2 Development Scenarios and Key Developments

2.1 Introduction

VoWHDC Local Plan Part 1 divides the district into three "sub-areas" with proposed housing allocations in or around a number of settlements. The Water Cycle Study was undertaken in parallel with the development of the housing allocations. There have been significant additions, removals and rescaling of allocations during development of the WCS. At the outset of the study, the numbers of dwelling listed in the VoWHDC WCS Brief were:

Abingdon on Thames and Oxford sub-area:

- 299 dwellings to allocate between Abingdon on Thames, Kingston Bagpuize with Southmoor, Marcham, Cumnor, Botley, Kennington, Drayton, Sutton Courtenay, Wootton and Radley

South East Vale sub-area:

- 1500 dwellings at Crab Hill, Wantage
- 750 dwellings at Monks Farm, Grove
- 2150 dwellings at Valley Park, Didcot
- 400 dwellings at Harwell Oxford Campus
- 419 dwellings to allocate between Wantage, Grove, west of Didcot, Harwell village, Harwell Oxford Campus, Blewbury, East Hendred, Milton, Steventon, East Hanney and East Challow

Western Vale sub-area:

- 350 South of Park Road, Faringdon
- 337 dwellings to allocate between Faringdon, Shrivenham, Watchfield, Uffington, and Stanford in the Vale.

In order to ensure that the WCS matched as closely as possible to the final draft allocations sites, a number of iterations of the assessment were necessary. Table 2-1 shows the final list of draft allocation sites assessed and the number of houses planned for each site.

Table 2-1: Final list of draft allocation sites assessed

Site No.	Location of Site	Number of units proposed
1	North West Abingdon	200
2	North Abingdon	800
3	South Kennington	270
4	North West Radley	240
5	East Sutton Courtenay	220
6	Kingston Bagpuize East	280
7	Milton Heights	400
8	Valley Park	At least 2550
9	North West Valley Park	800
10	West of Harwell	200
11	East of Harwell Campus	850
12	North of Harwell Campus	550
13	East Hanney	200
14	Crab Hill Wantage	1500
15	Monks Farm, Grove	750
16	Land South of Park Road, Faringdon	350

Site No.	Location of Site	Number of units proposed
17	Stanford in the Vale	200
18	South Faringdon, (Parish of Great Coxwell)	200
19	SW Faringdon	200
20	North Shrivenham	500
21	East of Coxwell Road, Faringdon	200

In addition to proposed site allocations, the locations and number of houses with planning permission but which have not yet been constructed were also collated (see Table 2-2). These were required to inform the water supply and wastewater assessments process, as requested by the water companies, in order to have the total volume of additional water to supply and to treat for the full period 2013-31. These sites have not been included in the environment and flood risk assessments on the basis these issues were appropriately addressed when the respective planning permissions were granted.

Table 2-2: Sites with planning permission (as of 14/02/2014) included in the assessment process.

Site classification	Site name	Total houses 2013-31
The Old Gaol Leisure Centre	Under construction	41
Land to the South of Chilton Field	Under construction	199
Timbmet Ltd, Cumnor Hill	Under construction	157
Former Tree Nursery & Cricket Club & Jespers Hill, Park Rd	Under construction	58
Land adj 31 & 34 Simpsons Way	Under construction	1
33 West, St Helen	Planning permission granted	10
Champion House, 12 Wootton Rd	Planning permission granted	24
Challow Country Club, Woodhill Ln	Planning permission granted	14
Nalder Estate & The Old Canal Building, Main St	Planning permission granted	71
Land South of Alfreds Place	Planning permission granted	15
Land adj to Folly Park, Park Rd	Planning permission granted	28
Land adj Coxwell House & Winslow House, Coxwell Rd	Planning permission granted	35
Land at Stockham Farm, Denchworth Rd	Planning permission granted	200
98-100 West Way, Botley	Planning permission granted	10
East of Highworth Rd	Planning permission granted	36
Land between Station Rd & Townsend Rd	Planning permission granted	30
Land Opp Shrivenham Hundred Business Park	Planning permission granted	120
46 Newbury Street	Planning permission granted	23
Ambulance Station, Ormond Rd	Planning permission granted	11
Land West of Witney Road and South of A420	Planning permission granted	108
Land South of Faringdon Rd, Southmoor	Planning permission granted	50
Land adj NE & NW of Tilbury Ln, Botley	Planning permission granted	150
Land off Barnett Rd	Planning permission granted	50

Site classification	Site name	Total houses 2013-31
Land at Didcot Road, Great Western Park	Planning permission granted	700
Broadwater, Manor Rd	Planning permission granted	14
Cowan's Camp Depot, High St	Planning permission granted	100
Land off Lime Rd, Botley	Planning permission granted	136
Major Amey's Site	Planning permission granted	140
17 to 20 Millbrook Sq	Planning permission granted	11
Christ Church, Hobbyhorse Ln	Resolution to grant	15
Anson Field, Morland Rd, Hyde Copse, Howard Cornish Rd	Resolution to grant	51
South of Lamb Ave	Resolution to grant	18
Land east of Chainhill Rd	Resolution to grant	85
Land off Rectory Farm Cl	Resolution to grant	13
Land at Grove Air Field, Denchworth Rd	Application under consideration	2500
Milton Road, Sutton Courtenay	Resolution to grant	70
Land at Causeway Farm, The Causeway	Resolution to grant	31
Land North of Priory Lane	Planning permission granted	18
Land at Milton Hill, Milton	Resolution to grant	48
Land off Walnut Trees Hill	Planning permission granted	18
Land East of A338, Crown Meadow, East Hanney	Planning permission granted	25
Land off Draycott Road	Planning permission granted	98
Land East of Drayton Road	Planning permission granted	160
King's Field, Sheepstead Rd, Marcham	Resolution to grant	43
Alder View, Land South of Grove Road, Harwell	Resolution to grant	55
Chailey House, Bessels Way, Blewbury	Planning permission granted	30
Land North of 92-112 Milton Rd	Resolution to grant	34
Fernham Fields, Land East of Coxwell Rd	Resolution to grant	154
Land West of Portway Villas, Reading Rd	Planning permission granted	21
Land West of the A417	Permissions since Apr 2013	70
Land off Colton Road	Resolution to grant	55
Land South of Downsview Road (Stockham Farm Phase 2)	Resolution to grant	60
LPP2 villages	Remainder of dwellings to find in LPP2	Up to 1000
Small sites	permissions under 10 dwellings	510
Windfall	Assumptions based on previous supply	900
Total number of houses committed or consented in addition to proposed strategic housing site allocations		8624

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3 Legislative and Policy Framework

This section introduces the policy and legislative framework which drives the management of development and the water environment in England.

3.1 National Planning and Sustainable Development Policy

3.1.1 National Planning Policy Framework (NPPF) and Practice Guidance

The National Planning Policy Framework (NPPF)[1] was published on 27th March 2012, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. The main NPPF provides guidance to planning authorities to take account of flood risk and water and wastewater infrastructure delivery in their Local Plans:

- Paragraph 100 of the NPPF states “Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change".
- Paragraph 156 of the NPPF states: “Local planning authorities should set out the strategic priorities for the area in the Local Plan. This should include strategic policies to deliver...the provision of infrastructure for transport, telecommunications, waste management, water supply, wastewater, flood risk and coastal changes management, and the provision of minerals and energy”.

In March 2014, a series of Planning Practice Guidance documents were issued by Department for Communities and Local Government, with the intention of providing guidance on the application of the National Planning Policy Framework (NPPF) in England. Two of these practice guidance documents are relevant to this study:

- Flood Risk and Coastal Change[2]
- Water Supply, Wastewater and Water Quality[3].

The influential content of these documents is summarised as follows:

3.1.2 Planning Practice Guidance: Flood Risk and Coastal Change

Diagram 1 in the Planning Practice Guidance also sets out how flood risk should be taken into account in the preparation of Local Plans. These requirements are addressed principally in the Council's Strategic Flood Risk Assessment (SFRA)[4] and Sequential Test[5].

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

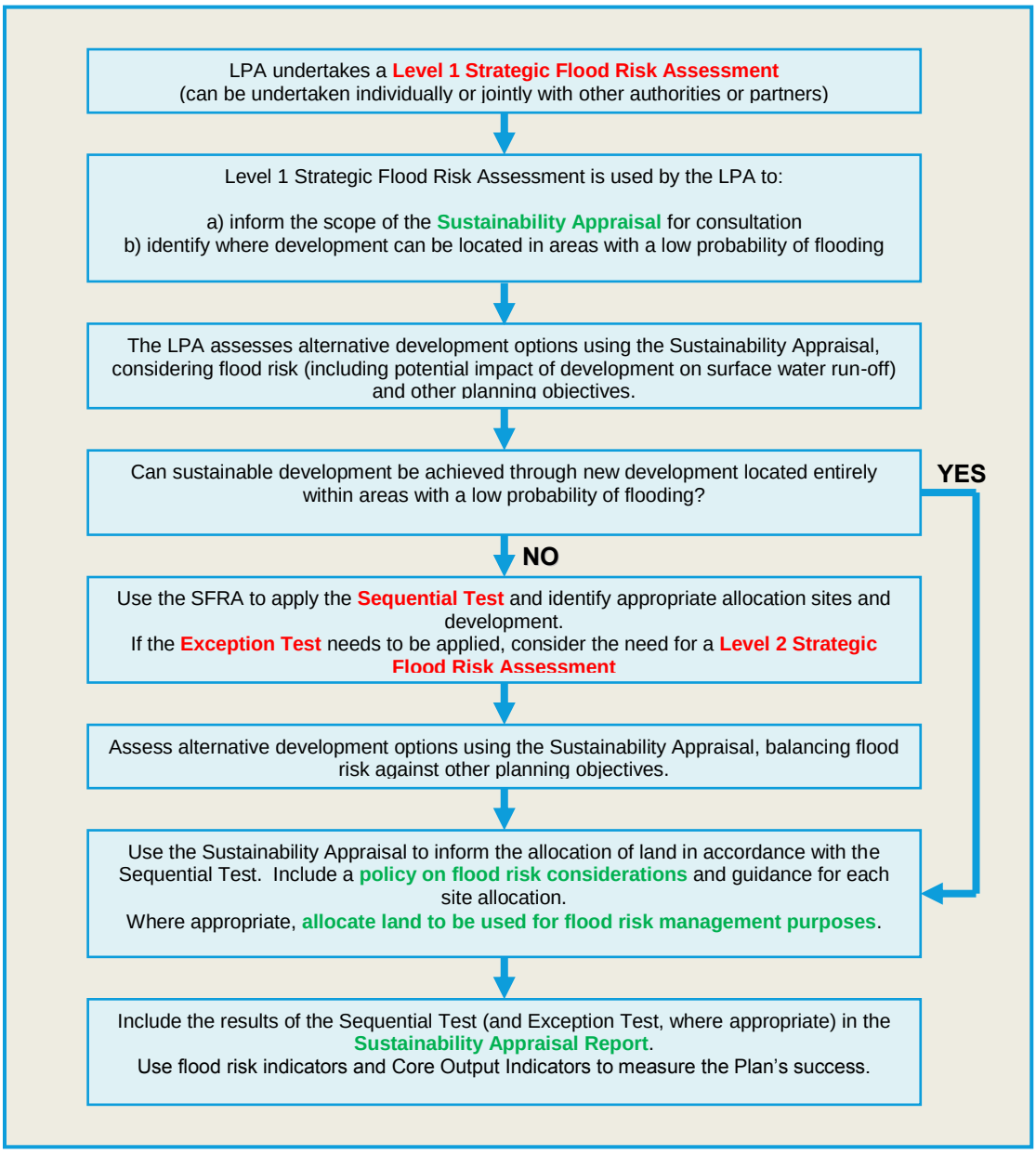
2 Department for Communities and Local Government (2014) Planning Practice Guidance: Flood Risk and Coastal Change (2014) Accessed online at http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/ on 15/04/2014.

3 Department for Communities and Local Government (2014) Planning Practice Guidance: Water supply, wastewater and water quality. Accessed online at http://planningguidance.planningportal.gov.uk/blog/guidance/ on 15/04/2014

4 Vale of White Horse District Council (2014) Strategic Flood Risk Assessment

5 Vale of White Horse District Council (2014) Sequential Test

Figure 3-1: Flood risk and the preparation of Local Plans



Based on Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-021-20140306) March 2014

3.1.3 Planning Practice Guidance: Water Supply, Wastewater and Water Quality

Under the previous system of Planning Policy Statements (PPSs) which were in place before implementation of the NPPF in 2011, there was no equivalent guidance document for planners, although there was some relevant guidance contained in PPS1[6]. Since the introduction of NPPF there had not been any other specific guidance issued on planning for water supply, wastewater and water quality issues.

The Planning Practice Guidance sets out a framework of linked guidance and documents:

- Local Planning Authorities (LPAs) must have regard for Water Framework Directive as implemented in the Environment Agency's River Basin Management Plans[7].

6 Department for Communities and Local Government (2005) Planning Policy Statement 1: Delivering Sustainable Development

7 Environment Agency (Dec 2009) River basin management plan for the Thames river basin district. Accessed online at: https://www.gov.uk/government/publications/thames-river-basin-management-plan

- The National Policy Statement for Waste Water. This sets out Government policy for the provision of major waste water infrastructure to construct a new wastewater treatment plan or increase the capacity of an existing plant to a population equivalent of more than 500,000. None of the proposed developments within the study area would fall into this category.
- Water Cycle Studies (WCS). These are identified as voluntary studies that assist the EA, LPAs and Water and Sewerage Companies (WaSCs) to work together. The EA's Water Cycle Study advice is referenced.
- Planners should consider the contribution that the catchment-based approach can make, for example by improving farming and land management practices to improve water quality, offsetting the need to implement more advanced water or wastewater treatment works. The Defra catchment-based approach guidance is referenced[8].
- The Environment Agency and OfWAT Drainage Strategy Framework[9] guidance is referenced. It is expected that public facing drainage strategies will become an integral part of WaSC business plans. However as yet there are none in place for this study area.
- LPAs are advised to discuss growth plans at an early stage with WaSCs, to enable growth to be allowed for in the company's five-yearly business plans. Wastewater treatment works are classified as waste developments, so in a 2-tier area the district and county authorities must co-operate.
- Specific guidance on how infrastructure, water supply, wastewater and water quality considerations should be accounted for in both plan-making and planning applications is summarised below in Table 3-1:

8 Department for Environment, Food and Rural Affairs (2013) Catchment Based Approach: Improving the quality of our water environment. Accessed online at https://www.gov.uk/government/publications/catchment-based-approach-improving-the-quality-of-our-water-environment on 15/04/2014

9 Environment Agency / OfWAT (2013) Drainage Strategy Framework. Accessed online at http://www.ofwat.gov.uk/future/sustainable/drainage/rpt_com201305drainagestrategy.pdf on 15/04/2014 .

