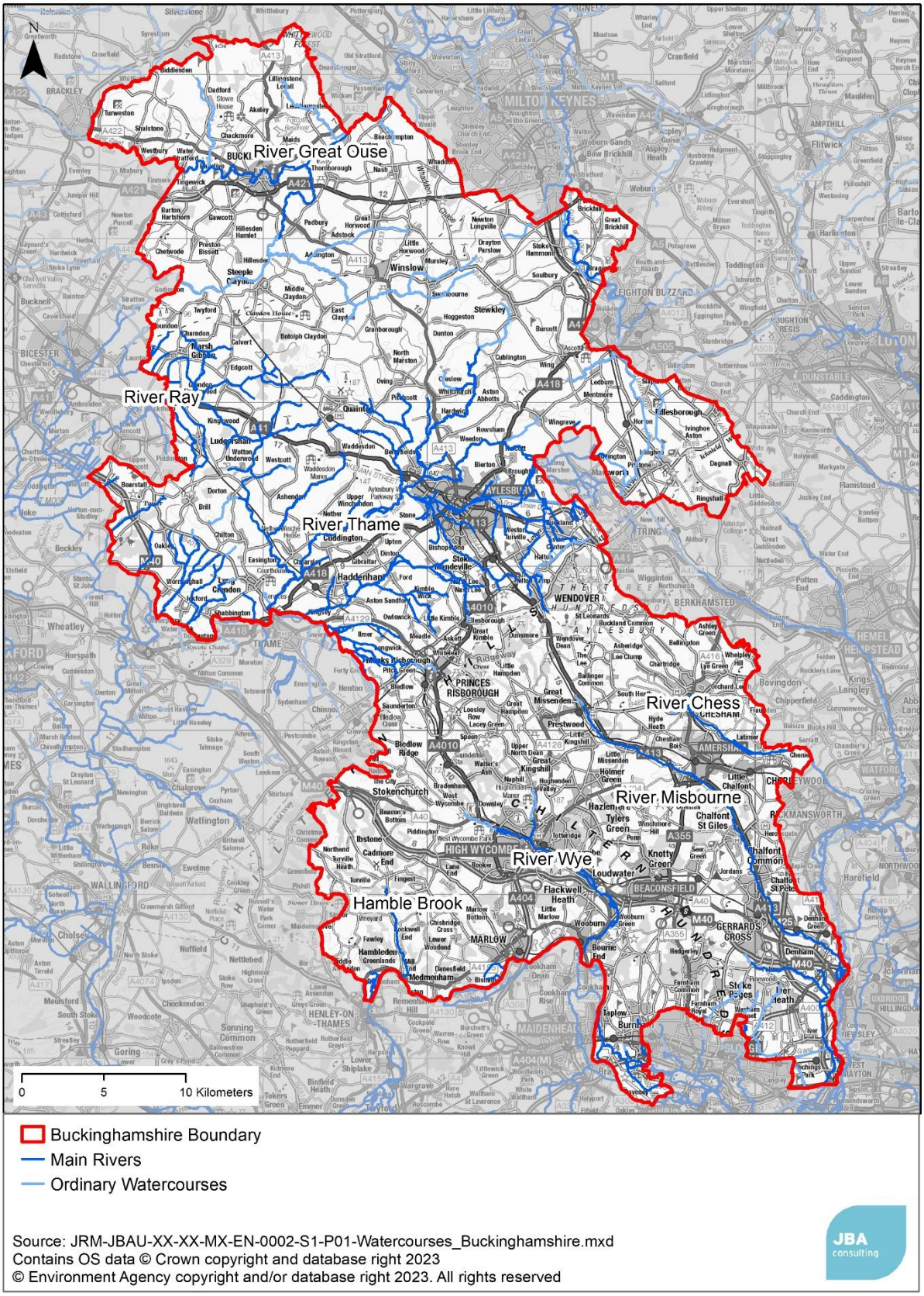



Figure 4.1 Significant watercourses within Buckinghamshire

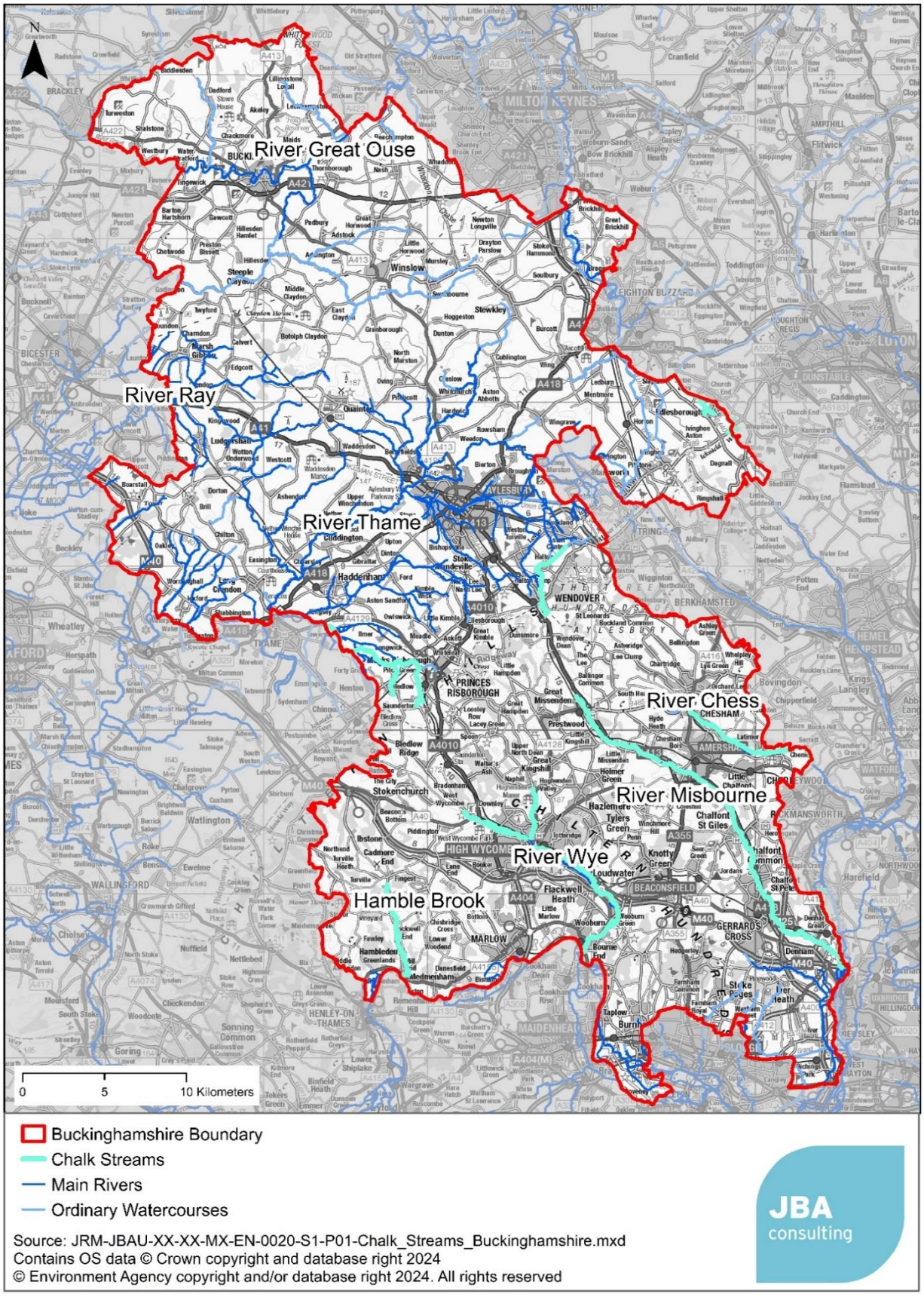



Figure 4.2 Chalk streams within Buckinghamshire

### 4.1.4 Groundwaters

Groundwater is any water that is below the surface of the ground in the saturation zone and in direct contact with the ground or sub-soil. Article 2.12 of the WFD defines a groundwater body as "a distinct volume of groundwater within and aquifer or aquifers". They are units for the management of groundwater resources that are either exploited by man or support surface ecosystems.

There are twelve groundwater bodies within the study area which are shown in Figure 4.3 and their corresponding WFD classification is summarised in Table 4.1 below. Most of these are found in the south of Buckinghamshire.

Five of the twelve groundwater bodies within the study area have poor quantitative status. These are mainly located along the eastern and south eastern borders of Buckinghamshire, with one covering the southern edge of the county. The poor quantitative status of the Mid-Chilterns Chalk and Radlett Tertiaries groundwater bodies has the potential to impact chalk streams within the study area.

Table 4.1 WFD status of groundwater bodies

| Groundwater Body | Quantitative Status | Chemical Status | Overall Status - WFD Cycle 2 (2019) |
|---|---|---|---|
| Chiltern Chalk Scarp | Good | Poor | Poor |
| Headington Corallian | Good | Poor | Poor |
| Lower Thames Gravels | Poor | Good | Poor |
| Maidenhead Chalk | Good | Poor | Poor |
| Mid-Chilterns Chalk | Poor | Poor | Poor |
| Radlett Tertiaries | Poor | Good | Poor |
| South-West Chilterns Chalk | Good | Good | Good |
| Twyford Tertiaries | Good | Good | Good |
| Upper Bedford Ouse Chalk | Poor | Poor | Poor |
| Upper Bedford Ouse Oolite Principal 1 | Good | Poor | Poor |
| Upper Bedford Ouse Oolite Secondary | Good | Good | Good |

| Groundwater Body | Quantitative Status | Chemical Status | Overall Status - WFD Cycle 2 (2019) |
|---|---|---|---|
| Upper Bedford Ouse Woburn Sands | Poor | Good | Poor |

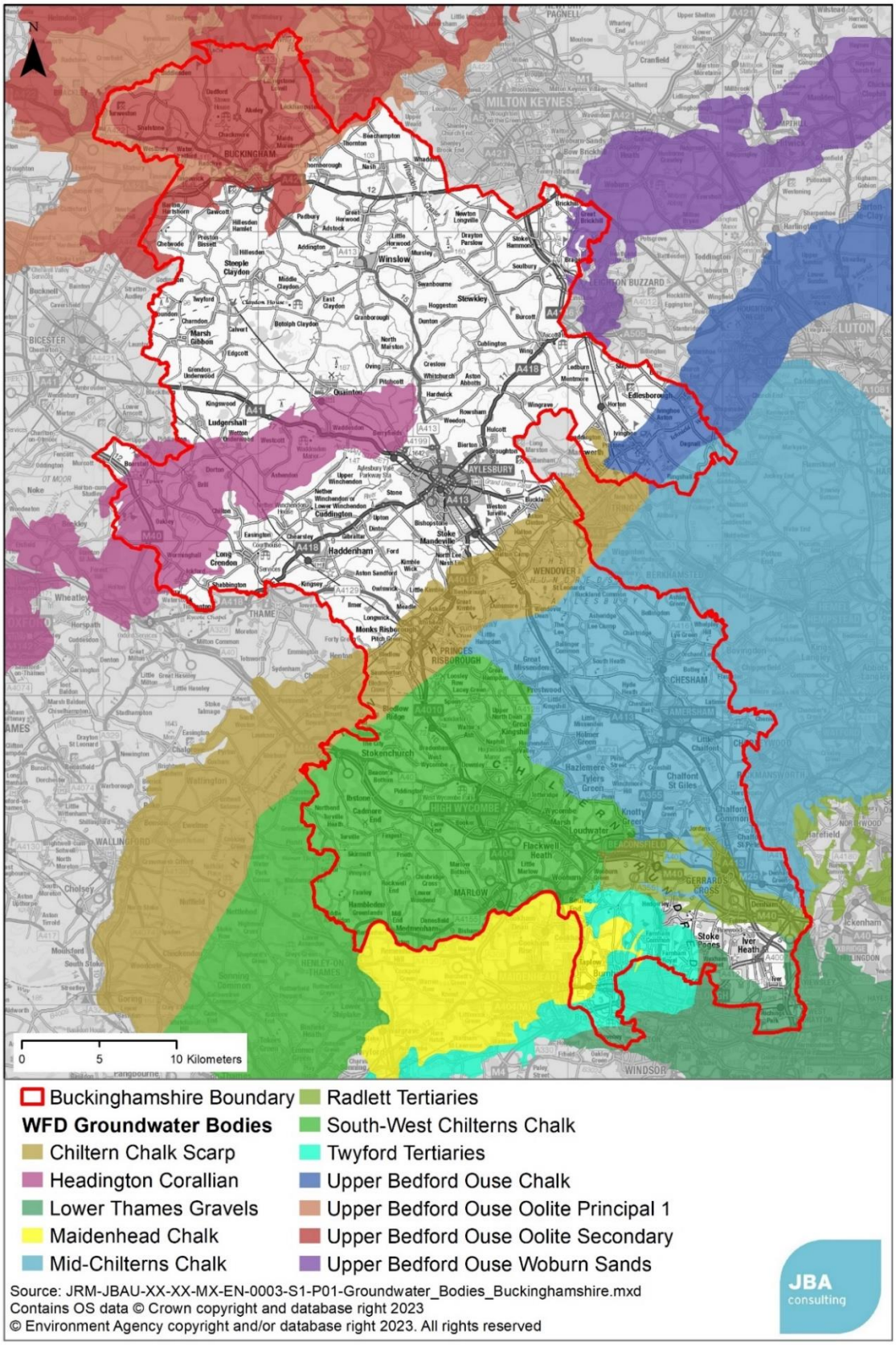



Figure 4.3 Groundwater bodies

### 4.1.5 Geology

The geology of the catchment can be an important influencing factor in the way that water runs off the ground surface, and also locally on the type of Sustainable Drainage System (SuDS) that is appropriate for development sites. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

Figure 4.4 shows the bedrock geology of the Buckinghamshire study area. The geology of Buckinghamshire is considerably varied. It is predominantly divided into Great Oolite Group, Kellaways Formation and White Chalk. The Great Oolite Group is comprised of sandstone, limestone and argillaceous rocks and covers the northern geology of Buckinghamshire. The Kellaways Formation is comprised of mudstone, siltstone and sandstone and covers north and central area of the local plan area. The White Chalk Formation is comprised of chalk and covers the south of Buckinghamshire.

Figure 4.5 shows superficial (at the surface) deposits of Diamicton in the majority of the local plan area with areas of sand and gravel to the south and clay, silt and till scattered throughout Buckinghamshire.

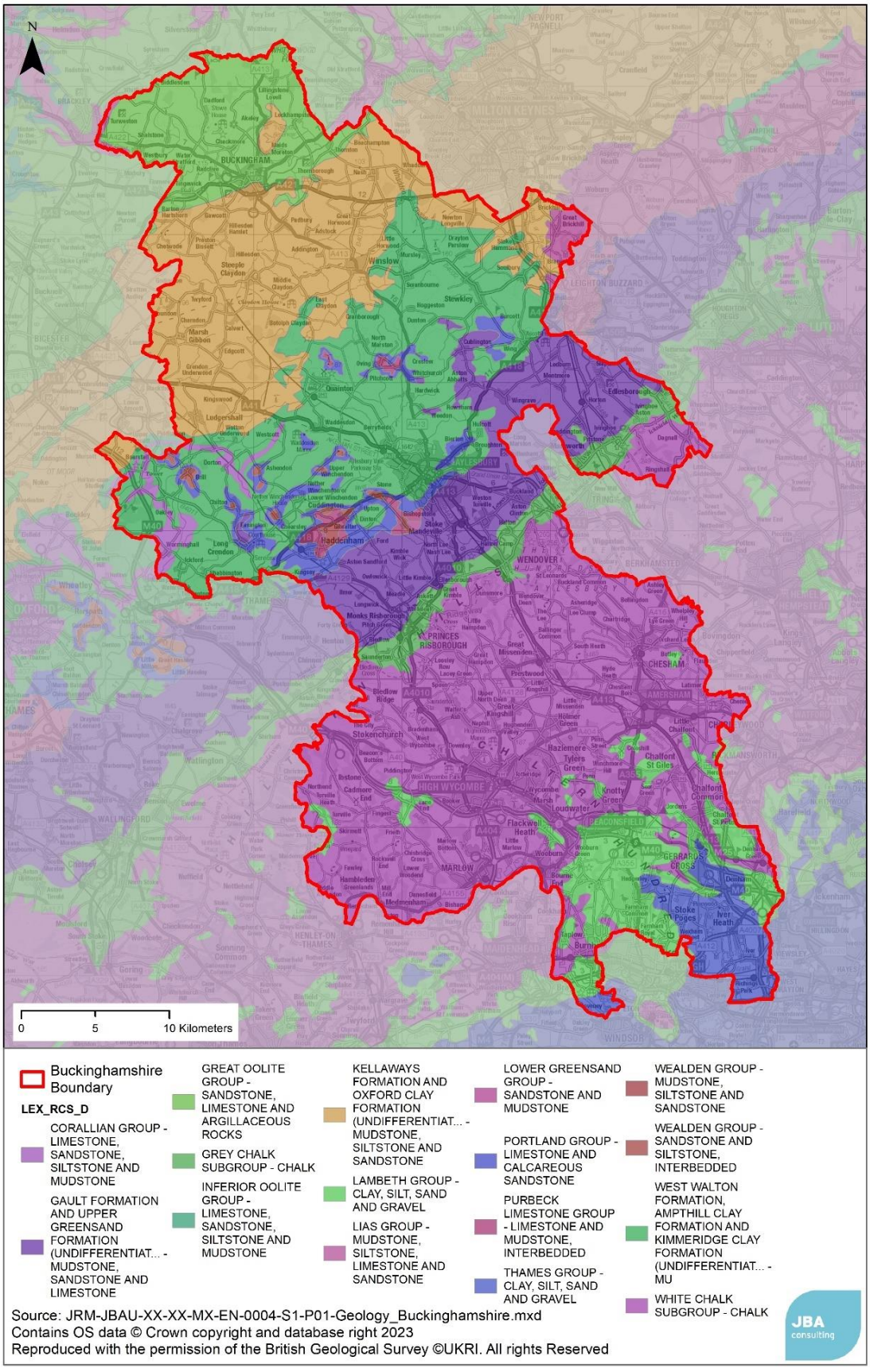



Figure 4.4 Bedrock geology of Buckinghamshire

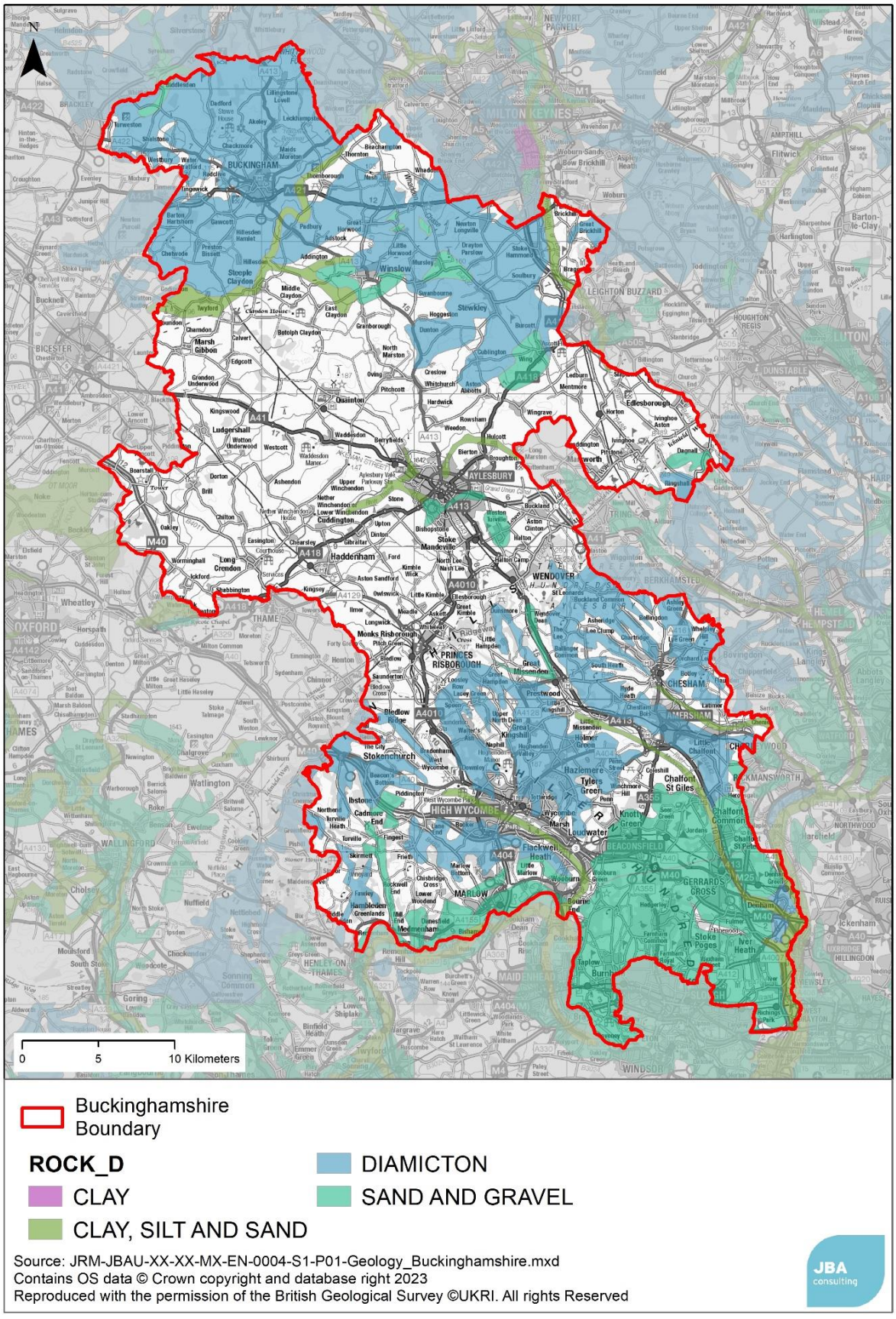



Figure 4.5 Superficial (at surface) geology of Buckinghamshire

## 4.2 Water Resource Assessment: Water Resource Management Plans

### 4.2.1 Introduction

When new development within a Local Planning Authority is being planned, it is important to ensure that there are sufficient water resources in the area to cover the increase in demand without risk of shortages in the future or during periods of high demand, and without causing a negative impact on the waterbodies from which water is abstracted.

The aim of this assessment was to compare the future additional demand as a result of development proposed within the emerging Local Plan, with the demand accounted for by Thames Water, Anglian Water and Affinity Water within their Water Resource Management Plans.

The water resources assessment has been carried out utilising two approaches; initially by reviewing the Water Resource Management Plans (WRMP) and secondly by providing the water company with a growth estimate allowing them to assess the impact of planned growth on their water resource zone.

This assessment has been undertaken using the draft 2024 Water Resource Management Plans. It is recommended that this section of the WCS is fully revised at Stage 2, to take account of the final WRMP24.

**Water Resource Planning**

Water Resource Zones are defined by the EA as areas in which the management of supply and demand is largely self-contained and where the supply infrastructure is linked such that customers within the zone experience the same risk of supply failure. Within a WRZ a customer may receive their water from anywhere within the zone, and not necessarily from the nearest source.

Each water company must publish a Water Resources Management Plan (WRMP), a 25-year strategy (updated every five years), which assesses future demand, water availability, demand management measures and how the impact of climate change will be mitigated. Where necessary they also set out the requirements for developing additional water resources to meet growing demand and reductions in abstraction from other sources to meet their environmental responsibilities.

### 4.2.2 Methodology

The Water Resources Management Plans for the water companies supplying Buckinghamshire were reviewed. Attention was mainly focussed upon:

- The available water resources and future pressures which may impact upon the supply element of the supply/demand balance.
- The allowance within those plans for housing and population growth and its impact upon the demand side of the supply/demand balance.

The Ministry for Housing, Communities and Local Government (MHCLG), (now Department for Levelling Up Housing and Communities (DLUHC)), 2018-based estimates of household growth up to 2041 has been used in the WCS to estimate the present-day number of houses in Buckinghamshire.

### 4.2.3 Thames Water

Thames Water (TW) is responsible for supplying the south of Buckinghamshire with water (see Figure 4.6). For the purposes of water resources planning, the TW supply area is divided into six Water Resources Zones (WRZs) which vary greatly in scale and have unique water resource concerns. The TW area of Buckinghamshire mostly is covered by the Slough, Wycombe, Aylesbury WRZ, with a small area covered by the Swindon and Oxfordshire (SWOX) WRZ which is the largest Thames WRZ.

Across the Thames Valley region, around 60% of water supply comes from groundwater sources in the upper Kennet Valley and the Cotswolds. The remaining 40% being abstracted from surface water sources such as the River Thames.

Thames Water's WRMP identifies a supply-demand surplus during AMP8 (2025 to 2030) followed by a transition to deficit during the early 2030s. Alternative ways of meeting customer demand need to be found as current water sources become unreliable. The water company aims to do this in the Slough, Wycombe, Aylesbury and SWOX WRZs through the combinations of demand-management and supply measures outlined in Table 4.2.

The draft WRMP24 can currently be found at:

https://thames-wrmp.co.uk/

Table 4.2 Thames Water's preferred plan

| Water Resource Zone | Measures |
|---|---|
| Slough, Wycombe Aylesbury WRZ | Progressive metering programme with the installation of household smart meters (achieving 84% penetration by the end of AMP8 and 95% by 2045).<br>Reduction in leakage by 2.75Ml/d during AMP8.<br>Promotion of water efficiency and metering to improve water use.<br>Mains rehabilitation to reduce leakage.<br>Further long-term demand reduction actions will need to be driven by Government to alter water use through societal changes and the adoption of minimum standards and building regulations changes. |

| Water Resource Zone | Measures |
|---|---|
| Swindon and Oxfordshire WRZ | Roll out of metering programme with the installation of household smart meters (achieving 95% penetration by the end of AMP8 and 98% by 2045).<br>Reduction in leakage by 5.45Ml/d during AMP8.<br>Promotion of water efficiency and metering to improve water use.<br>Mains rehabilitation to reduce leakage.<br>Further long-term demand reduction actions will need to be driven by Government to alter water use through societal changes and the adoption of minimum standards and building regulations changes. |

### 4.2.4 Anglian Water

Anglian Water (AW) is responsible for supplying the north of Buckinghamshire with water. The AW supply area is divided into 27 WRZs which vary considerably in scale and location. Buckinghamshire is covered by the Ruthamford West and Ruthamford Central WRZs. Neither of these two zones have their own sources of water and rely on transfers from Ruthamford North and Ruthamford South WRZs.

In their baseline supply-demand balance, neither zones are expected to be in deficit during the LP period in the Dry Year Annual Average (DYAA) planning scenario, but Ruthamford Central is expected to be in deficit by 2033 in the Dry Year Critical Period (DYCP) scenario (a water company planning scenario where supply-demand is at its lowest), and Ruthamford West by 2049. Both WRZs are expected to be in balance in their final plan[11].

Anglian Water is the largest water and water recycling company in England, supplying water and recycling services to almost seven million people in the East of England and Hartlepool. 50% of Anglian Water's supply comes from surface water (rivers and reservoirs) and the remaining 50% is obtained from groundwater sources.

Anglian Water's WRMP outlines how they aim to meet customer demand over the next five years. The demand-management and supply measures are outlined below:

- Continue the investment into smart metering across the region, reaching the maximum feasible meter penetration by 2030, achieving a demand saving of 25 Ml/d.
- Investigate how to pursue a compulsory metering strategy to be implemented by 2030.
- Promotion of water efficiency to homes by providing smart devices to monitor shower duration and volume.

11 Anglian Water Ruthamford Summaries: wrmp24-ruthamford-dec22.pdf (anglianwater.co.uk)

- Continuous engagement with customers and the community to embed behavioural changes within homes, with targeted communications during times of drought and peak summer demand.
- Implementing a 'Water Demand Reduction Discovery Fund' to increase understanding of customer behaviours and explore future water efficiency initiatives.

The draft WRMP24 can be found at:

https://www.anglianwater.co.uk/about-us/our-strategies-and-plans/water-resources-management-plan/

### 4.2.5 Affinity Water

Affinity Water (AFW) is responsible for supplying the south east of Buckinghamshire with water. The AW supply area is divided into eight WRZs. Buckinghamshire is covered by the Misbourne WRZ, Pinn WRZ and Lee WRZ which are part of Affinity Waters 'Central Communities' WRZ group. The 'Central Communities' baseline supply-demand balance is predicted to be in deficit from 2025, with a significant reduction in supply from 2030 to 2050[12].

Across the Affinity Water region, approximately 65% of water supply comes from groundwater sources, and the remainder is from surface water, principally the River Thames.

Affinity Water's WRMP outlines how they aim to meet customer demand over the next five years. The demand-management and supply measures are outlined below:

- Implementation of 100,000 smart meters per annum over three AMP periods.
- Improvement in interactions with customers, allowing more bespoke messaging based on patterns of water use to suggest ways in which they can save water.
- Home water efficiency checks (HWECs) continue to represent the most effective way of achieving substantial in-house efficiency.
- Continuous support from the Government to achieve Government-level initiatives, such as the target of 110 l/h/d PCC.
- A commitment to deliver at least a 50% reduction in leakage by 2050, by fixing the leaks on the communication and supply pipes and by renewing the mains network.

The draft WRMP24 can be found at:

https://affinitywater.uk.engagementhq.com/wrmp

12 Affinity Water dWRMP: b0a038665195d7b2a1bfb43584f42704_Revised_draft_WRMP.pdf (amazonaws.com)

### 4.2.6 Independent Water Networks Ltd

Independent Water Networks is a NAV supplier which provides the water supply for the development at Berryfields, Aylesbury. This lies within Thames Water's Slough, Wycombe, Aylesbury WRZ.

Independent Water Networks outlines their supply and demand balance across the Berryfields area in their WRMP. It states that there will be no additional efforts in regard to water efficiency, and that normal regard for the efficient use of water will be required. There are also no measures additional to routine leakage control required.

### 4.2.7 Leep Networks Ltd

Leep Networks is a NAV supplier which provides the water supply at Kingsbrook, to the north east of Aylesbury. This lies within Thames Water's Slough, Wycombe, Aylesbury WRZ. Kingsbrook is a residential demand zone, which at full build will comprise up to 2450 residential properties.

Leep Networks note within their WRMP that no demand control methods over and above the water efficiency measures and standards implemented by the developer of the site will be required to meet the demand.

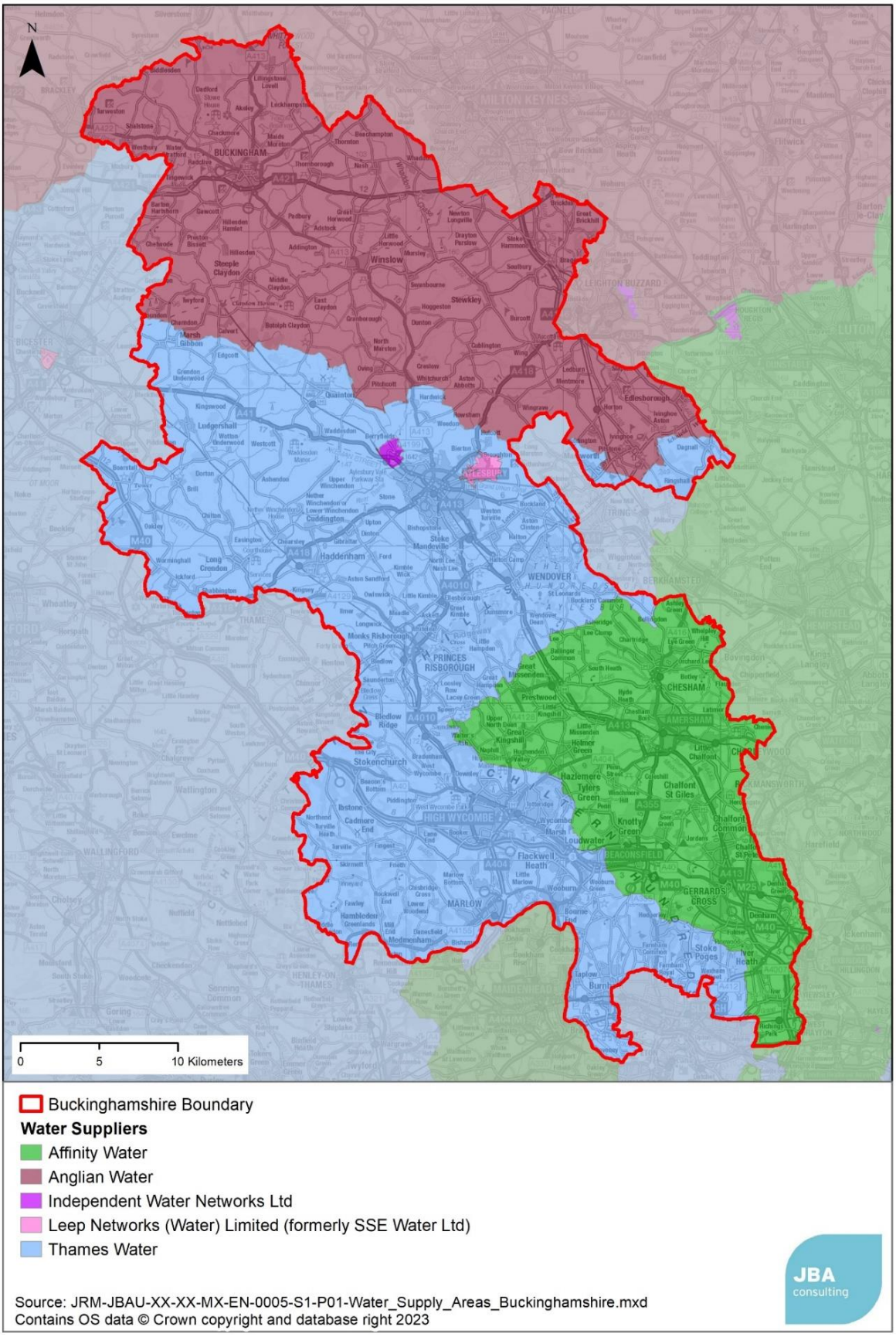



Figure 4.6 Water supply companies in Buckinghamshire

### 4.2.8 Population and household growth

Table 4.3 shows the household growth forecasts for the WRZs which serve growth within Buckinghamshire from the MHCLG 2018 forecast, the emerging Local Plan and the 2019 WRMPs. It is difficult to make direct comparisons between growth forecasts in Buckinghamshire and the WRZs due to their differing geographies, but in general the growth forecasted by the water companies is similar to that considered in the emerging Local Plan, with the exception of the Misbourne WRZ.

Table 4.3 Comparison of household growth forecasts

| Forecast | 2022 | 2045 | % increase |
|---|---|---|---|
| MHCLG 2018-based forecast – Buckinghamshire | 219,780 | 243,556 | 11% |
| Indicative growth in Local Plan period (from Table 2.3) based on standard method | 219,780 | 284,056 | 29% |
| WRMP19 Forecast – SWOX (Updated Nov 2022)* | 500,750 | 611,240 | 22% |
| WRMP19 Forecast – Slough, Wycombe, Aylesbury (Updated Nov 2022)* | 253,240 | 338,310 | 33% |
| WRMP19 Forecast – Ruthamford West (Updated Nov 2022)* | 38,430 | 48,330 | 26% |
| WRMP19 Forecast – Ruthamford Central (Updated Nov 2022)* | 139,650 | 178,640 | 28% |
| WRMP19 Forecast – Misbourne (Updated May 2020)* | 145,760 | 162,920 | 12% |
| WRMP19 Forecast – Pinn (Updated May 2020)* | 382,320 | 479,730 | 25% |

* These figures are based on the Water Resources Market Information tables published as part of WRMP19 and updated in 2020. This table should be updated in the Stage 2 WCS once the updated WRMP24 tables are available.

### 4.2.9 Summary

Buckinghamshire is within the Swindon and Oxfordshire (SWOX), Slough Wycombe Aylesbury, Ruthamford West, Ruthamford Central, Misbourne and Pinn WRZs.

Thames Water, Affinity Water and Anglian Water's WRMP highlights a deficit in their baseline supply-demand balance and defines the actions required to achieve a supply demand balance in their final plans to prevent the risk of future environmental deterioration.

Although Thames Water, Anglian Water and Affinity Water have not relied on new homes being more water-efficient than existing metered homes, the opportunity, through the planning system, to ensure that new homes do meet the higher standard of domestic water usage, at no significant additional cost to the developer, would be in line with general principals of sustainable development, and reducing energy consumed in the treatment and supply of water.

Growth during the Local Plan period is expected to be in the region of 29% between 2022 and 2045. This is broadly in line with the percentage growth forecast in the Slough, Wycombe, Aylesbury WRMP and in the Ruthamford Central WRMP, but is higher than the expected percentage growth in the other WRZs. It should be noted that WRZ boundaries cross multiple LPAs. This is based on data published as part of the WRMP19, updated in 2020 and 2022 and should be updated in the Stage 2 WCS once the final WRMP24 is published.