Table 3-1: Planning practice guidance: Water supply, wastewater and water quality considerations for plan making and planning applications

	Plan-making		Planning applications
Infrastructure	Identification of suitable sites for new or enhanced infrastructure. Consider whether new development is appropriate near to water and wastewater infrastructure. Phasing new development so that water and wastewater infrastructure will be in place when needed.	→	Wastewater considerations include: • first presumption is to provide a system of foul drainage discharging into a public sewer. • Phasing of development and infrastructure. • Circumstances where package sewage treatment plants or septic tanks are applicable.
Water supply		↘	Planning for the necessary water supply would normally be addressed through the Local Plan ... exceptions might include: • large developments not identified in Local Plans; • where a Local Plan requires enhanced water efficiency in new developments.
Water quality	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. Expectations relating to sustainable drainage systems.	→	Water quality is only likely to be a significant planning concern when a proposal would: • involve physical modifications to a water body; • indirectly affect water bodies, for example as a result of new development such as the redevelopment of land that may be affected by contamination etc. or through a lack of adequate infrastructure to deal with wastewater.
Wastewater	The sufficiency and capacity of wastewater infrastructure. The circumstances where wastewater from new development would not be expected to drain to a public sewer.	→	If there are concerns arising from a planning application about the capacity of wastewater infrastructure, applicants will be asked to provide information about how the proposed development will be drained and wastewater dealt with.
Cross-boundary concerns	Water supply and water quality concerns often cross local authority boundaries and can be best considered on a catchment basis. Recommends liaison from the outset.	→	No specific guidance (relevant to some developments).
SEA and Sustainability Appraisal	Water supply and quality are considerations in strategic environmental assessment and sustainability appraisal ... sustainability appraisal objectives could include preventing deterioration of current water body status, taking climate change into account and seeking opportunities to improve water bodies.	→	No specific guidance (should be considered in applications).

3.1.4 Code for Sustainable Homes and Building Regulations

The Code for Sustainable Homes (CfSH) is the Government's national standard for ***new housing***, even though it is optional. It became effective in England in April 2007 and a Code rating for new homes became mandatory in May 2008. It is not compulsory for every new home to be built to the Code, but each home must contain a rating against the Code.

The CfSH incorporates all key Government sustainability targets into one standard, measuring sustainability against categories such as energy and CO2 emissions, water, materials, surface water run-off, waste, pollution, management, ecology, and health and well-being.

A home is given a sustainability rating that ranges from one to six stars, where Level One is a modest improvement on minimum regulatory standards and Level Six is a zero carbon home with an exemplary level of sustainability performance.

In November 2010, the Government made changes to the Code for Sustainable Homes to bring it into line with new regulations such as the Part L of the Building Regulations as well as to simplify the Code.

The Government is seeking to simplify the various building codes that house builders have to adhere to. Following the Housing Standards Review consultation in 2013, in March 2014 the Government announced a simplified set of housing standards. Water efficiency is to be set by building regulations (125l/person/day). A more restrictive standard (110 l/person/day) can be set by local authorities in areas defined as water stressed. The definition of water stressed is being decided by Government.

The Government intends to implement the above standards by the end of 2014. Local authorities will not be able to require higher standards than the above through planning policy. The CfSH in its current form will no longer exist. The Government has asked the industry if there is interest in retaining those elements of the Code that relate to the standards outlined above, for the purposes of a voluntary house building code. No further information on how this might be taken forward is available.

Affordable housing funded by the Homes and Communities Agency (HCA) is currently required to meet Level 3 of the code. The HCA will not require this compliance for bids for the 2015-18 funding programme following the review of national housing standards. Water efficiency will be in accordance with relevant building standards. An Addendum to the HCA Affordable Homes Programme prospectus 2015-18 has been issued in response to the Housing Standards Review.[10]

Vale of White Horse District Council had been intending to require that all developments meet CfSH Level 4 (105l/person/day). However, with the pending withdrawal of CfSH new developments will be required to meet the Building Regulations G2 for Water Efficiency[11] which for new dwellings require "the potential consumption of wholesome water… must not exceed 125 litres per person per day." It is the Council's intention to require new homes to be built to the higher 110l/person/day on the assumption that the district will be classified as water stressed.

3.1.5 Sustainable Drainage Systems (SuDS)

Schedule 3 of the Flood and Water Management Act (FWMA) (not yet enacted), deals with Sustainable Drainage Systems (SuDS). The Act calls for the establishment of a SUDS Approving Body (SAB) to be set up within Lead Local Flood Authorities (LLFAs). The responsibilities of the SAB can be delegated to other organisations, such as the local planning authority, but the legal responsibility for drainage matters remains with the LLFA.

Schedule 3 requires the inclusion of sustainable drainage of surface water in developments that require planning approval or have drainage implications. It removes the automatic right, established by the Water Industry Act, to connect to public sewers and instead gives powers to local authorities as SABs to approve new drainage systems and their connection to public sewers. SABs will assess proposed SuDS in accordance with a new National Standard. The National Standard has yet to be published in its final form, but it will address the design, construction, maintenance and operation of drainage systems. It is likely to consider run-off destination, peak flow rates, run-off volume and water quality.

The National SuDS standards will consider drainage impacts as a result of changing rainfall intensity due to climate change, and thus will promote adaptation to future surface water flooding risks.

The introduction of these measures has been delayed several times and in September 2014 Defra released a public consultation document proposing that the approval of SuDS drainage

10 http://www.homesandcommunities.co.uk/sites/default/files/our-work/140326_ahp_prospectus_2015_addendum.pdf

11 Personal communication from KM, Vale of White Horse District Council, 17/07/2014

systems should be undertaken via the planning system, and outlining various options for maintenance of SuDS including by water companies and by independent management companies[12]. Therefore it is possible that approval for SuDS systems will become a responsibility of Local Planning Authorities in the near future.

Various councils have introduced their own guidelines to adopting and designing SuDS, such as Gloucester City Council[13] and seven councils in the south east of England[14].

3.1.6 BREEAM

BREEAM (Building Research Establishment Environmental Assessment Methodology) is an internationally recognised method of assessing, rating and certifying the sustainability of buildings. BREEAM can be used to assess the environmental performance of any type of building: new and existing. Standard BREEAM schemes exist for assessment of common domestic and non-domestic building types and less common building types can be assessed by developing bespoke criteria.

Using independent, licensed assessors, BREEAM 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. This promotes both climate change mitigation (energy efficiency) and adaptation (water efficiency). Buildings are rated and certified on a scale of 'Pass', 'Good', 'Very Good', 'Excellent' and 'Outstanding'.

BREEAM has expanded from its original focus on individual new buildings at the construction stage to encompass the whole life cycle of buildings from planning to in-use and refurbishment. The standard is regularly revised to improve sustainability, respond to industry feedback and support sustainability strategies and commitments. BREEAM standard can be applied to virtually any building and location, with versions for new buildings, existing buildings, refurbishment projects and large developments.

BREEAM certification may be required by procuring organisations but, following the Government's Housing Standards Review, cannot be made a requirement in Local Plans.

3.2 Local Planning and Sustainable Development Policy

3.2.1 Local Plan

The Vale of White Horse District Council is preparing a new Local Plan covering the period 2011 to 2031. This will partially replace the existing Local Plan from 2001 to 2011. In November 2014 VoWHDC published its Pre-submission draft Local Plan document.

The Local Plan identifies the number of jobs and new homes to provide up to 2031. Production of the Oxfordshire Strategic Housing Market Assessment 2014 and accompanying economic forecasts identified the potential for 22,980 additional jobs between 2011 and 2031 and the need for 20,560 additional homes 2011-2031 including to help meet future labour requirements. New facilities such as schools and road improvements are considered as part of the development alongside housing and jobs.

The sites will be designed to integrate with the local community whilst minimising the effects on the environment. Other requirements include flood protection, open spaces, green infrastructure and recreation provision.

The Local Plan Viability Study factors in a cost for accelerating work on capacity upgrades to water and wastewater assets where needed.

This Water Cycle Study will form one part of the evidence base for the Local Plan, including informing several of the core policies:

12 Defra (2014) Delivering Sustainable Drainage Systems. https://consult.defra.gov.uk/water/delivering-sustainable-drainage-systems

13 Gloucester City Council (2013) 'A Design and Adoption Guide' Accessed Online At http://www.gloucester.gov.uk/resident/Documents/Planning%20and%20Building%20Control/SUDS%20for%20GCC%20FINAL%20July%202013%20Document.pdf 25/09/2014

14Lead Local Flood Authorities of the South East of England (2013) Water. People. Places. A guide for master planning sustainable drainage into developments Accessed Online at http://www.medway.gov.uk/pdf/SE7%20suds%20masterplanning%20FINAL%20low%20res[1].pdf on 25/09/2014

Table 3-2: Local Plan Strategic Objectives relevant to the Water Cycle Study

Core policy	Aspects this WCS should contribute to:
1: Presumption in favour of sustainable development	Presumption in Favour of Sustainable Development – which provides support for appropriate and sustainable growth.
7: Providing Supporting Infrastructure and Services	Ensure new services and facilities are delivered alongside new housing and employment.
14: Upper Thames Reservoir	Policy to safeguard land for a reservoir and ancillary works between the settlements of East Hanney, Drayton and Steventon, until the examination of Thames Water's Resources Management Plan 2019. If the reservoir is included in the WRMP, the policy sets out the need to demonstrate that it is the best option, and requires a comprehensive master plan addressing issues such as construction disruption, impacts on landscape and wildlife habitats, road diversion and a new route for the Wilts and Berks Canal.
37: Design and Local Distinctiveness	All proposals for new development will be expected to be of high quality design that… is sustainable and resilient to climate change by taking into account landform, layout, building orientation, massing and landscaping to minimise energy consumption and mitigate water run-off and flood risks
38: Design Strategies for Strategic and Major Development Sites	Proposals for housing allocations and major development sites must be accompanied by a site-wide design strategy - this should include integration of SUDs within the public realm and a framework for Green Infrastructure.
40: Sustainable Design and Construction	All new development, including building conversions, refurbishments and extensions, should seek to incorporate climate change adaptation and design measures to combat the effects of changing weather patterns.
42: Flood Risk	The risk and impact of flooding will be minimised through: • directing new development to areas with the lowest probability of flooding • ensuring that all new development addresses the effective management of all • sources of flood risk • ensuring that development does not increase the risk of flooding elsewhere, and • ensuring wider environmental benefits of development in relation to flood risk.
43: Natural Resources	All development proposals will be required to make provision for the effective use of natural resources where applicable, including…making efficient use of water, for example through rainwater harvesting and grey water…causing no deterioration in, and where possible, achieving improvements in water quality.
45: Green Infrastructure	A net gain in Green Infrastructure, including biodiversity, will be sought either through on site provision or off-site contributions and the targeted use of other funding sources. A net loss of Green Infrastructure, including biodiversity, through development proposals will be resisted.

The consultation statement for the previous draft Local Plan consultation noted the main issues raised in the consultation, including that:

- There are concerns about the scale of the proposed housing and the allocated sites for development, as there have a shortage of provisions in the past. The document has stated that this "represents a very significant challenge in both the short and long term".

- It has been requested that the council works in partnership with key stakeholders where there are cross cutting boundary issues relating to the protection of the green belt land surrounding Oxford.
- The capacity of existing infrastructure would need to be sufficient to cope with the scale of the proposed development. There is a strong desire to see infrastructure in place before the developments are established. [15]

These concerns raise issues regarding water resources as it is important that the development proposals and their location do not adversely impact future water provisions and sewage treatment.

3.2.2 Infrastructure Delivery Plan

The purpose of the Infrastructure Delivery Plan (IDP) is to set out the infrastructure and services required to support the future levels of planned housing and employment in the District, including how, by whom and broadly when it will be provided and expected costs. The IDP identifies sources of funding to assist in the delivery of infrastructure to help upgrade facilities, promote economic growth to ultimately improve the quality of life.[16]

The Local Plan aims to sustainably develop towns and districts whilst maintaining a high quality environment. The vision for the Vale of White Horse District is to meet the needs of all the residents by creating safe, sustainable and socially balanced settlements, with sufficient services and facilities available. Housing is proposed in various areas throughout the district including Abingdon, Faringdon, Harwell and west of Didcot. The plan will support the local economy, whilst adapting to climate change by promoting sustainable living along with reducing flood risks in order to safeguard the landscape.

The IDP notes that for the new sites, gas and power supply is needed to accommodate the developments. There is also a need for sewage network upgrades, enhancing pumping station capacities, upsizing rising mains and the provision of storage tanks within the downstream network. Wastewater Treatment Works (WwTW) upgrades are required at Didcot, but developers need to undertake modelling of the systems to determine the changes needed. Drainage and water supply also needs to be addressed by new developments.

3.3 Environmental Policy

3.3.1 Urban Wastewater Treatment Directive (UWWTD)

The UWWTD is an EU Directive that concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the abovementioned wastewater discharges. More specifically Annex II.A (a) sets out the requirements for discharges of phosphates and/or nitrates from urban wastewater treatment plants to sensitive areas which are subject to eutrophication. The values for concentration or for the percentage reduction shall apply. For specific information regarding concentration limits please refer to the UWWTD[17]. The Directive has been transposed in to UK legislation through enactment of the Urban Waste Water Treatment (England and Wales) Regulations 1994 and 'The Urban Waste Water Treatment (England and Wales) (Amendments) Regulations 2003'.

3.3.2 Habitats Directive

The EU Habitats Directive aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The directive created a network of protected areas around the European Union of national and international importance called Natura 2000 sites.

These sites include:

- Special Areas of Conservation (SACs) - these support rare, endangered or vulnerable natural habitats, plants and animals (other than birds).

15 Vale of White Horse District Council (2014) Local Plan Consultant Statement Accessed Online at http://www.whitehorsedc.gov.uk/sites/default/files/2014-02-20_Vale%20of%20White%20Horse%20Local%20Plan%20Part%201%20ConsultatStatement.pdf On 01/10/2014

16 Vale of White Horse District Council (2014) Infrastructure Delivery Plan Accessed Online at http://www.whitehorsedc.gov.uk/sites/default/files/Microsoft%20Word%20-%202013_02_26_IDP%20RoD%20Whole%20Document_2.pdf on 01/10/2014

17 http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31991L0271

- Special Protection Areas (SPAs) - support significant numbers of wild birds and their habitats.

Special Protection Areas and Special Areas of Conservation are established under the EC Birds Directive and Habitats Directive respectively. All in all the directive protects over 1000 animals and plant species and over 200 so called "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance.

3.3.3 The Water Framework Directive

The Water Framework Directive (WFD) was first published in December 2000 and transposed into English and Welsh law in December 2003. It introduced a more rigorous concept of what "good status" should mean than the previous environmental quality measures. The WFD estimated that 95% of water bodies were at risk of failing to meet “good status”.

River Basin Management Plans are required under the WFD and are strategies that should influence development plans and be influenced by them. Vale of White Horse District is covered by the Thames[18] RBMPs.

One WFD objective is to have "no deterioration", therefore all water bodies must meet the class limits for its status class declared in the Final Thames and Severn River Basin Management Plans. A second 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 WFD objectives. The WFD objectives are summarised below.

The Environmental Objectives for surface waters are:

- Prevent deterioration in status for water bodies
- Aim to achieve good ecological and good surface water chemical status in water bodies by 2015
- For water bodies that are designated as artificial or heavily modified, aim to achieve good ecological potential by 2015
- Comply with objectives and standards for protected areas where relevant
- Reduce pollution from priority substances and cease discharges, emissions and losses of priority hazardous substances.

The Environmental Objectives for groundwater are:

- Prevent deterioration in the status of groundwater bodies
- Aim to achieve good quantitative and good groundwater chemical status by 2015 in all those bodies currently at poor status
- Implement actions to reverse any significant and sustained upward trends in pollutant concentrations in groundwater
- Comply with the objectives and standards for protected areas where relevant
- Prevent or limit the input of pollutants into groundwater.

3.3.3.1 Protected Area Objectives

The WFD specifies 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.

Article 4 of the WFD requires Member States to achieve compliance with the standards and objectives set for each protected area by 22 December 2015, unless otherwise specified in the Community legislation under which the protected area was established. Some areas may require special protection under more than one EC Directive 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:

[18] Environment Agency (2009) Thames River Basing Management Plan

- 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 areas designated as 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 Directive (UWWTD);
- 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.

Many WFD protected areas coincide with water bodies, these areas will need to achieve the water body status objectives in addition to the protected area objectives. Where water body boundaries overlap with protected areas the most stringent objective applies, that is the requirements of one EC Directive should not undermine the requirements of another.

The objectives for Protected Areas relevant to this study are as follows:

3.3.3.2 Drinking Water Protected Areas

- Ensure that, under the water treatment regime applied, the drinking water produced meets the requirements of the Drinking Water Directive; and
- Ensure necessary protection in the Drinking Water Protected Areas with the aim of avoiding deterioration in water quality in order to reduce the level of purification treatment required in producing drinking water.

3.3.3.3 Economically Significant Species (Freshwater Fish Waters)

- To protect or improve the quality of running or standing freshwater to enable them to support fish belonging to:
- Indigenous species offering a natural diversity; or
- Species the presence of which is judged desirable for water management purposes by the competent authorities of the Member States

3.3.3.4 Nutrient Sensitive Areas (Nitrate Vulnerable Zones)

- Reduce water pollution caused or induced by nitrates from agricultural sources and
- prevent further such pollution

3.3.3.5 Nutrient Sensitive Areas (Urban Waste Water Treatment Directive)

- To protect the environment from the adverse effects of urban waste water discharges and waste water discharges from certain industrial sectors.

3.3.3.6 Natura 2000 Protected Areas (water dependent SACs and SPAs)

The objective for Natura 2000 Protected Areas identified in relation to relevant areas designated under the Habitats Directive or Birds Directive is to:

- Protect and, where necessary, improve the status of the water environment to the extent necessary to achieve the conservation objectives that have been established for the protection or improvement of the site's natural habitat types and species of Community importance in order to ensure the site contributes to the maintenance of, or restoration to, favourable conservation status.

3.3.3.7 Groundwater Source Protection Zones

The Environment Agency has a Groundwater Protection Policy to help prevent groundwater pollution. In conjunction with this the Environment Agency have defined groundwater Source Protection Zones (SPZs) to help identify high risk areas and implement pollution prevention measures. The SPZs show the risk of contamination from activities that may cause pollution in

the area, the closer the activity, the greater the risk. There are three main zones (inner, outer and total catchment) and a fourth zone of special interest which is occasionally applied.

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 biggest. 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 area.

3.3.4 Catchment Abstraction Management Strategies

The Catchment Abstraction Management Strategy (CAMS) is prepared by the Environment Agency to manage abstractions in a particular area. The CAMS provides information on the resources available and what conditions might apply to new licences. The licences require abstractions to stop or reduce when a flow or water level falls below a specific point as a restriction to protect the environment and manage the balance between supply and demand for water users. The CAMS is published in a series of documents known as Abstraction License Strategies (ALSs), but for clarity here the term CAMS is used to refer to these.

New and varied licences are normally time limited, which allows time for a periodic review of the area as circumstances may have changed since the licences were granted. These are generally given for a twelve year duration, but shorter or longer duration licences can be accepted. This is dependent on local factors such as the lifetime of the infrastructure, the availability of resources and future plans or changes. The licences can be replaced or renewed near to the expiry date.

The CAMS is important in terms of the WRMP as this helps to determine the current and future pressures on water resources and how the supply and demand will be managed by water companies.[19]

The Vale of White Horse District is covered by two CAMS, the Thames Corridor and the Kennet and Vale of White Horse which have slightly different abstraction licences due to the local characteristics of the water body. Abstraction licences for the whole region are required if more than 20m³/day of water is withdrawn from a river, lake, reservoir, pond, spring or an underground source. The licence is granted dependent on the amount of water available after the required needs for the environment and existing abstractions, which generally lasts for twelve years. The CAMS boundaries covering the Vale of White Horse District Council are shown in Figure 3-2:

19 Environment Agency (2013) Managing Water Abstraction Accessed Online at https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process on 23/09/2014

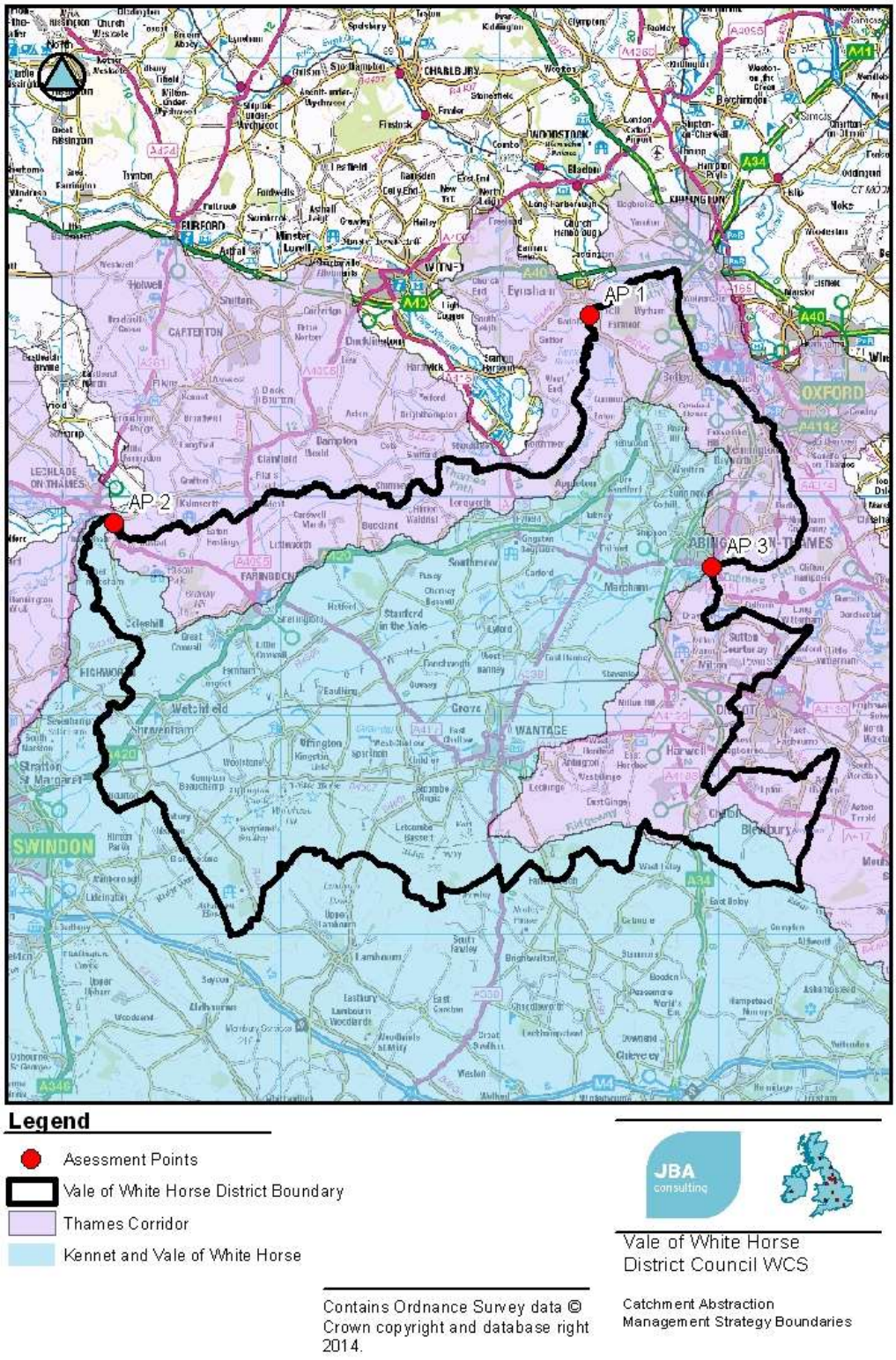


Figure 3-2: Catchment Abstraction Management Strategy Boundaries for the Vale of White Horse District

3.3.4.1 Thames Corridor

The Thames catchment is one of the driest in the UK and is a major water resource for abstractions for the public water supply. The next common end date for all of the licences is the 31 March 2016, which renews again in 2028. Abstractions are prohibited in low flow based on a minimum water level requirement at Kingston gauging station.

In order to meet this requirement the licensing strategy has been adopted whilst still meeting the Water Framework Directive (WFD) goals. A multi-tier “Hands-Off Flow” (HOF) is used to allow

abstractions to occur between the water levels of Q21 and Q50. Surface water abstractions can also occur in very high flows or when the river floods, which is approximately 77 days a year. Groundwater abstractions are permitted so long as there is no impact to the surface water and the groundwater level stays the same. [20]

3.3.4.2 Kennet and Vale of White Horse

Water abstractions in this catchment are from both surface and groundwater, with the majority of demand coming from public water supply[21]. The area consists of Chalk, Upper Greensand and Tertiary deposits with extensive gravel and alluvial deposits close to the River Kennet. Due to the topography in the area, a groundwater divide occurs which feeds the headwaters of the surface watercourses. Groundwater abstractions are permitted dependant on surface water availability unless more information is known on the aquifers or if there are local issues that need protecting.

The rivers in this catchment drain into the Thames which limits the abstractions upstream to protect the river level at Kingston gauging station. Water abstractions are accepted in both low and high flows in the Vale of White Horse District which is available less than 30% of the time.

The CAMS currently in place are presumed to be renewed, but no common end date has been determined. Whilst no common end date has been determined the EA are of the opinion that this would not have significant implications to the conclusion and recommendations of this Water Cycle Study[22].

3.3.4.3 Summary of resource availability

Table 3-3 summarises the resource availability at low flows around the district.

Table 3-3: Resource Availability for the Assessment Points within the Vale of White Horse District

Assessment Point Number	Name	Region	Local resource availability at low flows	HOF Q (1)	HOF (Ml/d) (2)	Days p.a (3)	Avail-able (Ml/d) (4)	Gauging Station (GS) at this AP?	Additional restrictions (assuming average conditions)
1	Eynsham Lock and Weir	Thames Corridor	No water available for licensing	Q21 at Kingston if <2 MLD		77	1568	Eynsham	
2	Cole	Kennet and Vale of White Horse	Water available for licensing	No Local HOF		365	2.7	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
3	Ock	Kennet and Vale of White Horse	Water available for licensing	No Local HOF		365	9.2	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
4	Ray	Kennet and Vale of White Horse	Water available for licensing	No Local HOF		365	37.6	Water Eaton	Thames Q50 HOF Abstraction restricted to 182 days per annum
5	Upper Kennet	Kennet and Vale of White Horse	No water available for licensing	Q75	21.3	274	3.5	Marlborough	Thames Q50 HOF Abstraction restricted to 182 days per annum
6	Og	Kennet	No water	Q56	10.4	208	1.2	Marlboro	Thames Q50

20 Environment Agency (2014) Thames Catchment Abstraction Licensing Strategy Accessed online at https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process on 25/09/2014

21 Environment Agency (2012) Kennet and Vale of White Horse Catchment Abstraction Licensing Strategy Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289893/LIT_2517_39dc0f.pdf on 01/10/2014

22 Environment Agency (2014) Response to draft water cycle study phase I report

Assessment Point Number	Name	Region	Local resource availability at low flows	HOF Q (1)	HOF (Ml/d) (2)	Days p.a (3)	Avail-able (Ml/d) (4)	Gauging Station (GS) at this AP?	Additional restrictions (assuming average conditions)
		and Vale of White Horse	available for licensing					ugh (Poulton Farm)	HOF Abstraction restricted to 182 days per annum
7	Upper Middle Kennet	Kennet and Vale of White Horse	Restricted water available for licensing	Q75	163.5	274	13.5	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
8	Lower Middle Kennet	Kennet and Vale of White Horse	No water available for licensing	Q75	222.3	274	8.2	Newbury	Thames Q50 HOF Abstraction restricted to 182 days per annum
9	Lambourn	Kennet and Vale of White Horse	Restricted water available for licensing	Q74	86.4	270	1.1	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
10	Enbourne	Kennet and Vale of White Horse	Water available for licensing	No local HOF		365	0	Np	Thames Q50 HOF Abstraction restricted to 182 days per annum
11	Foudry Brook	Kennet and Vale of White Horse	Water available for licensing	No Local HOF		365	57.1	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
12	Lower Kennet	Kennet and Vale of White Horse	Water available for licensing	No Local HOF		365	21.7	No	Thames Q50 HOF Abstraction restricted to 182 days per annum
13	Pang	Kennet and Vale of White Horse	No water available for licensing	Q22	73.5	80	10.4	Pangbourne	Thames Q50 HOF Abstraction restricted to 182 days per annum

(1) Hands off Flow restriction (Q value)
(2) Hands off Flow restriction (Ml/D value)
(3) Number of days per annum abstraction may be available
(4) Approximate volume available at restriction (Ml/D)

Throughout the district there are a variety of licensing strategies which change the availability of water in low flow conditions. This is due to the protection of other areas of the catchment that require a particular water level to be maintained. Abstractions at all the locations in Table 3-2 are still possible unless there is damage to the environment. The ALS does not consider the capacity of the catchments to provide water supplies for future domestic, industrial or agricultural demands. However, the results in Table 3-3 indicate that, in general, there are limited additional resources which can simply be exploited to meet rising demand.

3.3.4.4 Recommendations for better management practices

Due to abstraction, several water bodies in the district have fallen below the Ecological Flow Indicator (EFI) demonstrating the need to reduce abstraction by using more efficient management practices. This would increase the sustainability of abstraction and reduce the impacts to the environment.

The main options for this identified in the CAMS are to adopt water efficiency and demand management techniques. Methods include:

- Testing the level of water efficiency before granting an abstraction licence
- Promoting efficient use of water
- Taking actions to limit the demand
- Reducing leakage.