### 4.3 Water Environment National Environment Programme Measures

The Water Industry National Environment Programme (WINEP) is a set of actions that the EA have requested all 20 water companies operating in England to complete in a particular Asset Management Period (AMP) as part of their environmental commitments. Actions may include investigations or actual measures, examples could be reductions in abstraction in a particular river to maintain flow to support WFD objectives, or a reduction in phosphate pollution in a catchment through upgrades to a WwTW.

WINEP will provide a baseline for the Local Nature Recovery Strategies required by March 2025. As set out in the recently enacted Environment Act, new Local Plans will need to have regard to LNRSs when being developed.

Table 4.4 shows WINEP actions relating to water resources in surface and groundwater waterbodies in Buckinghamshire in AMP 7 (2020-2025). Actions relating to water quality are presented in Section 8 (Water Quality).

Development and population growth can increase abstraction, and so Buckinghamshire Council have an opportunity to contribute to these actions indirectly by pursuing policies that promote water efficiency in new development.

Table 4.4 Flow related WINEP actions on waterbodies in Buckinghamshire

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Chess | HNL00092<br>HNL00093 | 7TW100044 | Hawridge Pumping Station | Investigation to be completed together with Affinity Water<br>Sustainability reduction to support a chalk stream<br><br>Investigation, conducted by consultants on behalf of water company, hasn't concluded yet. Impacts of abstraction, however, have already been confirmed hence sustainability reductions included as in WINEP2. Options that will be implemented for both No Deterioration and WFD Improvements will be clarified further through options appraisal process. At the Operational Catchment Scale proposed WINEP3 schemes are cost beneficial. | 22/12/2024 - 31/03/2022 |
| Chinnor Brook and Sydenham Brook | THM00012 | 7TW110003 | Chiltern Scarp Surface Water Bodies (no deterioration) | Investigation and Options Appraisal at a combined waterbody scale | 31/03/2022 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Chess | HNL00063<br>HNL00001 | 7AF100116<br>7AF100054 | Alma Road Pumping Station | Sustainability Change<br>Investigation and Options Appraisal<br>Sustainability reduction to support a chalk stream | 22/12/2024 - 31/03/2022 |
| Misbourne | HNL00065<br>HNL00060 | 7AF100054<br>7AF100118 | Amersham Pumping Station | Sustainability Change<br>Investigation and Options Appraisal<br>Joint investigation with Thames Water | 22/12/2024 - 31/03/2022 |
| Pinn | HNL00011<br>HNL00034<br>HNL00035<br>HNL00036 | 7AF100054 | Blackford Pumping Station<br>Northmoor Pumping Station<br>Springwell Pumping Station<br>Stockers Pumping Station | Investigation and Options Appraisal<br>Join investigation with Thames Water | 31/03/2022 |

## 4.4 Water demand reduction

### 4.4.1 Water efficiency

It is widely recognised that the climate is changing. Climate change is predicted to increase pressure on water resources, increasing the potential for a supply-demand deficit in the future, and making environmental damage from over abstraction of water resources more likely. Furthermore, the delivery of water and wastewater services and the heating of water in the home require high energy inputs, and therefore contribute directly to emissions of greenhouse gases. Water efficiency therefore contributes to reducing energy use and carbon emissions.

It is important therefore that new development does not result in an unsustainable increase in water abstraction. This can be done in a number of ways from reducing the water demand from new houses through to achieving “water neutrality” in a region by offsetting a new development's water demand by improving efficiency in existing buildings. Further analysis of the practically of achieving water neutrality will be undertaken in Stage 2.

It is for Local Authorities to establish a clear need to adopt the tighter water efficiency target identified in the building regulations. This should be based on:

**Existing sources of evidence such as:**

- The Environment Agency classification of water stress;
- Water resource management plans produced by water companies;
- River Basin Management Plans which describe the river basin district and the pressure that the water environment faces. These include information on where water resources are contributing to a water body being classified as ‘at risk’ or ‘probably at risk’ of failing to achieve good ecological status, due to low flows or reduced water availability;
- Defra Plan for Water
- **c**onsultations with the local water and sewerage company, the Environment Agency and catchment partnerships; and
- **c**onsideration of the impact on viability and housing supply of such a requirement

This evidence is laid out below.

### 4.4.2 Water Stress

Water stress is a measure of the level of demand for water (from domestic, business and agricultural users) compared to the available freshwater resources, whether surface or groundwater. Water stress causes deterioration of the water environment in both the quality and quantity of water, and consequently restricts the ability of a waterbody to achieve a “Good” status under the Water Framework Directive.

The Environment Agency has undertaken an assessment of water stress across the UK. This defines a water stressed area as where:

- "The current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand; or
- The future household demand for water is likely to be a high proportion of the effective rainfall available to meet that demand.

In the Environment Agency assessment[13] the Thames Water, Anglian Water and Affinity Water supply regions were classified as being an area of serious water stress.

### 4.4.3 River Basin Management Plans

The study area is located within both the Thames and Anglian River Basin Districts. The management recommendations from both RBMP's are listed below:

- **Government and agencies (Environment Agency)** grant licences under the Water Resources Act 1991 to regulate how much water is taken from rivers, lakes estuaries and groundwater. The Environment Agency reviews the sustainability of time-limited abstraction licences as they expire, and the licence holders seek replacement licences.
- **All sectors** take up or encourage water efficiency measures, including water industry work on metering, leakage, audits, providing water efficient products, promoting water efficiency and education.
- **Local Government** sets out local plan policies requiring new homes to meet the tighter water efficiency standard of 110 litres per person per day as described in Part G of Schedule 1 to the Building Regulations 2010 (as amended).
- **Industry manufacturing and other business** implement tighter levels of water efficiency, as proposed by changes to the Building Regulations.
- **Agriculture and rural land management** manage demand for water and use water more efficiently to have a sustainable water supply for the future.
- **Local government** commissions water cycle studies to inform spatial planning decisions around local water resources.

The RBMP goes on to state that "dealing with unsustainable abstraction and implementing water efficiency measures is essential to prepare and be able to adapt to climate change and increased water demand in the future."

13 Water Stressed Areas - Final Classification, Environment Agency and Natural Resources Wales (2021). Accessed online at: https://www.gov.uk/government/publications/water-stressed-areas-2021-classification on: 08/02/2023.

### 4.4.4 Defra Plan for Water

Through their Plan for Water[14] Defra has signalled its intention to review the water efficiency standards for new homes, including consideration of a new national 105l/p/d standard and 100l/p/d where there is a clear local need.

### 4.4.5 National Water Resources Framework

A new National Framework for Water Resources was published by the Government in March 2020[15]. This outlines the water resources challenges facing England and sets out the strategic direction for the work being carried out by regional water resource groups.

A range of options were explored, and the most ambitious scenarios rely on policy change to introduce mandatory labelling of water using fittings and associated standards. The Government is currently reviewing policy on water efficiency following a recent consultation. The framework proposes that regional groups plan to help customers reduce their water use to around 110 l/p/d. This is achievable without policy interventions.

This aligns with the tighter standard of 110 l/p/d per day as described in building regulations. However, in order to achieve an average of 110 l/p/d across the UK, a water efficiency target for new build housing would need to be lower than 110 l/p/d to compensate for existing buildings where consumption is higher. New build housing should therefore have a standard lower than 110 l/p/d.

### 4.4.6 Water company advice

- Affinity Water's "Why Not Water" manifesto calls for every Local Plan in their area to include the 110l/p/d target.[16]
- Anglian Water, Environment Agency and Natural England have published joint advice for the whole Anglian Water supply area supporting LPAs to adopt the 110l/p/d standard in the Local Plans[17]. Anglian Water also has a Non-Domestic Water Request policy, and new connections of greater than 0.05Ml/d will have to demonstrate that they have optimised the efficiency of their processes before connection is made.

14 Defra (2023) Plan for Water. Accessed online at: https://www.gov.uk/government/publications/plan-for-water-our-integrated-plan-for-delivering-clean-and-plentiful-water/plan-for-water-our-integrated-plan-for-delivering-clean-and-plentiful-water on 30/11/2023

15 National Water Resources Framework, Environment Agency (2020). Accessed online at: https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources on: 08/02/2023.

16 https://www.affinitywater.co.uk/docs/manifesto-whynotwater.pdf

17 Anglian Water, Environment Agency & Natural England (2020) Joint advice to Local Planning Authorities: Optional higher water efficiency standard for new housing. https://www.anglianwater.co.uk/siteassets/household/about-us/aw-ea-natural-england-water-efficiency-advice-note-final.pdf

- Thames Water offer discounts on connection charges to developers adopting low water use devices.[18] It has a focus on designing water efficient homes using a fittings-based approach.

### 4.4.7 Impact on viability

As outlined in Section 4.5.1, the cost of installing water-efficient fittings to target a per capita consumption of 110l/d has been estimated as a one-off cost of £9 for a four-bedroom house. Engagement with developers and information from Defra that emerged as part of the Sussex North Water Neutrality Strategy[19] indicated that a target of 100l/p/d could be achieved with "minimal additional cost". Research undertaken for the devolved Scottish and Welsh governments indicated potential annual savings on water and energy bills for householders of £24-£64 per year as a result of such water efficiency measures. Water efficiency is therefore not only viable but of positive economic benefit to both private homeowners and tenants. In addition, financial incentives are available from the water companies to developers to encourage water-efficient design.

Research published by BRE[20] on the delivery of sustainable buildings reports that the cost of achieving lover BREEAM ratings incurs little or no additional cost and targeting higher BREEAM ratings incurs a typical cost of less than 2% above the baseline. The same study reports that the cost of achieving 3 credits in WAT01 (a 40% reduction in water consumption for baseline) would be £13,361 and payback could be achieved between 1 and 2.5 years depending on the price of water.

### 4.4.8 Summary

There is sufficient evidence to recommend the optional 110 litres per person per day design standard allowed under Building Regulations. This should be supported by an equivalent non-household water efficiency target. The BREEAM New Construction Standard can be used for this, and it is recommended that non-household development achieves a minimum of 3 credits under the measure “Wat01” which provides a 40% improvement in water consumption compared to the baseline for that type of building. Currently this approach is not adequately supported in building regulations and the NPPF and policies requiring water efficiency standards less than 100l/p/d may only be supported at Local Plan inspection in exceptional circumstances.

18 https://www.thameswater.co.uk/news/2022/feb/rewards-for-developers-who-achieve-water-neutrality

19 Sussex North Water Neutrality Study: Part C - Mitigation Strategy, JBA Consulting, 2022. Accessed online at: https://crawley.gov.uk/planning/planning-applications/you-apply/water-neutrality-crawley on: 12/12/2023

20 Delivering Sustainable Buildings: Savings and Payback, BRE, 2018. Accessed online at: https://files.bregroup.com/breeam/briefingpapers/Delivering-Sustainable-Buildings-Savings-and-Payback-Office-Case-Study-BREEAM-NC-2018_BREEAM_BRE_115359_BriefingPaper.pdf on: 12/12/2023

Given the evidence of pressures on the environment, particularly rare chalk streams, and on public water supply, it is recommended that the Council considers a domestic water efficiency target of 100l/p/d for all new homes, in line with proposals in the Defra Plan for Water, and works with the water suppliers to incentivise even lower consumption.

### 4.5 Water neutrality concept

Water neutrality is a relatively new concept for managing water resources, but one that is receiving increased interest as deficits in future water supply/demand are identified. The definition adopted by the Government and the Environment Agency[21] is:

"For every development, total water use in the wider area after the development must be equal to or less than total water use in the wider area before development".

It is useful to also refer to the refined definition developed by Ashton:

*"For every new significant development, the predicted increase in total water demand in the region due to the development should be offset by reducing demand in the existing community, where practical to do so, and these water savings must be sustained over time"* (V Ashton, 2014)[22]

This definition states the need to sustain water saving measures over time, and the wording "predicted increase in total water demand" reflects the need for water neutrality to be designed in at the planning stage.

Both definitions refer to water use in the region or "wider area", and the extent of this area should be appropriate to local authority boundaries, water resource zones, or water abstraction boundaries depending on what is appropriate for that particular location. For instance, if a development site is in an area of water stress relating to a particular abstraction source, offsetting water use in a neighbouring town that is served by a different water source will not help to achieve water neutrality.

In essence water neutrality is about accommodating growth in a region without increasing overall water demand.

Water neutrality can be achieved in a number of ways:

- Reducing leakage from the water supply networks
- Making new developments more water-efficient
- "Offsetting" new demand by retrofitting existing homes with water-efficient devices
- Encouraging existing commercial premises to use less water

21 Water Neutrality: An improved and expanded water resources management definition (SC080033/SR1), Environment Agency, 2009. Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291675/scho1009bqzr-e-e.pdf on: 08/02/2023.

22 Water Resources in the Built Environment, edited by Booth and Charlesworth (2014). Published by Wiley.

- Implementing metering and tariffs to encourage the wise use of water
- Education and awareness-raising amongst individuals

Suggestions for water-efficiency measures are listed in Table 4.5 below. Some of these approaches are currently subject to testing under a water neutrality pilot project being led by Affinity Water.[23]

### 4.5.1 Consumer water efficiency measures

Many interventions are designed to reduce water use if operated in a particular way, and so rely on the user being aware and engaged with their water use. The educational aspect is therefore important to ensure that home occupiers are aware of their role in improving water efficiency. Table 4.5 shows water efficiency measures that can be made by consumers.

23 https://www.affinitywater.co.uk/waterneutrality

Table 4.5 Consumer water efficiency measures

| Type of measure | Examples |
|---|---|
| Education and promotional campaigns | Encourage community establishments (e.g., schools, hospitals) to carry out self-audits on their water use<br>Deliver water conservation message to schools and provide visual material for schools<br>Building awareness with homeowners/tenants |
| Water-efficient measures for toilets | Cistern displacement devices to reduce volume of water in cistern<br>Retro-fit or replacement dual flush devices<br>Retro-fit interruptible flush devices<br>Replacement low-flush toilets |
| Water-efficient measures for taps | Tap inserts, such as aerators<br>Low flow restrictors<br>Push taps<br>Infrared taps |
| Water-efficient measures for showers and baths | Low-flow shower heads<br>Aerated shower heads<br>Low-flow restrictors<br>Shower timers<br>Reduced volume baths (e.g. 60 litres)<br>Bath measures |
| Rainwater harvesting and water reuse | Large-scale rainwater harvesting<br>Small-scale rainwater harvesting for example with a water butt, or rainwater tank for toilet flushing<br>Grey water recycling |
| Water-efficient measures addressing outdoor use | Hosepipe flow restrictors<br>Hosepipe siphons<br>Hose guns (trigger hoses)<br>Drip irrigation systems<br>Mulches and composting |
| Commercial properties | Commercial water audits<br>Rainwater recycling<br>Grey water recycling<br>Optimising processes<br>Provide water efficiency information to all newly metered businesses |

| Type of measure | Examples |
|---|---|
| Metering | Promote water companies free meter option<br>Compulsory metering (in water stressed areas)<br>Smart metering (to engage customer with their consumption)<br>Provide interactive websites that allow customers to estimate the savings associated with metering (environmental and financial)<br>Innovative tariffs (seasonal, peak, rising block)<br>Customer supply pipe leakage - supply pope repair and replacement |
| Other | Household water audits, including DIY or with help of plumber<br>Seek-and-fix internal leaks and/or dripping taps<br>Water efficient white goods, included washing machines and dishwashers<br>Ask customers to spot and report leaks |

Source: Adapted from (Booth & Charlesworth, 2014)

### 4.5.2 Rainwater and Greywater Recycling

**Rainwater harvesting**

Rainwater recycling or rainwater harvesting (RwH) is the capture of water falling on buildings, roads or pathways that would normally be drained via a surface water sewer, infiltrate into the ground or evaporate. In the UK this water cannot currently be used as a drinking water supply as there are strict guidelines on potable water, but it can be used in other systems within domestic or commercial premises.

Systems for collection of rainwater can be simple water butts attached to a drainpipe on a house, or it could be a complex underground storage system, with pumps to supply water for use in toilet flushing and washing machines. By utilising rainwater in this way there is a reduced dependence on mains water supply for a large proportion of the water use in a domestic property.

**Benefits of RwH**

- RwH reduces the dependence on mains water supply – reducing bills for homeowners and businesses
- Less water needs to be abstracted from river, lakes and groundwater
- Stormwater is stored in a RwH system reducing the peak surface water runoff leaving a site providing a flood risk benefit (for smaller storms)
- By reducing surface water flow, RwH can reduce the first flush effect whereby polluted materials adhering to pavement surfaces during dry periods are removed by the first flush of water from a storm and can cause pollution in receiving watercourses.

**Challenges of RwH**

- Dependency on rainfall can limit availability of harvested rainwater during drought and hot weather events.
- Increased capital (construction) costs to build rainwater harvesting infrastructure into new housing (£900 to £3,000 for a small-scale domestic system)[24]
- Payback periods are long as the cost of water is low so there is little incentive for homeowners to invest[25].

**Greywater harvesting**

Greywater refers to water that has been "used" in the home in appliances such as washing machines, showers and hand basins. Greywater recycling or greywater harvesting (GwH) is the treatment and re-use of this water in other systems such as for toilet flushing. By their nature, GwH systems require more treatment and are more complex than RwH systems, and there are limited examples of their use in the UK.

Greywater re-use refers to systems where wastewater is taken from source and used without further treatment. An example of this would be water from a bath or shower being used on plants in the garden. This sort of system is easy to install and maintain, however as mentioned above the lack of treatment to remove organic matter means the water cannot be stored for extended periods.

Greywater recycling refers to systems where wastewater undergoes some treatment before it is used again. These systems are complex and require a much higher level of maintenance than RwH or greywater re-use systems.

Domestic water demand can be significantly reduced by using GwH, and unlike with a RwH system where the availability of water is dependent on the weather, the source of water is usually constant (for instance if it is from bathing and showering). However, the payback period for a GwH system is usually long, as the initial outlay is large, and the cost of water relatively low.

Viability of greywater systems for domestic retrofit applications is therefore currently limited. However, communal systems may offer more opportunities where the cost can be shared between multiple households particularly on larger new build developments, or in new settlements.

24 Independent review of the costs and benefits of rainwater harvesting and grey water recycling options in the UK, Waterwise, 2020. Accessed online at: https://database.waterwise.org.uk/knowledge-base/independent-review-of-costs-and-benefits-of-rwh-and-gwr-options-in-the-uk/ on: 12/12/2023

25 Housing Standards Review, UK Government (2014). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf on: 08/02/2023.

### 4.5.3 Energy and Water use

According to EU statistics (Eurostat 2017), 17% of the UK's domestic energy usage is for water heating. If less water was being used within the home, for instance through more water efficient showers, less water would need to be heated, and overall domestic energy usage would be reduced.

In 2020-2021 the Government consulted on a Future Homes Standard that will involve changes to Part L (conservation of fuel and power) of the Building Regulations for new dwellings[26]. Unfortunately, this fails to identify the role of water efficiency in the home in also reducing energy usage.

### 4.5.4 Funding for water neutrality

Water neutrality is unlikely to be achieved by just one type of measure, and likewise it is unlikely to be achieved by just one funding source. Funding mechanisms that may be available could be divided into the following categories:

- Infrastructure-related funding (generally from developer payments)
- Fiscal incentives at a national or local level to influence buying decisions of households and businesses
- Water company activities, either directly funded by the five-year price review or as a consequence of competition and individual company strategies
- Joint funding through energy efficiency schemes (and possibly to integrate with the heat and energy saving strategy).

Currently in the UK, the main funding resource for the delivery of water efficiency measures is the water companies, with some discretionary spending by property owners or landlords. For water neutrality to be achieved, policy shifts may be required in order to increase investment in water efficiency. Possible measures could include:

- Further incentivisation of water companies to reduce leakage and work with customers to reduce demand
- Require water efficient design in new development
- Developer funding to contribute towards encouraging water efficiency measures
- Require water efficient design in refurbishments when a planning application is made
- Tighter standards on water using fittings and appliances.

26 The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings. Accessed online at: https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings on: 08/02/2023.

## 4.6 Water Efficiency Incentives

### 4.6.1 Thames Water Incentive

Thames Water offer significant reductions in the developer connection charges for new building housing that achieves water efficiency better than the Building Regulations 125l/p/d standard. A tiered approach is taken as follows:

**Tier 1: Basic water efficiency**

“You’ll need to submit evidence that your development has been designed (as per the planning application) to achieve the ‘Optional Requirement’ of 110 litres/person/day, using the ‘Fittings Approach’ as outlined in Part G2 of the Building Regulations 2010 Approved Document G.”

Discount £200 per property

**Tier 2: Rainwater Harvesting and Greywater Recycling**

In addition to fulfilling the requirements of Tier 1, a further discount is offered if RwH or GwR is incorporated into the developer's design.

Discount £1,000 per property

**Tier 3: Water neutrality**

“A water neutral development does not add additional water demand pressures to its water resource zone supply needs. This is achieved by making the development as water efficient as possible (by adhering to Tiers 1 and 2) and then offsetting the development’s remaining water demand through savings made on existing homes and businesses in the same water resource zone.”

Discount £1,800 per property

Developers should be strongly encouraged to take up at least the Tier 2 incentives. These may be particularly applicable to larger developments where community scale RwH schemes could be applied, pooling the incentives and sharing cost.

### 4.6.2 Affinity Water Incentive

Affinity Water offer discounts to the infrastructure charge for new connections where there is agreed evidence that there is a water efficiency design to a standard of 110l/p/d. The discount will be £258 per infrastructure charge.

## 4.7 Conclusions

- Buckinghamshire receives its water from Thames Water, Anglian Water and Affinity Water. Buckinghamshire is within the SWOX, Slough Wycombe Aylesbury, Ruthamford West, Ruthamford Central, Misbourne and Pinn Water Resource Zones (WRZ). In some WRZs, the forecast percentage growth is lower than the expected growth during the Local Plan period. This should be investigated further in Stage 2 once WRMP24 has been published.

- The Water Industry National Environment Programme (WINEP) is a set of actions that the EA have requested all 20 water companies operating in England to complete in a particular Asset Management Period (AMP) as part of their environmental commitments. A number of investigations are planned or underway to ensure that abstraction of water from both groundwater and rivers, is not leading to unsustainable reductions in flow, particularly in chalk streams. Development and population growth can increase abstraction, and so BC have an opportunity to contribute to these actions indirectly by pursuing policies that promote water efficiency in new development.
- It is important that new development does not result in an unsustainable increase in water abstraction. This can be done in a number of ways from reducing the water demand from new houses through to achieving “water neutrality” in a region by offsetting a new developments water demand by improving efficiency in existing buildings.
- There is sufficient evidence to recommend the optional 110 litres per person per day design standard allowed under Building Regulations. This should be supported by an equivalent non-household water efficiency target, for example a minimum of 3 credits under the measure “Wat01” BREEAM measure which provides a 40% improvement in water consumption compared to the baseline for that type of building
- Water resources are under significant pressure in the UK, and the direction of travel in water resources planning is to reduce per capita consumption in new build development below the optional building regulations standard of 110 l/p/d. Despite this, given the evidence of pressures on the environment, particularly rare chalk streams, and on public water supply, it is recommended that the Council considers a domestic water efficiency target of 100l/p/d for all new homes, in line with proposals in the Defra Plan for Water, and works with the water suppliers to incentivise even lower consumption.
- This is supported by Thames Water’s, Anglian Water's and Affinity Water's incentives for water efficient design in new builds outlined in Section 0 where significant incentives are offered to reduce design consumption below 110l/p/d.

## 4.8 Recommendations

The recommendations for water resources are provided in Table 4.6 below:

Table 4.6 Recommendations for water resources

| Action | Responsibility | Timescale |
|---|---|---|
| Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities. | Thames Water, Anglian Water, Affinity Water | Ongoing |

| Action | Responsibility | Timescale |
|---|---|---|
| Provide yearly updates of projected housing growth to water companies to inform WRMP updates. | Buckinghamshire Council | Ongoing |
| The council should consider a domestic water efficiency target of 100l/p/d for all new homes, and work with water suppliers to incentivise even lower consumption. This should be achieved using a fittings based approach. This should be supported by an equivalent non-household water efficiency target. | Buckinghamshire Council | In Buckinghamshire LP |
| The concept of water neutrality has the potential to provide a benefit in improving resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with the water companies and the Environment Agency how the Council's planning and climate change policies can encourage this approach.<br>This approach could have particular application in strategic sites and new settlements. | Buckinghamshire Council, Environment Agency, Thames Water, Anglian Water, Affinity Water | In Buckinghamshire LP |
| Larger residential developments (including strategic urban extensions and as planned for new settlements), and commercial developments should consider incorporating greywater recycling and/or rainwater harvesting into development at the master planning stage in order to reduce water demand. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | In Buckinghamshire LP |
| Water companies should advise Buckinghamshire Council of any strategic water resource infrastructure developments within the study, where these may require safeguarding of land to prevent other type of development occurring. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | Part of Buckinghamshire LP process |
| Review this section of the WCS following publication of the Water Resource Management Plans for 2024. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | Stage 2 WCS |

# 5 Water Supply Infrastructure

## 5.1 Introduction

An increase in water demand due to growth can exceed the hydraulic capacity of the existing supply infrastructure. This is likely to manifest itself as low pressure at times of high demand. An assessment is required to identify whether the existing infrastructure is adequate or whether upgrades will be required. The time required to plan, obtain funding and construct major pipeline works can be considerable and therefore water companies and planners need to work closely together to ensure that the infrastructure is able to meet growing demand.

Water supply companies make a distinction between supply infrastructure, the major pipelines, reservoirs and pumps that transfer water around a WRZ, and distribution systems, smaller scale assets which convey water around settlements to customers. This outline study is focused on the supply infrastructure. It is expected that developers should engage early with the Developer Services functions of the water and wastewater companies local to their site, and fund water company impact assessments and modelling of the distribution systems to determine requirements for local capacity upgrades to the distribution systems.

In addition to the work undertaken by water companies, there are opportunities for the local authority and other stakeholders to relieve pressure on the existing water supply system by increasing water efficiency in existing properties. This can contribute to reducing water consumption targets and help to deliver wider aims of achieving water neutrality.

A cost-effective solution can be for local authorities to co-ordinate with water supply companies and “piggyback” on planned leakage or metering schemes, to survey and retrofit water efficient fittings into homes[27]. This is particularly feasible within property owned or managed by the local authorities, such as social housing.

## 5.2 Methodology

Once potential allocations are available, these will be shared with the water companies who will be asked to assess the impact of each site on the water supply network. A red / amber / green score will be assigned to each site based on the presence of any significant constraints and the nature of any upgrades or new infrastructure required to accommodate them.

27 Water Efficiency Retrofitting: A Best Practice Guide, Waterwise (2009). Accessed online at: http://www.waterwise.org.uk/wp-content/uploads/2018/01/Waterwise-2009_Water-efficiency-Retrofitting_Best-practice.pdf on: 10/02/2023.

## 5.3 Recommendations

Table 5.1 Recommendations for water supply infrastructure

| Action | Responsibility | Timescale |
|---|---|---|
| Undertake network modelling to ensure adequate provision of water supply is feasible. | Water companies, Buckinghamshire Council | Ahead of planning applications |
| Buckinghamshire Council and Developers should engage early with water companies to ensure supply infrastructure is in place prior to occupation. | Water companies, Buckinghamshire Council, developers | Ongoing |
| Developers should engage early with water companies to ensure that the capacity of distribution systems is adequate prior to development coming forward | Water companies, developers | Ongoing |

# 6 Wastewater Collection

## 6.1 Sewerage undertakers

Thames Water (TW) and Anglian Water (AW) are the Sewerage Undertakers (SU) for the study area. The role of the sewerage undertaker includes the collection and treatment of wastewater from domestic and commercial premises, and in some areas, it also includes the drainage of surface water from building curtilages to combined or surface water sewers. It excludes, unless adopted by the SU, systems that do not connect directly to the wastewater network, e.g., Sustainable Drainage Systems (SuDS) or highway drainage.

Increased wastewater flows into collection systems due to growth in populations or per-capita consumption can lead to an overloading of the infrastructure, increasing the risk of sewer flooding and, where present, increasing the frequency of discharges from storm overflows. Seasonal and yearly variations in weather and infiltration can reduce headroom at WwTW.

Headroom at Wastewater Treatment Works (WwTW) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volumes of treated effluent rises, even if the effluent quality is maintained, the pollutant load discharged to the receiving watercourse will increase. In such circumstances the Environment Agency as the environmental regulator, may tighten consented effluent consents to achieve a “load standstill”, i.e., ensuring that as effluent volume increases, the pollutant discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent. Consents can also be tightened to prevent a deterioration in water quality due to growth, or to achieve environmental objectives.

In combined sewerage systems (a sewer managing both surface water and wastewater), or foul systems with surface water misconnections (where a surface water drain is mistakenly connected to a foul sewer), there is potential to create headroom in the system, thus enabling additional growth, by the removal of surface water connections and reducing infiltration. This can most readily be achieved during the redevelopment of brownfield sites which have combined sewerage systems, where there is potential to discharge surface waters via sustainable drainage systems (SuDS) to groundwater, watercourses or surface water sewers.

TW and AW are supportive of the use of SuDS and SuDS principles to manage surface water run-off. They recommend that the Drainage Hierarchy is used to direct surface water to natural outfall routes such as infiltration to the ground or into watercourses, before utilising sewers, as supported by paragraph 167 of the NPPF. Surface water should also not be permitted to connect to a foul sewer.

## 6.2 Storm overflows

Storm overflows are an essential component in the sewer network – however when they operate, they can cause environmental damage. They occur on combined sewer systems where the sewer takes both foul flow (sewage from homes and offices) and rainwater runoff. In normal conditions (Figure 6.1) all of this flow passed through the sewer network and is treated at a wastewater treatment works.

In periods of exceptional rainfall (Figure 6.2), the capacity in a combined sewer may be used up by the additional flow from rooftops and storm drains. Once the capacity is exceeded, wastewater would back up into homes, businesses and on to roads. A storm overflow acts as a relief valve, preventing this from happening.

Storm overflows become problematic when they operate frequently in moderate or light rainfall, or for long periods as a result of groundwater infiltration in the sewerage system – possibly in breach of their permit.

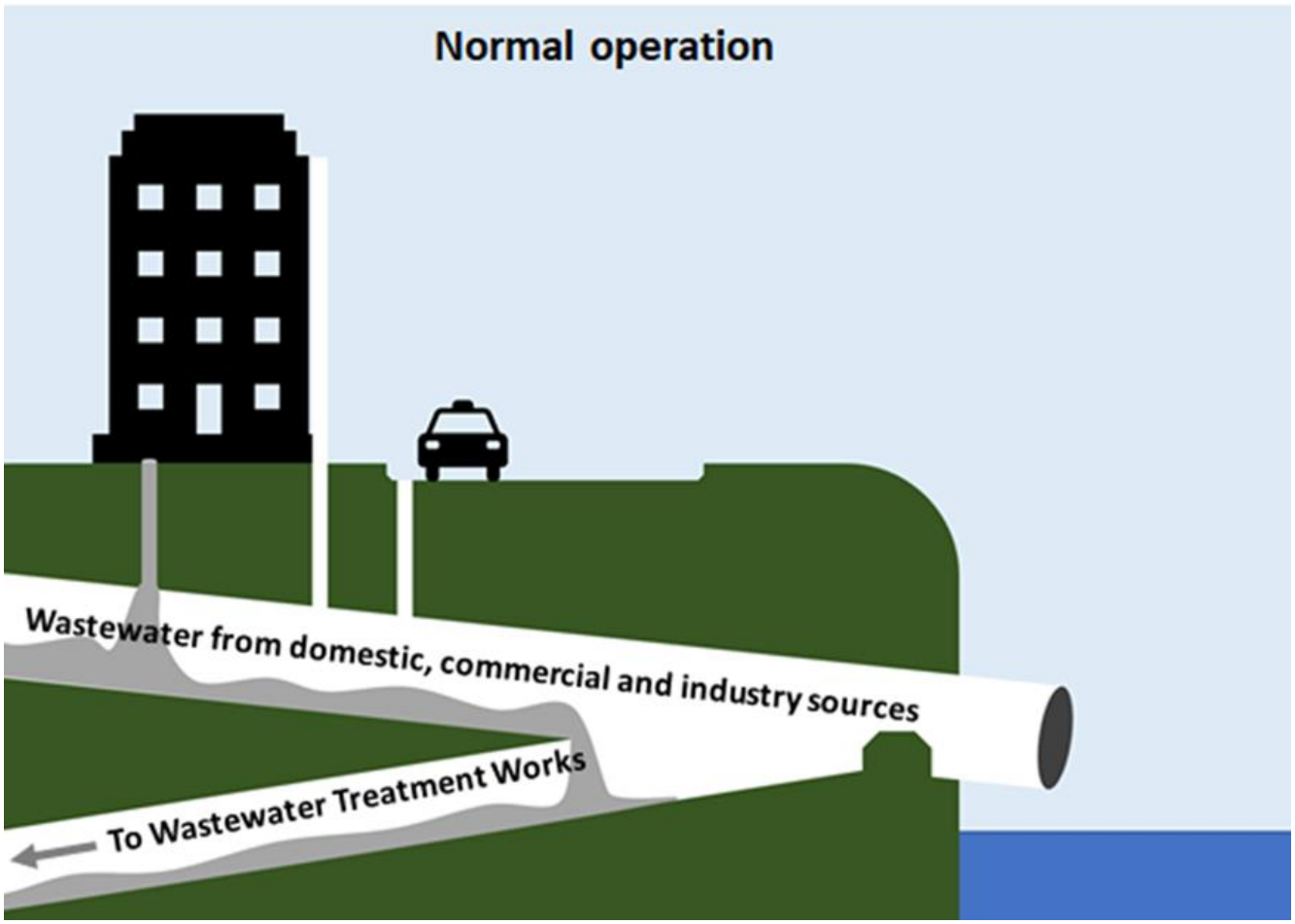



Figure 6.1 Storm overflow operation in normal conditions

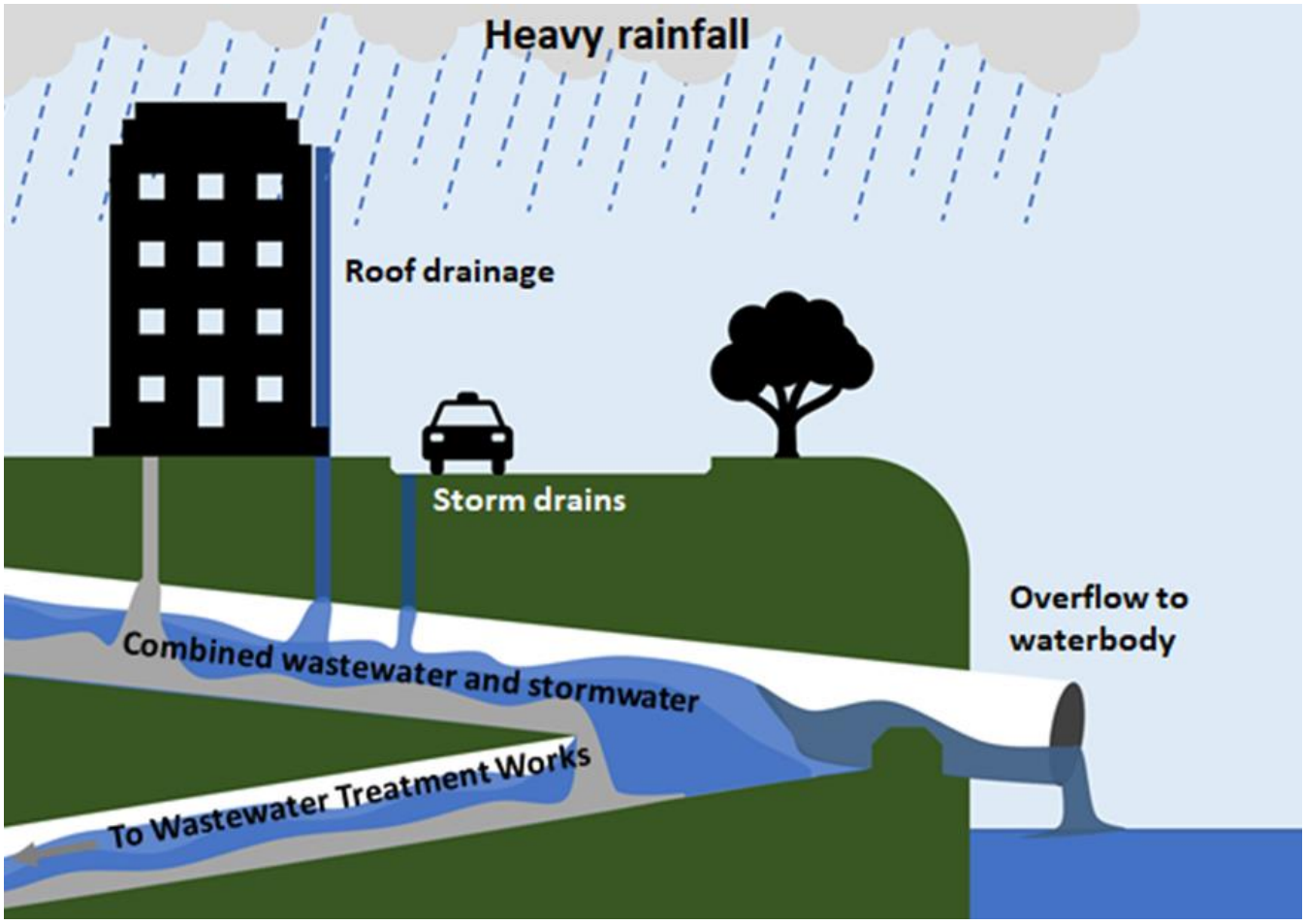



Figure 6.2 Storm overflow operation in exceptional rainfall

## 6.3 Methodology

### 6.3.1 Sewerage System Capacity Assessment

New residential developments and new employment land add pressure to the existing sewerage systems. An assessment is required to identify the available capacity within the existing systems, and the potential to upgrade overloaded systems to accommodate future growth. The scale and cost of upgrading works may vary significantly depending upon the location of the development in relation to the network itself and the receiving WwTW.