This would ultimately cut the growth in abstraction and limit the impacts on flow and the ecology.

3.3.5 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 both in the quality and quantity of water, and consequently limits the ability of a waterbody to achieve "Good Status" under the WFD.

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".

This assessment (2013) has classified the Thames Water supply region as an area of "serious" water stress. Under water industry regulations, water companies in areas classified as seriously water stressed need to evaluate compulsory metering alongside other options when preparing water resource management plans (WRMPs).

3.4 Water Industry Policy

3.4.1 The Water industry in England

Water and sewerage services in England and Wales are provided by 10 Water and Sewerage Companies (WaSCs) and 12 'water-only' companies. The central legislation relating to the industry is the Water Industry Act 1991[23]. The companies essentially 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 - these are 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 which could influence the future provision of water and wastewater services include:

- All non-domestic customers will be able to switch their water supplier and/or sewerage undertaker.
- New businesses will be able to enter the market to supply these services.
- Measures to promote a national water supply network.
- Enabling developers to make connections to water and sewerage systems.

3.4.2 Economic regulation of the water industry

The water industry is primarily regulated by three regulatory bodies;

- the Water Services Regulation Authority (OfWAT) - economic and customer service regulation
- Environment Agency - environmental regulation
- Drinking Water Inspectorate (DWI) - drinking water quality.

23 http://www.legislation.gov.uk/ukpga/1991/56/contents

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 demand 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.

At the time of writing the industry is coming to the end of AMP5 (2010-2015). Their draft plans have been reviewed by OfWAT, and a final "determination" of prices and outcomes is expected in December 2014. This will determine the company's objectives and budget for AMP6 (2015-2020).

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 reported on in their 25-year Strategic Direction Statements (SDS) and Water Resource Management Plans (WRMPs).

3.4.3 Water Resource Management Plans

Water companies are required to prepare 25-year forward looking WRMPs, with updates prepared every 5 years. In reality companies prepare internal updates more regularly. WRMPs are required to assess:

- Future demand (due to population and economic growth)
- Demand management measures (e.g. water efficiency and leakage reduction)
- How the company will address changes to abstraction licenses
- How the impacts of climate change will be mitigated
- Where necessary, set out the requirements for developing additional water resources to meet growing demand.

The individual WRMP for Thames Water is reviewed in section 4.1.3.

3.4.4 Developer contributions

Developments with planning permission have a right to connect to the public water and sewerage systems, although the Floods and Water Management Act removes the automatic right to connect surface water to sewerage systems.

Developers may either 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 of the infrastructure requires construction on third party land.

The costs of requisitions are shared between the water company and developer as defined in the Water Industry Act 1991.

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 action, for example the water company upgrading a sewer, is complete.

Legal agreements under the Town and Country Planning Act Section 106, and the Community Infrastructure Levy (CIL)[24] may not be used to obtain funding for water or wastewater infrastructure.

[24] Department for Communities and Local Government (2011) Community Infrastructure Levy: An Overview. Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6313/1897278.pdf on 03/11/2014

4 Water Resources and Water Supply

Key questions:

- Is there capacity in existing licences for development?
- Will existing licences remain valid?
- Can we reduce abstraction by better management practices?
- If new major infrastructure (reservoirs, water treatment works, boreholes) are needed, can they be provided in time, can they be funded, and are they sustainable?

Thames Water (TWUL) is responsible for supplying water for the entire District.

4.1 Water resources assessment

When new houses are planned it is important to ensure that there are enough water resources in the area to cover the increase in demand without the risk of shortage in the future or in periods of high demand.

The aims of this assessment are to flag if the actual housing number proposed by VoWHDC exceeds what TWUL has considered in planning the future demands so that actions can be implemented and resources planned to overcome future shortages.

4.1.1 Methodology

The TWUL Water Resource Management Plan (WRMP) was reviewed. Attention was focussed upon:

- The available water resources and future pressures which may impact 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.

In addition TWUL and BW were provided with the list of sites including the number of houses planned each year and the population equivalent and were invited to comment upon these.

The results were assessed using a red / amber / green traffic light definition to score each water resource zone:

WRMP evidences that the planned increase in demand can be met	Insufficient evidence to confirm that the planned increase in demand can be met.	WRMP evidences that the planned increase in demand cannot be met

4.1.2 Data collection

The datasets used to assess the water resource capacity were:

- Sites location in GIS format (provided by the VoWHDC)
- Number of planned houses for each year for each site (provided by the VoWHDC)
- Company and water resource zone boundaries (TWUL).
- Water Resource Management Plans (TWUL)

4.1.3 Results

Following the Water Cycle Study request for information, Thames Water provided the following response:

"The report should reference our Water Resources Management Plan which is a statutory document for anything water resources related"

Thames Water manage water resources in seven Water Resource Zones (WRZs). Their Swindon and Oxfordshire (SWOX) zone covers the whole of Vale of White Horse District, along with Swindon, the majority of Cotswold District, north Wiltshire and the majority of Oxfordshire. The extents of the SWOX zone are illustrated in Figure 4-1.

TWUL Draft Water Resources Management Plan 2015-2040 (WRMP)[25] sets out their proposed 25 year strategy for maintaining the balance between the supply and demand for water in their region. TWUL update their WRMP each new AMP period, and takes into account actual changes in population and consumption, as well as regulatory changes.

The SWOX zone was estimated to have a supply-demand credit of 40MLD in 2011, but is forecast to decline and to become a deficit of -3MLD by 2030 and -14MLD by 2040. Thames Water intends to address this through:

- 2015-20 - demand management measures including promoting water efficiency, increasing the percentage of properties metered and reducing leakage.
- 2020-25 - continued focus on demand management including increasing metering outside of London, and
- Beyond 2025 large-scale scheme(s) to provide additional resources. Currently the plan includes a major wastewater reuse scheme at Beckton WwTW in east London, however other options including bulk transfers from other regions and reservoirs will also be considered.

The WRMP notes that since the previous WRMP in 2009, regional spatial strategies have been revoked, and government policy upon which spatial planning is based, is now enshrined in the Localism Act. With the exception of London, where the London Plan remains, information for population and property growth was therefore compiled at a local authority level and local authorities are required to develop population and property forecasts as part of their local plans.

25 Thames Water (2014) Water Resource Management Plan 2015-2040, Accessed online at http://www.thameswater.co.uk/tw/common/downloads/wrmp/WRMP14_Section_0.pdf on 06/05/2014

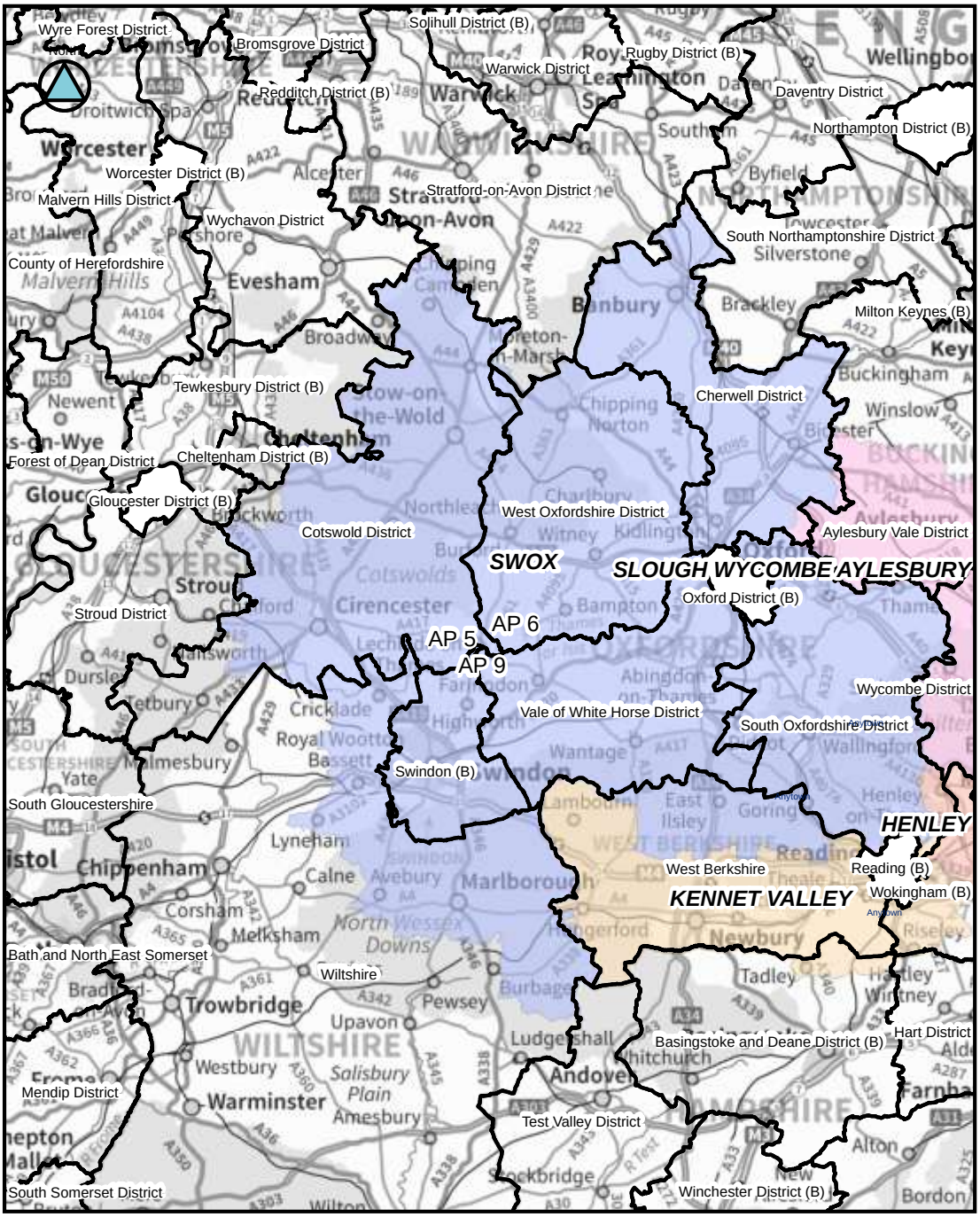


Figure 4-1: Thames Water's Swindon and Oxfordshire (SWOX) Water Resource Zone

To inform the WMRP property and population projections were undertaken by independent consultants Experian, as part of a collaborative project with other water companies. Following a

methodology developed in conjunction with the Environment Agency, Experian gathered information to produce three projections:

- Plan-based
- Trend-based
- An Experian own view of the 'most likely' forecast

Thames Water selected to base both their population and property forecasts upon the Plan-based scenario and this was confirmed with the Environment Agency. The final growth forecasts in the SWOX zone are summarised below in Table 4-1.

Table 4-1: Population, properties and average occupancy forecasts for SWOX

Parameter	Type	Year						
		11/12	14/15	19/20	24/25	29/30	34/35	39/40
Population (000s)	Unmeasured	474.6	435.7	411.2	389.5	368.5	348.6	330.9
	Measured	469.8	501.9	572.2	630.1	668.3	702.6	745.1
	Non Household	48.8	67.9	67.9	68.6	69.6	71.2	63.6
	Total	993.2	1005.4	1051.3	1088.2	1106.4	1122.4	1139.6
Properties (000s)	Unmeasured	174.3	164.2	153.4	143.6	133.9	124.1	114.4
	Measured	204.7	229.3	266.4	298.9	323.0	345.3	367.9
	Total	379.0	393.4	419.7	442.5	456.9	469.4	482.3
Occupancy	Unmeasured	2.7	2.7	2.7	2.7	2.8	2.8	2.9
	Measured	2.3	2.2	2.1	2.1	2.1	2.0	2.0

In summary therefore, the WRMP is based on a forecast of 77,910 additional properties in the SWOX zone between 2011/12 and 2029/30.

During preparation of the WCS, the publication of the Oxfordshire Strategic Housing Market Assessment drew attention to the very substantial increase in projected development in that county compared to the situation in 2012 when TWUL's Water WRMP was published. In order to make a high-level assessment of potential housing growth within the SWOX zone, the latest figures for all councils covering that Zone were collated as shown in Table 4-2:

Table 4-2: Summary of forecast housing growth within the SWOX water resource zone

Area	Forecast (properties)	Source
Oxfordshire	100,060 (2011-31)	2014 Strategic Market Housing Assessment (SHMA) for Oxfordshire (http://www.southoxon.gov.uk/news/2014/2014-03/countys-new-housing-market-assessment
Swindon	22,000 (2011-26)	2012 pre-submission Local Plan (http://www.swindon.gov.uk/ep/ep-planning/forwardplaning/ep-planning-localdev/Documents/Local%20Plan%20Pre-Submission%20draft.pdf)
Cotswold District	6,800 – 7,100 (2011-31)	Local Plan Consultation Paper: Preferred Development Strategy May 2013 (http://consult.cotswold.gov.uk/portal/fp/local_plan_2011-2031/development_strategy?pointId=s1365512025054#section-s1365512025054)
TOTAL	Approx 129,000	

The numbers, which have been confirmed by the respective councils, appear to indicate that current projected growth may be some 49,000 units (65%) greater than those available to TWUL during the preparation of the WRMP. One possible explanation for this dramatic increase in projected housing numbers is the requirement in NPPF for LPAs to establish the Objectively Assessed Need (OAN) for growth. This approach tends to produce growth estimates that don't take constraints (including water resource constraints) into account.

In response, Thames Water supplied an assessment of water resource and supply in the Vale of White Horse District. In summary:

- Housing growth for the period 2015 to 2030 from the supplied site information (20,815 properties) is significantly higher than that allowed for in the latest Water Resource Management Plan (16,710).
- From an overall water resources position, based on TWs forecast growth number, there remains sufficient water resources within the overall Swindon Oxfordshire Water Resource Zone (WRZ).

However the proposed increase in demand identified within the Vale has yet to be modelled. This will be undertaken in detail for the next WRMP in 2019, but in the interim Thames Water has initiated a study which will consider the water resources situation using the latest growth figures. This study is due to complete in early 2015. *"It is likely that appropriate phasing will be required to ensure that infrastructure upgrades are in place ahead of occupation of development. At this moment in time a back end loading of the additional housing allocations (beyond 2020) would be welcomed, however once the study is completed and solutions identified a more accurate picture of phasing options will be available."*

The following summary response was also received:

> "The WRMP is a live document with formal updates published annually. The additional growth of ~78k properties is certainly significant but we need the yearly profiles to model this demand in all the areas served by SWOX for the purposes of our supply demand balance. Given that the new planned level of growth is significant it would most likely have implications for our supply demand balance in SWOX. However as long as we have the relevant information in a timely fashion we should be able to address any supply demand issues that arise." (Thames Water).