It may be the case that an existing sewerage system is already working at its full capacity and further investigations have to be carried out to define which solution is necessary to implement an increase in its capacity. New infrastructure may be required if, for example, a site is not served by an existing system. Such new infrastructure will normally be secured through private third-party agreements between the developer and utility provider.

Sewerage Undertakers must consider the growth in demand for wastewater services when preparing their five-yearly Strategic Business Plans (SBPs) which set out investment for the next Asset Management Plan (AMP) period. Typically, investment is committed to provide new or upgraded sewerage capacity to support development only when planning

permission has been granted, although growth allocated in Local Plans is used to forward plan investment. Additional sewerage capacity to service windfall sites, smaller infill development or to connect a site to the sewerage network across third party land is normally funded via developer contributions, as third-party arrangements between the developer and utility provider.

### 6.3.2 Storm overflow assessment

The Environment Act now requires water companies to report and monitor storm overflows as well as reduce the harm caused to the rivers they discharge to. There are 24 network storm overflows and 37 WwTW storm tank overflow present in Buckinghamshire, the location of these are shown in Figure 6.3. Storm tank overflows at WwTWs are assessed in Section 7.3.

The Storm Overflow Taskforce[28] has agreed a long-term goal to end the damaging pollution caused by the operation of storm overflows. An important component of this is the monitoring of overflows, and a target has been set to monitor the frequency and duration of operation at all storm overflows by 2023[29]. This is called Event Duration Modelling (EDM). The EDM dataset (which contains performance data on the 16,791 storm overflows monitored in 2022) has been used to provide information on storm overflows in Buckinghamshire. Both Thames Water and Anglian Water have confirmed that work is currently underway to investigate storm overflows with the long-term aim of reducing the number of operations of the storm overflows.

In comparison to some urban areas or large cities, Buckinghamshire has relatively few storm overflows. The Storm Overflow Assessment Framework (SOAF) set a threshold of 60 operations in a year (based on 1 years data, 50 if based on 2 years data, and 40 if based on 3 years), above which a storm overflow should be investigated. The Environment Agency state that a revised SOAF methodology will be realised to coincide with the Environment Act obligation on storm overflows, which will require all overflows to ensure that they are not causing adverse ecological harm. The overflows identified in Buckinghamshire were assessed on the average number of operations over three years. As shown in Table 6.1, none of the overflows exceeded the 40 operations per year threshold averaged over 2020 to 2022.

The Storm Overflow Reduction Plan[30] which was published in August 2022 sets an objective that "storm overflows will not be permitted to discharge above an average of 10

28 Made up of Defra, the EA, Ofwat, Consumer Council for Water, Blueprint for Water and Water UK

29 Event Duration Monitoring – lifting the lid on storm overflows, Environment Agency (2021). Accessed online at: https://environmentagency.blog.gov.uk/2021/03/31/event-duration-monitoring-lifting-the-lid-on-storm-overflows/ on: 20/06/2023.

30 Storm overflow reduction plan, Environment Agency (2022). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1101686/Storm_Overflows_Discharge_Reduction_Plan.pdf on: 20/06/2023.

rainfall events per year by 2050". Five of the 14 monitored storm overflows are operating on average above 10 times per year so may require action to meet the long-term target. In this report storm overflows associated with WwTWs have been moved to the section on wastewater treatment.

Unmitigated development within Buckinghamshire could cause the frequency or duration of operation of storm overflows to increase.

There are opportunities through the planning system to ease pressure on the wastewater network by separating foul and storm flow in existing combined systems, and not allowing new surface water connections. Surface water can also be better managed by retrofitting SuDS in existing residential areas, and in new development, ensuring SuDS are incorporated into designs at the master planning stage to maximise the potential benefits.

The below thresholds are relevant for the WwTW storm overflow map in Section 7.3.

| Sewer Overflows RAG Score | Number of operations per year (average of available data) | Commentary |
|---|---|---|
| Green | 0-10 | Overflow is currently operating within the long-term (2050) target. Need to ensure that this is maintained in the long-term considering upstream development, climate change and urban creep. |
| Amber | 11-49 | An investigation is not required at present, but improvements will need to be made in the network and/or catchment to meet the long-term target. |
| Red | 50+ | The overflow may already be operating beyond the threshold which would trigger an investigation. Upstream development could further increase the discharge frequency, so mitigation should be required prior to significant development. |

Table 6.1 Network storm frequency of overflow and duration of operation

| Overflow | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Average number of operations 2020-2022 | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|---|
| Akeley PS - Anglian Water | No data | No data | 51 | 547 | 25 | 210 | 25 | N |
| Whaddon PS - Anglian Water | No data | No data | No data | No data | 16 | 120 | 5 | N |
| Whaddon Road PS - Anglian Water | No data | No data | 35 | 136 | 39 | 152 | 25 | N |
| Northall PS - Anglian Water | No data | No data | No data | No data | 1 (Less than 1 years data) | 1 (Less than 1 years data) | 0 | N |
| Steeple Claydon TPS - Anglian Water | 11 | 68 | 20 | 82 | 3 | 29 | 11 | N |
| Tingewick TPS - Anglian Water | No data | No data | 30 | 260 | 23 | 159 | 18 | N |
| School Lane, Twyford TPS - Anglian | 1 | 1.5 | 4 | 5 | 11 | 8 | 5 | N |

| Overflow | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Average number of operations 2020-2022 | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|---|
| Water | | | | | | | | |
| Marsh Lane Bridge, Taplow - Thames Water | 5 | 4 | 3 | 2 | 0 | 0 | 3 | N |
| Marsworth, Thames Water | 5 | 43 | 8 | 66 | 0 | 0 | 4 | N |
| Nash rear of church SP - Anglian Water | 1 | 10 | 0 | 0 | 0 | 0 | 0 | N |
| Buckingham-West Street CSO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N |
| Buckingham Hunter Street CSO | No data | No data | 0 | 0 | 0 | 0 | 0 | N |
| Granborough - Bates Close TPS | No data | No data | 0 | 0 | 0 | 0 | 0 | N |

| Overflow | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Average number of operations 2020-2022 | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|---|
| Poundon Terminal PS | No data | No data | No data | No data | 0 | 0 | 0 | N |

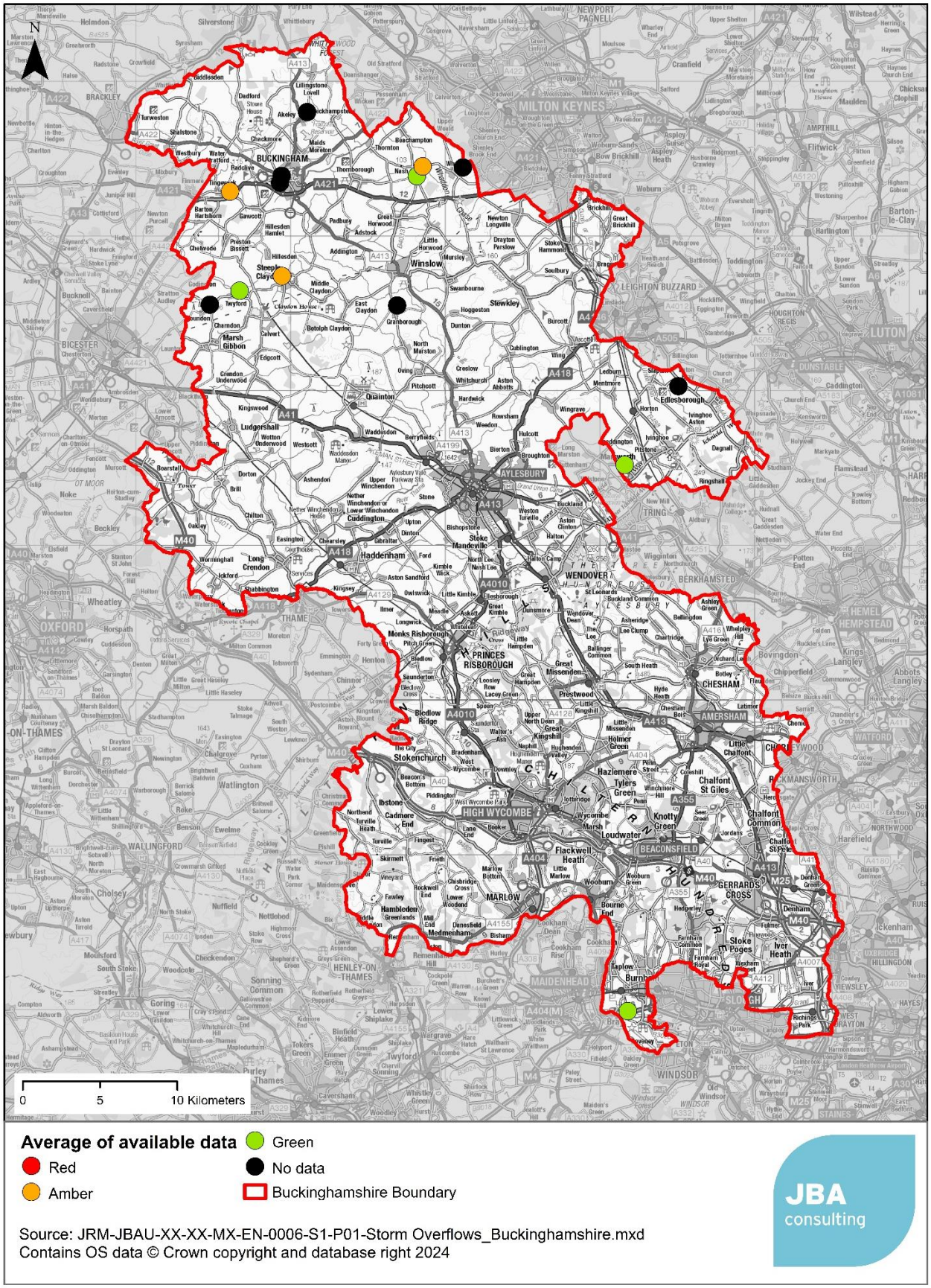



Figure 6.3 Three-year average of Network storm overflow spills (average from years available)

## 6.4 Conclusions

Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on customers, and increasing the likelihood of storm overflow operation. Early engagement with developers, Thames Water and Anglian Water is required, and further modelling of the network may be required in the Stage 2 WCS and at the planning application stage. Furthermore, in the Thames Water and Anglian Water networks, there are areas where the current network is a combined sewer system, and further separation of foul and surface water may be required, as well as suitably designed SuDS.

Early engagement between developers, Buckinghamshire Council and Thames Water and Anglian Water is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.

## 6.5 Recommendations

Table 6.2 Recommendations from wastewater network assessment

| Action | Responsibility | Timescale |
|---|---|---|
| Early engagement between Buckinghamshire Council and Thames Water and Anglian Water is required to ensure that where strategic infrastructure is required, it can be planned in by Thames Water and Anglian Water, and will not lead to any increase in discharges from sewer overflows. | Buckinghamshire Council, Thames Water and Anglian Water | Ongoing |
| Take into account wastewater infrastructure constraints in phasing development in partnership with the sewerage undertaker. | Buckinghamshire Council, Thames Water and Anglian Water | Ongoing |
| Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an Outline Drainage Strategy for sites. The Outline Drainage strategy should set out the following:<br>What – What is required to serve the site<br>Where – Where are the assets / upgrades to be located<br>When – When are the assets to be delivered (phasing)<br>Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and where required, used as a basis for a drainage planning condition to be set. | Buckinghamshire Council, Thames Water, Anglian Water and developers | Ongoing |

| Action | Responsibility | Timescale |
|---|---|---|
| Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to surface water sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA. | Buckinghamshire Council as LLFA, developers | Ongoing |

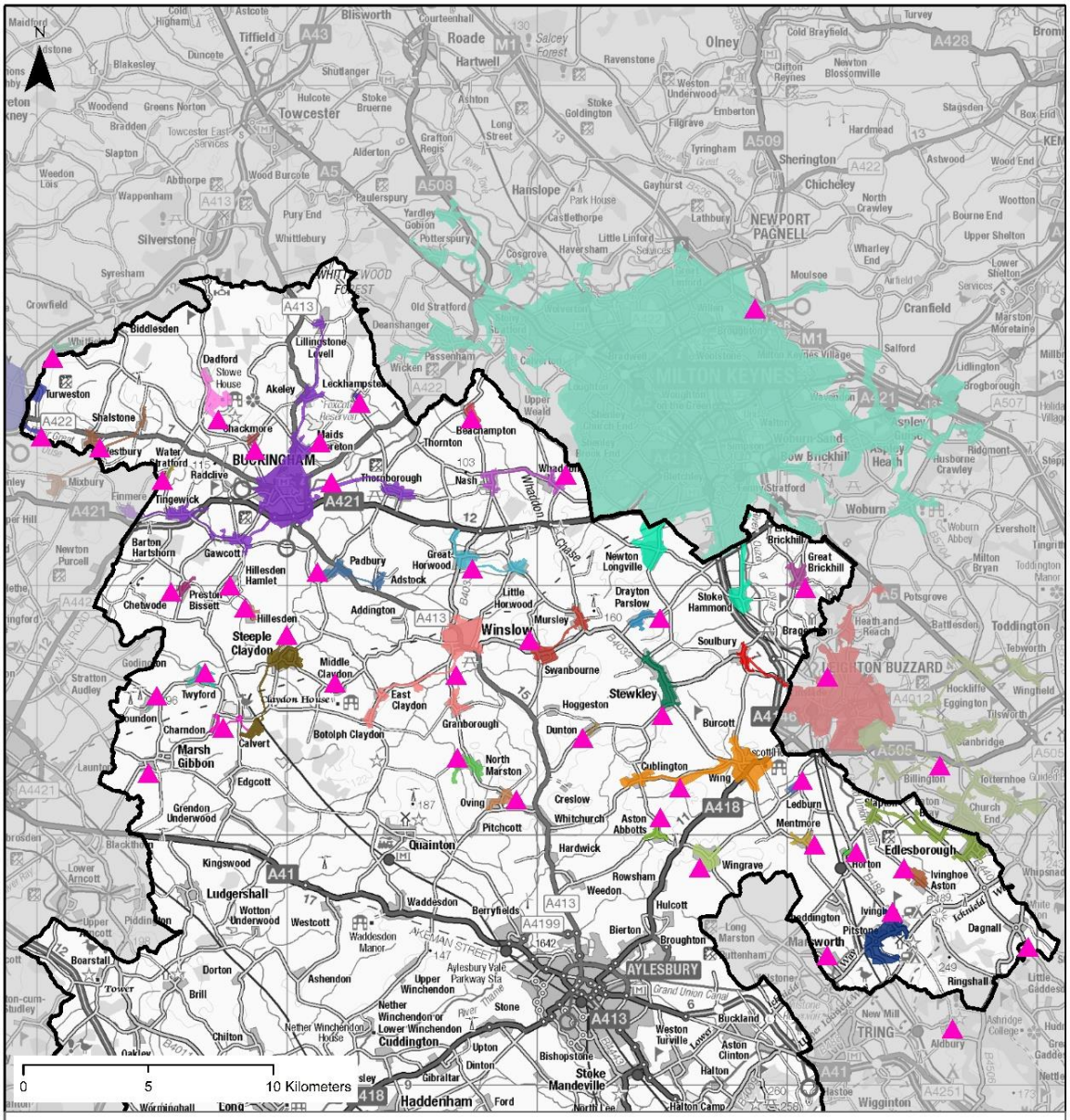
# 7 Wastewater Treatment

## 7.1 Wastewater Treatment Works in Buckinghamshire

Thames Water and Anglian Water provide wastewater services for development in Buckinghamshire. Thames Water refer to their wastewater processing plants as Wastewater Treatment Works (WwTW) whereas Anglian Water refer to theirs as Water Recycling Centres (WRCs). They may also be referred to as Sewage Treatment Works (STW) in some documents and data sources. For the purposes of this report, both Thames Water and Anglian Water's wastewater processing plants will be referred to as WwTWs. The location of the WwTWs in and around Buckinghamshire are shown in Figure 7.1 and Figure 7.2 below.

Sites already allocated in the adopted local plan, or already in the planning system (commitments) as well as an allowance for windfall, were assigned to a WwTW using the sewerage drainage area boundaries provided by each SU to set a baseline for WwTW capacity. Actual connection of a development site to a particular WwTW may be different and will depend on the capacity of the receiving works, and the local sewer network.

Some of the committed and completed sites did not fall within the catchment boundary of any WwTW. Very small developments in rural areas may be suitable for on-site treatment and discharge, however the Environment Agency will not usually permit this where there is a public sewerage system within a distance calculated as 30m per dwelling. There is therefore a localised risk to water quality if all of these small developments were to be served by septic tanks, especially where there are clusters of small-scale new development. It needs to be noted that the Environment Agency have stated they 'would also object to a proposal which included septic tanks if they were within a 'sewered area''.




Source: JRM-JBAU-XX-XX-MX-EN-0001-S1-P01-WwTW_Buckinghamshire.mxd
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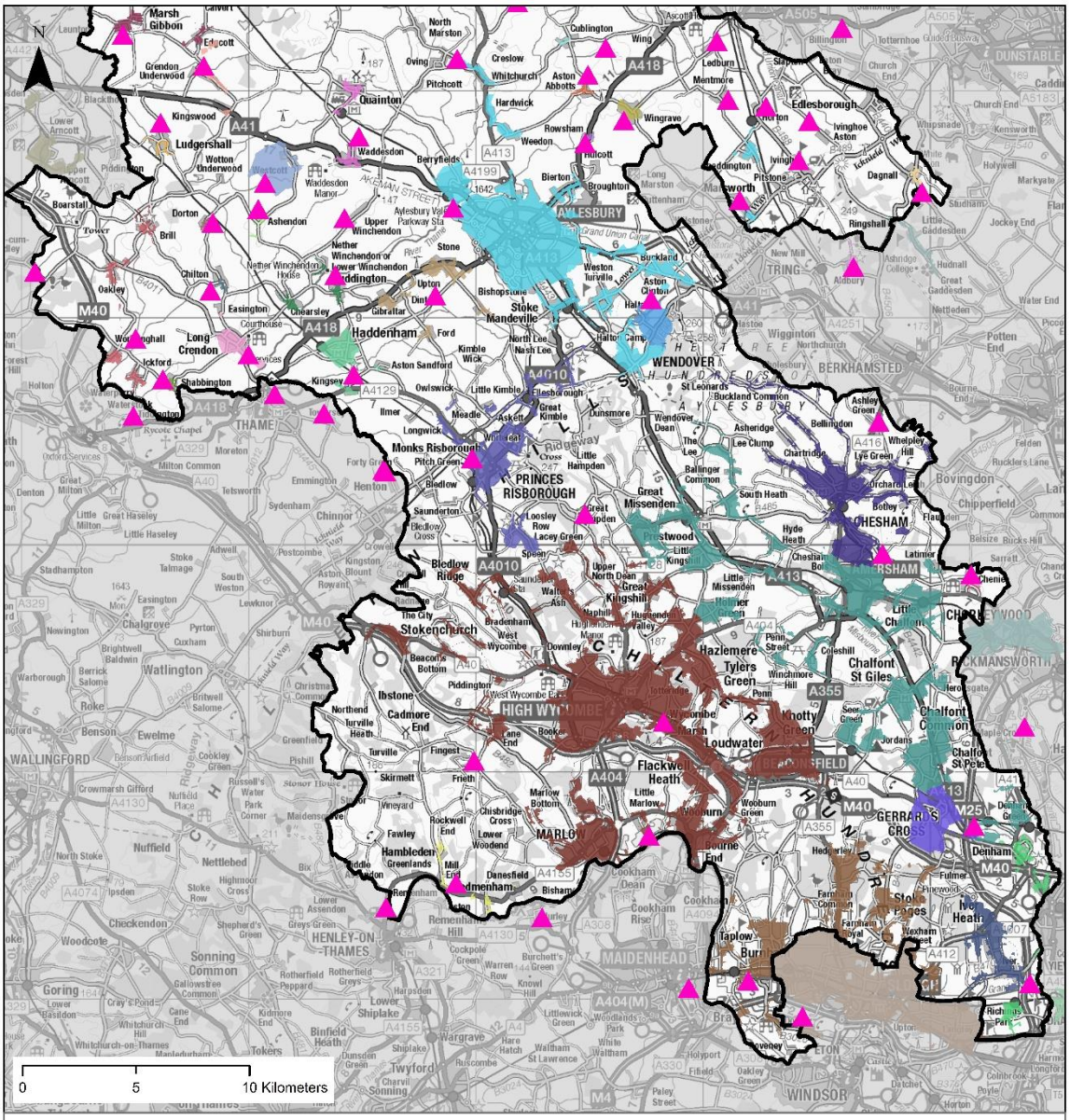
Figure 7.1 Anglian Water WwTW serving Buckinghamshire




Source: JRM-JBAU-XX-XX-MX-EN-0001-S1-P01-WwTW_Buckinghamshire.mxd
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Figure 7.2 Thames Water WwTW serving Buckinghamshire

## 7.2 Wastewater Treatment Works Flow Permit Assessment

### 7.2.1 Introduction

The Environment Agency is responsible for regulating sewage discharge releases via a system of Environmental Permits (EPs). Monitoring for compliance with these permits is the responsibility of both the EA and the plant operators.

Figure 7.3 summarises the different types of wastewater releases that might take place, although precise details vary from works to works depending on the design.

During dry weather, the final effluent from the WwTW should be the only discharge (1). With rainfall, the storm tanks fill and eventually start discharging to the watercourse (2) and Combined Sewer Overflows (CSOs) upstream of the storm tanks start to operate (3). The discharge of storm sewage from treatment works is allowed only under conditions of heavy rain or snow melt, and therefore the flow capacity of treatment systems is required to be sufficient to treat all flows arising in dry weather and the increased flow from smaller rainfall events. After rainfall, storm tanks should be emptied back to full treatment as soon as reasonably possible, freeing their capacity for the next rainfall event.

Environmental permits are used alongside water quality limits as a means of controlling the pollutant load discharged from a WwTW to a receiving watercourse. Sewage flow rates must be monitored for all WwTWs where the permitted discharge rate is greater than 50 $m^3$/day in dry weather.

Permitted discharges are based on a statistic known as the Dry Weather Flow (DWF). As well as being used in the setting and enforcement of effluent discharge permits, the DWF is used for WwTW design, as a means of estimating the ‘base flow’ in sewerage modelling and for determining the Flow to Full Treatment, (FFT), the minimum flow which must undergo full treatment, and above which additional flow is permitted to pass to the storm tanks (Figure 7.3).

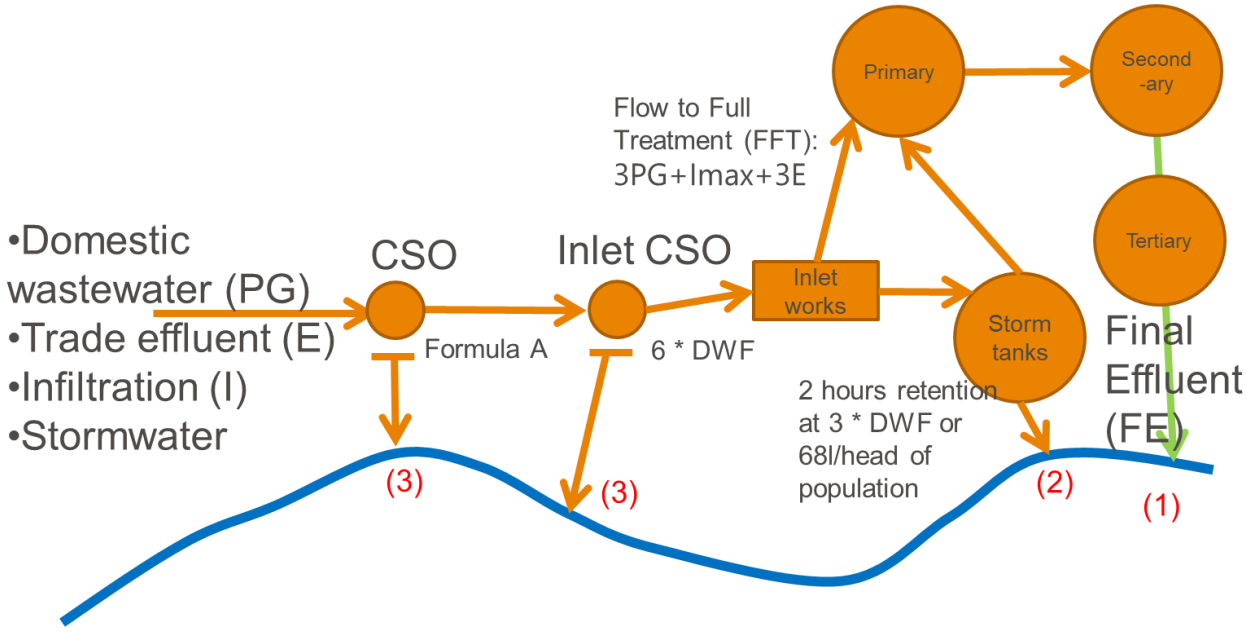



Figure 7.3 Overview of typical combined sewerage system and WwTW discharges

WwTW Environmental Permits also consent for maximum concentrations of pollutants, in most cases Suspended Solids (SS), Biochemical Oxygen Demand (BOD) and Ammonia ($NH_4$). Some works (usually the larger works) also have permits for Phosphorous (P). These are determined by the Environment Agency with the objective of ensuring that the receiving watercourse is not prevented from meeting its environmental objectives, with specific regard to the Chemical Status element of the Water Framework Directive (WFD) classification.

Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a WwTW. Where there is insufficient headroom at the works to treat these flows, this could lead to failures in flow consents. It should also be considered that even if there is sufficient headroom at a WwTW, this does not mean that there will not be an environmental impact from using that headroom.

There can also be issues that cannot be technologically addressed at the point of assessment (e.g. phosphorous improvements).

### 7.2.2 Methodology

An assessment of WwTW capacity was carried out by JBA using measured flow data supplied by the water companies. The process was as follows:

- Anglian Water and Thames Water provided their calculated 80th percentile exceedance flow statistic for each WwTW.
- Sites already in the planning system, windfall and neighbouring authority growth was assigned to a WwTW using the sewerage drainage area boundaries.
- For each site, the future DWF was calculated using the occupancy rates and per-capita consumption values obtained from the Water Resource Management Plans (Table 7.1), and the assumption that 95% of water used is returned to sewer. Permitted headroom was used as a substitute for actual designed hydraulic capacity for each WwTW being assessed.

- For employment sites, wastewater demand was estimated based on the predicted number of new employees. Floor space, employment use types, and employment densities were used to estimate the number of employees.

Table 7.1 Per capita consumption values used in water demand calculations

| Water Company and Water Resource Zone | Occupancy rate (persons per dwelling) | Per capita residential consumption ($m^3$/person/day) | Per capita employment consumption ($m^3$/person/day) |
|---|---|---|---|
| Thames Water - SWOX | 2.2 | 0.175 | 0.1 |
| Thames Water - Slough, Wycombe, Aylesbury | 2 | 0.171 | 0.1 |
| Anglian Water - Ruthamford West | 2.3 | 0.128 | 0.1 |
| Anglian Water - Ruthamford Central | 2.4 | 0.139 | 0.1 |
| Affinity Water - Misbourne | 2.8 | 0.165 | 0.1 |
| Affinity Water - Pinn | 2.8 | 0.208 | 0.1 |

### 7.2.3 Results

The impact of committed growth on wastewater treatment capacity in Buckinghamshire is shown in Figure 7.4 below. It should be noted that this map represents the remaining capacity (number of houses) once all committed sites are built and does not take into account planned increases in treatment capacity, or growth from future allocations. The following definition was used by JBA to score each WwTW:

Table 7.2 RAG rating thresholds for wastewater treatment works capacity.

| **Green - capacity for growth during local plan period** | **Amber - limited capacity during local plan period** | **Red - issues identified. WwTW capacity could be a constraint to growth.** |
|---|---|---|

There are 73 WwTWs within or serving Buckinghamshire. Once growth from adopted plans and existing commitments is taken into account, 41 WwTW are likely to be close to or exceed their permit during the plan period. An increase to the flow permit, and/or upgrades to treatment capacity will be required at these WwTWs.

Where a WwTW is likely to exceed its permit, the permit would be reviewed by the EA and if a higher flow consent was agreed, a tighter permit limit for substance concentrations is very likely to be required. In some cases, this may not be technically feasible if that means concentrations tighter than the Technically Achievable Limit (TAL) which is 0.25 mg/l for phosphate for example. In these cases, other solutions may be required such as relocating an outfall, or pumping effluent into a neighbouring wastewater catchment which does have environmental capacity for example. This will be assessed in the Stage 2 study.

At the remainder of the WwTWs, there is some capacity within the permit to serve additional growth above and beyond existing allocations, completions and commitments during the plan period. The results of the WwTW capacity assessment can be found in Table 7.3 and Figure 7.4. In two locations the closest WwTWs to planned growth are a private treatment works (Westcott) and one managed by Severn Trent Defence Services (RAF Halton). Flow data was not available for these WwTWs in the Stage 1 study, so it has not been possible to assess capacity. This should be investigated further in Stage 2.

In their response to this report, Anglian Water stated that they are "advising Councils that growth should follow the sustainability hierarchy and options should be assessed in accordance with paragraphs 20 and 152 to 154 of the NPPF. Specifically, the proposed locations of growth in Plan(s) should consider and mitigate greenhouse gas emissions as required by paragraph 154(b) including the embodied (capital) carbon impacts from supporting infrastructure." They identified existing capacity for around 3,350 additional dwellings in Buckinghamshire within the catchments that they serve including Winslow, Brackley and Cotton Valley. Additional comments on some of the WwTWs operated by Anglian Water were provided and can be found in D.

Table 7.3 WwTW capacity assessment

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| ASHENDON | 5 | 0 | 0 | Yes |
| ASHLEY GREEN | 0 | 0 | 305 | No |
| ASTON ABBOTTS | 0 | 0 | 4 | No |
| AYLESBURY | 30,540 | 72,410 | 0 | Yes |
| BEACHAMPTON | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for | N/A |

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| | | | growth | |
| BERKHAMSTED | 0 | 0 | 48,132 | No |
| BICESTER | 1,984 | 55,713 | 3,742 | No |
| BRACKLEY | 1,435 | 123,638 | 583 | No |
| BUCKINGHAM | 3,517 | 104,763 | 0 | Yes |
| CHACKMORE | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| CHENIES | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| CHESHAM | 162 | 595 | 3,987 | No |
| CHILTON | 0 | 0 | 6 | No |
| COTTON VALLEY | 37,510 | 1,210,399 | 21,312 | No |
| CUDDINGTON | 38 | 0 | 0 | Yes |
| DAGNALL | 0 | 0 | 116 | No |
| DORTON | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| DRAYTON PARSLOW | 0 | 0 | 83 | No |
| DUNTON | 0 | 0 | No requirement | N/A |

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| | | | for flow monitoring - unlikely to be significant capacity for growth | |
| FOXCOTE | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| FRIETH | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| GERRARDS CROSS | 84 | 0 | 7,543 | No |
| GREAT BRICKHILL | 0 | 0 | 357 | No |
| GREAT HORWOOD | 30 | 1,760 | 956 | No |
| GRENDON UNDERWOOD | 0 | 0 | 0 | Yes |
| HADDENHAM | 1,328 | | 429 | No |
| RAF HALTON MOD (PRIVATE) | 1739 | | Private works - no data available | Unknown |
| HAMBLEDON | 0 | 252 | 0 | Yes |
| HAMPDEN ROW | 0 | 0 | No requirement for flow monitoring - unlikely to be significant | N/A |

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| | | | capacity for growth | |
| HILLESDEN HAMLET | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| HILLESDEN CHURCH END | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| HORTON | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| IVER NORTH | 5 | 10,169 | 0 | Yes |
| IVINGHOE | 248 | 0 | 441 | No |
| IVINGHOE ASTON | 0 | 0 | 187 | No |
| LECKHAMPSTEAD | 0 | 0 | 65 | No |
| LEDBURN | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| LEIGHTON LINSDALE | 3,399 | 145,210 | 5,122 | No |
| LITTLE MARLOW | 5,365 | 844,849 | 14,372 | No |
| LONG CRENDON | 54 | | 0 | Yes |
| LUDGERSHALL | 0 | 0 | 0 | Yes |
| MAPLE LODGE | 2,752 | 913 | 31,455 | No |
| MARSH GIBBON | 36 | 0 | 1,090 | No |
| MENTMORE | 0 | 0 | 165 | No |
| MIDDLE CLAYDON | 0 | 0 | 26 | No |
| MOGDEN | 947 | 0 | 375,581 | No |
| NORTH MARSTON | 0 | 0 | 171 | No |
| OVING | 0 | 0 | 200 | No |
| PADBURY | 0 | 0 | 313 | No |
| POUNDON | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| PRESTON BISSETT | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| PRINCES RISBOROUGH | 3,974 | 510 | 0 | Yes |
| ROWSHAM | 0 | 0 | 78 | No |
| SHABBINGTON | 0 | 0 | 182 | No |
| SLOUGH | 13,244 | 53 | 0 | Yes |
| STANBRIDGEFORD | 949 | 21,400 | 0 | Yes |

| WwTW | Proposed housing growth over Local Plan period | Proposed employment growth over Local Plan period ($m^2$) | Approximate remaining headroom (no. dwellings) following all planned growth | Is DWF flow forecast to exceed permitted flow over local plan period? (JBA assessment) |
|---|---|---|---|---|
| STEEPLE CLAYDON | 501 | 0 | 0 | Yes |
| STEWKLEY | 75 | 0 | 0 | Yes |
| STONE | 57 | 0 | 545 | No |
| STOWE | 0 | 0 | 618 | No |
| SWANBOURNE | 5 | 1,466 | 0 | Yes |
| TWYFORD | 0 | 0 | 348 | No |
| UPPER WINCHENDON | 0 | 0 | 70 | No |
| WADDESDON | 455 | 0 | 0 | No |
| WATER STRATFORD | 0 | 0 | No requirement for flow monitoring - unlikely to be significant capacity for growth | N/A |
| WESTBURY | 0 | 0 | 231 | No |
| WESTCOTT (PRIVATE) | 6 | 2,499 | No data available | Unknown |
| WHADDON | 0 | 0 | 204 | No |
| WHITFIELD | 0 | 0 | 122 | No |
| WING-CUBLINGTON ROAD | 0 | 0 | 905 | No |
| WINGRAVE | 0 | 0 | 1,141 | No |
| WINSLOW | 1,705 | 28,072 | 0 | Yes |
| WORMINGHALL | 188 | 2,362 | 1,048 | No |

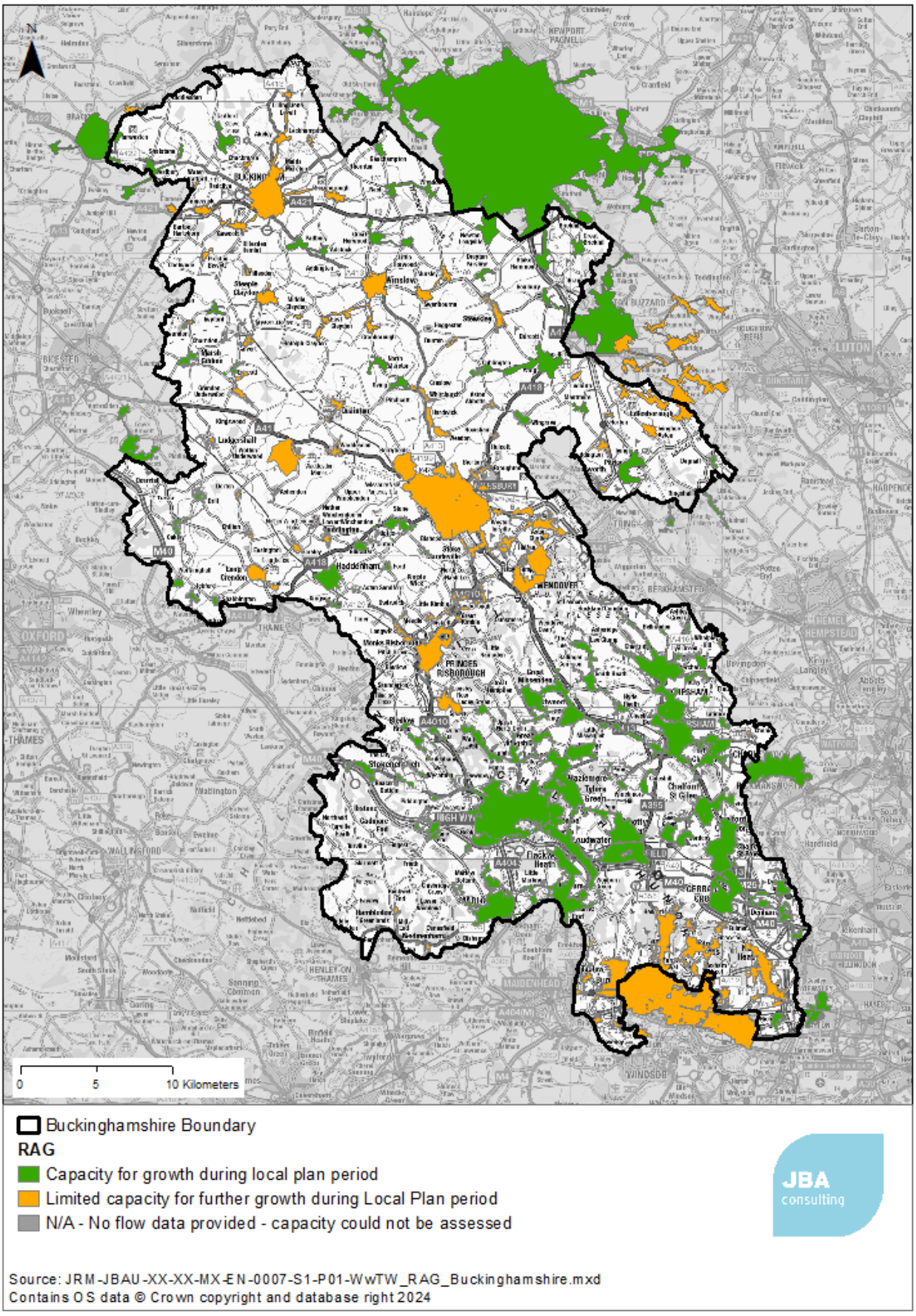



Figure 7.4 JBA WwTW flow capacity RAG results

## 7.3 Storm tank overflows

Appendix A presents performance of storm tank overflows at WwTWs in Buckinghamshire. 20 storm tank overflows were operating above the threshold for investigations based on monitoring between 2020 and 2022. Figure 7.5 shows 14 storm tank overflows that need investigation based on the average of available data. Mogden WwTW (at Isleworth, LB of Hounslow) discharges to the River Thames a considerable distance from the study area and so does not appear on the mapping. Due to the large size of this WwTW, additional flow from Buckinghamshire is likely to make up an insignificant proportion of the overall flow at this WwTW.

Where a storm tank overflow is operating in periods of moderate or light rainfall, or even in dry conditions it indicates either an infiltration problem within the network, the WwTW or its storm tanks are undersized for the population served, or that there are potential operational issues at the WwTW. Further development within a catchment that has a poorly performing storm tank overflow is likely to exacerbate the issue.

The local plan can contribute to this by encouraging the use of SuDS to divert storm water away from the sewer network, reducing the volume that reaches the WwTW. This opportunity is greatest at brownfield sites connected to existing combined sewerage systems.

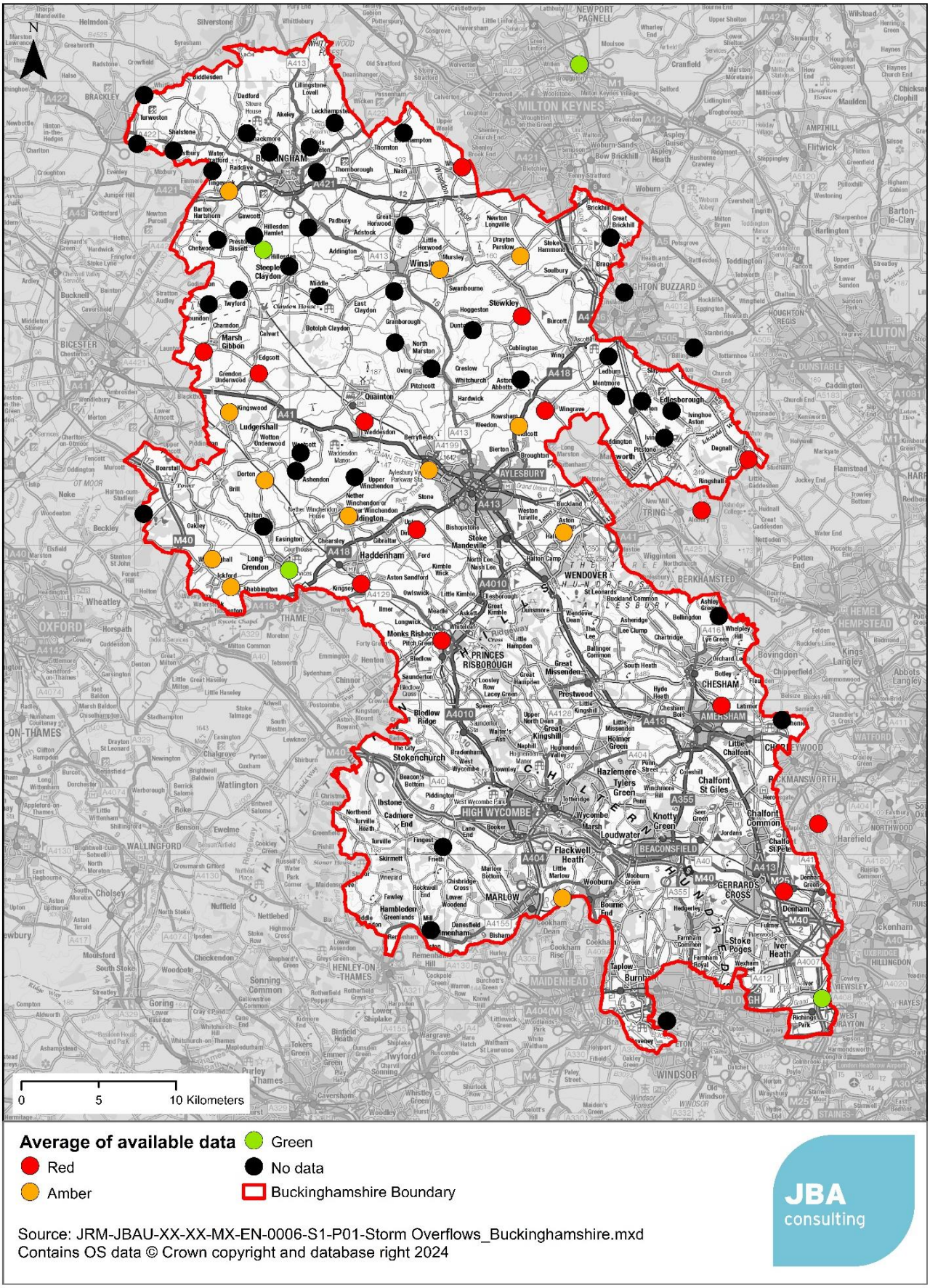



Figure 7.5 Three-year average of WwTW storm overflow spills (average from years available)

## 7.4 Wastewater Treatment Works Odour Impact Assessment

WwTWs have a typical range where odour is experienced. Where developments encroach upon this range, there may become a cause for odour annoyance and even statutory nuisance and complaints from residents. Managing odour at WwTWs can add considerable capital and operational costs, particularly when retro fitted to existing WwTWs. National Planning Policy Guidance recommends that plan makers consider whether new development is appropriate near to sites used (or proposed) for water and wastewater infrastructure, due to the risk of odour annoyance.

### 7.4.1 Methodology

Sewerage undertakers recommend that an odour impact assessment may be required if the site of a proposed development is close to a WwTW and is encroaching closer to the WwTW than existing urban areas.

A GIS assessment was carried out to identify areas that the sewerage undertaker considers may be at risk from odour annoyance due to encroachment on an existing WwTW. For Thames Water, this is defined as development sites less than 800m from the WwTW and encroaching closer to the WwTW than existing urbanised areas. For Anglian Water, this is defined as development sites less than 400m from the WwTW. If there are no existing houses close to a WwTW it is more likely than an odour impact assessment is needed.

### 7.4.2 Results

Areas where an odour impact assessment would be recommended for new development are shown in Figure 7.6 for Anglian Water WwTW and Figure 7.7 for Thames Water WwTW.

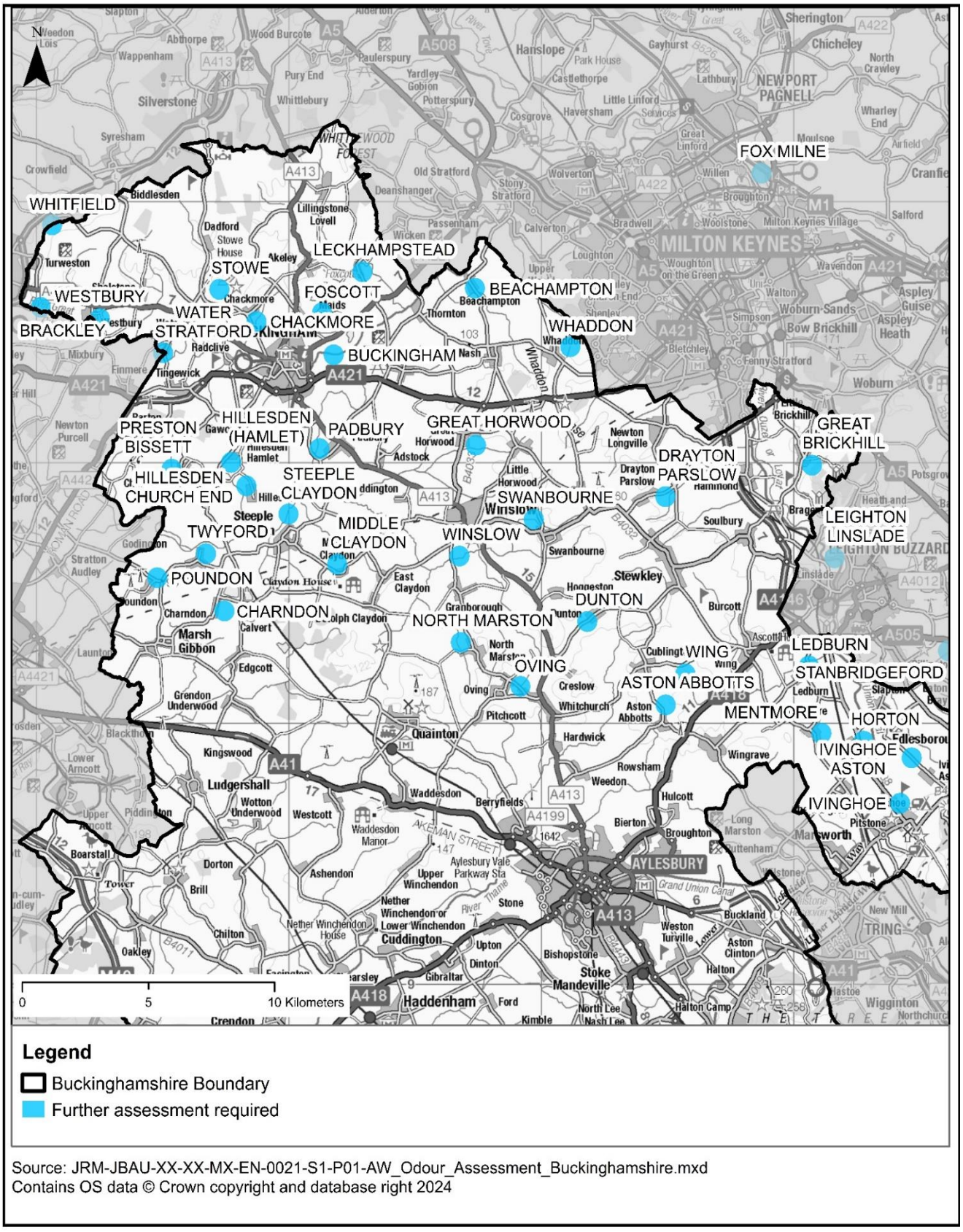



Figure 7.6 Anglian Water 400m WwTW odour assessment buffer

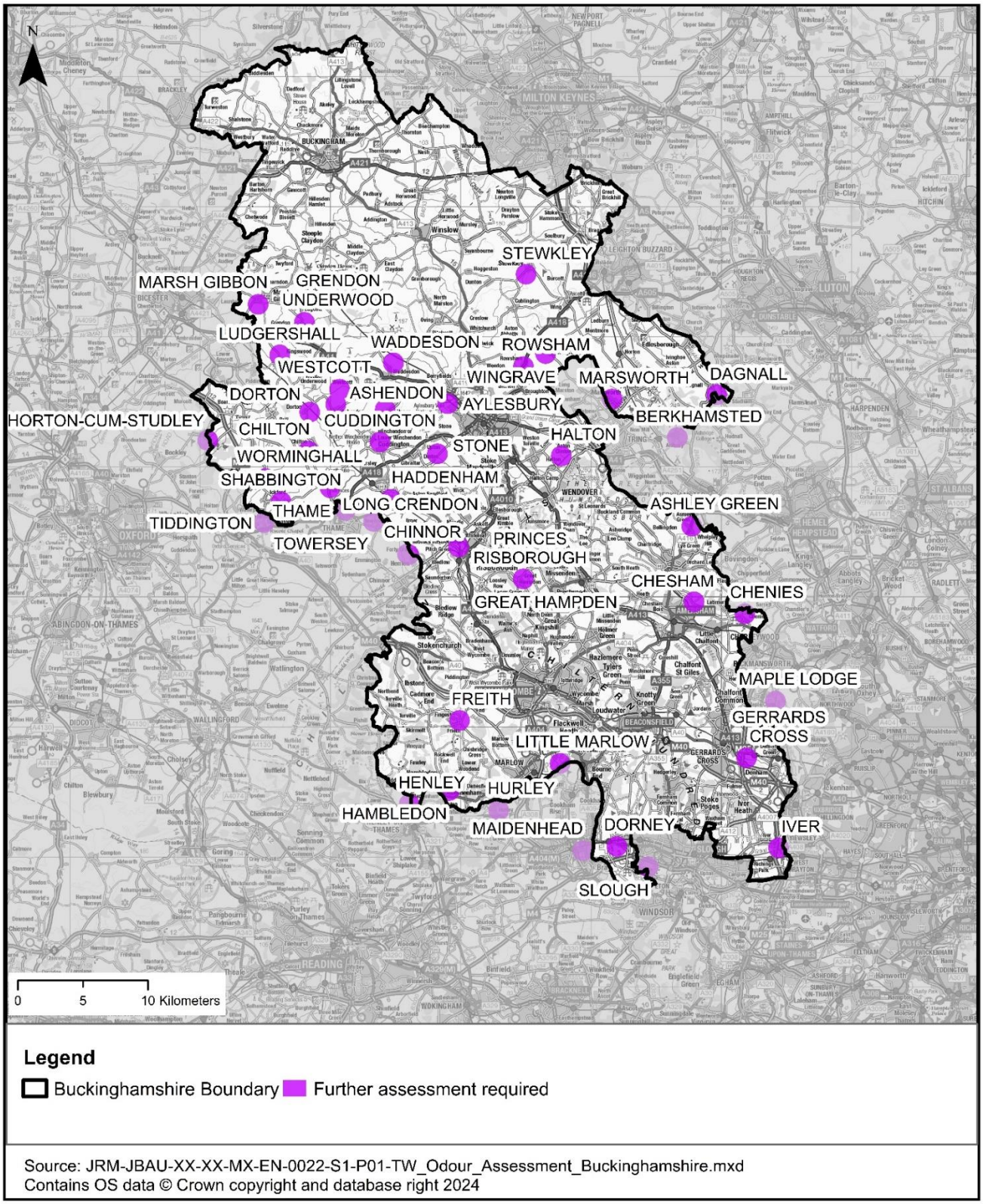



Figure 7.7 Thames Water 800m WwTW odour assessment buffer

### 7.4.3 Conclusions

The odour screening assessment has identified the areas an odour impact assessment would be recommended if development is proposed within the buffered region. Odour impact assessments for sites subsequently indicated to be potentially at risk of experiencing odour annoyance, should be undertaken by site developers.

## 7.5 Conclusions

A headroom assessment was carried out comparing the current flow from each WwTW, making allowance for growth already planned, with the permit limit. This provides an estimate of the spare capacity in wastewater treatment infrastructure in Buckinghamshire.

41 of the WwTWs in the study area are expected to be close to or exceeding their permit during the Local Plan period. An increase in the permit limit, and / or upgrades to treatment capacity may be required at these WwTWs in order to accommodate further growth.

Consideration should be given where possible to using capacity in existing permits as this provides a lower carbon cost than upgrading capacity at existing WwTW or building new treatment works. This may however not always be feasible due to other local plan considerations.

There are a number of poorly performing storm tank overflows at WwTWs in Buckinghamshire. Growth within these catchments could result in an increase in the operations of these overflows contributing to a worsening of water quality in the area. Action should be taken by the water companies to address these overflows prior to an increase in wastewater demand being generated by new development.

New development proposed within the Thames Water and Anglian Water's WwTW odour buffer zones are recommended to undergo an odour impact assessment.

## 7.6 Recommendations

Table 7.4 Recommendations for wastewater treatment

| Action | Responsibility | Timescale |
|---|---|---|
| Early engagement with Anglian Water and Thames Water is required to ensure that provision of WwTW capacity is aligned with delivery of development. | Buckinghamshire Council | Ongoing |
| Provide Annual Monitoring Reports to Anglian Water and Thames Water detailing projected housing growth. | Buckinghamshire Council | Ongoing |
| Anglian Water and Thames | Anglian Water, | Ongoing |

| Action | Responsibility | Timescale |
|---|---|---|
| Water to assess growth demands as part of their wastewater asset planning activities and feedback to the Council if concerns arise. | Thames Water | |
| Carry out an odour impact assessment for sites which fall within the buffer zone of WwTW. | Buckinghamshire Council, developers | Ongoing |

# 8 Water Quality

## 8.1 Introduction

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area in which they serve can lead to a negative impact on the quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourses. Where the scale of development is such that a deterioration is predicted, a variation to the Environmental Permit (EP) may be required for the WwTW to improve the quality of the final effluent, so that the increased pollution load will not result in a deterioration in the water quality of the watercourse. This is known as "no deterioration" or "load standstill". The need to meet river quality targets is also taken into consideration when setting or varying a permit.

The Environment Agency operational instructions on water quality planning and no-deterioration are currently being reviewed. Previous operational instructions[31] (now withdrawn but with no published replacement) set out a hierarchy for how the no-deterioration requirements of the WFD should be implemented on inland waters. The potential impact of development should be assessed in relation to the following objectives:

- **Could the development cause a greater than 10% deterioration in water quality?** This objective is to ensure that all the environmental capacity is not taken up by one stage of development and there is sufficient capacity for future growth.
- **Could the development cause a deterioration in WFD class of any element assessed?** This is a requirement of the Water Framework Directive to prevent a deterioration in class of individual contaminants. The "Weser Ruling"[32] by the European Court of Justice in 2015 specified that individual projects should not be permitted where they may cause a deterioration of the status of a water body. If a water body is already at the

31 Water Quality Planning: no deterioration and the Water Framework Directive, Environment Agency (2012). Accessed online at: http://www.fwr.org/WQreg/Appendices/No_deterioration_and_the_WFD_50_12.pdf on: 10/02/2023.

32 PRESS RELEASE No 74/15, European Court of Justice (2015). Accessed online at: https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf on: 10/02/2023.

lowest status ("bad"), any impairment of a quality element was considered to be a deterioration. Emerging practice is that a 3% limit of deterioration is applied.

- **Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) or Potential?** Is GES possible with current technology or is GES technically possible after development with any potential WwTW upgrades.

The overall WFD classification of a water body is based on a wide range of ecological and chemical classifications. This assessment focuses on three physio-chemical quality elements; Biochemical Oxygen Demand (BOD), Ammonia, and Phosphate which are key to Water Framework Directive compliance.

## 8.2 Methodology

### 8.2.1 General approach

In the Stage 1 WCS, it was proposed to carry out a sensitivity analysis of the water bodies in Buckinghamshire to changes in the volume of treated effluent rather than a detailed modelling study which will form part of the Stage 2 WCS.

### 8.2.2 Water quality sensitivity assessment

SIMCAT is used by the Environment Agency to model water bodies and identify where permit changes are needed to prevent deterioration or improve water quality as well as supporting decision making to guide development to locations where environmental deterioration will be reduced. SIMCAT is a 1-Dimensional model which represents inputs from both point-source effluent discharges (i.e. the point at which the WwTW discharges into the watercourse) and diffuse sources (i.e. further along within the watercourse where the discharge is more diluted), and the behaviour of solutes in the river.

SIMCAT can simulate inputs of discharge and water quality data and statistically distribute them from multiple effluent sources along the river reach. It uses the Monte Carlo method for distribution that randomly models up to 2,500 boundary conditions. The simulation calculates the resultant water quality as the calculations cascade further downstream. The Monte Carlo method is further explained here.

The study area is covered by the Thames and Wash SIMCAT models.

Within SIMCAT, the determinands modelled were Biochemical Oxygen Demand (BOD), Ammonia ($NH_4$) and Phosphorus (P). In fresh waterbodies, phosphate is usually the limiting nutrient for algal growth.

The following methodology was used:

- Run SIMCAT with current flow data and extract water quality outputs for ammonia, biochemical oxygen demand (BOD) and phosphate.
- Increase effluent flows at WwTWs by 22% to account for potential future development.
- Re-run SIMCAT with higher effluent flows and extract relevant river water quality data.
- Compare the two model runs for all three water quality indicators and categorise the percentage change.

Potential future development within Buckinghamshire has been calculated using an interim Local Housing Need (LHN) figure of 64,240 homes over the plan period provided by Buckinghamshire Council. Using average consumption and occupancy rates across Buckinghamshire (shown in Table 7.1), the LHN has been converted into a wastewater demand and compared against the total flow at WwTWs in Buckinghamshire to calculate the planned growth as a percentage of WwTW flow.

Two additional growth scenarios have been modelled whereby a 15% buffer has been applied above and below the proposed growth to represent increased and decreased growth respectively. The potential future growth has been calculated as a 22% increase in flow, with the potential upper end growth calculated at 25%, and potential lower end growth at 19%. These percentages have been used to upscale all WwTWs in the Thames and Wash models.

Where water quality downstream of a WwTW in any given determinant deteriorates by 10% or more in response to a 22% increase in effluent flow, the sewer catchment can be said to be “more sensitive” to changes in effluent flow, and therefore growth. It should be noted that this assessment takes the existing SIMCAT model based on 2014-2020 data and increases flow by a consistent figure across the whole model. In some cases, a WwTW may be able to accommodate a higher flow, in other cases, a 22% increase may not be likely or feasible. This assessment therefore just highlights the relative risk of deterioration.

This analysis also does not take into account planned changes in permits at WwTWs beyond 2025 that would have the effect of improving water quality.

## 8.3 Results

### 8.3.1 Water Framework Directive Overview

The Water Framework Directive (WFD) aims to ensure "no deterioration" in the environmental status of rivers and sets objectives to improve rivers to meet "good" status. LPAs must have regard to the WFD and associated statutory objectives as implemented in the EA's River Basin Management Plans (RBMPs).

Figure 8.1 shows the overall WFD classification (2019) for waterbodies in Buckinghamshire. This is broken down in Table 8.1 into the determinands usually

assessed in WCSs for each of the waterbodies that are predicted to receive additional effluent from growth during the plan period. Several of the WwTWs discharge to small watercourses which are not within the WFD classifications. These WwTW will still be included in the water quality modelling to be undertaken in Stage 2 and the impact of additional wastewater on the resulting water quality assessed.

Within Buckinghamshire only the Grand Union Canal (Wendover) has an overall status of "good", the majority have “moderate” and "poor" status, and two (Wye - source to High Wycombe fire station, and Summerstown Ditch/ Launton and Cutters Brook) have a classification of "bad" - which is the lowest status possible.

The overall WFD status is made of Ecological and Chemical status, which are further broken down into sub-elements, the measurement of which is prioritised for each waterbody based on its characteristics and risk, hence not all elements are reported for each river (Labelled as "not assessed" in Table 8.1). The WFD classification for invertebrates shows a wide variation across the study area with some waterbodies classed as "high" (the highest status possible) and one classified as Bad (Summerstown Ditch/ Launton and Cutters Brook). Invertebrate status is an indicator of the overall health of the aquatic ecology and other biological elements.

Maps showing the WFD Overall Status, Ecological Status, Fish Status and Invertebrates status of the waterbodies in Buckinghamshire are also shown below in Figure 8-1 to Figure 8-4. Invertebrate and fish statuses are used within the WFD as indicators of the overall health of the aquatic ecology and water quality.

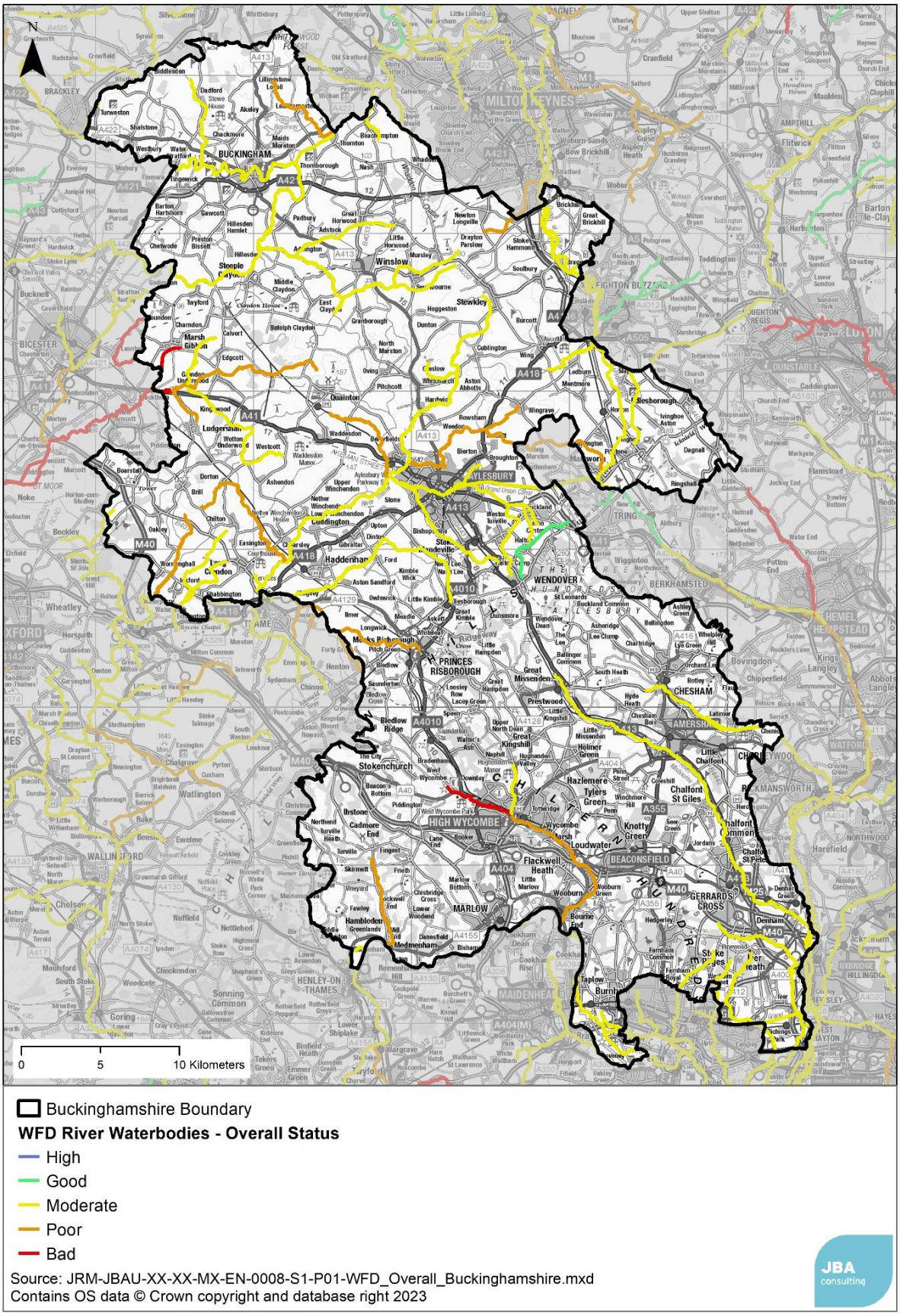



Figure 8.1 Overall WFD status for rivers in Buckinghamshire

Table 8.1 2019 WFD classifications for waterbodies acting as discharge point for WwTWs serving growth in the study area

| WwTW | Receiving Waterbody | Overall Status | BOD | Ammonia | Phosphate |
|---|---|---|---|---|---|
| Aylesbury | Thame (Aylesbury to Scotsgrove Brook) | Moderate | Not assessed | High | Poor |
| Buckingham | Ouse (Buckingham to Cosgrove) | Moderate | Not assessed | High | Moderate |
| Chesham | Chess | Moderate | Not assessed | High | Poor |
| Cotton Valley | Ouse (Newport Pagnell to Roxton) | Moderate | High | High | Poor |
| Cuddington | Thame (Aylesbury to Scotsgrove Brook) | Moderate | Not assessed | High | Poor |
| Gerrards Cross | Misbourne | Moderate | High | High | High |
| Great Horwood | Horwood Tributary | Moderate | - | High | Poor |
| Grendon Underwood | Ray and tributaries North East of Grendon Underwood | Poor | High | High | Good |
| Haddenham | Scotsgrove Brook (upstream Kingsey Cuttle Brook) | Moderate | Not assessed | High | Poor |
| Iver North | Colne (Confluence with Chess to River Thames) | Moderate | High | High | Poor |
| Ivinghoe | Whistle Brook | Moderate | Not assessed | High | Poor |
| Leighton Linslade | Ouzel US Caldecote Mill | Moderate | Not assessed | High | Poor |
| Little Marlow | Thames (Reading to | Moderate | Moderate | High | Moderate |

| WwTW | Receiving Waterbody | Overall Status | BOD | Ammonia | Phosphate |
|---|---|---|---|---|---|
| | Cookham) | | | | |
| Long Crendon | Thame (Aylesbury to Scotsgrove Brook) | Moderate | Not assessed | High | Poor |
| Maple Lodge | Colne (Confluence with Chess to River Thames) | Moderate | High | High | Poor |
| Marsh Gibbon | Summerstown Ditch and Launton and Cutters Brook | Bad | Not assessed | Bad | Poor |
| Princes Risborough | Kingsey Cuttle Brook and tributaries at Thame | Poor | Not assessed | High | Poor |
| Slough | Roundmoor Ditch and Boveney Ditch | Moderate | Not assessed | Poor | Poor |
| Stanbridgeford | Ouzel Brook | Moderate | Not assessed | High | Poor |
| Steeple Claydon | Padbury Brook (The Twins) | Moderate | Not assessed | High | Poor |
| Stone | Scotsgrove Brook (upstream Kingsey Cuttle Brook) | Moderate | Not assessed | High | Poor |
| Swanbourne | Claydon Brook | Moderate | Not assessed | High | Poor |
| Westcott | Tetchwick Brook, Source to Ray and tribs | Moderate | Not assessed | Good | Poor |
| Winslow | Claydon Brook | Moderate | Not assessed | High | Poor |
| Worminghall | Worminghall Brook and tributaries | Poor | Not assessed | High | Moderate |