In response to the above, the Environment Agency made the following statement:

> "The Phase 1 WCS does not provide sufficient evidence to conclude that the water resource and supply required due to the proposed growth can be delivered. We would stress that the WRMP should be revised to include the updated growth figures.
> Further assessment will be required, within the Phase 2 WCS, to fundamentally determine whether the water supply infrastructure required to support the levels of growth are deliverable. The water supply assessment will form part of the evidence base which relates to the effectiveness of a Local Plan, a fundamental soundness point which needs to be resolved."(Environment Agency).

In summary an "amber" assessment has been assigned to the water resource situation in Thames Water's SWOX zone. This should be reviewed once TWUL have prepared their updated assessment in early 2015.

4.1.4 Conclusions

Table 4-3: Water resource summary

Settlement	Assessment
All settlements	Insufficient evidence to confirm that the planned increase in demand can be met.

4.1.5 Recommendations

Table 4-4: Water resource actions

Action	Responsibility	Timescale
Take account of the updated housing growth projections across SWOX in the growth study. Use the Housing Supply Statements published by each LPA.	TWUL	Early 2015
Consider potential for phasing development beyond 2020	VoWHDC	TBC
Consider the contribution to water resource management that can be made through spatial planning, in particular when the revised building regulations emerge consider using the optional building regulations requiring greater water efficiency	VoWHDC	On hold - dependent on release of revised building regulations and their content.

4.1.6 Water supply infrastructure assessment

Increase in water demand adds pressure to the existing supply infrastructures. An assessment is required to identify whether the existing infrastructure is adequate or whether upgrading 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 WSZ, and distribution infrastructure, smaller scale assets which convey water around settlements to customers. This assessment is focussed on the supply infrastructure. It is expected that developers should fund assessments and the modelling of the distribution systems to assess requirements for local capacity upgrades.

4.1.7 Methodology

TWUL was provided with the list of sites including:

- the number of houses planned each year
- the population equivalent

together with a red / amber / green traffic light definition to score each site:

Can accommodate the proposed site allocation without upgrades	Can accommodate the proposed site allocations without upgrades but will bring the system close to its current capacity limit	Cannot accommodate all proposed site allocations. Further modelling will be required and subsequent upgrades may be needed.

TWUL has assessed each site using the different data set they hold.

4.1.8 Data collection

The datasets used to assess the water supply and distribution capacity are the following:

- Sites location in GIS format (provided by the VoWHDC)
- Number of planned houses for each year for each site (provided by the VoWHDC)

4.1.9 Results

Thames Water supplied an assessment of water resource and supply in the Vale of White Horse District. In summary:

- The overriding principle of water supply into the Vale of White Horse is by transfer from the Beacon Hill reservoir at Farmoor to North Oxfordshire and Swindon. The reservoir provides support to Faringdon, Abingdon and Hinksey. Additionally it provides supplies to the Boars Hill reservoir, which supports Appleton and Cummor.
- There are other water supplies from the Hagbourne Hill reservoir, which supports the local area of Didcot and provides supplies to reservoirs in Wantage, South Oxford, Grove, Drayton, Sutton Courtenay and the East of Didcot. Hagbourne Hill reservoir also provides supplies to Faringdon via a strategic transfer, linking the Beacon Hill and Hagbourne Hill mains.
- Two forecasts have been undertaken for the housing growth in the district, one based on the Thames Water's flow monitoring zones forecasting the level of growth in water demand, and the other based on growth forecasts from the latest WRMP. The WRMP suggests an increase of 20,815 houses, which is significantly higher than the Thames Water forecast of 16,710.
- The FMZs in the VoWHDC are not discreet as there is an overlap with other local authorities, such as West Oxford and Oxford City. The only FMZs wholly within the VoWHDC area are Blewbury, Faringdon, Hagbourne Hill and Wantage.
- There are four principal areas of concern relating to water supply within this area. The concerns relate to TWUL's ability to maintain a continuous supply to customer demands during a hot, dry weather period. TWUL plan to ensure we can transfer volumes of water to our service reservoirs in excess of that which our customers demand. These are;
    - a. Abingdon FMZ: Route a will be able to support the proposed levels of growth with only local reinforcements required. The development would be preferred to the North and East of Abingdon, where the transfer mains are located.
    - b. Faringdon FMZ: Route b is the area of greatest concern. The supply from the reservoir is expected to meet the increase level of demand but there is a concern that the mains from the reservoir may be insufficiently sized. The development would be preferred around Faringdon, near to the reservoir, but this may cause issues with existing infrastructure at Shrivenham and Stanford in the Vale. Modelling needs to be undertaken to assess this further.
    - c. Hagbourne Hill FMZ: Route c will be able to support the proposed levels of growth with only local reinforcements required. Development can best be supported in close proximity to Didcot (Valley Park developments).
    - d. Wantage FMZ: Route d will be able to support developments near Didcot (Harwell) with existing infrastructure, but this route may need local reinforcements and possibly a new booster station, as the current one has almost reached its maximum. The development within the Wantage FMZ would need an upgrade of these pumps, but the existing mains should be enough to support the development. Modelling needs to be undertaken to confirm this. The booster upgrade would take a number of years to construct.

The water supply status is summarised below and presented as an R/A/G analysis in Table 4-5:

4.1.10 Conclusions

Table 4-5: Water supply and distribution summary

Settlements	Assessment
Settlements in Faringdon FMZ: Coxwells Craven Faringdon Longworth Shrivenham Stanford Settlements in the Wantage FMZ: Challow Charlton Grove Hanneys Hendreds Wantage	Cannot accommodate all proposed site allocations. Further modelling will be required and subsequent upgrades may be needed.
All other settlements	Can accommodate the proposed site allocation without upgrades

4.1.11 Recommendations

Table 4-6: Water supply and distribution actions

Action	Responsibility	Timescale
Undertake a technical study to understand options to provide sufficient bulk and local transfer capacity and communicate findings to VoWHDC.	TWUL	Early 2015
Consider potential for phasing development beyond 2020 in Abingdon, Faringdon and Wantage	VoWHDC	TBC

5 Wastewater Collection and Treatment

Key questions:

- Is there volumetric capacity in existing effluent discharge consent for growth?
- Will discharge consent be valid to meet future standard (e.g. WFD)?
- Will additional discharge be allowed if there is no additional environmental capacity to assimilate it?
- If new major infrastructure (wastewater treatment works, major pumping mains or sewer mains) are needed, can they be provided in time, and can they be funded?

Thames Water (TWUL) is the Sewerage Undertaker (SU) for the whole District. The role of sewerage undertaker includes collection and treatment of wastewaters from domestic and commercial premises, and in some areas drainage of surface water from building curtilages to combined or surface water sewers. It excludes, unless adopted by TW, systems that do not connect directly to the wastewater network, e.g. SuDS or highway drainage.

Increased wastewater flows into collection systems due to growth in population or per-capita consumption can lead to overload of infrastructure, increasing the risk of sewer flooding and, where present, increasing the frequency of discharges from Combined Sewer Overflows (CSOs).

Likewise, headroom at wastewater treatment works can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volume 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 the consented effluent consents in order to achieve a "load standstill", i.e. ensuring that as effluent volumes increase the pollutant load discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent.

In combined sewerage systems, or foul systems with surface water misconnections, there is potential to create headroom in the system, thus enabling additional growth, by removal of surface water connections. This can most readily be achieved on redevelopment of brownfield sites with combined sewerage, where there is potential to discharge surface water via sustainable drainage systems (SuDS) to groundwater, watercourses or surface water sewers.

5.1 Sewerage system capacity assessment

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

It may be possible 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 to increase its capacity. New infrastructures may be required if for example a site is not served by an existing system.

Sewerage undertakers must consider 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 allocated growth with a high certainty of being delivered. Additional sewerage capacity to service windfall sites, smaller infill development or to connect a site to the sewerage network across third party land are normally funded via developer contributions.

5.1.1 Methodology

TWUL were provided with the list of sites including:

- the number of houses planned each year

- the population equivalent
- the increase in dry weather flow

together with a red / amber / green traffic light definition to score each site:

Can accommodate the proposed site allocation without upgrades	Can accommodate the proposed site allocation without upgrades but will bring the network close to its current capacity limit	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed.

TWUL assessed each site using various data sources including models and Drainage Area Plans (DAPs).

5.1.2 Data collection

The datasets used to assess the sewerage system capacity are the following:

- Sites location in GIS format (provided by the VoWHDC)
- Number of planned houses for each year for each site (provided by the VoWHDC)
- Occupancy rate, water demand and % of water that reach the WwTW

5.1.3 Results

For each WwTW catchment, TWUL has provided a plan showing the extents of the foul sewerage catchment, and a schematic showing the general arrangement of the network, pumping stations and treatment works.

TWUL undertook a desktop assessment of WwTW catchments, taking into consideration issues such as size of the receiving sewers, known sewer flooding downstream, local topography and existing planned studies and investment. Catchments were not colour coded following the R/A/G analysis - this has been interpreted subsequently by JBA Consulting. Not all sites were analysed by TWUL.

5.1.4 Conclusions

Table 5-1: Sewerage system summary

TWUL Site ID	Site Name	Waste Response
37041	East Harwell Oxford Campus	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed
32573	East of Coxwell Road, Faringdon	
37039	East Sutton Courtenay	
41813	Great Coxwell Parish, South Faringdon	
41244	Harwell and Milton Parishes east of the A34 adjoining Didcot Town, Valley Park	
20581	Kingston Bagpuize East	
21181	Land at Crab Hill, Land north of A417 of A338, Wantage	
38647	Land East of East Hanney	
39920	Land South of Park Road Faringdon SN7 7PL	
34616	Land West of Harwell	
39900	Milton Parish west of the A34, Milton Heights	
36172	Monks Farm, Grove	
38536	North Abingdon-on-Thames	

TWUL Site ID	Site Name	Waste Response
41240	North Shrivenham	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed
37016	North West Abingdon-on-Thames	
37054	North West of Harwell Oxford Campus	
37023	North West Radley	
39908	North West Valley Park - Site 11	
38093-	South Kennington	
	ALL OTHER SITES	Not assessed

Given that, of those sites assessed none have been identified as having spare sewerage network capacity, it is recommended that the same situation would prevail at all other sites until proven otherwise.

5.1.5 Recommendations

Table 5-2: Sewerage system actions

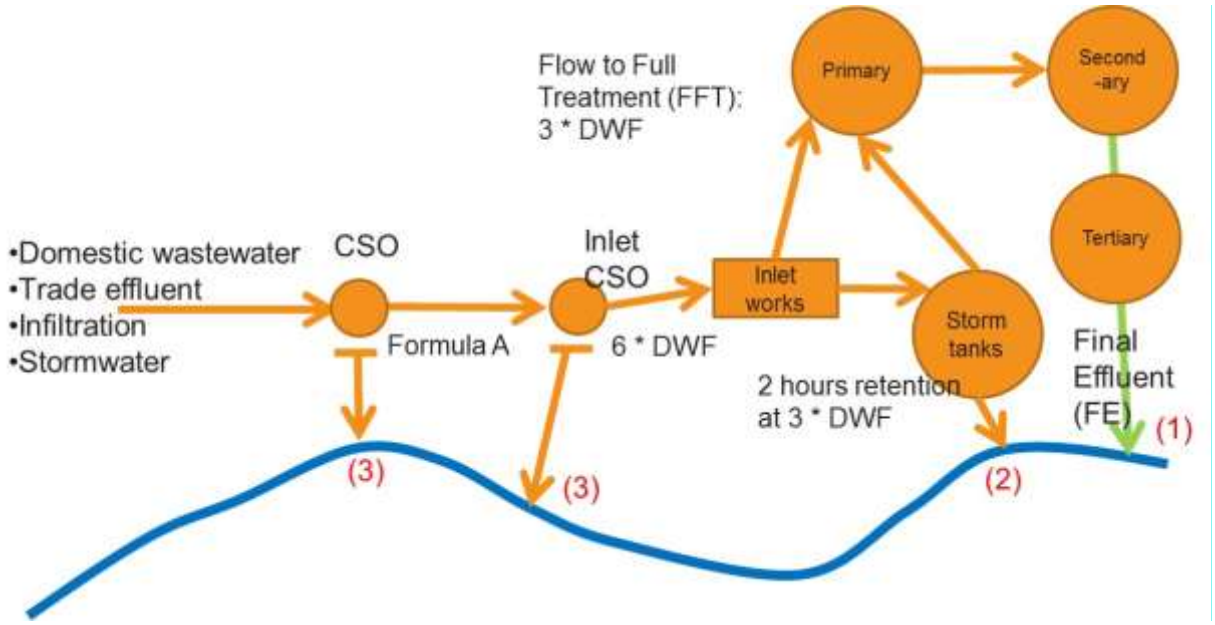
Action	Responsibility	Timescale
Take into account the existing sewerage infrastructure constraints when allocating and phasing development sites	VoWHDC	Ongoing
Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to VoWHDC where concerns arise.	TWUL	Ongoing
Developers should consult with the relevant sewerage undertaker at an early stage to identify capacity for connection, any upgrading works required, phasing and timescales.	Developers	Ongoing

5.2 Wastewater treatment works flow and quality consent assessment

The EA 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 5-1 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 sewage treatment works 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, freeing their capacity for the next rainfall event.

Figure 5-1: Overview of typical combined sewerage system and sewage treatment works discharges



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 Wastewater Treatment Works (WwTWs) where the permitted discharge rate is greater than 50 m3/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 wastewater treatment works design, as a means of estimating the 'base flow' in sewerage modelling and for determining the flow at which discharges to storm tanks will be permitted by the permit (Flow to Full Treatment, FFT).

WwTW Environmental Permits also consent for maximum concentrations of pollutants, in most cases suspended solids (SS), Biochemical Oxygen Demand (BOD) and Ammonia (NH_4). These are determined by the Environment Agency with the objective of ensuring that the receiving watercourse is not prevented from meeting its environmental objectives, in particular that 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 of flow consents. As a works operates closer to its capacity the quality of treated effluent may decline, leading the works to breach its quality consents.

5.2.1 Methodology

TWUL were provided with the total extra flow due to the future developments for each WwTW and a red / amber / green traffic light definition to score each of them:

Can accommodate the proposed site allocation without upgrades	Can accommodate the proposed site allocation without upgrades but will bring the network close to its current capacity limit	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed.

The extra flow has been calculated by:

- Grouping the sites that are served by the same WwTW using the sewerage drainage area boundaries
- Calculating the total number of houses for each WwTW and the population equivalent by using a occupancy rate of 2.4p/h
- Multiplying the population equivalent for the water demand of 134 l/p/d and assuming that 95% of the water consumption reaches the WwTW

- The occupancy rate, water demand and % were agreed with the Sewerage Undertakers.

5.2.2 Data collection

The datasets used to assess the sewerage system capacity are the following:

- Sites location in GIS format (provided by the VoWHDC)
- Number of planned houses for each year for each site (provided by the VoWHDC)
- Sewerage drainage area boundaries (provided by TWUL)
- Occupancy rate, water demand and % of water that reach the WwTW

5.2.3 Results

Thames Water has provided a spreadsheet model known as SOLAR (Strategic Overview of Long term Assets and Resources) for each of their WwTWs that could receive additional flows due to growth in VoWH District. The model assesses the current and future status of the flow and quality consents at each works. The assessment was undertaken using growth figures up to 2021.