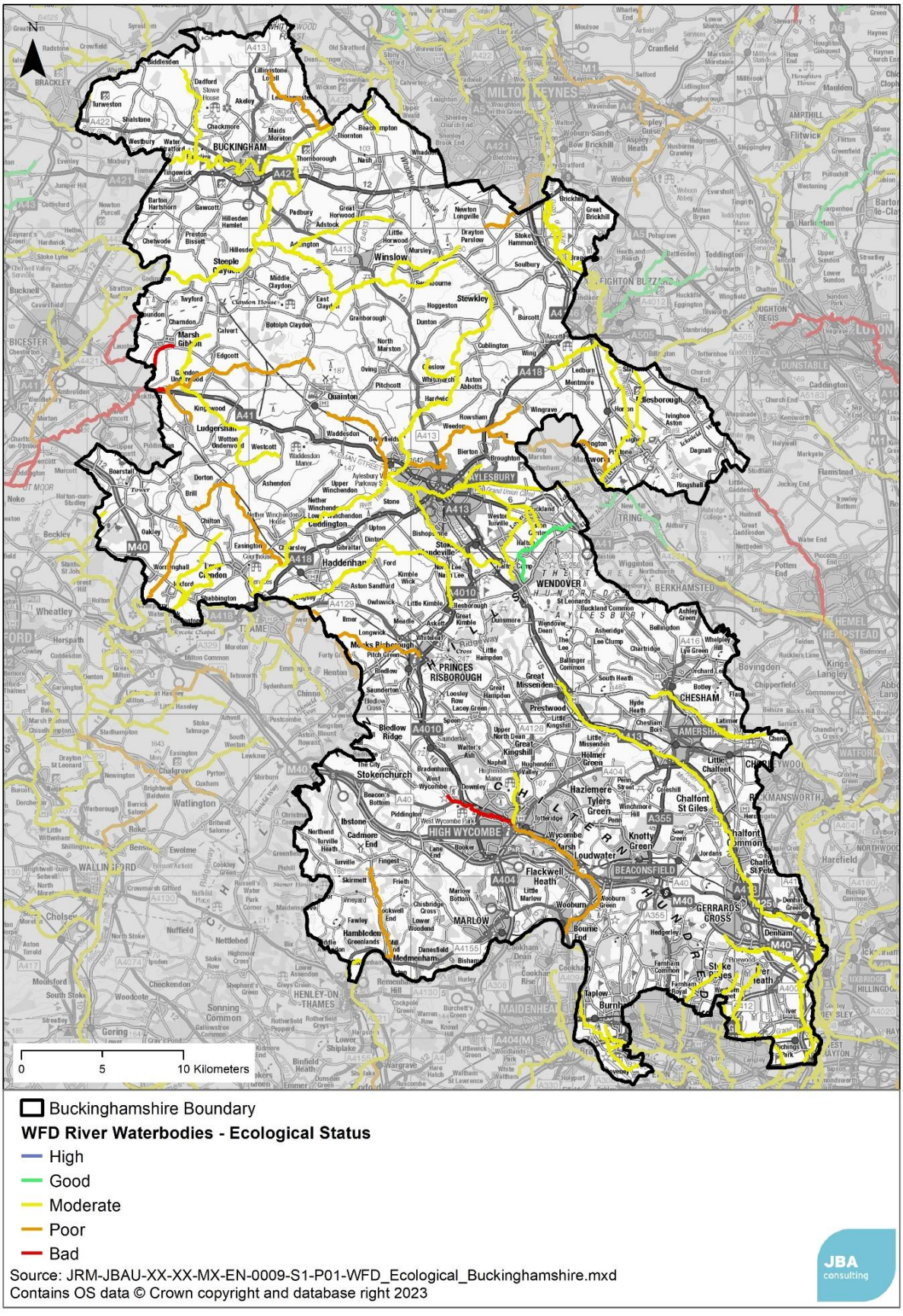



Figure 8.2 WFD Ecological status for rivers in Buckinghamshire

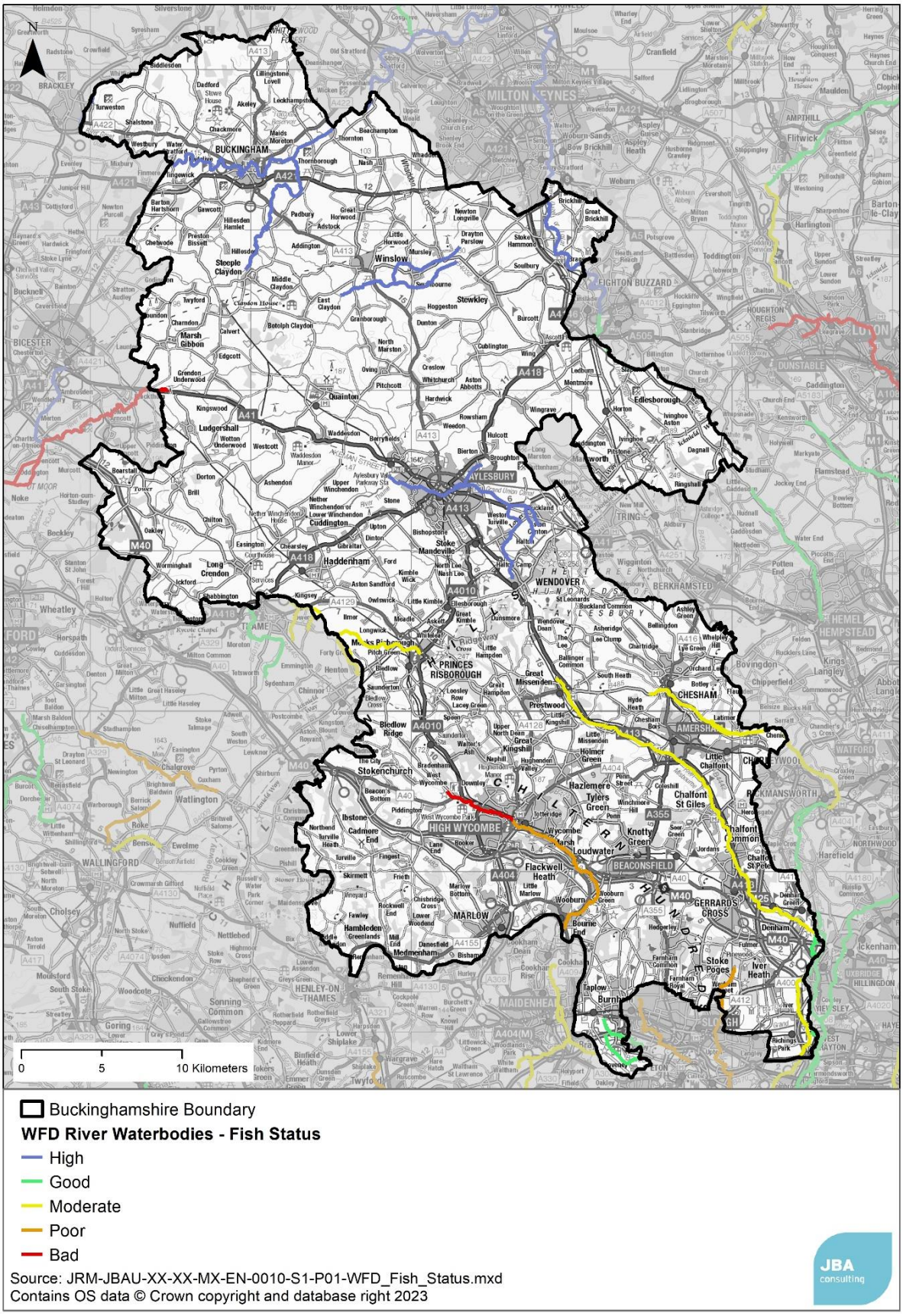



Figure 8.3 WFD Fish status for rivers in Buckinghamshire

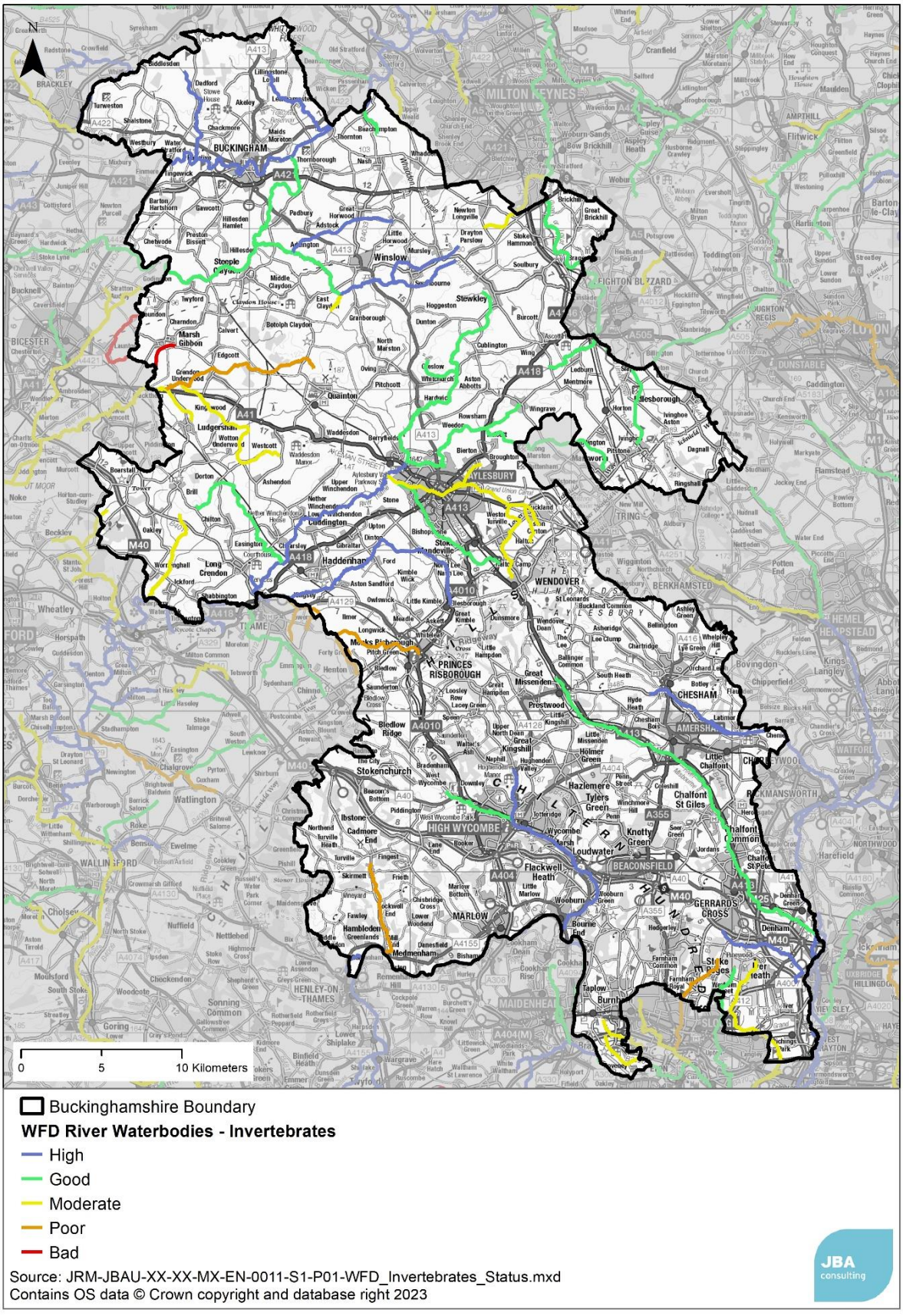



Figure 8.4 WFD Invertebrate status for rivers in Buckinghamshire

### 8.3.2 Reasons for Not Achieving Good (RNAG)

The latest Water Framework Directive assessment data shows that the majority of watercourses in Buckinghamshire have “moderate” and "poor" status, and two (Wye - source to High Wycombe fire station, and Summerstown Ditch/ Launton and Cutters Brook) have a classification of "bad". The EA reasons for not achieving good (RNAG) dataset indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock and arable) are the main reasons for watercourses not achieving good status in this area.

### 8.3.3 Priority substances

As well as the physico-chemical water quality elements (BOD, Ammonia, Phosphate etc.) addressed above, a watercourse can fail to achieve Good Ecological Status due to exceeding permissible concentrations of hazardous substances. Currently 45 substances[33] are defined as hazardous or priority hazardous substances, with others under review. Such substances may pose risks both to humans (when contained in drinking water) and to aquatic life and animals feeding in aquatic life. These substances are managed by a range of different approaches, including EU and international bans on manufacturing and use, targeted bans, selection of safer alternatives and end-of-pipe treatment solutions. There is considerable concern within the UK water industry that regulation of these substances by setting permit values which require their removal at wastewater treatment works will place a huge cost burden upon the industry and its customers, and that this approach would be out of keeping with the "polluter pays" principle.

We also consider how the planning system might be used to manage priority substances:

- Industrial sources – whilst this report covers potential employment sites, it doesn't consider the type of industry and therefore likely sources of priority substances are unknown. It is recommended that developers should discuss potential uses which may be sources of priority substances from planned industrial facilities at an early stage with the EA and, where they are seeking a trade effluent consent, with the sewerage undertaker.
- Agricultural sources - There is limited scope for the planning system to change or regulate agricultural practices. UK water companies are involved in a range of “Catchment-based Approach” schemes aimed at reducing diffuse sources of pollutants, including agricultural pesticides.
- Surface water runoff sources - some priority substances e.g., heavy metals, are present in urban surface water runoff. It is recommended that future developments would manage these sources by using SuDS that provide

33 River basin management plans, updated 2022: summary programmes of measures – mechanisms - 12. Chemicals and priority substances - Guidance - GOV.UK (www.gov.uk)

water quality treatment, designed following the CIRIA SuDS Manual. This is covered in more detail in Sections 9.4.2 and 9.4.3.

- Domestic wastewater sources - some priority substances are found in domestic wastewater as a result of domestic cleaning chemicals, detergents, pharmaceuticals, pesticides, or materials used within the home. Whilst an increase in the population due to housing growth could increase the total volumes of such substances being discharged to the environment, it would be more appropriate to manage these substances through regulation at source, rather than through restricting housing growth through the planning system.

No further analysis of priority substances will be undertaken as part of this study.

## 8.4 WINEP

The actions from the Water Industry National Environment Programme that relate to water quality are set out in Appendix E and show that most WwTWs in the study area have an action against them. In most cases these include monitoring of storm overflows and the volume of sewage being treated. In many, a permit condition to limit the concentration of phosphorus and ammonia in the treated effluent is being applied in order to improve downstream water quality. WINEP Actions relating to water quality summary can be seen in Appendix E.

The sensitivity analysis was conducted using the EA's SIMCAT models and the full results are shown in Appendices B and C. The modelling results suggest changes in the volume of treated wastewater in Buckinghamshire cause a significant increase in the concentrations of ammonia, BOD, and phosphate within Buckinghamshire.

For ammonia, most waterbodies are highly sensitive with a greater than 10% deterioration in response to a 22% increase in the discharged volume of treated effluent, with higher sensitivity concentrated more in the north of Buckinghamshire. Generally, sensitivity of ammonia across the waterbodies in Buckinghamshire is greater than 10%. A deterioration of greater than 3% is observed at Ludgershall WwTW which is at "Bad" WFD status. Of the 73 WwTWs within or serving growth in Buckinghamshire, a deterioration in class is observed at the Brackley (High to Good), Cotton Valley, Leighton Linslade, and Winslow (Good to Moderate), Ludgershall (Poor to Bad), and Stone (Moderate to Poor) WwTWs.

For BOD, most waterbodies are moderately sensitive with a 0% to 10% deterioration, concentrated more in the north. Generally, sensitivity of BOD across waterbodies in the north-east of Buckinghamshire is less than 3%. In the centre and west of Buckinghamshire, deterioration is generally less than 8%. A deterioration of greater than 3% is observed at Marsh Gibbon WwTW which is already at Bad status for BOD. A deterioration in class is observed at Princes Risborough (Moderate to Poor), Stewkley (Good to Moderate), and Wingrave (Good to Moderate).

For phosphate, most waterbodies are highly sensitive with a greater than 10% deterioration, with higher sensitivity concentrated more in the north. A deterioration of greater than 3% is observed at 8 WwTWs which are at "Bad" WFD status for Phosphate. These are Chilton, Cotton Valley, Grendon Underwood, Haddenham, Leighton Linslade, Ludgershall, Mentmore, Padbury, Shabbington, Stanbridgeford, Stewkley, Stone, and Padbury WwTWs. A deterioration in class is predicted at Ivinghoe, Ivinghoe Aston, Maple Lodge, and Twyford, and Water Stratford WwTWs.

The water bodies downstream of following WwTWs are shown to deteriorate by greater than 10% as a result of a 22% increase in WwTW flows:

| WwTW | Ammonia | BOD | Phosphate |
|---|---|---|---|
| Brackley | 14.46% | N/A | N/A |
| Buckingham | 15.48% | N/A | 11.75% |
| Chackmore | 15.93% | N/A | 10.35% |
| Chilton | 11.47% | N/A | N/A |
| Cotton Valley | 14.22% | N/A | N/A |
| Drayton Parlsow | 17.92% | N/A | N/A |
| Gerrards Cross | 12.11% | N/A | 10.86% |
| Great Brickhill | 13.49% | N/A | N/A |
| Great Horwood | 15.67% | N/A | N/A |
| Grendon Underwood | N/A | N/A | 11.23% |
| Haddenham | 10.15% | N/A | N/A |
| Hilledsen Church End | 13.96% | N/A | 19.30% |
| Hillesden (Hamlet) | 13.71% | N/A | 19.19% |
| Horton | 10.01% | N/A | N/A |
| Ivinghoe Aston | 14.08% | N/A | N/A |
| Leckhamstead | 11.48% | N/A | N/A |
| Leighton Linslade | 11.52% | N/A | N/A |
| Middle Clayton | 18.45% | N/A | 10.32% |
| North Marston | 19.06% | N/A | N/A |
| Oving | 18.04% | N/A | N/A |
| Padbury | 15.84% | N/A | N/A |
| Poundon | 15.31% | N/A | 19.18% |
| Shabbington | 14.93% | 10.32% | 12.93% |
| Steeple Claydon | 18.37% | N/A | 14.69% |
| Stewkley | 13.28% | 10.27% | N/A |
| Stone | 16.03% | 13.90% | N/A |
| Stowe | N/A | N/A | 16.20% |

| WwTW | Ammonia | BOD | Phosphate |
|---|---|---|---|
| Swanbourne | 14.65% | N/A | 11.51% |
| Twyford | 14.01% | N/A | 19.43% |
| Water Stratford | 16.43% | N/A | N/A |
| Westbury | 15.99% | N/A | N/A |
| Whaddon | 12.52% | N/A | N/A |
| Winslow | 12.55% | N/A | N/A |

The majority of site commitments in Buckinghamshire are located around Aylesbury, High Wycombe and Buckingham. Buckingham shows sensitivity of ammonia to increased WwTW flow and may need additional treatment measures to accommodate additional growth in the future. It is noted that a deterioration is shown at High Wycombe, however the discharge to the River Wye at High Wycombe is treated effluent pumped there from Little Marlow WwTW, following the closure of High Wycombe WwTW and transfer to Little Marlow in the early 2000's. It is therefore anticipated that any increased effluent as a result of growth in High Wycombe would be discharged from Little Marlow WwTW to the River Thames and not to the River Wye. Following a model run with no additional flow applied at High Wycombe, there is no change in river quality downstream of High Wycombe outfall. Water Quality mapping can be found in Appendix B and details of the WwTW deterioration can be found in Appendix C.

## 8.5 Growth scenarios

Similar trends are observed in the upper and lower growth scenario results, with deteriorations in ammonia, BOD, and phosphate predicted at a number of treatment works.

During the lower growth scenario, 29 WwTWs are shown to deteriorate by greater than 10% for ammonia, 1 WwTW for BOD, and 8 WwTWs for phosphate. Deteriorations in class are unchanged from the proposed growth scenario with the exception of Twyford which does not deteriorate from 'Good' phosphate status with a 19% increase in flow. During the higher growth scenarios, 37 WwTWs are shown to deteriorate by greater than 10% ammonia, 6 WwTWs for BOD, and 18 WwTWs for phosphate. Deteriorations in class are unchanged from the proposed growth scenario.

## 8.6 Conclusions

The EA "reasons for not achieving good" (RNAG) dataset indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock and arable) are the main reasons for watercourses not achieving good status in this area. Growth during the local plan period will also increase the discharge of treated wastewater from WwTWs in Buckinghamshire. There is a potential for this to cause a deterioration in water quality in the receiving watercourses and this must be carefully

considered. A significant deterioration in water quality is not acceptable under the Water Framework Directive, and large-scale investment in treating effluent to higher standards may therefore be required. The sensitivity analysis suggests that watercourses within Buckinghamshire may be sensitive to increases in the discharge of treated wastewater. Further modelling should be undertaken in the Stage 2 WCS.

## 8.7 Recommendations

Table 8.2 Recommendations for water quality

| Action | Responsibility | Timescale |
|---|---|---|
| Provide annual monitoring reports to TW and AW detailing projected housing growth in the Local Authority | Buckinghamshire Council | Ongoing |
| When preferred options for growth are identified, undertake water quality impact modelling as part of a Stage 2 WCS. | Buckinghamshire Council | Ongoing |
| Take into account the full volume of growth (from Buckinghamshire and neighbouring authorities within the catchment when considering WINEP schemes or upgrades at WwTWs | Anglian Water and Thames Water | Ongoing |

# 9 Environmental Opportunities and Constraints

## 9.1 Introduction

Development has the potential to cause an adverse impact on the environment through a number of routes, such as worsening of air quality, pollution to the aquatic environment or disturbance to wildlife. In the context of a Water Cycle Study, the impact of development on the aquatic environment is assessed. This chapter considered both water quantity (impact of abstraction) and water quality (impact of wastewater discharge and runoff) on protected sites. Protected sites considered in this report are:

- Special Areas of Conservation (SAC) (and candidate SACs)
- Special Protected Areas (SPA) (and candidate SPAs)
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites (and potential Ramsar sites)

A source-pathway-receptor approach can be taken to investigate the risk and identify where further assessment or action is required.

## 9.2 Impact of abstraction

### 9.2.1 Overview

Abstraction of water within a catchment, either from groundwater or surface water sources, is necessary to provide a public water supply, for industrial processes and for agriculture. When the volume of water being abstracted becomes too high, it can cause environmental damage by reducing river flow, or lowering the water table.

Changes in river flow can impact sensitive ecosystems, for example trout require a clean gravel bed to lay their eggs. A reduction in river flow can cause sediment to build up, blocking the spaces the fish require to lay their eggs impacting their reproductive cycle. Changes in groundwater levels can also affect the flow regime in rivers and can cause drying of wetland sites.

Chalk stream catchments are particularly sensitive to changes in groundwater levels.

The precise location of abstraction points for public water supply in England is not available for reasons of national security. Furthermore, water demand within a WRZ can be met by anywhere within that WRZ, or from a neighbouring WRZ if the transfer between WRZs is used to provide some of the water available for use. It is therefore not possible to trace an impact of an individual development site back to a particular water abstraction and therefore to an environmental impact. The assessments in this report therefore rely on information in the public domain.

### 9.2.2 Methodology

Buckinghamshire is served by Affinity Water via its Pinn and Misbourne WRZs, Anglian Water via its Ruthamford West and Ruthamford Central WRZs and Thames Water via its SWOX, Slough, Wycombe, and Aylesbury WRZs. Abstraction either from surface water sources or from groundwater sources can occur anywhere within these zones. However, the impact of the abstraction could be felt outside of the WRZ within the same groundwater body, or downstream in surface waterbodies. In both cases this could be well outside the LPA boundary.

**Groundwater dependent ecosystems**

Figure 9.1 shows a schematic of how Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were identified. The LPA boundary is within a WRZ. Water abstracted anywhere within that WRZ could be used to serve growth within the LPA. In the diagram below, there are two abstraction points. Abstraction 1 could impact an area outside of both the LPA boundary and the WRZ. However, there are no protected sites within that groundwater body. Abstraction 2 also impacts an area both within and outside of the LPA boundary. Protected site A is within the WRZ, but may not be impacted directly by an abstraction. Protected site B is outside of the WRZ and outside of the groundwater body containing an abstraction and is therefore unlikely to be impacted by growth. Protected site C is within a groundwater body containing an abstraction. There is a risk that an increase in abstraction could impact the protected site.

The location of abstraction points within the study area is not known, and so the approach must be taken that GWDTE anywhere within the combined extent of the WRZ and groundwater bodies overlapping the WRZ could be impacted by an increase in abstraction.

A further check was done on whether abstraction may already be an issue in those GWDTEs. The Water Framework Directive (WFD) records "Significant Water Management Issues" (SWMIs) in each water body. These are pressures on the water environment that put our ability to achieve the environmental objectives of the WFD most at risk.

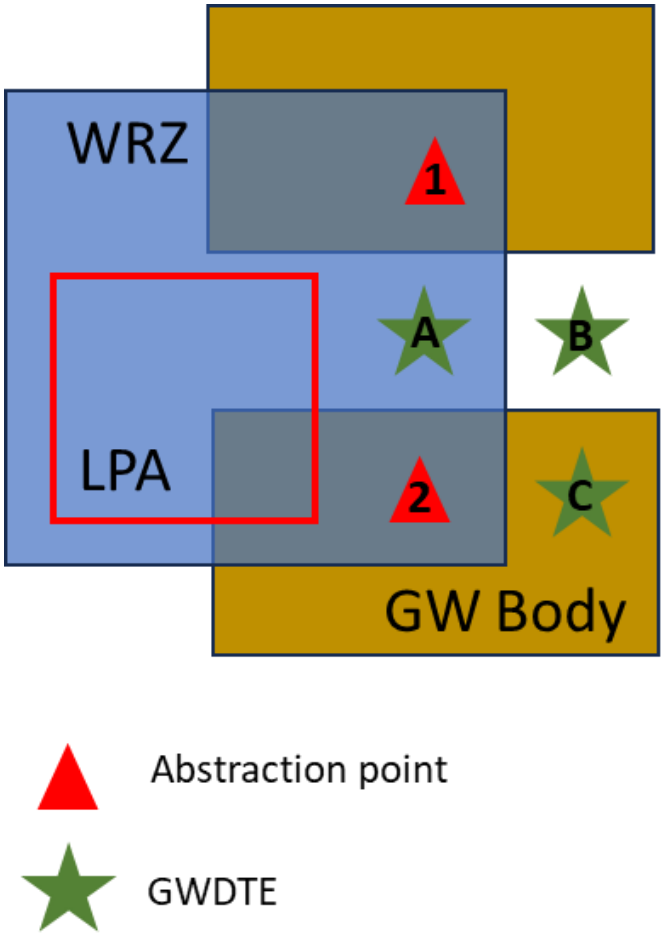



Figure 9.1 Definition of groundwater study area

The following procedure was followed:

- Define study area for Bucks - based on extent of WRZ and WFD Groundwater bodies that overlap with the WRZs.
- Identify Groundwater Dependent Terrestrial Ecosystems (GWDTE) within the study area using the EA's GWDTE dataset.
- Identify GWDTEs that are within groundwater bodies with flow identified as a Significant Water Management Issue (SWMI).

**Surface water based ecosystems**

Figure 9.2 shows a schematic of how protected sites on surface waterbodies were identified. As in the groundwater example, water could be abstracted from anywhere within the WRZ. Protected site A is downstream of an abstraction and so could be impacted by changes in river flow resulting from the abstraction. Protected site B whilst further downstream in the river basin, it is on a tributary not connected with the WRZ, abstraction is unlikely to have an impact. Protected site C is upstream of the abstraction so would not be impacted.

As with the groundwater abstractions, their location was not available as part of this study. The approach is therefore taken that any protected site directly on a waterbody

that flows through or is downstream of the WRZ could be impacted by abstraction. Protected sites upstream or on tributaries that have not flowed through the WRZ are ignored.

In order to identify protected sites that may be at risk, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either adjacent to a river or could be reasonably expected to receive surface water from a river.

The following procedure was followed:

- Define study area for Bucks - based on extent of WRZ and WFD Surface water bodies that overlap with the WRZs.
- Identify protected sites within the study area.
- Filter these based on their proximity to waterbodies within the study area defined using Flood Zone 2 as a proxy.
- Identify the protected sites within a catchment where flow is recorded as a significant water management issue.

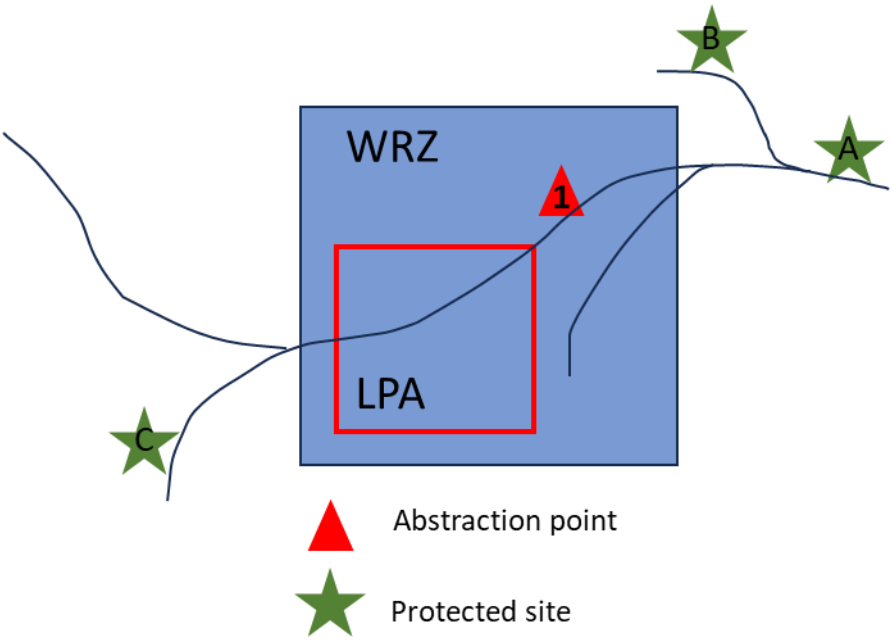



Figure 9.2 Definition of surface water study area

### 9.2.3 Results

Table 9.1 shows the GWDTEs within the WRZs serving Bucks that are in a groundwater body that overlaps with the water resource zones serving Buckinghamshire. It is also noted where flow (either groundwater or surface water abstraction) has been identified as a significant water management issue (SWMI).

Table 9.1 Groundwater Dependent Terrestrial Ecosystems within groundwater bodies

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Alder Wood & Meadow (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Aldwincle Marsh (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Alpine Meadow (SSSI) | Mid-Chilterns Chalk | Yes |
| Badby Wood (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Badby Wood (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Baynhall Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Bestmoor (SSSI) | Banbury Jurassic | No |
| Birch Spinney & Mawsley Marsh (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Bittell Reservoirs (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Bix Bottom (SSSI) | South-West Chilterns Chalk | Yes |
| Black Park (SSSI) | Not within WFD groundwater body | No |
| Blagrove Common (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Blow's Down (SSSI) | Mid-Chilterns Chalk | Yes |
| Blow's Down (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Bosworth Mill Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Bozeat Meadow (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Brandon Marsh (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Brasenose Wood & Shotover Hill (SSSI) | Headington Corallian | No |
| Bray Meadows (SSSI) | Twyford Tertiaries | No |
| Bray Meadows (SSSI) | Maidenhead Chalk | No |
| Bray Pennyroyal Field (SSSI) | Lower Thames Gravels | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Brent Reservoir (SSSI) | Not within WFD groundwater body | No |
| Bucknell Wood Meadows (SSSI) | Upper Bedford Ouse Oolite Principal 1 | No |
| Bugbrooke Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Bulwick Meadows (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Burnham Beeches (SSSI) | Twyford Tertiaries | No |
| Burnham Beeches (SSSI) | Radlett Tertiaries | No |
| Calcutt Locks Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Castor Flood Meadows (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Castor Flood Meadows (SSSI) | Northampton Sands | No |
| Castor Hanglands (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Castor Hanglands (SSSI) | Northampton Sands | No |
| Cave's Inn Pits (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Chinnor Hill (SSSI) | Chiltern Chalk Scarp | No |
| Cooksholme Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Croxley Common Moor (SSSI) | Mid-Chilterns Chalk | Yes |
| Dagnell End Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Dean Brook Valley Pastures (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Denham Lock Wood (SSSI) | Radlett Tertiaries | No |
| Denham Lock Wood (SSSI) | Mid-Chilterns Chalk | Yes |
| Dormston Church Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Draycote Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Drybank Meadow, Cherington (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Dungee Corner Meadow (SSSI) | Northampton Sands | No |
| Fancott Woods & Meadows (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Felmersham Gravel Pits (SSSI) | Upper Bedford Ouse Principal Oolite 2 | No |
| Finemere Wood (SSSI) | Not within WFD groundwater body | No |
| Flitwick Moor (SSSI) | Upper Bedford Ouse Woburn Sands | Yes |
| Foster's Green Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Fray's Farm Meadows (SSSI) | Lower Thames Gravels | No |
| Fray's Farm Meadows (SSSI) | Radlett Tertiaries | No |
| Frieth Meadows (SSSI) | South-West Chilterns Chalk | Yes |
| Frogmore Meadows (SSSI) | Mid-Chilterns Chalk | Yes |
| Galley & Warden Hills (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Grafton Wood (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Great Blaythorn Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Great Thrift Wood (SSSI) | Twyford Tertiaries | No |
| Great Thrift Wood (SSSI) | Maidenhead Chalk | No |
| Hampstead Heath Woods (SSSI) | Not within WFD groundwater body | No |
| Hardwick Lodge Meadow (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Herald Way Marsh (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Hewell Park Lake (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Houghton Regis Marl Lakes (SSSI) | Upper Bedford Ouse Chalk | Yes |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Ipsley Alders Marsh (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Kingcup Meadows & Oldhouse Wood (SSSI) | Radlett Tertiaries | No |
| Kingcup Meadows & Oldhouse Wood (SSSI) | Radlett Tertiaries | No |
| King's Wood & Glebe Meadows, Houghton Conquest (SSSI) | Upper Bedford Ouse Woburn Sands | Yes |
| Langham Pond (SSSI) | Lower Thames Gravels | No |
| Littleworth Common (SSSI) | Twyford Tertiaries | No |
| Lobbington Hall Farm Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Lodge Wood & Sandford Mill (SSSI) | Twyford Tertiaries | No |
| Long Meadow, Thorn (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Lower Saleway Farm Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Loxley Church Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Lye Valley (SSSI) | Headington Corallian | No |
| Maulden Church Meadow (SSSI) | Upper Bedford Ouse Woburn Sands | Yes |
| Maulden Wood & Pennyfather's Hills (SSSI) | Upper Bedford Ouse Woburn Sands | Yes |
| Merriman's Hill Farm Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Mid Colne Valley (SSSI) | Mid-Chilterns Chalk | Yes |
| Midsummer Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Mill Crook (SSSI) | Upper Bedford Ouse Oolite Secondary | No |
| Misterton Marshes (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Moorend Common (SSSI) | South-West Chilterns Chalk | Yes |
| Murcott Meadows (SSSI) | Not in groundwater extent | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Naphill Common (SSSI) | South-West Chilterns Chalk | Yes |
| Nares Gladley Marsh (SSSI) | Not in groundwater extent | No |
| Naunton Court Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Oak Tree Farm Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Old Park Wood (SSSI) | Radlett Tertiaries | No |
| Old Park Wood (SSSI) | Mid-Chilterns Chalk | Yes |
| Old Rectory Meadows (SSSI) | Mid-Chilterns Chalk | Yes |
| Otmoor (SSSI) | Not within WFD groundwater body | No |
| Oxley Mead (SSSI) | Not within WFD groundwater body | No |
| Pilch Fields (SSSI) | Not within WFD groundwater body | No |
| Plumpton Pasture (SSSI) | Upper Bedford Ouse Oolite Secondary | No |
| Pokers Pond Meadow (SSSI) | Not within WFD groundwater body | No |
| Portway Farm Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Racecourse Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Railway Meadow, Langley (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Rectory Farm Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| River Ise & Meadows (SSSI) | Nene Mid Lower Jurassic Unit | No |
| River Itchen (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Rodbed Wood (SSSI) | South-West Chilterns Chalk | Yes |
| Rookery Cottage Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Ruislip Woods (SSSI) | Radlett Tertiaries | No |
| Rushbeds Wood & Railway Cutting (SSSI) | Headington Corallian | No |
| Salt Meadow, Earl's Common (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Sarratt Bottom (SSSI) | Mid-Chilterns Chalk | Yes |
| Shabbington Woods Complex (SSSI) | Headington Corallian | No |
| Sherbourne Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Sidlings Copse & College Pond (SSSI) | Headington Corallian | No |
| Smithcombe, Sharpenhoe & Sundon Hills (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Southfield Farm Marsh (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Southorpe Paddock (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Staines Moor (SSSI) | Lower Thames Gravels | No |
| Stevington Marsh (SSSI) | Upper Bedford Ouse Principal Oolite 2 | No |
| Stock Wood Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Stoke Common (SSSI) | Not within WFD groundwater body | No |
| Sundon Chalk Quarry (SSSI) | Upper Bedford Ouse Chalk | Yes |
| Sutton Heath & Bog (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Sutton Heath & Bog (SSSI) | Northampton Sands | No |
| Syon Park (SSSI) | Lower Thames Gravels | No |
| Syresham Marshy Meadows (SSSI) | Upper Bedford Ouse Oolite Principal 1 | No |
| Temple Island Meadows (SSSI) | South-West Chilterns Chalk | Yes |
| Thorpe Hay Meadow (SSSI) | Lower Thames Gravels | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Tiddesley Wood (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Tingewick Meadows (SSSI) | Not within WFD groundwater body | No |
| Titchmarsh Meadow (SSSI) | Northampton Sands | No |
| Trickses Hole (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Tring Reservoirs (SSSI) | Chiltern Chalk Scarp | No |
| Ullenhall Meadows (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Upper Nene Valley Gravel Pits (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Upper Nene Valley Gravel Pits (SSSI) | Northampton Sands | No |
| Wadenhoe Marsh & Achurch Meadow (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Wadenhoe Marsh & Achurch Meadow (SSSI) | Northampton Sands | No |
| Wansford Pasture (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Wavendon Heath Ponds (SSSI) | Upper Bedford Ouse Woburn Sands | Yes |
| Welford Field (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Weston Turville Reservoir (SSSI) | Chiltern Chalk Scarp | No |
| Whichford Wood (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |
| Widdenton Park Wood (SSSI) | South-West Chilterns Chalk | Yes |
| Windsor Forest & Great Park (SSSI) | Not within WFD groundwater body | No |
| Wollaston Meadows (SSSI) | Nene Mid Lower Jurassic Unit | No |
| Wraysbury & Hythe End Gravel Pits (SSSI) | Lower Thames Gravels | No |
| Wylde Moor, Feckenham (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |

| Protected Site | Waterbody Name | Flow identified as a significant water management issue |
|---|---|---|
| Yardley Chase (SSSI) | Northampton Sands | No |
| Yardley Chase (SSSI) | Upper Bedford Ouse Principal Oolite 2 | No |
| Yellow House Meadow (SSSI) | Warwickshire Avon - Secondary Mudrocks | No |

The location of all of the GWDTEs in Bucks is shown in Figure 9.3 and Figure 9.4.