5.2.4 Conclusions

Table 5-3: Wastewater treatment works flow and quality consent summary

Receiving WwTW	Comment on WwTW capacity assessment
Abingdon (New Stream Outfall)	Can accommodate the proposed site allocation without upgrades
Abingdon (Lagoon Outfall)	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit on its BOD consent by 2021.
Appleton	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit on its BOD consent by 2021.
Didcot	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Ammonia consent by 2030/31.
Drayton	Cannot accommodate proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Suspended Solids and BOD consents by 2021 and to be close to its current Ammonia consent by the same date.
Faringdon	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Suspended Solids consent by 2021 and to be close to its current BOD consent by the same date.
Kingston Bagpuize	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Flow and Ammonia consents by 2021 and to be close to its current BOD consent by 2031.
Oxford	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Ammonia consent by 2021 and to be close to its current Flow consent by the same date.
Shrivenham	Cannot accommodate all proposed site allocation. Further modelling will be required and subsequent upgrades may be needed. Predicted to fail on Suspended Solids and Ammonia consents by 2021 and on BOD consent by 2031.
Stanford-in-the-Vale	Can accommodate the proposed site allocation without upgrades
Wantage	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit on its Flow, Suspended Solids and Ammonia consents by 2021.

See appendix A to identify which WwTW each site drains to.

5.2.5 Recommendations

Table 5-4: Wastewater treatment works flow and quality consent actions

Action	Responsibility	Timescale
Take into account the existing WwTW constraints when allocating and phasing development sites	VoWHDC	Ongoing
TWUL to assess growth demands as part of their wastewater asset planning activities and feedback to VoWHDC where concerns arise.	TWUL	Ongoing

5.3 Wastewater treatment works odour assessment

Where new development encroaches upon existing wastewater treatment works, odour from that works may become a cause for nuisance and complaints from residents. Managing odour at WwTWs can add considerable capital and operational costs, particularly when retro-fit to existing WwTWs.

National Planning Policy Guidance recommends that plan-makers considering whether new development is appropriate near to sites used (or proposed) for water and wastewater infrastructure, in particular due to the risk of odour impacting on residents and requiring additional investment to address.

5.3.1 Methodology

TWUL's policy is that a new development may need an odour assessment if the site is less than 800m from a WWTW and is encroaching closer to the WwTW than existing urbanised areas.

An ArcGIS exercise was carried out to identify sites that are less than 800m from a WwTW and encroaching closer to the WwTW than existing urbanised areas. If there are no existing houses it is more likely that an odour assessment is needed. Another important aspect is the location of the site in respect to the WWTW because the predominant winds blow from the south west.

A red / amber / green assessment was applied:

Site is unlikely to be impacted by odour from WwTWs	Site location is such that an odour impact assessment is recommended	Site is in an area with confirmed WwTW odour issues

5.3.2 Data collection

The datasets used to assess the sewerage system capacity are the following:

- Sites location in GIS format (provided by the VoWHDC)
- WwTWs location in GIS format (provided by sewerage undertakers)
- OS maps

5.3.3 Results

Table 5-5 list those development sites where it is recommended that an odour assessment be undertaken.

Table 5-5: Sites where an odour assessment is recommended

Site name	WWTW	Encroachment?	Direction of the WwTW from the site	Site boundary distance from WwTW (m)
Monks Farm Phase I & II	Wantage	Yes	North	215
South Drayton	Drayton	Yes	West	300

5.3.4 Conclusions

Table 5-6: Wastewater treatment odour summary

Sites	Assessment
Monks Farm Grove, South Drayton	Site location is such that an odour impact assessment is recommended
All other sites	Site is unlikely to be impacted by odour from WwTWs

5.3.5 Recommendations

Table 5-7: Wastewater treatment odour actions

Action	Responsibility	Timescale
Consider odour risk in selection of site allocations	VoWHDC	
Carry out an odour assessment for Monks Farm, Grove and South Drayton sites	Site promoters	

5.4 Water quality impact assessment

The increased discharge of effluent due to an increase in the population served by a WwTW may impact on the quality of the receiving water. The Water Framework Directive (WFD) does not allow a watercourse to deteriorate from its current class (either water body or element class).

It is EA policy to model the impact of increasing effluent volumes on the receiving watercourse. Where the scale of development is such that a deterioration is predicted, a new consent may be required for the STW to improve the quality of the final effluent, so that the extra pollution load will not result in a deterioration in the water quality of the watercourse. This is known as a “no deterioration” or “load standstill".

EA guidance states that a 10% deterioration in the receiving water can be allowed in some circumstances as long as this does not cause a class deterioration to occur.

If a watercourse fails the 'good status' target, further investigations are needed in order to define the 'reasons for fail' and which actions could be implemented to reach such status.

During the preparation of the phase I Water Cycle Study (WCS) the EA advised that it would be necessary to undertake an assessment of the water quality impact of development in the 11 WwTW catchments which will receive the majority of additional flows in the Vale of White Horse District (12 outfalls as Abingdon has 2 outfalls to different watercourses).

The full water quality assessment is included in Appendix B. This section provides a summary of the methodology, results and conclusions.

5.4.1 Methodology

- The assessment required development of a stochastic (statistics based) model of river water quality and flows and wastewater discharge quality and flows for the present day (base case) and future scenarios (2020/21 and 2030/31). The Environment Agency's River Quality Planning (RQP) tool was used.
- The WFD targets for Biological Oxygen Demand (BOD), Ammonia (NH_4) and Phosphate (P) set by the EA are shown in below:

Table 5-8: WFD targets

Determinand	Statistic	1st cycle (2009)	2nd cycle (2013)
BOD	90 percentile	5mg/l	5mg/l
NH_4	90 percentile	0.6mg/l	0.6mg/l
P	Mean	0.12 mg/l	See Table 2 in Appendix B for reach-specific targets

- Where a treatment works was predicted to lead to either a WFD class deterioration, or a deterioration of greater than 10%, it was necessary to determine a possible future consent value which would prevent either class deterioration or would return the works to a "no deterioration or "load standstill" situation, as follows:
    - For a class deterioration situation, the RQP tool can be set to "calculate required discharge quality" to calculate a consent value that would retain the water body at its current class.
    - For a "no-deterioration" situation, the future scenario presenting the worst case deterioration was used for each determinand. The discharge data Mean Quality and Standard Deviation were iteratively reduced until the present day 90th-percentile value was achieved. The standard deviation was assumed to be 1/3 of the mean.
- Where modelling indicated that a tightening of the consent is likely to be required to prevent deterioration, an assessment was made of the potential to meet that consent by either extending the existing treatment processes on the site or adding additional treatment processes considered as "Best Available Technology" (BAT). Treatment to even higher standards would require additional, potable water treatment technologies to be introduced which would add considerable capital and operational costs to wastewater treatment.

The methodology followed is summarised in the flow chart below:

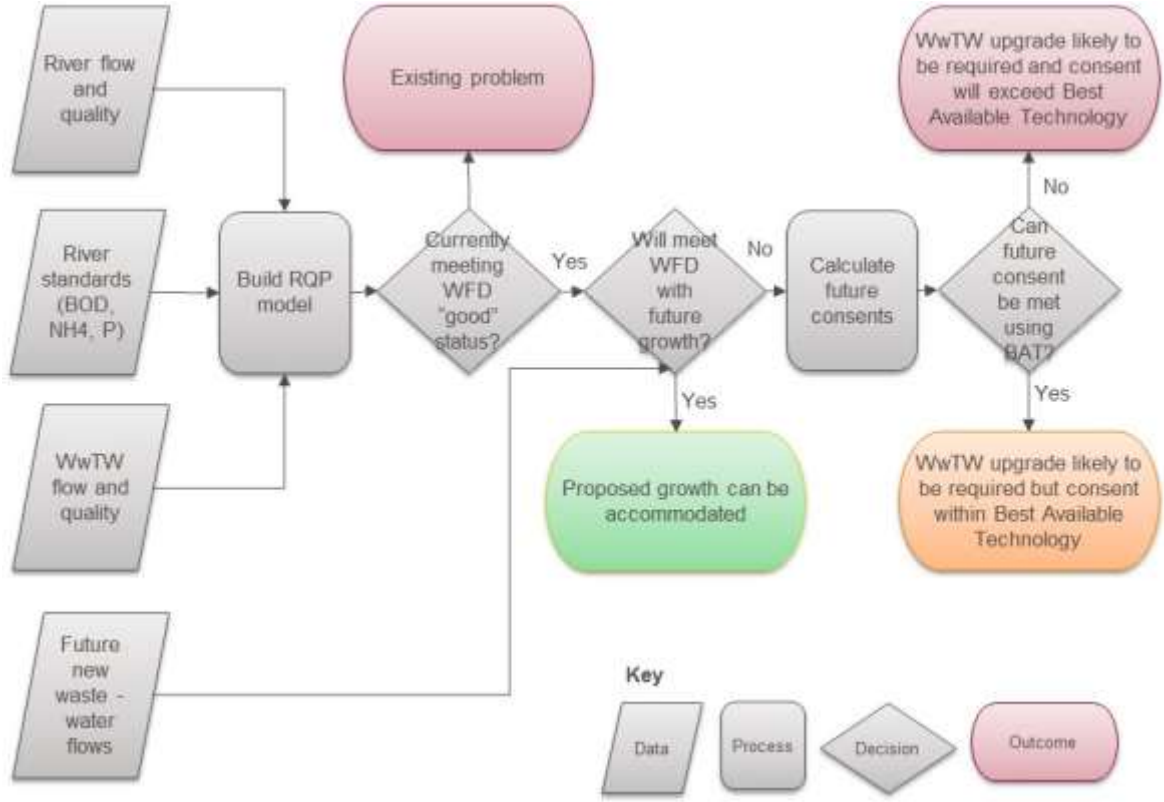


Figure 5-2: Water quality assessment methodology flow chart

A red / amber / green assessment was applied:

Proposed growth can be accommodated. No class deterioration or deterioration >10% is predicted.	WwTW upgrade is likely to be required but the calculated future consent is within the capabilities of Best Available Technology.	WwTW upgrade is likely to be required and the calculated future consent will exceed the capabilities of Best Available Technology. Preventing deterioration is therefore likely to require the addition of high capital and operation cost drinking water treatment processes.

5.4.2 Data collection

The datasets used to assess the water quality impact were the following:

Upstream river data:

- Mean flow
-
- 95% exceedance flow
- Mean for each contaminants
- Standard deviation for each contaminant

Discharge data:

- Mean flow
- Standard deviation for the flow
- Mean for each contaminants
- Standard deviation for each contaminant

River quality target data:

- No deterioration target
- 'Good status' target

Treatment processes:

- Existing treatment process (TWUL)
- Assessment of achievable treatment standards for current wastewater treatment technologies (TWUL).

5.4.3 Results

Table 5-9: 'Good status' and 'No deterioration' target summary.

STW	Scenario	Failing 'Good status' target?			Failing 'No deterioration' target?			Model result for achieving good 'status'
		BOD	Amm	P	BOD	Amm	P	
Abingdon Lagoon	Actual	No	No	Yes	NA	NA	NA	The river target for P cannot be achieved without improving the upstream quality of the river
	19/20	No	No	Yes	No	No	No	
	30/31	No	No	Yes	No	No	No	
Abingdon New Stream	Actual	Yes	Yes	Yes	NA	NA	NA	River target can be achieved for all pollutants with improvement to the works
	19/20	Yes	Yes	Yes	2%	10%	No	
	30/31	Yes	Yes	Yes	2%	12%	No	
Appleton	Actual	No	No	Yes	NA	NA	NA	The river target for P cannot be achieved without improving the upstream quality of the river
	19/20	No	No	Yes	15%	48%	5%	
	30/31	No	No	Yes	9%	48%	1%	
Didcot	Actual	No	Yes	Yes	NA	NA	NA	River target can be achieved for Amm and P with improvement to the works
	19/21	No	Yes	Yes	8%	65%	3%	
	30/32	No	Yes	Yes	22%	212%	6%	
Drayton	Actual	No	No	Yes	NA	NA	NA	River target can be achieved for Amm and P with improvement to the works
	19/21	No	Yes	Yes	9%	66%	16%	
	30/32	No	No	Yes	6%	55%	6%	
Faringdon	Actual	Yes	Yes	Yes	NA	NA	NA	River target can be achieved for BOD and Amm with improvement to the works but cannot be achieved for P without improving the upstream quality of the river
	19/21	Yes	Yes	Yes	26%	80%	5%	
	30/32	Yes	Yes	Yes	21%	85%	3%	
Kingston Bagpuize without contingencies sites	Actual	No	Yes	Yes	NA	NA	NA	No calculation was done for this scenario
	19/22	No	Yes	Yes	11%	40%	2%	
	30/33	No	Yes	Yes	10%	52%	1%	
Kingston Bagpuize with contingencies sites	Actual	No	Yes	Yes	NA	NA	NA	River target can be achieved for Amm with improvement to the works but cannot be achieved for P without improving the upstream quality of the river
	19/22	No	Yes	Yes	18%	71%	3%	
	30/33	Yes	Yes	Yes	33%	160%	5%	
Oxford	Actual	Yes	Yes	Yes	NA	NA	NA	River target can be achieved for all pollutants with improvement to the works
	19/22	Yes	Yes	Yes	No	8%	No	
	30/33	Yes	Yes	Yes	No	4%	No	
Shrivenham	Actual	No	No	Yes	NA	NA	NA	River target can be achieved for P with improvement to the works
	19/22	No	No	Yes	18%	83%	9%	
	30/33	No	Yes	Yes	22%	120%	7%	
Standford in the Vale	Actual	No	No	Yes	NA	NA	NA	The river target for P cannot be achieved without improving the upstream quality of the river
	19/23	No	No	Yes	1%	12%	13%	
	30/34	No	No	Yes	1%	12%	9%	
Wantage	Actual	No	No	Yes	NA	NA	NA	The river target for P cannot be achieved without improving the upstream quality of the river
	19/23	No	No	Yes	11%	54%	4%	
	30/34	No	No	Yes	27%	159%	7%	

Table 5-10 considers the technical feasibility of the STWs where an improvement would be required to achieve a 'No deterioration' target. Here, the type of process in each STW, found on the TW STW assessment spreadsheets, was taken into account to assess whether a WwTW

upgrade might be achieved with an extension of the existing process, the addition of a new but standard process (for example activated sludge) or would be beyond the capabilities of existing "Best Available Technologies". In the latter case, this could require use of drinking water treatment technologies, adding significant capital and operational costs.