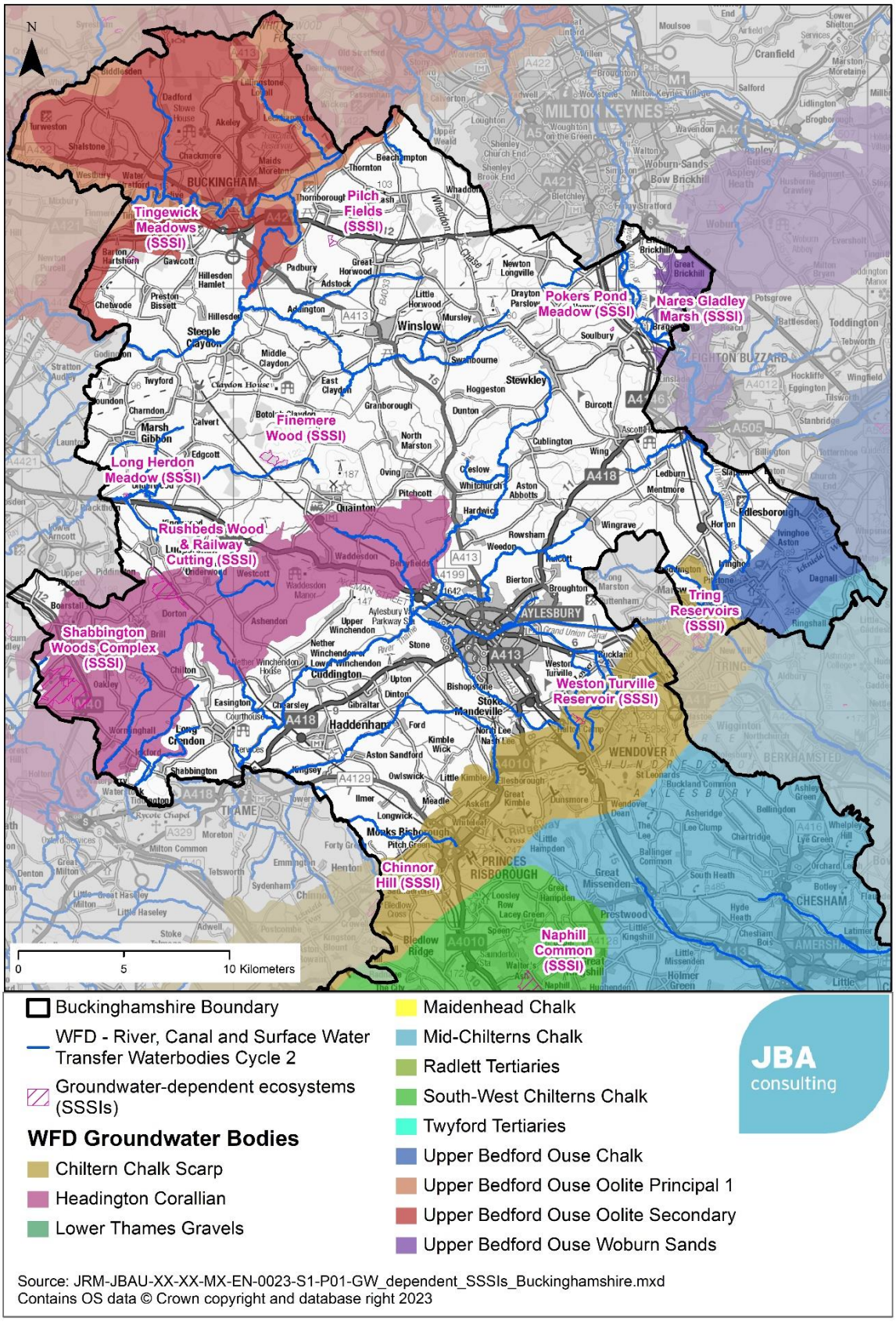



Figure 9.3 Groundwater Dependent Terrestrial Ecosystems - North of Buckinghamshire

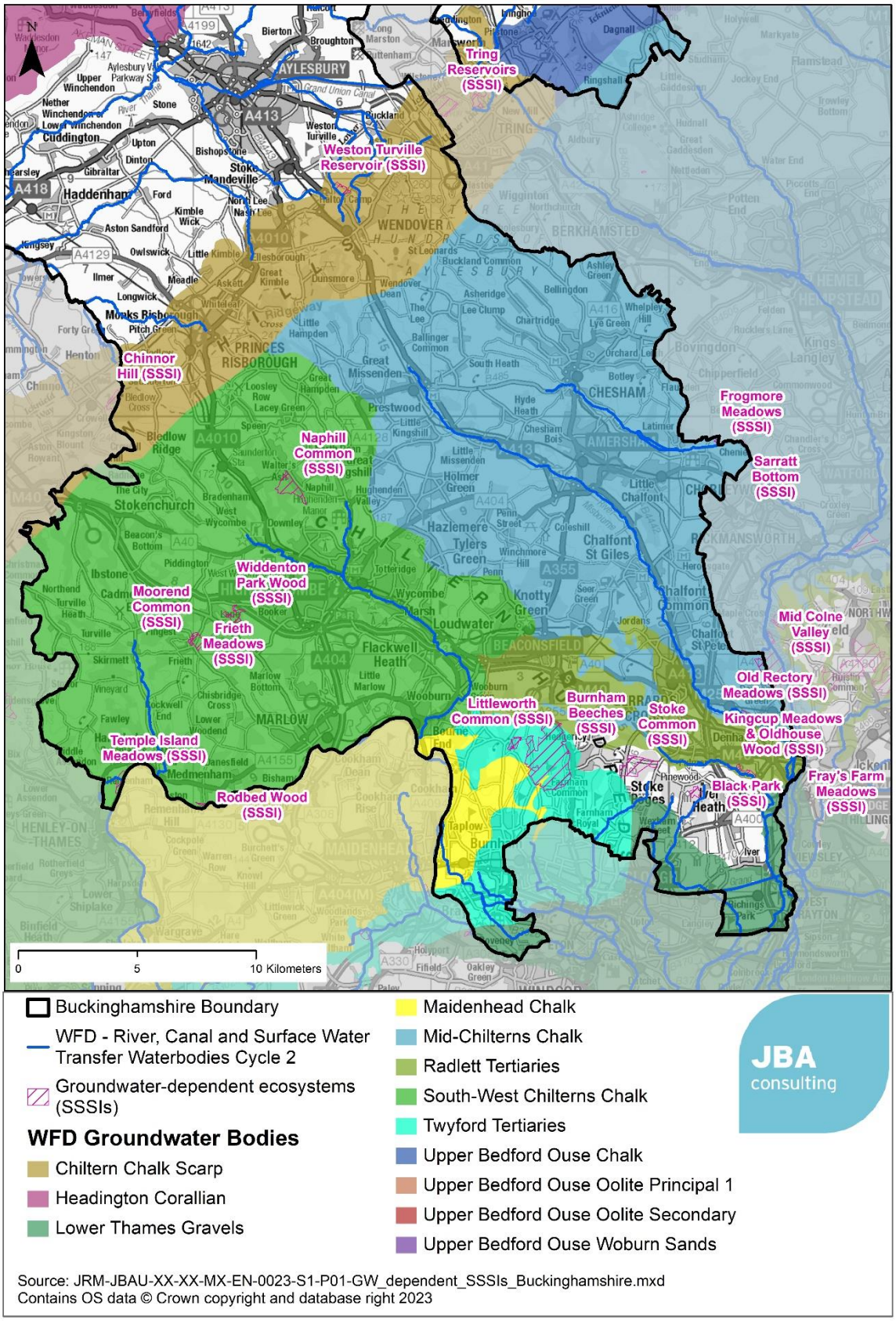



Figure 9.4 Groundwater Dependent Terrestrial Ecosystems - South of Buckinghamshire

Table 9.2 shows the protected sites that are adjacent to waterbodies within the WRZs serving Bucks (based on Flood Zone 2). SSSIs within a waterbody that has flow (abstraction from surface water) identified as a significant water management issue is also noted.

The location of all the SSSIs identified adjacent to rivers (within Buckinghamshire only) are shown in Figure 9.5 and Figure 9.6. Other SSSIs are present downstream outside of the study area.

Table 9.2 Protected sites adjacent to rivers within WRZ serving Buckinghamshire

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Ardley Trackways | Langford Brook (Bicester to Ray inc Gagle Brook) | No |
| Arncott Bridge Meadows | Oxon Ray (upstream A41 to Cherwell) including Otmoor | No |
| Bassenhally Pit | Mortons Leam | No |
| Bentley Priory | Silk Stream and Edgware Brook | No |
| Berry Fen | Ouse (Roxton to Earith) | No |
| Bestmoor | Cherwell (Nell Bridge to Bletchingdon) | No |
| Bisham Woods | Thames (Reading to Cookham) | No |
| Bisham Woods | Maidenhead Ditch | No |
| Bray Meadows | Maidenhead Ditch | No |
| Bray Pennyroyal Field | Thames (Cookham to Egham) | No |
| Brent Reservoir | Silk Stream and Edgware Brook | No |
| Brent Reservoir | Dollis Brook and Upper Brent | No |
| Brent Reservoir | Lower Brent | No |
| Bushy Park and Home Park | Thames (Egham to Teddington) | No |
| Cassington Meadows | Thames (Evenlode to Thame) | No |
| Cock Marsh | Maidenhead Ditch | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Croxley Common Moor | Gade (from confluence with Bulbourne to Chess) | No |
| Croxley Common Moor | Colne (from Confluence with Ver to Gade) | No |
| Culham Brake | Thames (Evenlode to Thame) | No |
| Denham Lock Wood | Colne (Confluence with Chess to River Thames) | No |
| Dumsey Meadow | Thames (Egham to Teddington) | No |
| Felmersham Gravel Pits | Ouse (Newport Pagnell to Roxton) | No |
| Finemere Wood | Ray and tributaries NorthEast of Grendon Underwood | No |
| Fray's Farm Meadows | Colne (Confluence with Chess to River Thames) | Yes |
| Frogmore Meadows | Chess | No |
| Godmanchester Eastside Common | Ouse (Roxton to Earith) | No |
| Grendon and Doddershall Woods | Ray and tributaries NorthEast of Grendon Underwood | No |
| Hartslock | Thames Wallingford to Caversham | No |
| Helmdon Disused Railway | Radstone Brook | No |
| Helmdon Disused Railway | Ouse US Brackley | No |
| Helmdon Disused Railway | Helmdon Brook | No |
| Holme Fen | Middle Level | No |
| Holton Wood | Holton Brook and tributaries | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Hook Meadow and The Trap Grounds | Thames (Evenlode to Thame) | No |
| Houghton Meadows | Ouse (Roxton to Earith) | No |
| Iffley Meadows | Thames (Evenlode to Thame) | No |
| Kingcup Meadows and Oldhouse Wood | Alderbourne | No |
| Kirtlington Quarry | Cherwell (Nell Bridge to Bletchingdon) | No |
| Knight & Bessborough Reservoirs | Thames (Egham to Teddington) | No |
| Langham Pond | Thames (Cookham to Egham) | No |
| Little Paxton Pits | Ouse (Roxton to Earith) | No |
| Little Wittenham | Thames Wallingford to Caversham | No |
| Little Wittenham | Thames (Evenlode to Thame) | No |
| Long Herdon Meadow | Oxon Ray (upstream A41 to Cherwell) including Otmoor | No |
| Long Herdon Meadow | Ray and tributaries NorthEast of Grendon Underwood | No |
| Lye Valley | Thames (Evenlode to Thame) | No |
| Mid Colne Valley | Colne (Confluence with Chess to River Thames) | Yes |
| Mill Crook | Tove (DS Greens Norton) | No |
| Monks Wood and The Odd Quarter | Middle Level | No |
| Nares Gladley Marsh | Ouzel US Caldecote Mill | No |
| Nene Washes | Mortons Leam | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Nene Washes | Middle Level | No |
| New Marston Meadows | Cherwell (Ray to Thames) and Woodeaton Brook | No |
| Northaw Great Wood | Colne (upper east arm including Mimshall Brook) | No |
| Old Rectory Meadows | Misbourne | No |
| Otmoor | Oxon Ray (upstream A41 to Cherwell) including Otmoor | No |
| Ouse Washes | Ouse (Roxton to Earith) | No |
| Ouse Washes | Old Bedford River / River Delph (inc The Hundred Foot Washes) | No |
| Ouse Washes | Counter Drain (Sutton and Mepal IDB incl. Cranbrook Drain) | No |
| Ouse Washes | Counter Drain (Manea and Welney IDB) | No |
| Ouse Washes | Counter Drain (Upwell and Outwell IDB) | No |
| Pixey and Yarnton Meads | Thames (Evenlode to Thame) | No |
| Port Meadow with Wolvercote Common & Green | Thames (Evenlode to Thame) | No |
| Portholme | Ouse (Roxton to Earith) | No |
| Rodbed Wood | Thames (Reading to Cookham) | No |
| Ruislip Woods | Pinn | No |
| Ruislip Woods | Colne (Confluence with Chess to River Thames) | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Rushy Meadows | Thames (Evenlode to Thame) | No |
| Sarratt Bottom | Chess | No |
| Shabbington Woods Complex | Thame (Scotsgrove Brook to Thames) | No |
| Shabbington Woods Complex | Holton Brook and tributaries | No |
| Sheephouse Wood | Ray and tributaries NorthEast of Grendon Underwood | No |
| South Lodge Pit | Roundmoor Ditch and Boveney Ditch | No |
| St. Neot's Common | Ouse (Roxton to Earith) | No |
| Staines Moor | Colne (Confluence with Chess to River Thames) | No |
| Staines Moor | Thames (Cookham to Egham) | No |
| Staines Moor | Surrey Ash | No |
| Staines Moor | Colne (Confluence with Chess to River Thames) | No |
| Stevington Marsh | Ouse (Newport Pagnell to Roxton) | No |
| Syon Park | Lower Brent | No |
| Syresham Marshy Meadows | Syresham Stream | No |
| Temple Island Meadows | Thames (Reading to Cookham) | No |
| Tring Reservoirs | Thame upstream of Aylesbury | No |
| Upper Cherwell at Trafford House | Cherwell (Source to Trafford Bridge) | No |
| Upper Cherwell at Trafford House | Cherwell (Ashby Brook to Cropredy) | No |
| Upper Cherwell at Trafford House | Ashby Brook (Source to Cherwell) | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Walthamstow Marshes | Lee (Tottenham Locks to Bow Locks/Three Mills Locks) | No |
| Water End Swallow Holes | Colne (upper east arm including Mimshall Brook) | No |
| Wendlebury Meads and Mansmoor Closes | Oxon Ray (upstream A41 to Cherwell) including Otmoor | No |
| Wendlebury Meads and Mansmoor Closes | Langford Brook (Bicester to Ray inc Gagle Brook) | No |
| Weston Fen | Gallos Brook | No |
| Weston Turville Reservoir | Bear Brook and Wendover Brook | No |
| Wiggenhall St. Germans | Middle Level | No |
| Windsor Forest and Great Park | Thames (Cookham to Egham) | No |
| Wolvercote Meadows | Thames (Evenlode to Thame) | No |
| Woodwalton Fen | Middle Level | No |
| Wraysbury & Hythe End Gravel Pits | Colne Brook | No |
| Wraysbury & Hythe End Gravel Pits | Horton Brook | No |
| Wraysbury & Hythe End Gravel Pits | Thames (Cookham to Egham) | No |
| Wraysbury No. 1 Gravel Pit | Horton Brook | No |
| Wraysbury No. 1 Gravel Pit | Thames (Cookham to Egham) | No |
| Wraysbury Reservoir | Colne (Confluence with Chess to River Thames) | No |
| Wraysbury Reservoir | Thames (Cookham to Egham) | No |

| Protected site | Surface waterbody | Flow identified as significant water management issue |
|---|---|---|
| Wytham Ditches and Flushes | Thames (Evenlode to Thame) | No |

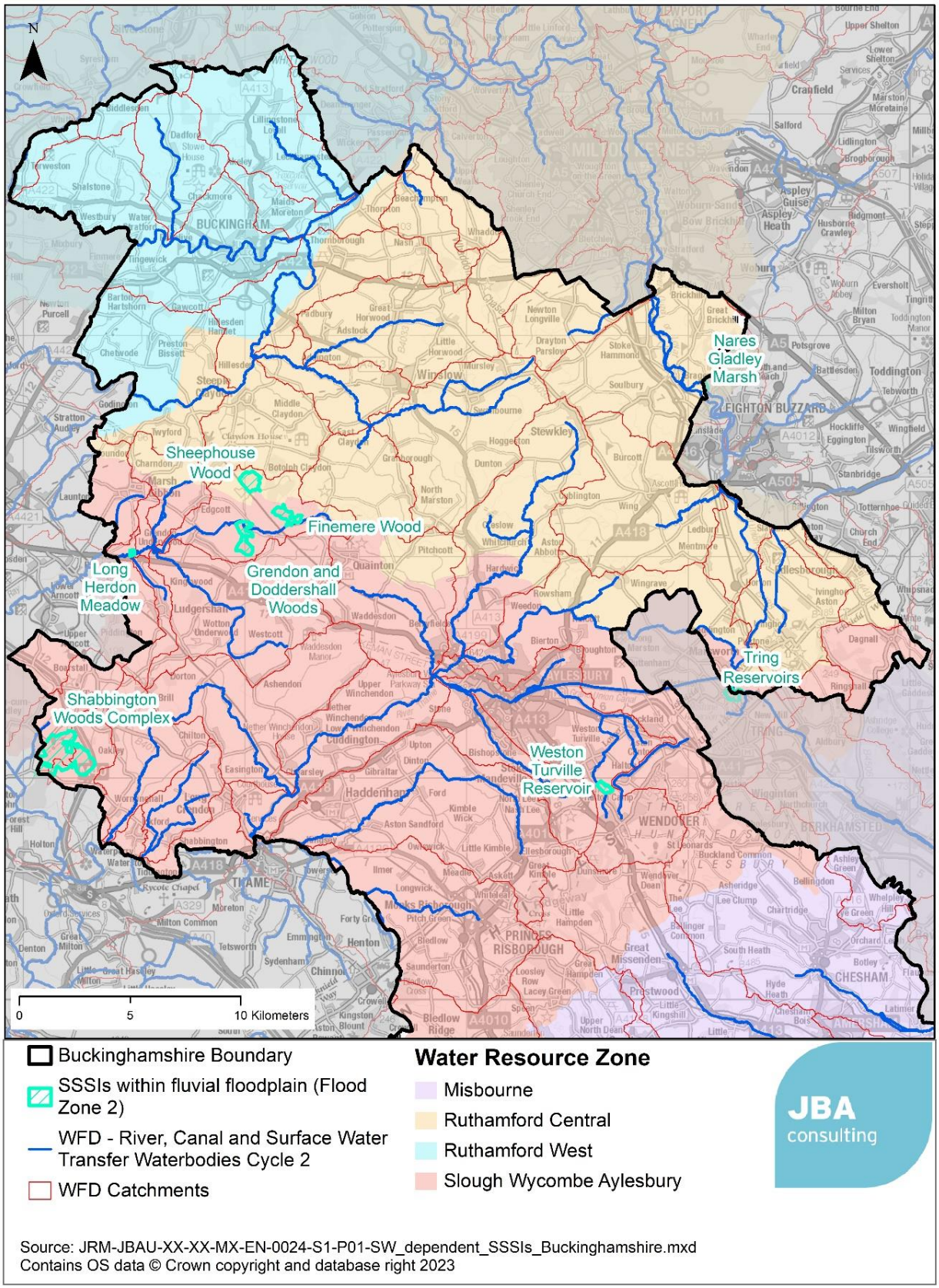



Figure 9.5 Protected sites adjacent to surface waterbodies within WRZs serving Buckinghamshire (North)

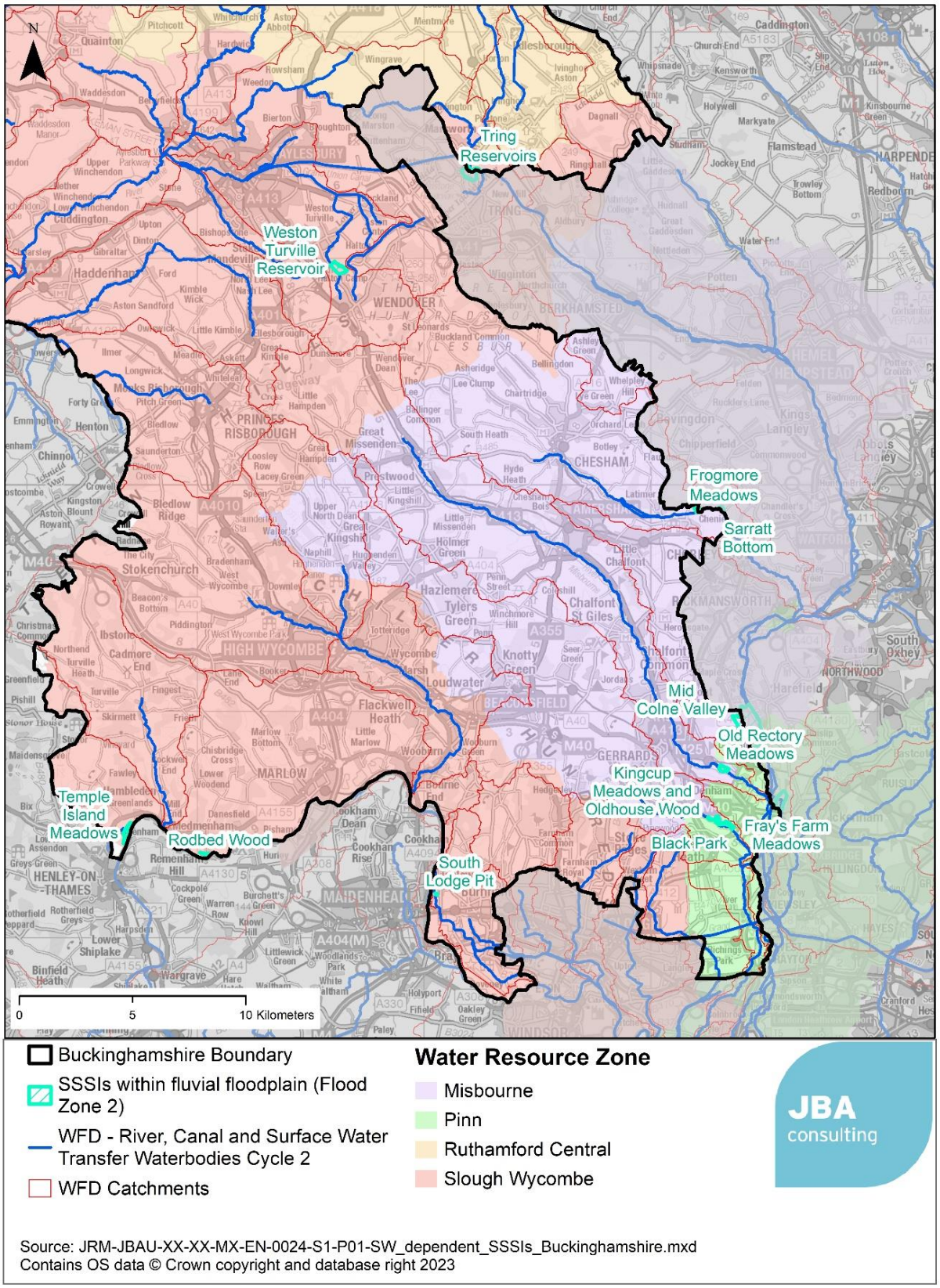



Figure 9.6 Protected sites adjacent to surface waterbodies within WRZs serving Bucks (South)

## 9.3 Water quality impact

### 9.3.1 Sources of pollution

Water pollution is usually categorised as either diffuse or point source. Point source sources come from a single well-defined point, an example being the discharge from a WwTW.

Diffuse pollution is defined as “unplanned and unlicensed pollution from farming, old mine workings, homes and roads. It includes urban and rural activity and arises from industry, commerce, agriculture and civil functions and the way we live our lives.”

Examples of diffuse sources of water pollution include:

- Contaminated runoff from roads – this can include metals and chemicals
- Drainage from housing estates
- Misconnected sewers (foul drains to surface water drains)
- Accidental chemical/oil spills from commercial sites
- Surplus nutrients, pesticides and eroded soils from farmland
- Septic tanks and non-mains sewer systems

The most likely sources of diffuse pollution from new developments include drainage from housing estates, runoff from roads and discharges from commercial and industrial premises. The pollution risk posed by a site will depend on the sensitivity of the receiving environment, the pathway between the source of the runoff and the receiving waters, and the level of dilution available. After or during heavy rainfall, the first flush of water carrying accumulated dust and dirt is often highly polluting.

Whilst the threat posed by an individual site may be low, a number of sites together may pose a cumulative impact within the catchment.

Runoff from development sites should be managed by a suitably designed SuDS scheme. More information on SuDS can be found in Section 9.4.2. Potential impacts on receiving surface waters include the blanketing of riverbeds with sediment, a reduction in light penetration from suspended solids, and a reduction in natural oxygen levels, all of which can lead to a loss in biodiversity.

### 9.3.2 Pathways

Pollutants can take a number of different pathways from their source to a “receptor” – a habitat or species that can be impacted. This could be overland via surface water flow paths, via the river system, or via groundwater or a combination of all three. For the purpose of this study, it should be assumed at any protected site has the potential to be impacted by surface runoff from adjacent development sites. Linkages between development sites and protected sites will be explored further in Stage 2 once potential allocations are identified. The potential for a protected site to be impacted by

pollution from WwTWs via the river system will be explored by a screening exercise in Stage 1 and water quality modelling in Stage 2.

### 9.3.3 Receptors

A receptor in this case is a habitat or species that is adversely impacted by a pollutant. Both the rivers and groundwater as well as being pathways, can also be considered to be receptors. Groundwater bodies are also given a status under the WFD which is reported in Section 4.1.4 for the groundwater bodies across Buckinghamshire.

Within the study area and downstream are many sites with environmental designations such as:

- Special Areas of Conservation (SAC) (and candidate SACs)
- Special Protection Areas (SPA) (and candidate SPAs)
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites (Wetlands of International Importance) (and potential Ramsar sites)
- Priority Habitats and Priority Headwaters

Protected sites within Buckinghamshire can be seen in Figure 9.7 and Figure 9.8.

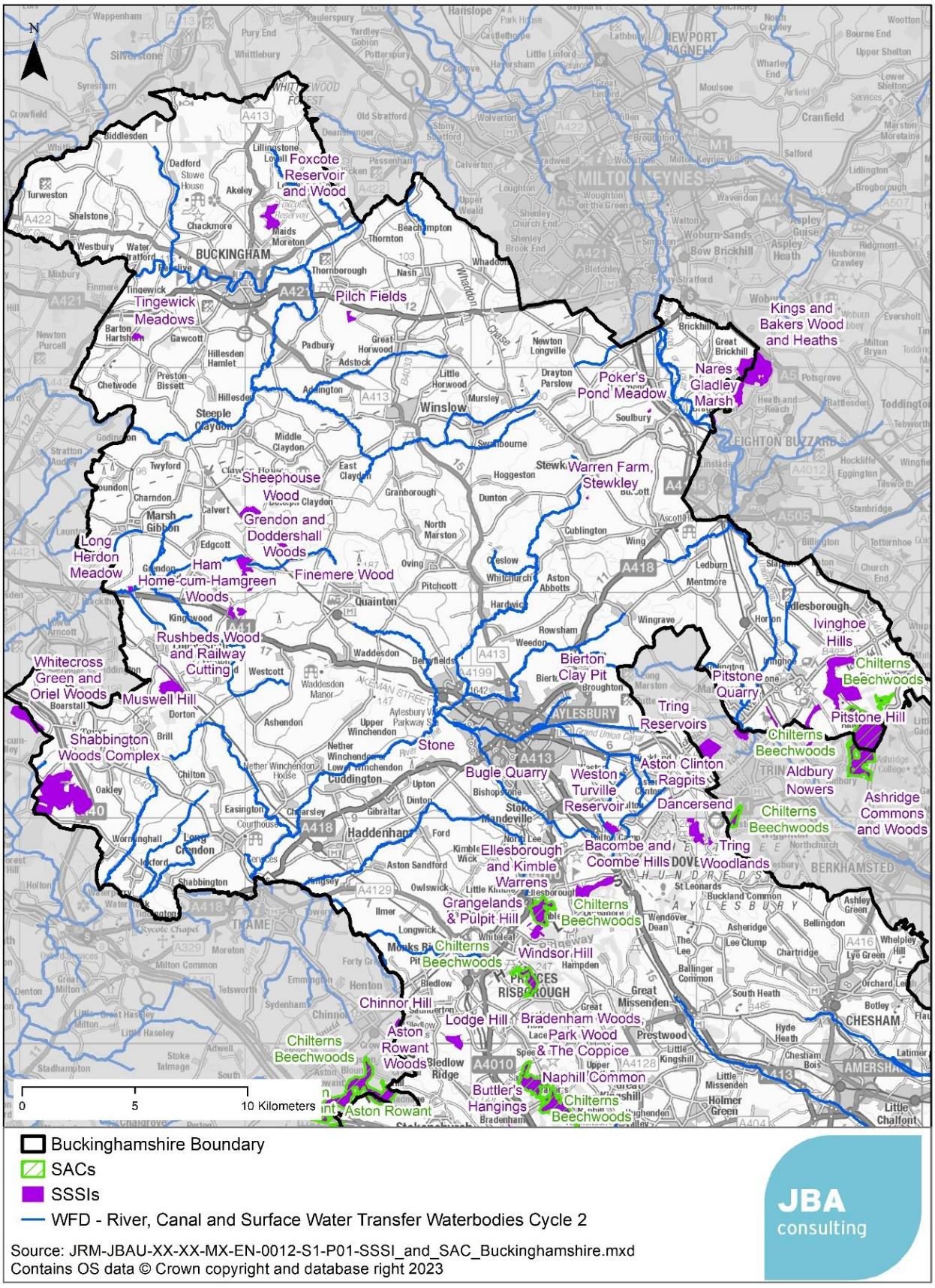



Figure 9.7 Protected sites in the North of Buckinghamshire

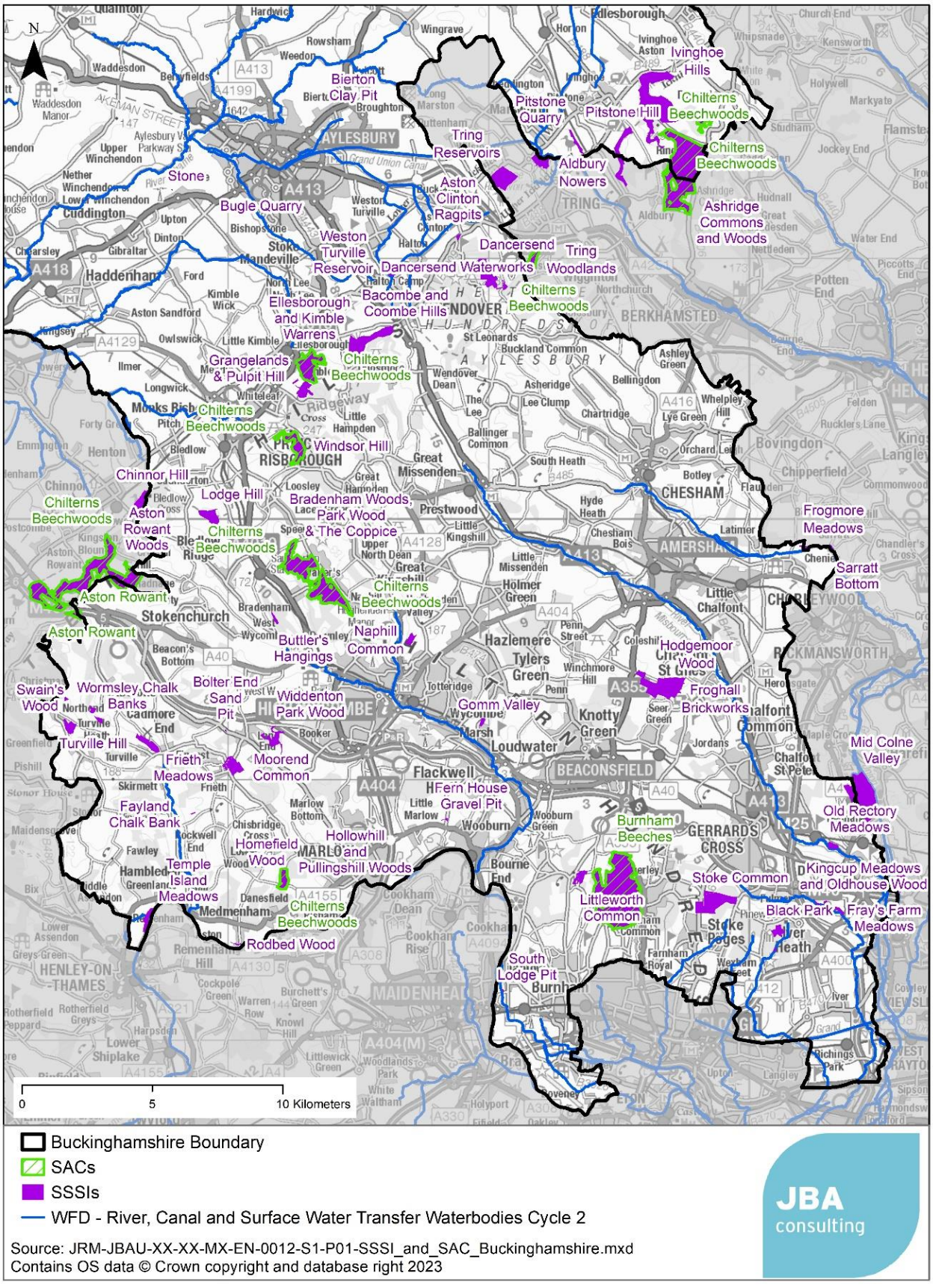



Figure 9.8 Protected sites in the South of Buckinghamshire

Note: there are no SPA or Ramsar sites within Buckinghamshire.

All of these sites should be considered to be at risk from surface water runoff should development occur in the vicinity. This will be explored further in Stage 2 once potential development sites are available.

Protected sites within Buckinghamshire which may be at risk from an increase in the discharge of treated effluent due to growth are identified in Table 9.3 to Table 9.5. The relevant legislation that defined and protects them can be found in Section 3. Further protected sites are present in watercourses downstream of Buckinghamshire and may be impacted by increases in discharge within Buckinghamshire. These are listed in Appendix F.

In order to identify protected sites that may be at risk, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either adjacent to a river or could be reasonably expected to receive water from a river. This method has limitations in that pathways between ordinary watercourses and protected sites may not be identified. A manual check will be performed in Stage 2 before water quality modelling is undertaken. Where a WwTW was present in the catchment upstream of the protected site, it was considered that there was a risk of deterioration in water quality due to growth during the local plan period, and the first WwTW upstream of the site is reported in the table (other WwTWs must also be considered in future analysis). Where there were no WwTWs serving growth upstream, risk of deterioration is considered to be low, and would not be shown by water quality modelling. However, in these cases the overall catchment water quality should be considered where for example they are designated for migratory fish species that may spend part of their lifecycle elsewhere in the catchment.

Priority Habitats are available to view on the DEFRA Magic Map website[34].

34 DEFRA Magic Map- https://magic.defra.gov.uk/magicmap.aspx

Table 9.3 SAC sites which could be affected by a change in WwTW discharge

| Site | Reference | First Upstream WwTW |
|---|---|---|
| Windsor Forest & Great Park | SU952727 | Slough |
| Chilterns Beechwoods (Bisham Woods SSSI component of SAC) | SP974133 | Hurley |

Table 9.4 SSSI sites which could be affected by a change in WwTW discharge

| Site | Reference | First Upstream WwTW |
|---|---|---|
| Weston Turville Reservoir | SP862095 | Aylesbury |
| Kingcup Meadows and Oldhouse Wood | TQ033850 | Maple Lodge |
| Old Rectory Meadows | TQ032874 | Maple Lodge |
| Bray Pennyroyal Field | SU915782 | Little Marlow |
| Bray Meadows | SU898800 | Little Marlow |
| Windsor Forest and Great Park | SU961718 | Slough |
| Wraysbury & Hythe End Gravel Pits | TQ009735 | Slough |
| Wraysbury No. 1 Gravel Pit | TQ003747 | Slough |
| Staines Moor | TQ043731 | Slough |
| Wraysbury Reservoir | TQ025745 | Slough |
| Denham Lock Wood | TQ054863 | Maple Lodge |
| Fray's Farm Meadows | TQ057860 | Maple Lodge |
| Mid Colne Valley | TQ043894 | Maple Lodge |
| Arncott Bridge Meadows | SP608185 | Bicester |
| Wendlebury Meads and Mansmoor Closes | SP561175 | Bicester |
| Howe Park Wood | SP832343 | Cotton Valley |
| Oxley Mead | SP819348 | Cotton Valley |

Table 9.5 Ramsar and SPA sites which could be affected by a change in WwTW discharge

| Site | Reference | First Upstream WwTW |
|---|---|---|
| South West London Waterbodies | TQ042729 | Slough |

JBA are aware of specific concerns relating to water levels affecting Burnham Beeches SAC / SSSI. These are documented in a Development Management Guidance Note[35]. An important feature of the SSSI is a mire which is fed Withy Stream and surface water from the surrounding catchment. Currently all planning applications within the upstream catchment are subject to a hydrology report. This will be investigated further in Stage 2.

## 9.4 Protection and mitigation

### 9.4.1 Groundwater Protection

Groundwater is an important source of water in England and Wales.

The Environment Agency is responsible for the protection of "controlled waters" from pollution under the Water Resources Act 1991. These controlled waters include all watercourses and groundwater contained in underground strata.

The zones are based on an estimate of the time it would take for a pollutant which enters the saturated zone of an aquifer to reach the source of abstraction or discharge point (Zone 1 = 50 days, Zone 2 = 400 days, Zone 3 is the total catchment area). The Environment Agency will use Source Protection Zones (SPZs) alongside other datasets such as the Drinking Water Protected Areas (DrWPAs) and aquifer designations as a screening tool to show:

- Areas where the EA would object in principle to certain potentially polluting activities, or other activities that could damage groundwater,
- Areas where additional controls or restrictions on activities may be needed to protect water intended for human consumption,
- How it prioritises responses to incidents.

The EA have published a position paper[36] outlining its approach to groundwater protection which includes direct discharges to groundwater, discharges of effluents to ground and surface water runoff. This is of relevance to this water cycle study where a development may manage surface water through SuDS.

**Sewage and Trade Effluent**

Discharge of treated sewage of 2m$^3$ per day or less to ground are called small sewage discharges (SSDs). The majority of SSDs do not require an environmental permit if

35 https://buckinghamshire-gov-uk.s3.amazonaws.com/documents/DM_guidance_note_on_BB_Final_1.pdf

36 The Environment Agency's approach to groundwater protection, Environment Agency (2018). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Envirnment-Agency-approach-to-groundwater-protection.pdf on: 10/02/2023.

they comply with certain qualifying conditions. A permit will be required for all SSDs in source protection zone 1 (SPZ1).

For treated sewage effluent discharges, the EA requires the use of shallow infiltration systems, which maximise the attenuation within the drainage blanket and the underlying unsaturated zone. Whilst some sewage effluent discharges may not pose a risk to groundwater quality individually, the cumulative risk of pollution from aggregations of discharges can be significant. Improvement or pre-operational conditions may be imposed before granting an environmental permit. The EA will only agree to developments where the addition of new sewage effluent discharges to ground in an area of existing discharges is unlikely to lead to an unacceptable cumulative impact.

Generally, the Environment Agency will only agree to developments involving release of sewage effluent, trade effluent or other contaminated discharges to ground if it is satisfied that it is not reasonable to make a connection to the public foul sewer. The EA would normally expect to only permit new private discharges where the distance to connect to the nearest public sewer exceeds the number of dwellings multiplied by 30m. So, for example, a development of 100 dwellings would need to be more than 3km from a public sewer. The developer would have to provide evidence of why the proposed development cannot connect to the foul sewer in the planning application. This position will not normally apply to surface water run-off via sustainable drainage systems and discharges from sewage treatment works operated by sewerage undertakers with appropriate treatment and discharge controls.

Deep infiltration systems (such as boreholes and shafts) are not generally accepted by the EA for discharge of sewage effluent as they bypass soil layers and reduce the opportunity for attenuation of pollutants.

Discharges of surface water run-off to ground at sites affected by land contamination, or from sites for the storage of potential pollutants are likely to require an environmental permit. This could include sites such as garage forecourts and coach and lorry parks. These sites would be subject to a risk assessment with acceptable effluent treatment provided.

**Discharge of Clean Water**

“Clean water” discharges such as runoff from roofs or from roads, may not require a permit. However, they are still a potential source of groundwater pollution if they are not appropriately designed and maintained.

Where infiltration SuDS schemes are proposed to manage surface runoff they should:

- Be suitably designed;

- Meet Government non-statutory technical standards[37] for sustainable drainage systems – these should be used in conjunction with the NPPF and PPG; and
- Use a SuDS management treatment train

A hydrogeological risk assessment is required where infiltration SuDS is proposed for anything other than clean roof drainage in a SPZ1.

**Source Protection Zones in Buckinghamshire**

Source protection zones (SPZs) form a key part of the Environment Agency's approach to controlling the risk to groundwater supplies from potentially polluting activities and accidental releases of pollutants.

The Environment Agency's Manual for the Production of Groundwater Source Protection Zones[38], details position statements which provide information about the Environment Agency's approach to managing and protecting groundwater.

Proposed development locations within or close to Source Protection Zones, should be assessed in relation to the relevant Environment Agency position statements.

The Source Protections Zones (SPZs) that are present within Buckinghamshire are shown on Figure 9.9.

37 Sustainable Drainage Systems: non-statutory technical standards, Department for Environment, Food & Rural Affairs (2015). Accessed online at:
https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards
on: 10/02/2023.

38 Manual for the Production of Groundwater Source Protection Zones, Environment Agency (2019). Accessed online at:
https://www.gov.uk/government/publications/groundwater-source-protection-zones-spz-production-manual on: 10/02/2023.

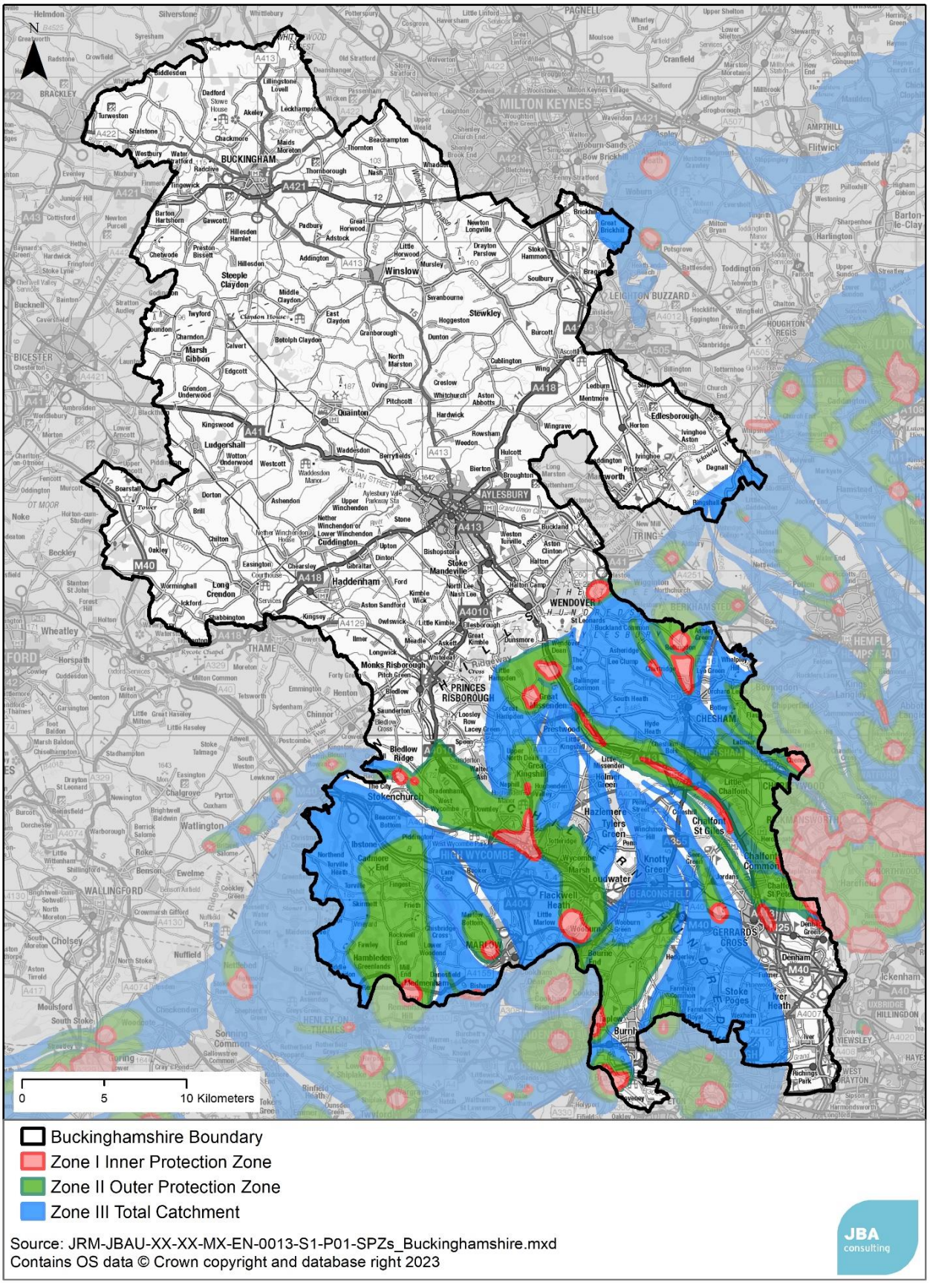



Figure 9.9 Source Protection Zones in Buckinghamshire

### 9.4.2 Surface Water Drainage and SuDS

Since April 2015[39], management of the rate and volume of surface water has been a requirement for all major development sites, through the use of Sustainable Drainage Systems (SuDS).

Lead Local Flood Authorities (LLFAs) are the statutory consultees to the planning system for surface water management within major development, which covers the following development scenarios:

- 10 or more dwellings
- a site larger than 0.5 hectares, where the number of dwellings is unknown
- a building greater than 1,000 square metres
- a site larger than 1 hectare

SuDS are drainage features which attempt to replicate natural drainage patterns, through capturing rainwater at source, and releasing it slowly into the ground or a water body. They can help to manage flooding through controlling the quantity of surface water generated by a development and improve water quality by treating urban runoff. SuDS can also deliver multiple benefits, through creating habitats for wildlife and green spaces for the community. SuDS also have the advantage of providing effective Blue and Green infrastructure and ecological and public amenity benefits when designed and maintained properly.

National standards on the management of surface water are outlined within the Defra Non-statutory Standards for Sustainable Drainage Systems[40]. The CIRIA C753 SuDS Manual[41] and Guidance for the Construction of SuDS[42] provide the industry best practice guidance for design and management of SuDS.

Local guidance, provided by the Lead Local Flood Authorities covering the study area, is detailed below:

39 House of Commons: Written Statement (HCWS161) Written Statement made by: The Secretary of State for Communities and Local Government (Mr Eric Pickles) on 18 Dec 2014. Accessed online at:
https://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf on: 10/02/2023.

40 Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems, DEFRA (2015). Accessed online at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf on: 10/02/2023.

41 CIRIA Report C753 The SuDS Manual, CIRIA (2015). Accessed online at:
https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx on: 10/02/2023.

42 Guidance on the Construction of SuDS (C768), CIRIA (2017), Accessed online at:
https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK on: 10/02/2023.

- Buckinghamshire Council is the LLFA and plays a key role in ensuring that the proposed drainage schemes for all new developments comply with technical standards and policies in relation to SuDS. The "Sustainable Drainage Systems (SuDS): guidance for developers"[43] contains guidance for the design and application of SuDS in the county.

The UK Government is in the process of implementing Schedule 3 of the Flood and Water Management Act. In January 2023, the UK Government released their report setting out the findings of a review into the implementation of Schedule 3 of The Flood and Water Management Act 2010, which outlined the possibility of LLFAs becoming a SuDS Approving Body (SAB). This would create a new process for the approval and adoption of SuDS, separate to the planning system.

Enactment of Schedule 3 would also remove the automatic right to connect surface water into the public sewer network. Instead, the right to connect would become conditional upon the drainage system being approved by the SAB, in consultation with the Water and Sewerage Companies, before construction can commence. The SAB approval will be separate from the planning application system; applicants' schemes would need to be approved both by the SAB and the Local Planning Authority.

### 9.4.3 Use of SuDS in Water Quality Management

SuDS allow the management of diffuse pollution generated by urban areas through the sequential treatment of surface water reducing the pollutants entering lakes and rivers, resulting in lower levels of water supply and wastewater treatment being required. This treatment of diffuse pollution at source can contribute to meeting WFD water quality targets, as well as national objectives for sustainable development.

This is usually facilitated via a SuDS Management Train of a number of components in series that provide a range of treatment processes delivering gradual improvement in water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site. Considerations for SuDS design for water quality are summarised in Table 9.6 below.

43 Sustainable Drainage Systems (SuDS): guidance for developers (2022). Accessed online at:
https://www.buckinghamshire.gov.uk/environment/flooding-and-flood-risk-management/submitting-a-surface-water-drainage-strategy-guidance/flooding-guidance-for-developers/design-standards-for-suds-components/ on: 10/02/2023.

Table 9.6 Considerations for SuDS Design for Water Quality

| Goal | Action |
|---|---|
| Manage surface water close to source | Where practicable, treatment systems should be designed to be close to source of runoff.<br>It is easier to design effective treatment when the flow rate and pollutant loadings are relatively low.<br>Treatment provided can be proportionate to pollutant loadings and sensitivity receptor.<br>Accidental spills or other pollution events can be isolated more easily without affecting the downstream drainage system.<br>Encourages ownership of pollution.<br>Poor treatment performance or component damage/ failure can be dealt with more effectively without impacting on the whole site. |
| Treat surface water runoff on the surface | Where practicable, treatment systems should be designed to be on the surface.<br>Where sediments are exposed to UV light, photolysis and volatilisation processes can act to break down contaminants.<br>If sediment is trapped in accessible parts of the SuDS, it can be removed more easily as part of maintenance.<br>It enables use of evapotranspiration and some infiltration to the ground to reduce runoff volumes and associated total contamination loads (provided risk to groundwater is managed appropriately).<br>It allows treatment to be delivered by vegetation.<br>Sources of pollution can be easily identified.<br>Accidental spills or misconnections are visible immediately and can be dealt with rapidly.<br>Poor treatment performance can be easily identified during routine inspections, and remedial works can be planned efficiently. |
| Treat surface water runoff to remove a range of contaminants | SuDS design should consider the likely presence and significance of any contaminant that may pose a risk to the receiving environment.<br>The SuDS component or combination of components selected should include treatment processes that, in combination, are likely to reduce this risk to acceptably low levels. |
| Minimise risk of sediment remobilisation | The SuDS design should consider and mitigate the risks of sediments (and other contaminants) being remobilised and washed into receiving surface waters during events greater than those which the component has been specifically designed for. |
| Minimise impacts from accidental spills | By using several components in series, SuDS can help ensure that accidental spills are trapped in/on upstream component surfaces, facilitating contamination management and removal.<br>The selected SuDS components should deliver a robust treatment |

| Goal | Action |
|---|---|
| | design that manages risks appropriately - considering the uncertainty and variability of pollution loadings, sensitivity of receptors and treatment processes. |

Managing pollution close to its source can help keep pollutant levels and accumulation rates low, allowing natural processes to be more effective. Treatment can often be delivered within the same components that are delivering water quantity design criteria, requiring no additional cost or land-take.

SuDS designs should control the 'first flush' of pollutants (usually mobilised by the first 5mm of rainfall) at source, to ensure contaminants are not released from the site. Best practise is that no runoff should be discharged from the site to receiving watercourses or sewers for the majority of small (e.g., less than 5mm) rainfall events.

Infiltration techniques will need to consider Groundwater Source Protection Zones and are likely to require consultation with the Environment Agency. Early consideration of SuDS within master planning will typically allow a more effective scheme to be designed.

Further guidance on designing SuDS to reduce phosphorus[44] and nitrogen[45] in surface water runoff can be found in the relevant CIRIA guidance documents.

### 9.4.4 Additional Benefits

**Flood Risk**

The Buckinghamshire Level 1 SFRA contains recommendations for SuDS to manage surface water on development sites, with the primary aim of reducing flood risk.

SuDS are most effective at reducing flood risk for relatively high intensity, short and medium duration events, and are particularly important in mitigating potential increases in surface water flooding, sewer flooding and flooding from small and medium sized watercourses resulting from development.

**Water Resources**

A central principle of SuDS is the use of surface water as a resource. Traditionally, surface water drainage involved the rapid disposal of rainwater, by conveying it directly into a sewer or wastewater treatment works.

44 CIRIA (2022) Using SuDS to reduce phosphorus in surface water runoff (C808F). Accessed online at: Using SuDS to reduce phosphorus in surface water runoff (ciria.org) on: 05/12/2023.

45 CIRIA (2023) Using SuDS to reduce nitrogen in surface water runoff (C815F). Accessed online at: New guidance for Using SuDS to reduce nitrogen in surface water runoff (ciria.org) on: 05/12/2023.

SuDS techniques such as rainwater harvesting, allow rainwater to be collected and re-used as non-potable water supply within homes and gardens, reducing the demand on water resources and supply infrastructure.

**Climate Resilience**

Climate projections for the UK suggest that winters may become milder, and wetter and summers may become warmer, but with more frequent higher intensity rainfall events, particularly in the south east. This would be expected to increase the volume of runoff, and therefore the risk of flooding from surface water, and diffuse pollution, and reduce water availability.

SuDS offer a more adaptable way of draining surfaces, controlling the rate and volume of runoff leaving urban areas during high intensity rainfall, and reducing flood risk to downstream communities through storage and controlled release of rainwater from development sites.

Through allowing rainwater to soak into the ground, SuDS are effective at retaining soil moisture and groundwater levels, which allows the recharge of the watercourses and underlying aquifers. This is particularly important where water resource availability is limited, and likely to become increasingly scarce under future drier climates**.**

**Biodiversity**

The water within a SuDS component is an essential resource for the growth and development of plants and animals, and biodiversity benefits can be delivered even by very small, isolated schemes. The greatest value can be achieved where SuDS are planned as part of a wider green landscape, providing important habitat, and wildlife connectivity. With careful design, SuDS can provide shelter, food, foraging and breeding opportunities for a variety of species including plants, amphibians, invertebrates, birds, bats and other animals.

**Amenity**

Designs using surface water management systems to help structure the urban landscape can enrich its aesthetic and recreational value, promoting health and well-being and supporting green infrastructure. Water managed on the surface rather than underground can help reduce summer temperatures, provide habitat for flora and fauna and act a resource for local environmental education programmes and working groups and directly influence the sense of community in an area. Although there are few comparative studies, the sites compared in available studies indicate that SuDS are more cost-effective than traditional drainage systems[46].

46 Susdrain (2023) Comparisons of costs and benefits. Available at: Comparison of costs and benefits (susdrain.org)

**Kingsbrook, Aylesbury - SuDS Case Study**

As part of the Kingsbrook, a new neighbourhood on the edge of Aylesbury, Barratt Homes and David Wilson Homes worked with the RSPB and the former Aylesbury Vale District Council to deliver a SuDS scheme which created habitats for wildlife, while improving the quality of life for the new community. The design included a network of swales to collect and convey surface water runoff along the ground surface, which then discharged into a series of storage ponds. It also included the creation of the wetland habitat of Oakfield Lake Nature reserve. Footpaths, benches and viewing platforms were designed to overlook the water features. The banks of the ponds were planted with native wildflowers, and less than one year after the first ponds were installed, the RSPB recorded egrets and several species of dragonfly[47].

Figure 9.10: Seating area and footpath overlooking water feature at Kingsbrook development site, Aylesbury (Credit: JBA)

47 Ponds and streams: information for Kingsbrook residents. Available at: 4-suds-information-sheet-v4.pdf (kingsbrook-aylesbury.co.uk)

Figure 9.11: Homes overlooking drainage feature in Kingsbrook, Aylesbury (Credit: JBA)

### 9.4.5 Suitable SuDS Techniques

The hydraulic and geological characteristics of each property development site across Buckinghamshire should be assessed to identify the most appropriate forms of surface water management and any constraining factors to the utilisation of SuDS. These assessments are designed to inform the early-stage site planning process and should be followed up the site-specific detailed drainage assessments.

Appropriate SuDS techniques have been categorised into five main groups, as shown in Table 9.7, with further details provided on the Susdrain website[48]. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 9.7 Summary of SuDS Categories

| SuDS Type[49] | Technique |
|---|---|
| Source Control | Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens |
| Infiltration | Infiltration Trench, Infiltration Basin, Soakaway |
| Detention | Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin |
| Filtration | Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench |
| Conveyance[50] | Dry Swale, Under-drained Swale, Wet Swale |

### 9.4.6 Natural Flood Management

Natural Flood Management (NFM) is used to protect, restore, and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g., people, property, infrastructure, etc.).

Techniques and measures, which could be applied in Buckinghamshire include:

- Peatland and moorland restoration in upland catchments
- Offline storage areas
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains

48 SuDS components overview (susdrain.org)
49 SuDS components overview (susdrain.org)
50 Swales & conveyance channels overview (susdrain.org)

- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS

In 2017, the Environment Agency published an online evidence base[51] to support the implementation of NFM and with JBA produced maps showing locations with the potential for NFM measures[52]. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps; however, it is a useful tool to help start dialogue with key partners.

### 9.4.7 Multiple Benefits of NFM

In addition to flood risk benefits, there are also significant benefits in other areas such as habitat provision, air quality, climate regulation and water quality.

Many NFM measures have the ability to reduce nutrient and sediment sources by reducing surface runoff flows from higher ground, reducing soil erosion, trapping sediment at the edge of agricultural land, or encouraging deposition of sediments behind natural dams upstream in watercourses.

Suitable techniques may include:

- Leaky dams
- Woodland planting
- Buffer strips
- Runoff retention ponds
- Land management techniques (soil aeration, cover crops etc.)

**Case Study - Black Brook Slow the Flow**

Four engineered log dams were installed on Black Brook at an estimated cost of £2,000, funded by Natural England and the Environment Agency to restore Stanley Bank SSSI. The scheme aimed to improve habitat and reduce the risk of flooding. However, the scheme also resulted in reduced levels of phosphate and nitrate in

51 Working with natural processes to reduce flood risk, Environment Agency (2018). Accessed online at: https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk on: 10/02/2023.

52 Mapping the potential for working with natural process, Environment Agency and JBA (2017). Accessed online at: https://www.arcgis.com/home/item.html?id=7315f943998847e2b3797a85665f5438 on: 10/02/2023.

Black Brook, with phosphate concentrations falling by 3.6mg/l. By 2035, it is predicted that 792m$^3$ of sediment will be stored in three ponds retained by the dams.

*Reproduced from Case Study 17. Black Brook Slow the Flow, St Helens, Norbury, Rogers and Brown, EA WwNP Evidence Base 2017. Photograph taken on 8 May 2015; courtesy of Matthew Catherall*

### 9.4.8 Integrated Constructed Wetlands

An integrated constructed wetland (ICW) is an artificial wetland created for the purpose of treating polluted water, whether this is municipal wastewater, grey water from residential properties, or agricultural runoff.

They are usually unlined, free surface flow wetlands, designed to contain and treat influents within emergent vegetated areas.

Defra carried out a systematic review of the effectiveness of various wetland types, including ICWs for mitigating agricultural pollution such as phosphate and nitrate. The overall conclusion was that all wetland types are very effective at reducing major nutrients and suspended sediments, with the exception of nitrite in ICWs. Nitrate is only reduced when passing through overland buffer strips and through constructed wetlands with vegetation, where the systematic review showed a mean reduction of 29% across the evidence included in the study.

The mean reduction in Total Phosphorus across the evidence base was 78%. The EA have advised that although ICWs have been shown to be effective at "polishing" final effluent discharges to help achieve the lower end of phosphate removal, the effectiveness of treating high levels of phosphate is less certain.

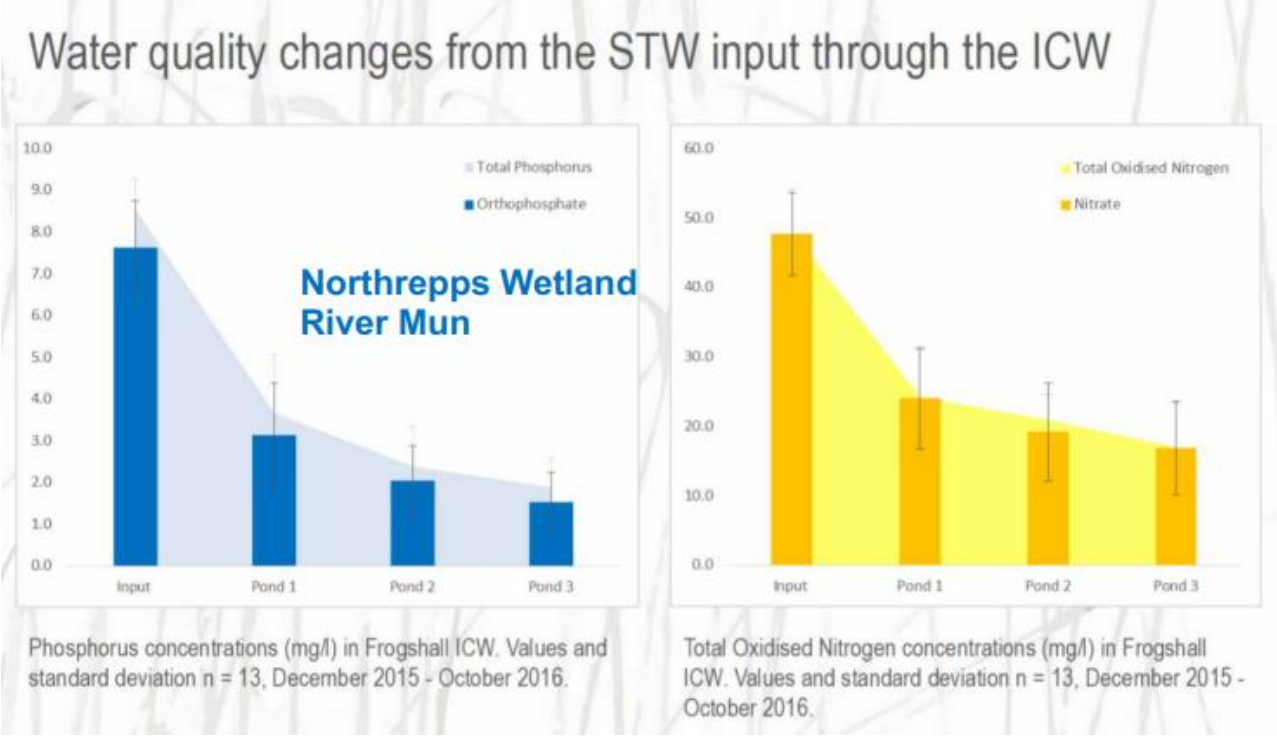
Other techniques to manage nutrients are possible such as catchment nutrient balancing, where excess nutrients are managed at a catchment level, as well as catchment permitting. These techniques are recommended where environmental capacity is restrictive to growth. TW is not eligible for this due to a low Environmental Performance Assessment (EPA) rating. The situation for Anglian Water and Affinity Water is unknown and will be investigated in Stage 2.

**Case Study - Frogshall ICW**

The Upper River Mun in Norfolk was experiencing chronic pollution, and a loss in biodiversity in the river. Investigation found that nutrients from a Sewage Treatment Works upstream were contributing to this issue.

A pilot ICW was created consisting of three shallow ponds, filled with 18,000 emergent aquatic plants, and the outfall from the treatment works was diverted to pass through the wetland.

Early monitoring has shown that 90% of the phosphate is being removed by the wetland, and a large increase in biodiversity downstream observed.




*Reproduced from "Stripping the Phosphate" a presentation by the Norfolk Rivers Trust (2018). https://www.theriverstrust.org/media/2018/08/2.-Stripping-the-phosphate-David-Diggens-Norfolk-Rivers-Trust.pdf*

### 9.4.9 Agricultural Management

The Environment Agency's 'Reason for Not Achieving Good' database indicates that one of the reasons for some of the watercourses in the area not to meet 'Good' WFD standards can be related to agriculture and rural land use. The cause of this includes pollution from fertilisers, manures, pesticides and soils washing into streams when it rains or percolating into the groundwater. Other pressures from agriculture include deepening, widening or re-routing of streams for land drainage, gravel removal and bankside erosion.

There is a big potential to improve water quality by interventions aimed at agricultural sources, especially considering the measures already taken by the water companies to reduce their contribution to phosphate load.

Potential schemes could include:

- Buffer strips
- Cross slope tree planting
- Runoff retention basins
- Contour ploughing
- Cover crops

There is considerable overlap with NFM measures, and the challenges are also very similar. Exact impacts are difficult to measure, although modelling tools such as Farmscoper[53] exist to help with this. Once a scheme is implemented it relies on the landowner to continue to maintain it in order to maintain the mitigation benefit.

Funding for agricultural interventions could come from Catchment Sensitive Farming or a Payment for Ecosystem Services approach.

**Case Study - Wessex Water - EnTrade**

Wessex Water catchment team used EnTrade to invite farmers to bid to grow cover crops over winter to reduce the nitrogen leaching into the watercourse.

This avoided the need to upgrade Dorchester WwTW to provide the same nitrogen removal capacity.

A trial auction was held in 2015, and two further auctions have since taken place attracting 557 bids from 63 farmers to save 153 tonnes of nitrogen.

53 Farmscoper webpage, ADAS (2020). https://www.adas.uk/Service/farmscoper Accessed on 10/02/2023.

*“Using EnTrade to create a market in measures to deliver reductions in nitrogen has delivered a 30% saving for Wessex Water compared to traditional catchment approaches.” - Ruth Barden, Director of Environmental Strategy, Wessex Water*

### 9.4.10 Barriers

Whilst there are many benefits to implementing NFM and constructed wetlands, or modifying agricultural practises, the impact of these techniques is hard to quantify, and relies on ongoing maintenance to maintain that benefit. Where a potential scheme is not on a development site it will also require permission and support of the landowner. It may not be possible to influence this through planning policy.

## 9.5 Conclusions

- The potential impact of development on a number of protected sites such as SAC and SSSIs within, or downstream of the study area should be carefully considered in future plan making. There are also a large number of Priority Habitats within Buckinghamshire.
- There are a number of groundwater Source Protection Zones (SPZs) within Buckinghamshire. The impact of future development on groundwater should be investigated fully.
- Development sites within the study area could be sources of diffuse pollution from surface runoff.
- SuDS are required on all development sites. Their design should consider both water quantity and water quality and site level investigations should be undertaken to define the most appropriate SuDS types for each specific development.

- Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity.
- Buckinghamshire Council should be consulted at an early stage of development to ensure that SuDS are implemented and designed in response to site characteristics and policy factors.
- In the wider area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.

## 9.6 Recommendations

Table 9.8 Recommendations for Environmental Constraints and Opportunities

| Action | Responsibility | Timescale |
|---|---|---|
| Consider the environmental impact of development on protected sites downstream of receiving wastewater treatment works in the Habitats Regulations Assessment | Buckinghamshire Council | Local Plan Development |
| The Local Plan should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in line with the relevant legislation and where stated, in consultation with Natural England (for national and international designations and priority habitats). | Buckinghamshire Council | Ongoing |
| The Local Plan should include policies that require development sites to adopt SuDS to manage water quality of surface runoff. | Buckinghamshire Council | Ongoing |
| In partnership, identify opportunities for incorporating SuDS into open spaces and green infrastructure, to deliver strategic flood risk management and meet WFD water quality targets. | Buckinghamshire Council, Anglian Water, Thames Water, Affinity Water, Environment Agency, Bedford Group of Drainage Boards | Ongoing |
| Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme. | Developers | Ongoing |
| Work with developers to discourage connection of new developments into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding. | Buckinghamshire Council, developers | Ongoing |

| Action | Responsibility | Timescale |
|---|---|---|
| Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution within Buckinghamshire. | Buckinghamshire Council, Environment Agency, Natural England | Ongoing |

# 10 Summary of overall conclusions and recommendations

## 10.1 Conclusions

| Assessment | Conclusion |
|---|---|
| Water resources | Buckinghamshire receives its water from Thames Water, Anglian Water and Affinity Water. Buckinghamshire is within the following Water Resources Zones (WRZ):<br>- Swindon and Oxfordshire,<br>- Slough, Wycombe and Aylesbury,<br>- Ruthamford West,<br>- Ruthamford Central,<br>- Misbourne and<br>- Pinn<br>. In some WRZs, the forecast percentage growth is lower than the expected growth during the Local Plan period. This should be investigated further in Stage 2 once the water companies' final Water Resource Management Plans (WRMP24) have been published.<br>The Water Industry National Environment Programme (WINEP) is a set of actions that the EA have requested all 20 water companies operating in England to complete in a particular Asset Management Period (AMP) as part of their environmental commitments. A number of investigations are planned or underway to ensure that abstraction of water from both groundwater and rivers is not leading to unsustainable reductions in flow, particularly in chalk streams. Development and population growth can increase abstraction, and so BC have an opportunity to contribute to these actions indirectly by pursuing policies that promote water efficiency in new development.<br>It is important that new development does not result in an unsustainable increase in water abstraction. This can be done in a number of ways from reducing the water demand from new houses through to achieving “water neutrality” in a region by offsetting a new developments water demand by improving efficiency in existing buildings.<br>There is sufficient evidence to recommend the optional 110 litres per person per day design standard allowed under Building Regulations. This should be supported by an equivalent non-household water efficiency target, for example a minimum of 3 credits under the measure |

| Assessment | Conclusion |
|---|---|
| | "Wat01" BREEAM measure which provides a 40% improvement in water consumption compared to the baseline for that type of building.<br>Water resources are under significant pressure in the UK, and the direction of travel in water resources planning is to reduce per capita consumption in new build development below the optional building regulations standard of 110 l/p/d.<br>Despite this, given the evidence of pressures on the environment, particularly rare chalk streams, and on public water supply, it is recommended that the Council considers a domestic water efficiency target of 100l/p/d for all new homes, in line with proposals in the Defra Plan for Water, and works with the water suppliers to incentivise even lower consumption.<br>This is supported by Thames Water's, Anglian Water, and Affinity Water's incentives for water efficient design in new builds outlined in 4.5 where significant incentives are offered to reduce design consumption below 110l/p/d. |
| Wastewater collection | Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on customers, and increasing the likelihood of storm overflow operation. Early engagement with developers, Thames Water and Anglian Water is required, and further modelling of the network may be required in the Stage 2 WCS and at the planning application stage. Furthermore, in the Thames Water and Anglian Water networks, there are areas where the current network is a combined sewer system, and further separation of foul and surface water may be required, as well as suitably designed SuDS.<br>Early engagement between developers, Buckinghamshire Council and Thames Water and Anglian Water is recommended to allow time for the strategic infrastructure required to serve these developments to be planned. |
| Wastewater treatment assessment | A headroom assessment was carried out comparing the current flow from each WwTW, making allowance for growth already planned, with the permit limit. This provides an estimate of the spare capacity in wastewater treatment infrastructure in Buckinghamshire.<br>Some of the WwTWs in the study area are expected to be close to or exceeding their permit during the Local Plan period. An increase in the permit limit, and / or upgrades to treatment capacity may be required at these WwTWs in order to accommodate further growth. |

| Assessment | Conclusion |
|---|---|
| | Consideration should be given where possible to using capacity in existing permits as this provides a lower carbon cost than upgrading capacity at existing WwTW or building new treatment works. This may however not always be feasible due to other local plan considerations.<br>There are a number of poorly performing storm tank overflows at WwTWs in Buckinghamshire. Growth within these catchments could result in an increase in the operations of these overflows contributing to a worsening of water quality in the area. Action should be taken by the water companies to address these overflows prior to an increase in wastewater demand being generated by new development.<br>New development proposed within the Thames Water and Anglian Water's WwTW odour buffer zones are recommended to undergo an odour assessment. |
| Water quality | The EA "reasons for not achieving good" (RNAG) dataset indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock and arable) are the main reasons for watercourses not achieving good status in this area.<br>Growth during the local plan period will also increase the discharge of treated wastewater from WwTWs in Buckinghamshire. There is a potential for this to cause a deterioration in water quality in the receiving watercourses and this must be carefully considered. A significant deterioration in water quality is not acceptable under the Water Framework Directive. The sensitivity analysis suggests that watercourses within Buckinghamshire may be sensitive to increases in the discharge of treated wastewater. Further modelling should be undertaken in the Stage 2 WCS. |
| Environmental constraints and opportunities | The potential impact of development on a number of protected sites such as SAC and SSSIs within, or downstream of the study area should be carefully considered in future plan making. There are also a large number of Priority Habitats within Buckinghamshire.<br>There are a number of groundwater Source Protection Zones (SPZs) within Buckinghamshire. The impact of future development on groundwater should be investigated fully.<br>Development sites within the study area could be sources of diffuse pollution from surface runoff.<br>SuDS are required on all development sites. Their design should consider both water quantity and water quality and |

| Assessment | Conclusion |
|---|---|
| | site level investigations should be undertaken to define the most appropriate SuDS types for each specific development.<br>Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity.<br>Buckinghamshire Council should be consulted at an early stage of development to ensure that SuDS are implemented and designed in response to site characteristics and policy factors.<br>In the wider area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation. |

## 10.2 Recommendations

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| Water resources | Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities. | Thames Water, Anglian Water, Affinity Water | Ongoing |
| Water resources | Provide yearly updated of projected housing growth to water companies to inform WRMP updates. | Buckinghamshire Council | Ongoing |
| Water resources | The council should consider a domestic water efficiency target of 100l/p/d for all new homes, and work with water suppliers to incentivise even lower consumption. This should be achieved using a fittings based approach.<br>This should be supported by an equivalent non-household water | Buckinghamshire Council | In Buckinghamshire LP |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| | efficiency target. | | |
| Water resources | The concept of water neutrality has the potential to provide a benefit in improving resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with the water companies and the Environment Agency how the Council's planning and climate change policies can encourage this approach.<br>This approach could have particular application in strategic sites and new settlements. | Buckinghamshire Council, Environment Agency, Thames Water, Anglian Water, Affinity Water | In Buckinghamshire LP |
| Water resources | Larger residential developments (including strategic urban extensions and as planned for new settlements), and commercial developments should consider incorporating greywater recycling and/or rainwater harvesting into development at the master planning stage in order to reduce water demand. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | In Buckinghamshire LP |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| Water resources | Water companies should advise Buckinghamshire Council of any strategic water resource infrastructure developments within the study, where these may require safeguarding of land to prevent other type of development occurring. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | Part of Buckinghamshire LP process |
| Water resources | Review this section of the WCS following publication of the Water Resource Management Plans for 2024. | Buckinghamshire Council, Thames Water, Anglian Water, Affinity Water | Stage 2 WCS |
| Water supply | Undertake network modelling to ensure adequate provision of water supply is feasible. | Water companies, Buckinghamshire Council | Ahead of planning applications |
| Water supply | Buckinghamshire Council and Developers should engage early with water companies to ensure infrastructure is in place prior to occupation. | Water companies, Buckinghamshire Council, developers | Ongoing |
| Water supply | Developers should engage early with water companies to ensure that the capacity of distribution systems is adequate prior to development coming forward | Water companies, developers | Ongoing |
| Wastewater network | Early engagement between Buckinghamshire Council and Thames Water and Anglian Water is required to ensure that where strategic infrastructure is required, it can be planned in by Thames Water and Anglian Water, and will not lead to any | Buckinghamshire Council, Thames Water and Anglian Water | Ongoing |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| | increase in discharges from sewer overflows. | | |
| Wastewater network | Take into account wastewater infrastructure constraints in phasing development in partnership with the sewerage undertaker. | Buckinghamshire Council, Thames Water and Anglian Water | Ongoing |
| Wastewater network | Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an Outline Drainage Strategy for sites. The Outline Drainage strategy should set out the following:<br>What – What is required to serve the site<br>Where – Where are the assets / upgrades to be located<br>When – When are the assets to be delivered (phasing)<br>Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and where required, used as a basis for a drainage planning condition to be set. | Buckinghamshire Council, Thames Water, Anglian Water and developers | Ongoing |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| Wastewater network | Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to surface water sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA. | Buckinghamshire Council as LLFA, developers | Ongoing |
| Wastewater treatment | Early engagement with Anglian Water and Thames Water is required to ensure that provision of WwTW capacity is aligned with delivery of development. | Buckinghamshire Council | Ongoing |
| Wastewater treatment | Provide Annual Monitoring Reports to Anglian Water and Thames Water detailing projected housing growth. | Buckinghamshire Council | Ongoing |
| Wastewater treatment | Anglian Water and Thames Water to assess growth demands as part of their wastewater asset planning activities and feedback to the Council if concerns arise. | Anglian Water, Thames Water | Ongoing |
| Wastewater treatment | Carry out an odour impact assessment for sites which fall within the buffer zone of WwTW. | Buckinghamshire Council, developers | During planning process. |
| Water quality | Provide annual monitoring reports to TW and AW detailing projected housing growth in the Local Authority | Buckinghamshire Council | Ongoing |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| Water quality | When preferred options for growth are identified, undertake water quality impact modelling as part of a Stage 2 WCS. | Buckinghamshire Council | Ongoing |
| Water quality | Take into account the full volume of growth (from Buckinghamshire and neighbouring authorities within the catchment when considering WINEP schemes or upgrades at WwTWs | Anglian Water and Thames Water | Ongoing |
| Environmental impact | Consider the environmental impact of development on protected sites downstream of receiving wastewater treatment works in the Habitats Regulations Assessment | Buckinghamshire Council | Local Plan Development |
| Environmental impact | The Local Plan should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in line with the relevant legislation and where stated, in consultation with Natural England (for national and international designations and priority habitats). | Buckinghamshire Council | Ongoing |
| Environmental impact | The Local Plan should include policies that require development sites to adopt SuDS to manage water quality of surface runoff. | Buckinghamshire Council | Ongoing |
| Environmental impact | In partnership, identify opportunities for incorporating SuDS into open spaces and green | Buckinghamshire Council, Anglian Water, Thames Water, Affinity | Ongoing |

| Aspect | Action | Responsibility | Timescale |
|---|---|---|---|
| | infrastructure, to deliver strategic flood risk management and meet WFD water quality targets. | Water, Environment Agency, Bedford Group of Drainage Boards | |
| Environmental impact | Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme. | Developers<br>Lead Local Flood Authority | Ongoing |
| Environmental impact | Work with developers to discourage connection of new developments into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding. | Buckinghamshire Council, developers | Ongoing |
| Environmental impact | Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution within Buckinghamshire. | Buckinghamshire Council, Environment Agency, Natural England | Ongoing |