Table 5-10: Summary of technical feasibility of STW improvements to achieve the 'No deterioration' and “Good status” targets

Outfall	STW Process	>10% Deterioration	New Consent Required	Technically Feasible
Abingdon (New outfall)	Percolating Filter	No	No	No upgrade required
Abingdon (Lagoon)	Percolating Filter	Yes	No	Existing problem. Predicted consent value cannot be met using any current standard treatment technologies
Appleton	Percolating Filter	Yes for BOD and NH4	Yes	Predicted consent value cannot be met using any current standard treatment technologies
Didcot	Activated Sludge Plant	Yes for BOD and NH4	Yes	Predicted consent value cannot be met using any current standard treatment technologies
Drayton	Unknown	Yes	Yes	Upgrade may be required with a change to treatment technology
Faringdon	Filters	Yes for BOD and NH4	Yes	Upgrade may be required using existing treatment technology
Kingston Bagpuize	Rotating Biological Contactor	Yes for BOD and NH4	Yes	Upgrade may be required using existing treatment technology
Oxford	Activated Sludge	No	Yes	Existing problem. Predicted consent value cannot be met using any current standard treatment technologies
Shrivenham	Aeration	Yes for BOD and NH4	Yes	Predicted consent value cannot be met using any current standard treatment technologies
Stanford in the Vale	Unknown	Yes for NH4 and P	Yes	Upgrade may be required with a change to treatment technology
Wantage	Sludge	Yes for NH4 and P	Yes	Upgrade may be required using existing treatment technology

5.4.4 Conclusions

Table 5-11: Water quality summary

WwTW	Assessment
Abingdon	Proposed growth can be accommodated. No class deterioration or deterioration >10% is predicted.
Drayton, Faringdon, Kingston Bagpuize, Stanford-in-the-Vale, Wantage.	WwTW upgrade is likely to be required but the calculated future consent is within the capabilities of Best Available Technology.
Appleton, Didcot, Oxford, Shrivenham	WwTW upgrade is likely to be required and the calculated future consent will exceed the capabilities of Best Available Technology. Preventing deterioration is therefore likely to require the addition of high capital and operation cost drinking water treatment processes” is replaced with “Preventing deterioration may not be possible without long distance transfers of wastewater or development of new wastewater treatment technologies.

Note: It has been assumed that additional flows at Abingdon can be discharged via the New Outfall rather than the Lagoon outfall.

5.4.5 Recommendations

Table 5-12: Water quality actions

Action	Responsibility	Timescale
Where possible, take into account the water quality constraints when allocating and phasing development sites	VoWHDC	Ongoing
Take into account the findings of the water quality assessment when considering requirements for WwTW upgrades and feedback to EA and VoWHDC where concerns arise.	TWUL	Ongoing
Where the water quality assessment indicates that consents may require a higher standard of treatment than currently achievable using Best Available Technologies, provide clear guidance to TWUL and VoWHDC on: • the approach to consenting, • requirements for any additional studies (for example additional water quality sampling, modelling, macro-invertebrate surveys etc.), • advise VoWHDC where water quality constraints may limit the potential for growth.	EA	Ongoing

6 Flood Risk Management

This section considers the flood risk to the potential site allocations, as well as the potential risk of increased flood flows in watercourses due to additional flows of sewage effluent.

> *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere*." NPPF Paragraph 100.

6.1 Flood risk assessment

6.1.1 Methodology

The VoWHDC Strategic Flood Risk Assessment (SFRA)[26] along with the accompanying Sequential Test[27] and October 2014 addendum[28], is the main source of information regarding the flood risk to settlements and to the proposed strategic site allocations. As both of these documents have been refreshed in 2014, there is no need to reproduce their contents within the WCS. Instead, a simple Red / Amber / Green assessment has been prepared from that information. This was prepared as follows:

Fluvial Flood Risk	Pluvial Flood Risk
>95% of the site is within fluvial Flood Zone 1 (Low Risk). Very unlikely to be a constraint to development as long as access to the site can be maintained	<5% of site is within the Updated Flood Map for Surface Water 1 in 1000 year outline. Potential surface water drainage constraints are extremely low.
90-95% of the site is within fluvial Flood Zone 1 (Low Risk). Unlikely to be a constraint to development as long as access to the site can be maintained	5-20% of site is within the Updated Flood Map for Surface Water 1 in 1000 year outline. Potential surface water drainage constraints are very low to low.
<90% of the site is within fluvial Flood Zone 1 (Low Risk). Some constraint is likely for example housing numbers may be reduced	>20% of site is within the Updated Flood Map for Surface Water 1 in 1000 year outline. Potential surface water drainage constraints are medium to very high

6.1.2 Data collection

The datasets used to assess the risk of flooding have been provided by the EA and are listed below:

- Flood Zone 2 and 3
- Updated Flood Map for Surface Water

6.1.3 Results

The results are included within the final summary of results in section 9.2.

6.2 Assess flooding from increased WwTW discharge

In catchments with a large planned growth in population which discharge effluent to a small watercourse, the increase in the discharged effluent might have a negative effect on the risk of flooding. An assessment has been carried out in order to quantify such effect.

26 Vale of White Horse District Council (2014) Strategic Flood Risk Assessment

27 Vale of White Horse District Council (2014) Sequential Test

28 Vale of White Horse District Council (2014) Strategic Flood Risk Assessment Addendum

6.2.1 Methodology

The following process has been used to assess the potential risk increase of flood due to extra flow reaching a specific WwTW:

- Identify which WwTWs will be receiving the additional flows;
- Calculate the increase in DWF as a result of planned growth.
- Identify point of discharge of these WwTWs;
- At each point of outfall, use the FEH CD-ROM to extract the catchment descriptors;
- Use ReFH spreadsheet to calculate peak 1 in 30 (Q30) and 1 in 100 (Q100) year fluvial flows at the WwTW outfall;
- Calculate the additional foul flow as a percentage of the Q30 and Q100 flow.

The risk associated is calculated using the values below:

Additional flow = <5% of Q30 - Low risk discharges will increase fluvial flood risk	Additional flow = >5% of Q30 – Moderate risk discharges will increase fluvial flood risk	Additional flow = >5% of Q100 – High risk discharges will increase fluvial flood risk

6.2.2 Data collection

The datasets used to assess the risk of flooding are the following:

- Current and predicted future DWF for each WwTW (provided by TWUL)
- Location of WwTW outfall
- Catchment descriptors from FEH CD-ROM

6.2.3 Results

Table 6-1 shows that the effect of the increase of flow due to the future development has a negligible effect on the predicted peak flow for events with return period of 30 and 100 years. The WwTW with the highest flow increase is Kingston Bagpuize with the extra two sites and Wantage where there is respectively a 2.40% and 1.15% increased risk during a 30 year return period event.

Table 6-1: Summary of the predicted DWFs increase

WwTW	Receiving watercourse	ReFH Q30 m3/s	ReFH Q100 m3/s	Current DWF m3/d	Max predicted DWF	Flow increase m3/s	Flow increase % Q30	Flow increase % Q100
WANTAGE	Letcombe Brook	1.2	2	4954	6143	0.01	1.15%	0.69%
ABINGDON	Drain (Oday Ditches)	0.7	1	2331	2367	< 0.01	0.06%	0.04%
ABINGDON	Thames	184.8	227.5	6248	6389	< 0.01	< 0.01%	< 0.01%
OXFORD	Unknown	1.2	1.6	47845	47243	< -0.01	-0.58%	-0.44%
STANFORD IN THE VALE	River Ock	13.9	17.5	312	395	< 0.01	0.01%	0.01%
APPLETON	Drain	1	1.4	831	951	< 0.01	0.14%	0.10%
DIDCOT	Moor Ditch	2.5	3.4	8002	9448	0.02	0.67%	0.49%
SHRIVENHAM	Tuckmill Brook	7.9	10.1	1419	1646	< 0.01	0.03%	0.03%
FARINGDON	Unknown	2.3	3	1113	1388	< 0.01	0.14%	0.11%
DRYTON	Ginge Brook	1.4	2.4	1123	1343	< 0.01	0.18%	0.11%
KINGSTON BAGPUIZE	Unknown	0.2	0.3	544	694	< 0.01	2.40%	1.60%

Note: The above flood estimates are based solely on extracted catchment descriptors. They are suitable only for this simple analysis of the impact of WwTW effluent flows, and should not be used for flood modelling purposes.

6.2.4 Conclusions

The impact of increased effluent flows is unlikely to have a significant impact upon flood risk in the receiving watercourses.

6.2.5 Recommendations

None.

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7 Environmental constraints and opportunities

7.1 Methodology

A desk study exercise to identify environmental risks and opportunities associated with the draft allocation sites has been carried out using GIS analysis of a range of notable environmental designations and features. This should be used in conjunction with Sustainability Appraisals (SA) and/or Strategic Environmental Assessments (SEAs) when these are available.

Each site was analysed to identify the presence of environmental features within the site area or within a specified distance of the site. These search buffer zones were chosen to reflect the type, nature and potential sensitivity of different environmental designations and features to the development of the sites for residential use. The potential adverse impacts associated with the development of the site were then considered in relation to these features, and potential environmental opportunities, such as habitat creation or recreational opportunities were also identified.

The environmental assessment provides an overview of the wider environment within the VoWHDC area and the potential risks and opportunities associated with the development of the proposed sites. The traffic-light scoring system has not been applied to this element of the study as its focus is on risks to the water environment, whilst the environmental appraisal has also considered the sensitivity of non-water related features. As such, there may be instances where development does not pose a risk to the water environment but could have a detrimental effect or could lead to an improvement to a sensitive environmental feature i.e., designated habitat, historic monument, etc. Application of the scoring system may therefore result in a misleading outcome in relation to such sites.

7.2 Data collection

Information was collected on a range of environmental designations and features (Table 7-1). This information was provided by the EA and the Vale of White Horse District Council, and was also sourced from OS OpenData. The features were grouped into seven topic areas: Biodiversity, Historic environment, Landscape, Water, Geology and soils, Air and Waste (see Table 7-2).

Table 7-1: Environmental designations and features

Environmental feature	Description
Agricultural Land Classification	Agricultural Land Classification (ALC) is a method for assessing the quality of farmland. The ALC system classifies land into five grades: Grade 1: Excellent Grade 2: Very Good Grade 3: 3a – Good / 3b – Moderate Grade 4: Poor Grade 5: Very Poor The highest quality and most versatile land is defined as Grades 1, 2 and 3a.
Air Quality Management Area	An area that the local authority must declare where national air quality objectives are not likely to be achieved.
Aquifer - Bedrock / Superficial Deposits	Underground layers of water-bearing permeable rock or drift deposits from which groundwater can be extracted. These are split into: Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels. Bedrock -solid permeable formations e.g. sandstone, chalk and limestone. These classifications are further split into the following designations: Principle Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability. Secondary Aquifers include a wide range of rock layers or drift deposits

Environmental feature	Description
	with an equally wide range of water permeability and storage.
Area for Landscape Enhancement	Areas for landscape enhancement identified in the local plan are areas of damaged or compromised landscape. Proposals within or affecting these areas must provide a landscape scheme which enhances the appearance of the area.
Area of High Landscape Value	A non-statutory area designated by the local planning authority within which the quality of the landscape is of overriding significance. Development should not harm its special character and particular regard should be given to the siting, mass, scale, appearance, external materials used, external lighting and extent of any associated landscape proposals.
Ancient or Semi-Natural Woodland	Ancient woodland is land that has had a continuous woodland cover since at least 1600 AD, and may be ancient semi-natural woodland (ASNW), which retains a native tree and shrub cover that has not been planted.
Area of Outstanding Natural Beauty	An Area of Outstanding Natural Beauty (AONB) is an area of high scenic quality which has statutory protection in order to conserve and enhance the natural beauty of its landscape. AONB landscapes range from rugged coastline to water meadows to gentle lowland and upland moors.
Conservation Area	Conservation Areas are designated for their special architectural and historic interest. Most are designated by the local planning authority and place restrictions on a range of development including property alterations, tree works, advertisements and demolition.
Great Western Community Forest	The Great Western Community Forest is one of England's 12 Community Forests and covers an area of 168 square miles, stretching from Wootton Bassett to Faringdon and the North Wessex Downs to the Thames. The Community Forest aims to deliver long-term environmental improvements by promoting tree planting and sustainable woodland management.
Green Belt	A designation for land around certain cities and large built-up areas. The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open. Inappropriate development that is harmful to the Green Belt should not be approved except in very special circumstances.
Green Corridor	Green corridors are areas identified by the council that link development to amenity areas and help to promote environmentally sustainable forms of transport such as walking and cycling within urban areas. They also act as vital linkages for wildlife dispersal between urban and rural areas.
Groundwater Source Protection Zones	Source Protection Zones (SPZs) are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.
Landfill/Historic Landfill	Landfill sites and Historic landfill sites are places where records indicate waste materials have been buried. Some sites remain open to further waste deposits (landfill), whilst others are now closed or covered (historic landfill).
Listed Building	Listed buildings are buildings or structures of exceptional architectural or historic special interest. Listed building have three grades: Grade I buildings are of exceptional interest, sometimes considered to be internationally important; Grade II* buildings are particularly important buildings of more than special interest; and Grade II buildings are nationally important and of special interest.
Local Wildlife Site	Local Wildlife Sites (LWSs) are non-statutory areas of local importance for nature conservation that complement nationally and internationally

Environmental feature	Description
	designated geological and wildlife sites. Local Wildlife Sites are protected within the local planning system. They are a 'material consideration' in the determination of planning applications, and there is a general presumption against development upon them.
National Nature Reserve	A National Nature Reserve (NNR) is one of the finest sites in England for wildlife and/or geology. A NNR is given protection against damaging operations, and any such operations must be authorised by the designating body. It also has strong protection against development on and around it.
National Park	National Parks are areas protected for their outstanding value in terms of natural beauty, ecological, archaeological, geological and other features, and recreational value.
National Trails	National Trails are long distance walking, cycling and horse riding routes through the best landscapes in England and Wales.
Ramsar Site	Ramsar sites are wetlands of international importance, designated under the Ramsar Convention 1971. As a matter of UK Government policy, Ramsar sites are protected as European sites (as set out in the Habitats Regulations).
Registered Battlefield	Registered battlefields are designated heritage assets and are included on the English Heritage Register of Historic Battlefields. Its purpose is to offer them protection and to promote a better understanding of their significance.
Registered/Historic Park and Garden	Registered parks and gardens are designated heritage assets and planning authorities must consider the impact of any proposed development on the landscapes' special character.
Scheduled Monument	Scheduled Monuments are historic sites of national importance and are protected under the Ancient Monuments and Archaeological Areas Act, as amended by the National Heritage Act 1983.
Site of Special Scientific Interest	Protected under a range of UK legislation, a Site of Special Scientific Interest (SSSI) is an area of land of special interest by reason of any of its flora, fauna, geological or physiographical features. An SSSI is given certain protection against damaging operations, and any such operations must be authorised by the designating body.
Special Area of Conservation / Sites of Community Importance	A Special Area of Conservation (SAC) is an area which has been given special protection under the European Union's Habitats Directive (as transcribed into UK law under the Conservation of Habitats and Species Regulations 2010 (As amended) – known as the 'Habitats Regulations'). SACs provide increased protection to a variety of wild animals, plants and habitats and are a vital part of global efforts to conserve the world's biodiversity.
Special Protection Area	A Special Protection Area (SPA) is an area of land, water or sea which has been identified as being of international importance for the breeding, feeding, wintering or migration of rare and vulnerable bird species found within the European Union. SPAs are European designated sites, classified under the European Wild Birds Directive.
Vale Archaeological Constraint Area	Vale Constraint Areas are sites of local archaeological interest identified by Oxfordshire County Council using the Historic Environment Record.
Waste Licence site	An environmental license granted for specific activities. The majority of waste management facilities are licensed under the Waste Management Licensing Regulations 1994.
Watercourse	A river, stream or other riparian feature i.e., ditch, as shown on OS mapping.