# Appendices

## A WwTW Storm Overflows

Table 0.1: WwTW storm overflow frequency of operation and duration

| WwTW | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|
| Ashendon (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Ashley Green (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Aston Abbotts (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Aylesbury (TW) | 12 | 151.67 | 20 | 234.95 | 2 | 7.28 | N |
| Beachampton (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Berkhamsted (TW) | 53 | 861 | 168 | 3770 | 12 | 64 | Y |
| Bicester (TW) | 117 | 1236.22 | 52 | 861 | 25 | 226 | Y |
| Brackley (AW) | No data | No data | 26 | 225 | 23 | 484.25 | N |
| Buckingham (AW) | No data | No data | No data | No data | 26 | 241 | N |
| Chackmore (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Chenies (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Chesham (TW) | 59 | 963.3 | 116 | 1814.05 | 2 | 3.68 | Y |
| Chilton (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Cotton Valley (AW) | 10 | 115 | 10 | 68.75 | 0.5 | 1 | N |
| Cuddington (TW) | 33 | 589.55 | 90 | 1931.12 | 4 | 62.16 | Y |
| Dagnall (TW) | 70 | 524.42 | 52 | 360.27 | 47 | 250 | Y |
| Dorton (TW) | 34 | 79.79 | 30 | 48.09 | 15 | 24.82 | N |
| Drayton Parslow (AW) | No data | No data | 17 | 288.88 | 47 | 139.25 | N |
| Dunton (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Foxcote (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Frieth (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Gerrards Cross (TW) | 82 | 1320 | 76 | 1171.88 | 66 | 1205.98 | Y |
| Great Brickhill (AW) | No data | No data | No data | No data | 13 | 189.5 | N |
| Great Horwood (AW) | No data | No data | No data | No data | 21.5 | 8 | N |
| Grendon Underwood (TW) | 100 | 1031.65 | 70 | 865.32 | 45 | 409.58 | Y |
| Haddenham (TW) | 101 | 1948.72 | 60 | 983.51 | 27 | 435.38 | Y |
| Halton MOD (Private) | No data | No data | No data | No data | No data | No data | N/A |

| WwTW | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|
| Hambleden (TW) | 12 | 35.47 | 2 | 0.46 | 0 | 0 | N |
| Hillesden Hamlet (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Hillesden Church End (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Horton (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Iver (TW) | 0 | 0 | 11 | 162.89 | 0 | 0 | N |
| Ivinghoe (AW) | No data | No data | No data | No data | 4 | 2.25 | |
| Ivinghoe Aston (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Leckhampstead (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Ledburn (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Leighton Linsdale (AW) | No data | No data | 50 | 879 | 103.5 | 11 | Y |
| Little Marlow (TW) | 15 | 150.94 | 27 | 464.69 | 0 | 0 | N |
| Long Crendon (TW) | 5 | 9.83 | 4 | 13.32 | 1 | 2 | N |
| Ludgershall (AW) | 0 | 0 | 29 | 317.77 | 70 | 948.38 | N |
| Maple Lodge (TW) | 83 | 1109.95 | 64 | 960 | 23 | 204 | Y |
| Marsh Gibbon (TW) | 114 | 2186.68 | 87 | 1635.63 | 64 | 1195.49 | Y |
| Mentmore (AW) | No data | No data | No data | No data | 7 | 34.5 | N |
| Middle Claydon (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Mogden (TW) | 42 | 412 | 43 | 438 | 20 | 164 | N |
| North Marston (AW) | No data | No data | 124 | 846 | 49 | 86.5 | Y |
| Oving (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Padbury (AW) | No data | No data | 86 | 1705.56 | 40 | 650.75 | Y |
| Poundon (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Preston Bisset (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Princes Risborough (TW) | 106 | 1706.84 | 93 | 1685.68 | 10 | 58.24 | Y |
| Rowsham (TW) | 20 | 97.02 | 14 | 136.2 | 9 | 83.58 | N |
| Shabbington (TW) | 28 | 279.93 | 24 | 315.94 | 32 | 243.04 | N |
| Slough (TW) | 4 (Some missing data) | 23.34 | 16 | 173 | 8 | 64 | N |
| Stanbridgeford (AW) | No data | No data | No data | No data | 16 | 116 | N |
| Steeple Claydon (AW) | No data | No data | No data | No data | 0 | 0 | N |
| Stewkley (TW) | 82 | 756.82 | 122 | 1861.17 | 107 | 1931.44 | Y |
| Stone (TW) | 123 | 2452.6 | 127 | 2683.03 | 56 | 1013.37 | Y |

| WwTW | Number of operations in 2020 | Duration of operation in 2020 (hours) | Number of operations in 2021 | Duration of operation in 2021 (hours) | Number of operations in 2022 | Duration of operation in 2022 (hours) | Above threshold for investigation? (Y/N) |
|---|---|---|---|---|---|---|---|
| Stowe (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Swanbourne (AW) | 86 | 1444.25 | 27 | 341.25 | 3 | 33.25 | N |
| Twyford (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Upper Winchendon (TW) | No data | No data | No data | No data | No data | No data | N/A |
| Waddesdon (TW) | 112 | 1704.92 | 109 | 1760.59 | 55 | 763.98 | Y |
| Water Stratford (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Westbury (AW) | No data | No data | 8 | 169.41 | 1.25 | 4 | N |
| Westcott (Private) | No data | No data | No data | No data | No data | No data | N/A |
| Whaddon (AW) | 158 | 2767.75 | 162 | 2980.75 | 41 | 684.25 | Y |
| Whitfield (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Wing-Cublington Road (AW) | No data | No data | No data | No data | 84.25 | 7 | Y |
| Wingrave (TW) | 109 | 1649.74 | 72 | 1237.59 | 89 | 1433.53 | Y |
| Wing Cublington (AW) | No data | No data | 21 | 256.86 | 7 | 84.25 | N |
| Winslow (AW) | No data | No data | No data | No data | No data | No data | N/A |
| Worminghall (TW) | 59 | 814.56 | 42 | 479.53 | 17 | 131.11 | N |

# B Water Quality Mapping

# C Water quality modelling – predicted deterioration at WwTW

Table 0.2: WwTW deterioration

| SIMCAT WwTW | Model | Ammonia | BOD | Phosphate |
|---|---|---|---|---|
| Ashendon STW | Thames | 0.00% | 0.00% | 0.00% |
| Ashley Green STW | Thames | #N/A | #N/A | #N/A |
| Aston Abb STW | Wash | 0.00% | 0.00% | 0.00% |
| Aylesbury STW | Thames | 3.42% | 4.04% | -1.32% |
| Beachampton STW | Wash | 0.00% | 0.00% | 0.00% |
| BERKHAMSTED STW | Thames | 7.78% | 5.09% | 6.40% |
| BICESTER STW | Thames | -0.50% | 1.51% | 2.64% |
| BRACKLEY STW (NEW) | Wash | 12.60% | 1.26% | 7.45% |
| BUCKINGHAM(MAIDS MOR | Wash | 13.54% | 2.44% | 10.22% |
| CHACKMORE STW | Wash | 13.89% | 0.00% | 8.98% |
| Chardon STW | Thames | #N/A | #N/A | #N/A |
| CHENIES STW | Thames | 7.11% | 4.49% | 4.08% |
| Chesham STW | Thames | 3.77% | 2.73% | 3.12% |
| Chilton STW | Thames | 10.48% | 2.66% | 7.05% |
| Cotton Valley STW | Wash | 12.15% | 0.04% | 6.77% |
| CUBLINGTON (WING) ST | Wash | 8.35% | 0.13% | 7.11% |
| Cuddington STW | Thames | 4.95% | 6.93% | -0.43% |
| DAGNALL STW | Thames | #N/A | #N/A | #N/A |
| Dorney WTW | Thames | 0.00% | 0.00% | 0.00% |
| DORTON | Thames | 0.00% | 0.00% | 0.00% |
| DRAYTON PARSLOW STW | Wash | 15.27% | 2.87% | 6.35% |
| Dunton (Aylesbury Vale) | Wash | #N/A | #N/A | #N/A |
| FOXCOTE STW | Wash | 7.60% | 0.00% | 4.57% |
| FRIETH STW | Thames | #N/A | #N/A | #N/A |
| Gerrards Cross STW | Thames | 10.50% | 7.65% | 9.45% |
| GREAT BRICKHILL STW | Wash | 11.78% | 2.86% | 7.06% |
| GREAT HORWOOD STW | Wash | 13.33% | -0.16% | 5.61% |

| SIMCAT WwTW | Model | Ammonia | BOD | Phosphate |
|---|---|---|---|---|
| Grendon Underwood STW | Thames | 6.29% | 8.24% | 9.79% |
| Haddenham STW | Thames | 8.54% | 8.00% | 4.05% |
| HALTON MOD STW (PRIVATE) | Thames | #N/A | #N/A | #N/A |
| HAMBLEDON STW | Thames | 6.34% | 4.20% | 6.16% |
| HAMPDEN ROW STW | Thames | #N/A | #N/A | #N/A |
| High Wycombe STW | Thames | 9.19% | 5.39% | 4.08% |
| HILLESDEN (HAMLET) STW | Wash | 11.81% | 0.49% | 16.56% |
| Hillesden Church End | Wash | 11.89% | 0.49% | 16.67% |
| HORTON STW | Wash | 8.69% | -0.04% | 7.29% |
| Hurley STW | Thames | 7.88% | 3.44% | 6.18% |
| Iver ( North ) STW | Thames | 0.39% | 5.64% | 5.31% |
| Ivinghoe Aston | Wash | 12.30% | 1.13% | 8.70% |
| IVINGHOE STW | Wash | 8.61% | 1.33% | 8.40% |
| LECKHAMSTEAD STW | Wash | 10.14% | 0.08% | 1.25% |
| Ledburn STW | Wash | 0.00% | 0.03% | 0.11% |
| Leighton Linslade STW | Wash | 10.13% | 5.50% | 6.34% |
| LITTLE MARLOW STW | Thames | 7.59% | 3.95% | 6.32% |
| Long Crendon STW | Thames | 6.88% | 4.35% | 1.20% |
| Ludgershall STW | Thames | 7.10% | 7.64% | 7.35% |
| MAPLE LODGE STW | Thames | 5.21% | 5.59% | 3.30% |
| Marsh Gibbon STW | Thames | 2.10% | 2.98% | 0.13% |
| Mentmore | Wash | 7.56% | 0.04% | 6.78% |
| MIDDLE CLAYDON STW | Wash | 15.94% | 1.94% | 8.92% |
| MOGDEN STW | Thames | #N/A | #N/A | #N/A |
| NORTH MARSTON STW | Wash | 16.55% | 0.56% | 0.18% |
| OVING STW | Wash | 15.51% | 0.40% | 1.10% |
| PADBURY STW | Wash | 14.45% | 0.94% | 3.04% |
| POUNDON STW | Wash | 12.81% | 0.42% | 16.58% |
| Preston Bissett STW | Wash | #N/A | #N/A | #N/A |
| Princes Risborough STW | Thames | 6.85% | 5.42% | 6.15% |

| SIMCAT WwTW | Model | Ammonia | BOD | Phosphate |
|---|---|---|---|---|
| ROWSHAM STW | Thames | 2.83% | 6.33% | -1.06% |
| Shabbington STW | Thames | 13.01% | 8.83% | 11.20% |
| Stanbridgeford STW | Wash | 6.31% | 1.76% | 3.39% |
| STEEPLE CLAYDON STW | Wash | 15.84% | 1.45% | 12.69% |
| Stewkley STW | Thames | 11.91% | 9.00% | 8.10% |
| Stone STW | Thames | 13.96% | 12.24% | 4.20% |
| STOWE STW | Wash | 2.38% | 0.18% | 13.96% |
| SWANBOURNE STW | Wash | 12.34% | 1.53% | 9.97% |
| TWYFORD STW | Wash | 12.20% | 0.52% | 16.80% |
| UPPER WINCHENDEN STW | Thames | 0.00% | 0.00% | 0.00% |
| Waddesdon STW | Thames | 2.44% | 5.25% | 1.87% |
| Water Stratford STW | Wash | 14.16% | 0.22% | 8.18% |
| Westbury STW | Wash | 13.80% | -0.18% | 8.05% |
| WESTCOTT STW (PRIVATE) | Thames | #N/A | #N/A | #N/A |
| Whaddon STW | Wash | 10.93% | 1.13% | -2.34% |
| Whitfield STW | Wash | 1.49% | 0.28% | 1.31% |
| Wingrave STW | Thames | 5.63% | 8.16% | 3.10% |
| WINSLOW STW | Wash | 10.57% | 2.09% | 2.60% |
| Worminghall STW | Thames | -1.10% | 5.46% | -4.65% |

# D Summary of Anglian Water comments on Water Recycling Centre capacity (24/09/2023)

| Water Recycling Centre | Anglian Water Comment |
|---|---|
| All | Using permitted dry weather flows at a Q80 level, Anglian Water's nineteen Water Recycling Centres (WRC) in Buckinghamshire have capacity to serve 3,350 homes. Growth at these locations would not need significant new capacity or indeed new WRC(s) to be constructed with its attendant carbon impacts.<br><br>AW's assessment of flow and housing capacity considers that as of today and using dry weather flows from 2022 there is capacity for 6,370 homes in communities served by the 19 WRC in north Buckinghamshire. This figure does not consider the existing allocations and planning permissions for housing which were not constructed and connected to the wastewater network in 2022. Nor does it consider flows from allocated or permitted but unconstructed/ operational businesses. Whilst the 6,370 figure isn't markedly different to the 6,100 potential homes in Table 10-1 it does mask some significant differences in individual WRCs between the table and AW only DWF capacity assessment.<br><br>A quantum of growth served by WRCs which principally manage homes and businesses outside of Buckinghamshire, but whose WRC catchments extend into the area (Brackley and Milton Keynes-Cotton Valley) would similarly not need significant new infrastructure at the WRC.<br>If that growth were to be located elsewhere in north Buckinghamshire which did not have capacity at the WRC serving the settlement(s), then new water recycling capacity would need to be constructed with its attendant embodied (capital) carbon emissions.<br>In addition to Buckingham, two of AW's WRC located in Bucks serve catchments which extend into Cherwell. Neither they nor the WRC located in Cherwell have significant surplus that would support the scale of growth extending across the council boundary. |
| Aylesbury | Anglian Water's assessment of capacity indicates that in Aylesbury some further 6,000 homes could be built and served by WRCs in the AW service area that have existing capacity. A further quantum of homes – perhaps in the order of 5,000 units could be built in the Aylesbury area and served via the Cotton Valley WRC in Milton Keynes. |
| Brackley | AW 's assessment is that Brackley WRC has more capacity than the 1,435 homes identified in Table 2.11. The eastern growth of Brackley within Buckinghamshire would therefore be sustainable and potentially of a size which would have carbon economies of scale. |
| Buckingham | Growth at Buckingham has already led to the DWF being exceeded. Consequently, whilst new capacity is planned at Buckingham WRC in the AW Drainage and Wastewater Management Plan in the medium term (i.e., before 2035) the additional quantum of growth in the second half of the new Local Plan would determine the design and phasing of that WRC expansion.<br>The existing planned growth at Buckingham will necessitate an expansion of capacity at the WRC to serve circa 2,000 new homes. The remaining indicative growth of some 29,000 should be assessed against available capacity in the Thames Water service area in Aylesbury. |
| Cotton Valley | Cotton Valley WRC in Milton Keynes serves a catchment which extends into Bucks and two other Council areas. AW has assessed Cotton Valley as having an available capacity to serve 45,900 new homes across the four Council areas.<br>By subtracting the known level of growth from the available capacity circa 14,900 additional homes could be served. This figure though will be further reduced by employment growth in Milton Keynes and the wider Cotton Valley WRC catchment. Given the levels and past trajectory of growth (homes and employment) the spare capacity at Cotton Valley would probably be fully utilised in the 2030's. |
| Leighton Linslade | Leighton Linslade has capacity to serve circa 7,300 new homes and consequently the Plan could assess the option for all or more probably some of the remaining 3,000 additional homes to be located adjacent to the A4146 to the west of Leighton Buzzard in Buckinghamshire. |
| Stanbridgeford | AW considers that Stanbridgeford WRC doesn't have capacity to serve growth. Growth in Buckinghamshire at Edlesborough for example would require new capacity to be built and so would not comply with the sustainability hierarchy. |
| Winslow | Has a permitted flow which could serve an additional 950 homes. |

# E Water Industry National Environment Programme

The tables below contain many acronyms that are part of the original Environment Agency database. These have been retained for accuracy, but definitions are included in Table 0.5 below.

Table 0.3 Water Industry National Environment Programme (WINEP) actions relating to water quality on surface water bodies

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Kingsey Cuttle Brook and tributaries at Thame | THM00421<br>THM00240 | 7TW200402<br>7TW200583 | Princes Risborough WwTW | U_MON*3 -<br>Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with. To be completed by: 31/03/2024<br><br>U_MON4 -<br>Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. To be completed by: 31/03/2024 | 31/03/2024 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Scotsgrove Brook (upstream Kingsey Cuttle Brook) | THM00197<br>THM00378<br>DLO01296<br>THM00264<br>THM00445<br>THM00268<br>THM00449 | 7TW200359<br>7TW200540<br>7TW200911<br>7TW200426<br>7TW200607<br>7TW200430<br>7TW200611 | Haddenham WwTW<br>Stone WwTW<br>Thame WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with. To be completed by: 31/03/2021(THM00197) and 31/03/2025 (THM00264 and THM00268)<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver. To be completed by: 31/03/2022<br><br>U_IMP6 - The WwTW storm tank capacity must be increased to 68 litres/head or to 2 hours at max flow through the tanks.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. To be completed by: 31/03/2021 (THM00445) and 31/03/2025 (THM00449). | 31/03/2021<br>31/03/2022<br>N/a<br>31/03/2025<br>31/03/2021<br>31/03/2025<br>31/03/2025 |
| Peppershill and Shabbington Brooks | THM00703 | 7TW200864 | Chilton WwTW | WFD_NDLS_Chem2- Investigations. Discharges to TRAC waters investigations | 22/12/2022 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Worminghall Brook and tributaries | THM00290<br>THM00471<br>THM00573 | 7TW200452<br>7TW200633<br>7TW200735 | Worminghall WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates.<br><br>WFD_IMPg- Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology. | 31/03/2025<br>31/03/2025<br>22/12/2024 |
| Thame (Aylesbury to Scotsgrove Brook) | THM00120<br>THM00301<br>THM00169<br>THM00350<br>THM00224<br>THM00405 | 7TW200282<br>7TW200463<br>7TW200331<br>7TW200512<br>7TW200386<br>7TW200567 | Aylesbury WwTW<br>Cuddington WwTW<br>Long Crendon WwTW | U_MON3 -<br>Install EDM on WwTW overflows to storm tanks at those WwTW where we can`t use existing monitors to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 -<br>Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 31/03/2022<br>31/03/2021<br>31/03/2023<br>31/03/2021<br>31/03/2024<br>31/03/2021 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Dorton, Chearsley and Waddesdon Brooks | THM00174<br>THM00355<br>THM00475<br>THM00520 | 7TW200336<br>7TW200517<br>7TW200637<br>7TW200682 | Dorton WwTW | U_MON3 -Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates.<br><br>U_MON5 - Provide MCERTS flow monitoring for the first time at WwTW where permitted DWF or maximum daily flow is greater than 50m3/d.<br><br>WFD_IMPg- Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology. | 31/03/2021<br>31/03/2022<br>31/03/2025<br>22/12/2024 |
| Thame upstream of Aylesbury | THM00283<br>THM00464<br>THM00570 | 7TW200445<br>7TW200626<br>7TW200732 | Wingrave WwTW | U_MON3 -Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver<br><br>WFD_IMPg - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as | 31/03/2021<br>31/03/2022<br>22/12/2024 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| | | | | different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology. Proposed Phosphorus permit of 0.7mg/l | |
| Fleet Marston Brook, Denham Brook, Pitchcott Brook west | THM00271<br>THM00452<br>THM00564 | 7TW200433<br>7TW200614<br>7TW200726 | Waddesdon WwTW | U_MON3 -Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver<br>WFD_IMPg - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology. Proposed Phosphorus permit of 0.5mg/l | 31/03/2021<br>31/03/2022<br>22/12/2024 |
| Hardwick Brook (source to Thames) | THM00263<br>THM00444 | 7TW200425<br>7TW200606 | Stewkley WwTW | U_MON3 -Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver. | 31/03/2021<br>31/03/2022 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Whistle Brook | EAN00507<br>EAN00687<br>EAN01490<br>EAN01491 | 7TW200090<br>7TW200265<br>7TW202066<br>7TW201067 | Ivinghoe WwTW | WFD_IMPg -Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology Phosphorus permit of 0.3mg/l.<br><br>WFD_ND - Scheme to meet requirement s to prevent deterioration in phosphorus. Phosphorus permit of 3.5mg/l.<br><br>U_MON3 -<br>Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 -<br>Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 22/12/2024<br>31/03/2025<br>31/03/2022<br>31/03/2021 |
| Ouzel US Caldecote Mill | EAN01059<br>EAN01060<br>EAN01061 | 7AW200635<br>7AW200636<br>7AW200637 | Cotton Valley WwTW | U_MON3 -<br>Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 -<br>Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 31/03/2022<br>31/03/2021<br>31/03/2025 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Claydon Brook | EAN02061<br>EAN02062<br>EAN02062<br>EAN00701<br>EAN00713<br>EAN02275<br>EAN02276<br>EAN02277<br>EAN02278 | 7AW201637<br>7AW201638<br>7AW201640<br>7AW200279<br>7AW200291<br>7AW201851<br>7AW201852<br>7AW201853<br>7AW201854 | Swanbourne WwTW<br>Winslow WwTW | U_MON3 -<br>Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 -<br>Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver.<br><br>WFD_ND - Scheme to meet requirement s to prevent deterioration in phosphorus. Phosphorus permit of 5.5mg/l and Ammonia permit of 3mg/l.<br><br>U_IMP5 - The WwTW FFT must be increased to 3PG + IMAX + 3E . | 31/03/2025<br>31/03/2022<br>31/03/2022<br>31/03/2025<br>31/03/2024<br>31/03/2024<br>31/03/2025<br>31/03/2025 |
| Beachampton Brook | EAN00475 | 7AW200058 | Beachampton WwTW | WFD_IMPg - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measure to meet a Good standard for the element. There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology. Phosphorus permit of 2.5mg/l. | 22/12/2024 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Colne Brook | HNL00126<br>HNL00161 | 7TW200027<br>7TW200062 | Iver WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 31/03/2023<br>31/03/2024 |
| Colne (confluence with Chess to River Thames) | HNL00130<br>HNL00165<br>HNL00192<br>HNL00234 | 7TW200031<br>7TW200066<br>7TW200093<br>7TW200123 | Maple Lodge WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver.<br><br>U_IMP6 - The WwTW storm tank capacity must be increased to 68 litres/head or to 2 hours at max flow through the tanks.<br><br>WFD_IMPm - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measures to meet a Moderate standard.<br><br>There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology.<br>Phosphorus permit of 0.25mg/l. | 31/03/2021<br>31/03/2022<br>31/03/2025<br>22/12/2024 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Horwood Tributary | EAN00500<br>EAN01316<br>EAN01317<br>EDM00228 | 7AW200083<br>7AW200892<br>7AW200893<br>7AW300300 | Great Horwood WwTW | WFD_IMPg - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measures to meet a Good standard.<br><br>There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology.<br>Phosphorus permit of 0.4mg/l.<br><br>U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 22/12/2024<br>31/03/2022<br>31/03/2021<br>31/03/2021 |
| Padbury Brook (The Twins) | EDM00224<br>EAN01787<br>EAN01788<br>EAN02000<br>EAN02001 | 7AW300296<br>7AW201363<br>7AW201364<br>7AW201576<br>7AW201577 | Fritwell WwTW<br>Padbury WwTW<br>Steeple Claydon WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver. | 31/03/2022<br>31/03/2021<br>31/03/2022<br>31/03/2022<br>31/03/2022 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Thames (Reading to Cookham) | THM00198<br>THM00379<br>FLO01271<br>THM00204<br>THM00385<br>THM00668<br>THM00222<br>THM00403 | 7TW200360<br>7TW200541<br>7TW200906<br>7TW200366<br>7TW200547<br>7TW200829<br>7TW200384<br>7TW200565 | Hambleden WwTW<br>Henley WwTW<br>Hurley WwTW<br>Little Marlow WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates.<br><br>U_IMP5 - WwTW FFT must be increased to 3PG + IMAX + 3E<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver.<br><br>WFD_ND - Scheme to meet requirement for Ammonia. Ammonia permit of 8mg/l. | 31/03/2023<br>31/03/2023<br>31/03/2025<br>31/03/2021<br>31/03/2022<br>31/03/2025<br>31/03/2021<br>31/03/2022 |
| Misbourne | HNL00122<br>HNL00157 | 7TW200023<br>7TW200058 | Gerrards Cross WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 31/03/2023<br>31/03/2023 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Roundmoor Ditch and Boveney Ditch | THM00099<br>THM00254<br>THM00435<br>THM00672 | 7TW200261<br>7TW200416<br>7TW200597<br>7TW200833 | Slough WwTW | U_IMP5 - WwTW FFT must be increased to 3PG + IMAX + 3E<br>U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where we can`t use existing monitors to be confident that the permitted FFT setting is being complied with.<br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver.<br>WFD_ND - Scheme to meet requirement for Ammonia. Ammonia permit of 1mg/l. | 31/03/2025<br>31/03/2021<br>31/03/2022<br>31/03/2025 |
| Chess | HNL00118<br>HNL00153<br>HNL00183<br>HNL00232 | 7TW200019<br>7TW200054<br>7TW200084<br>7TW200121 | Chesham WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver.<br>U_IMP5 - WwTW FFT must be increased to 3PG + IMAX + 3E<br>WFD_IMPm - Measures to reduce ammonia, phosphorus, BOD or nitrogen at STWs in order to meet WFD standards in rivers, transitional or coastal waters. Measures to meet a Moderate standard.<br><br>There may also be situations where a WFD biological element fails its water body objective due ammonia and/or dissolved oxygen (i.e. reason for not achieving good status (RNAG) is confirmed as ammonia and/or dissolved oxygen), but the ammonia and/or dissolved oxygen element at the designated monitoring location achieved good status. This may be due to circumstances such as different monitoring sites used for chemistry and biology. There must be a confirmed link between the water company asset and the observed effect for measures to improve biology.<br>Phosphorus permit of 0.25mg/l. | 31/03/2021<br>31/03/2022<br>31/03/2025<br>22/12/2024 |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes | Completion date |
|---|---|---|---|---|---|
| Ludgershall Brook and Muswellhill Brook | THM00225<br>THM00406 | 7TW200387<br>7TW200568 | Ludgershall WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. | 31/03/2021<br>31/03/2021 |
| Ray and tributaries North East of Grendon Underwood | THM00195<br>THM00376 | 7TW200357<br>7TW200538 | Grendon Underwood WwTW | U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where existing monitors cannot be used to be confident that the permitted FFT setting is being complied with.<br><br>U_INV2 - Investigation to confirm if any existing front end flow monitor or the back end MCERTS flow monitor can be used to measure PFF to full treatment at a WwTW. Existing front end monitors must be considered first and where they can be MCERTS certified to measure PFF they should be used to provide data within AMP7. Where there is no front end monitor or it cannot be MCERTS certified investigate whether the back end flow monitor can be MCERTS certified to measure PFF. If it can, then use it to provide data within AMP7. If neither can be MCERTS certified then a new inlet MCERTS flow monitor will be required under a PR24 driver. | 31/03/2021<br>31/03/2022 |

Table 0.4 Water Industry National Environment Programme (WINEP) actions relating to water quality on groundwater bodies

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes |
|---|---|---|---|---|
| Upper Bedford Ouse Chalk | EAN00451<br>EAN00452<br>EAN00450<br>EAN02328 | 7AF200010<br>7AF200011<br>7AF200009<br>7AW201904 | Offley Bottom nitrate catchment management<br>Oughton Head nitrate catchment management<br>Slip End nitrate catchment management<br>Upper Sundon STW | DrWPA_ND- Catchment Measure - the Offley Bottom, Oughton Head and Slip End nitrate catchment management schemes aim to reduce nitrate leaching into groundwater from agriculture and other sources.<br><br>Catchment Investigation - an investigation of the historic landfill site to the north should be undertaken to understand its current status and to refine the conceptual model. |

| Waterbody Name | WINEP ID | Unique ID | Scheme Name(s) | Type of scheme/notes |
|---|---|---|---|---|
| South-west Chilterns Chalk | CM00308<br>THM00255<br>THM00436 | 7TW300060<br>7TW200417<br>7TW200598 | Sonning Common STW | WFD_INV_CHEM1 - Investigation: A risk-based extension of the CIP2 programme to new discharges. The criteria for inclusion need to be decided but could include discharges to TRaC waters that have been subject to limited assessment in CIP 1 and 2 because of the criteria used to set up these programmes.<br><br>U_MON3 - Install EDM on WwTW overflows to storm tanks at those WwTW where we can`t use existing monitors to be confident that the permitted FFT setting is being complied with.<br><br>U_MON4 - Install MCERTS flow monitoring as close to the overflow as practicable to record FFT at WwTW where the existing DWF MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates. |
| Mid-Chilterns Chalk | HNL00200<br>HNL00196<br>HNL00195<br>HNL00204<br>HNL00201 | 7AF200020<br>7AF200016<br>7AF200015<br>7AF200024<br>7AF200021 | Chartridge Nitrate Catchment Management<br>Clay Lane Group "at risk" Pesticides Catchment Management<br>North Mymms DrWPA "at risk" Pesticides Catchment Management<br>Roestock PS Agricultural Pesticides Investigation | Catchment Measure - the Chartridge nitrate catchment management scheme aims to reduce nitrate leaching into groundwater from agriculture and other sources.<br>Catchment measure - the Clay Lane group and North Mymms DrWPA Pesticides scheme will build on the current AMP6 scheme for metaldehyde and expand to mitigate the effect of key "at risk" pesticides.<br>Catchment investigation - investigate the source and migration pathways for the current inputs of nitrate to groundwater and gain a more detailed understanding of the likely future seasonal trends in nitrate groundwater concentrations |

Table 0.5 WINEP definitions

| Abbreviation | Definition |
|---|---|
| MON i.e., U_MON3, U_MON4, U_MON5 | Long-term monitoring |
| INV i.e., U_INV2 | Investigation |
| IMP i.e., U_IMP6, | Action (to improve) |
| WFD_IMP i.e., WFD_IMPg and WFD_IMPm | Measure to reduce ammonia, phosphorus, BOD or nitrogen at WwTWs in order to meet WFD standards in rivers, transitional or coastal waters. The letters after 'WFD_IMP' correspond to indicate what target the measure is aimed at achieving:<br>• h- measure to meet High status for the element<br>• g- measure to meet Good status for the element<br>• p- measure to meet Poor status for the element<br>• m- measure to meet Moderate status for the element |
| WFD_NDLS_Chem2 | Measures related to load standstill requirements for chemicals (below EQS). These are set where a wastewater treatment works is discharging significant concentrations of a chemical, but the EQS is not threatened. Targets are set to ensure that current effluent quality does not deteriorate. |

# F SSSIs within and downstream of Buckinghamshire that could be impacted by changes in wastewater flow

| SSSI NAME | SSSI REFERENCE |
|---|---|
| Ardley Trackways | SP541250 |
| Kingcup Meadows and Oldhouse Wood | TQ033850 |
| Bassenhally Pit | TL286985 |
| Bentley Priory | TQ156927 |
| Bestmoor | SP492297 |
| Bray Pennyroyal Field | SU915782 |
| Brent Reservoir | TQ216873 |
| Croxley Common Moor | TQ081948 |
| Grendon and Doddershall Woods | SP699208 |
| Cock Marsh | SU882866 |
| Wytham Ditches and Flushes | SP464098 |
| Denham Lock Wood | TQ054863 |
| Fray's Farm Meadows | TQ057860 |
| Felmersham Gravel Pits | SP990584 |
| St. Neot's Common | TL182612 |
| Monks Wood and The Odd Quarter | TL196801 |
| Wendlebury Meads and Mansmoor Closes | SP561175 |
| Helmdon Disused Railway | SP589409 |
| Dumsey Meadow | TQ056665 |
| Sarratt Bottom | TQ031989 |
| Hartslock | SU619790 |
| Langham Pond | TQ002720 |
| Holme Fen | TL206889 |
| Iffley Meadows | SP523037 |
| Holton Wood | SP599079 |
| Bray Meadows | SU898800 |
| Lye Valley | SP547058 |
| Berry Fen | TL378745 |

| SSSI NAME | SSSI REFERENCE |
|---|---|
| Long Herdon Meadow | SP648201 |
| Mid Colne Valley | TQ043894 |
| Little Wittenham | SU572928 |
| Portholme | TL236708 |
| Culham Brake | SU508964 |
| Old Rectory Meadows | TQ032874 |
| Otmoor | SP574138 |
| South Lodge Pit | SU905819 |
| Rodbed Wood | SU803836 |
| Shabbington Woods Complex | SP618110 |
| Rushy Meadows | SP481142 |
| Ruislip Woods | TQ093889 |
| Nares Gladley Marsh | SP907277 |
| Temple Island Meadows | SU768846 |
| Mill Crook | SP773463 |
| Houghton Meadows | TL293716 |
| Frogmore Meadows | TQ020989 |
| Stevington Marsh | SP985551 |
| Bushy Park and Home Park | TQ159692 |
| Syon Park | TQ174765 |
| Syresham Marshy Meadows | SP638425 |
| Weston Fen | SP525195 |
| Weston Turville Reservoir | SP862095 |
| Water End Swallow Holes | TL230042 |
| Wiggenhall St. Germans | TF588138 |
| Arncott Bridge Meadows | SP608185 |
| Cassington Meadows | SP462101 |
| Hook Meadow and The Trap Grounds | SP500087 |
| New Marston Meadows | SP520076 |
| New Marston Meadows | SP520076 |
| Pixey and Yarnton Meads | SP482101 |
| Port Meadow with Wolvercote Common & Green | SP493086 |
| Walthamstow Marshes | TQ351875 |
| Wolvercote Meadows | SP485096 |

| SSSI NAME | SSSI REFERENCE |
|---|---|
| Wytham Woods | SP463080 |
| Kirtlington Quarry | SP494199 |
| Windsor Forest and Great Park | SU961718 |
| Ouse Washes | TL490879 |
| Little Paxton Pits | TL199637 |
| Northaw Great Wood | TL282040 |
| Wraysbury & Hythe End Gravel Pits | TQ009735 |
| Wraysbury No. 1 Gravel Pit | TQ003747 |
| Bisham Woods | SU857849 |
| Tring Reservoirs | SP905130 |
| Staines Moor | TQ043731 |
| Wraysbury Reservoir | TQ025745 |
| Woodwalton Fen | TL229844 |
| Upper Cherwell at Trafford House | SP528488 |
| Knight & Bessborough Reservoirs | TQ119680 |
| Finemere Wood | SP718218 |
| Sheephouse Wood | SP702234 |
| Walthamstow Reservoirs | TQ351891 |
| Nene Washes | TL307999 |
| Godmanchester Eastside Common | TL269713 |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