Environmental feature	Description
Water Framework Directive (WFD) classification	The Water Framework Directive (WFD) requires that all 'water bodies' (rivers, lakes, estuaries, coastal waters and groundwater) achieve good ecological potential by 2015. Under the WFD, all waterbodies are classified by their current and future predicted water quality, and specifically their ecological and chemical status.
World Heritage Site	World Heritage Sites are places of outstanding universal value to all humanity and are of great importance for the conservation of mankind's cultural and natural heritage. They need to be preserved for future generations, as part of a common universal heritage.

Table 7-2: Environmental designations and features buffer zones

Topic	Environmental feature	Search buffer (m)
Biodiversity	Site of Special Scientific Interest (SSSI)	1000m
	Special Area of Conservation (SAC)	2000m
	Special Protection Area (SPA)	2000m
	Ramsar site	2000m
	National Nature Reserve	1000m
	Local Nature Reserves	100m
	Ancient or Semi-Natural Woodland	100m
Historic environment	Scheduled Monument	500m
	Listed Building	100m
	Registered/Historic Park and Garden	500m
	World Heritage Site	500m
	Registered Battlefield	500m
Landscape	Area of Outstanding Natural Beauty (AONB)	1000m
	National Park	1000m
	National Trails	500m
	Green Belt	100m
Water	Watercourse	200m
	Water Framework Directive (WFD) classification	No Buffer applicable
	Groundwater source protection zones (SPZ)	No Buffer applicable
	Aquifer Maps - Superficial Deposits Designation	No Buffer applicable
	Aquifer Maps - Bedrock Designation	No Buffer applicable
Geology and soils	Agricultural Land Classification (ALC)	100m
Waste	Landfill	100m
	Historic Landfill	100m

7.3 Baseline natural environment

The Vale of White Horse area is predominantly rural in character with the River Thames forming the northern boundary of the district and the River Cole flowing along the western boundary. The River Ock and its numerous tributaries flow in an eastwards direction through the centre of the Vale, where the river joins the River Thames at Abingdon.

Abingdon, Wantage and Faringdon form the main urban areas within the Vale, with Didcot, Oxford and Swindon located in close proximity to the district boundary. In addition, there are over 70 villages and small hamlets across the Vale, and many isolated farmsteads in the wider countryside.

The Vale contains a diverse range of sites designated for their nature conservation value. There are two Special Conservation Area (SAC) sites within the district. These are sites designated under the EC Habitats Directive (Council Directive 92/43/EEC of 21 May 1992) and are

internationally important for threatened habitats and species. Hackpen Hill SAC, located south west of Wantage, consists of unimproved chalk grassland and scrubland, whilst Cothill Fen SAC, situated north-west of Abingdon, supports a calcium-rich springwater-fed alkaline fen. In addition, Oxford Meadows SAC, comprising a complex of lowland hay meadow sites, is located on the northern boundary of the district.

There are also 23 Sites of Special Scientific Interest (SSSIs) within the Vale, of which almost all are in 'favourable' or 'favourable – recovering' condition[29]. Several of these sites are located within the vicinity of the proposed draft allocation sites, and therefore could potentially be affected by pollution, disturbance or a reduction in water resources as a result of their development. In addition, water sensitive sites in the district could be affected by changes in flow conditions in local watercourses and groundwater flow, and impacts on water quality. Such sites include Fernham Meadows SSSI and Grafton Lock Meadows SSSI, and the complex of fens located along the line of Sandford Brook, which is a tributary of the River Ock. These areas are characterised by a variety of vegetation types that are found on groundwater-fed peaty or mineral soils. These may be permanently, seasonally or periodically waterlogged.

At the local level, there are 84 County Wildlife Sites (also known as Local Wildlife Sites), five Local Nature Reserves and nine Regionally Important Geological Sites (RIGS) within the Vale. River corridors also form natural wildlife corridors and are an important feature of the landscape in the district.

The North Wessex Downs Area of Outstanding Natural Beauty (AONB) covers a large area in the south of the Vale (comprising approximately 23% of the area of the district) and consists of extensive areas of chalk downland. In addition, a substantial area in the north of the district is identified as an Area of High Landscape Value, and contains a complex of Ancient Woodland sites associated with the North Corallian Ridge. A Green Belt is present in the northeast of the district on the outer edges of Oxford and Abingdon, further highlighting the high quality and highly valued landscape in much of the Vale.

There are 68 Scheduled Monuments in the Vale, where consent is required for any works affecting the monument from the Secretary of State. In addition, the Vale currently has over 2,000 Listed Buildings, which occur in clusters across the district and are located in the many small villages and market towns. The Vale also has 52 designated Conservation Areas and eight historic parks and gardens that are included in the English Heritage National Register of Parks and Gardens of Special Historic Interest. The Vale Constraint Areas, which are associated with heritage features in the district, are most notable in a swathe along its southern boundary and along the northern boundary stretching across the Vale between Abingdon and Didcot. Scheduled Monuments follow the same pattern as the Vale Constraint Areas although they are more sparsely spread.

The distribution of good quality agricultural land within the Vale varies. A large band of ALC Grade 2 (very good quality) agricultural land stretches across the south of the district, with smaller areas of Grade 2 and Grade 3 land present in the south west. The central area of the Vale has a relatively large area of Grade 4 (poor quality) agricultural land although this is intersected with Grade 3 agricultural land. The north of the district contains a large swathe of Grade 2 land interspersed with smaller areas of Grade 3 and Grade 4 land.

River water quality in the Vale is generally good, with the River Ock and its tributaries recorded as having moderate water quality. Pressures on water quality in the district include phosphate contamination through diffuse pollution from agricultural areas. Much of the south of the Vale is identified as a Principal Aquifer, with a large swathe of the central section of the district classified as a Secondary (A) Aquifer. There are three groundwater Source Protection Zones (SPZs) present in the south of the Vale, which identify groundwater deposits sensitive to contamination, and within which pollution prevention measures may apply.

7.4 Environmental risks

Each of the draft allocation sites has been assessed to determine the presence of environmental features within the site or in within a specified distance from the site. The outcomes of this process are shown in Table 7-3. The presence of an environmental designation or feature may

29 Vale of White Horse District Council (2012), Core Strategy Sustainability Appraisal Scoping report, September 2012 http://www.whitehorsedc.gov.uk/sites/default/files/SA%20Scoping%20Report%20FINAL.pdf

present a constraint to the development of the site or may require the implementation of mitigation measures to enable the development to proceed in a manner that does not have a significant adverse effect on the environment.

Potential adverse impacts on the environment from the development of the draft allocation sites and associated water supply/sewerage infrastructure improvements include:

- Habitat loss and species disturbance in areas associated with new infrastructure and residential developments and along pipeline routes;
- Increased surface runoff and sediment loading leading to increased turbidity in receiving watercourses;
- Pollutants in chemicals and sewage effluent affecting water quality in surface waters and groundwaters;
- Increased pressure on water resources due to over-abstraction;
- Temporary and permanent landscape and visual impacts associated with ground disturbance, construction activities and the presence of new residential development/water treatment works;
- Loss or disturbance of archaeological features in areas associated with new infrastructure and residential developments and along pipeline routes;
- Increased waterlogging or drying out of buried archaeological features due to changes in groundwater levels and surface water runoff;
- Increased energy consumption and carbon emissions associated with construction and operation of new development, and the piping and treatment of increased volumes of water;
- Temporary air quality impacts associated with dust generated during construction; and
- Noise and vibration generated from construction activities.

Table 7-3: VoWHDC sites with high Environmental Risk potential

Site name	Topic	Environmental risks	Environmental opportunities
Faringdon (S1)	Biodiversity	Wicklesham & Coxwell Pits SSSI is within 1km of the site. The site is designated for its geological features and is of great historical importance. However, it is not likely to be affected by the development of the site. The site is within the Great Western Community Forest (CF). Development of the site will need to demonstrate how they will contribute to the objectives of the CF project. The development site is Greenfield and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site.	Broadleaved tree planting to contribute to the Community Forest project. Vegetation cover will help manage surface water run-off. Restricted development in flood zones could be used to provide flood storage areas and provide a number of other environmental benefits such as biodiversity and recreational benefits. The use of SuDS could help to (or maintain) recharge the groundwater aquifer. Development of the site may present an opportunity to investigate the archaeological remains. Landscape mitigation measures in the form of vegetation planting may help integrate development into the North Corallian Ridge and could contribute to the management of surface water run-off.
	Historic environment	A Vale Archaeological Constraints Area has been identified in the south west corner of the site, highlighting the potential for prehistoric ring ditches. Appropriate mitigation will need to be agreed with the Council and Oxfordshire County Council to protect these features.	
	Landscape	The site lies within an Area of High Landscape Value known as the North	

Site name	Topic	Environmental risks	Environmental opportunities
		Corallian Ridge. Appropriate measures should be taken to help preserve the special character of the area such as massing, scale and appearance of the development, which will need to be agreed with the Council to avoid any adverse impacts on the AHLV.	
	Water	Holywell Brook is located 200m to the east of the site. Appropriate site drainage measures may need to be provided to avoid any risk of an impact on the water quality of this waterbody. The site is within a Secondary (A) Aquifer (bedrock) and measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS in the site.	
	Geology and soils	The southern part of the site is classified as ALC Grade 3. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	
Crab Hill (S2)	Biodiversity	The site is within 40m of Letcombe Brook, which is classified as having Good Ecological Status under the WFD. The watercourse has the potential to contain a range of notable ecological features. The development site is Greenfield and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site.	Mitigation measures such as buffer zones around heritage assets could provide important green space and help manage surface water run-off. There may be an opportunity to enhance the setting of listed buildings and Conservation Areas through removal of intrusive features or appropriate vegetation planting. There is an opportunity to link into the Green Corridor to promote recreational opportunities. The use of SuDS could help to (or maintain) recharge the groundwater aquifer. Development of the site may present an opportunity to investigate the archaeological remains.
	Historic environment	There are three Grade II listed buildings within 100m of the site and two Conservation Areas within 500m of the site. Development of the site will need to demonstrate no adverse impact on the setting of these features. Charlton Historic Core is a Vale Archaeological Constraint Area located along the central southern boundary of the site. Appropriate mitigation will need to be agreed with the Council and Oxfordshire County Council to protect these features.	
	Landscape	The North Wessex Downs AONB is adjacent to the southern boundary of the site. Appropriate mitigation measures may need to be agreed with the Council to avoid any adverse	

Site name	Topic	Environmental risks	Environmental opportunities
		impact on the landscape quality of the AONB. A Green Corridor runs north-south through Wantage and Grove adjacent to the western boundary of the site.	
	Water	Letcombe Brook flows approximately 40m to the west of the site. Appropriate site drainage measures will need to be provided to avoid any risk of an impact on the water quality of this waterbody. The site is located within a Principal Aquifer (bedrock). Measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS on the site.	
	Geology and soils	The majority of the site is classified as ALC Grade 2 land, whilst the western edge of the site is Grade 3 land. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	
	Waste	There is a waste licence site within 100m of the site.	
	Landscape	The site is adjacent to the North Wessex Downs AONB. Development in this area may be restricted and appropriate mitigation will need to be agreed with the Council to avoid any adverse impact on the landscape quality of the AONB.	
Valley Park - North (S3)	Biodiversity	The development site is Greenfield and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site. There are a number of watercourses present within or in close proximity to the development site, which have the potential to contain a range of notable ecological features.	The Council should aim to set back development a minimum of 6m from the unnamed watercourse, providing an 8m buffer strip to 'make space for water' and allow additional capacity to accommodate climate change. Developments should look at opportunities for river restoration, de-culverting and river enhancement as part of the development. Such measures could provide an important contribution to the WFD objectives for the watercourse. Restricted development in flood zones could be used to
	Landscape	The North Wessex Downs AONB is located 850m south of the site. Appropriate mitigation may be required to avoid any adverse impact on the landscape quality of the AONB. There is a large area identified as an Area for Landscape Enhancement approximately 85m to the north of the site.	

Site name	Topic	Environmental risks	Environmental opportunities
	Water	A watercourse (labelled in the RBMP as Moor Ditch and Ladygrove Ditch) flows along the western boundary of the site. In addition, several other small watercourses and drainage ditches flow through the site or in close proximity to the site. An assessment should be made of the impact of site development on the WFD status of each waterbody that site water will drain into. The assessment should consider both water quality and quantity. Measures may need to be provided to avoid any impact on water quality or channel morphology in these waterbodies. The south of the site is within a Principal Aquifer (bedrock) and the north of the site is within a Secondary (undifferentiated) Aquifer (superficial deposits). Measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS on the site.	provide flood storage areas and provide a number of other environmental opportunities such as biodiversity and recreational benefits. Development of the site may present an opportunity to investigate the archaeological remains. The use of SuDS could help to (or maintain) recharge the groundwater aquifer.
	Geology and soils	The site contains ALC Grade 2 and 3 land. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	
Valley Park - South (S4)	Biodiversity	The development site is Greenfield and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site. There is a watercourse present along the eastern boundary of the site, which has the potential to contain a range of notable ecological features.	The Council should aim to set back development a minimum of 6m from the river, providing an 8m buffer strip to 'make space for water' and allow additional capacity to accommodate climate change. Developments should look at opportunities for river restoration, de-culverting and river enhancement as part of the development. Such measures could provide an important contribution to the WFD objectives for the watercourse. Restricted development in flood zones could be used to provide flood storage areas and provide a number of other environmental opportunities such as biodiversity and recreational benefits.
	Landscape	The North Wessex Downs AONB is located immediately south of the site. Appropriate mitigation may be required to avoid any adverse impact on the landscape quality of the AONB.	
	Water	A watercourse flows along the eastern boundary of the site. In addition, several other small watercourses and drainage ditches flow in close proximity to the site. An assessment should be made of the impact of site development on the WFD status of each waterbody that site water will drain into. The assessment should consider both water quality and	

Site name	Topic	Environmental risks	Environmental opportunities
		quantity. Measures may need to be provided to avoid any impact on water quality or channel morphology in these waterbodies. The site is within a Principal Aquifer (bedrock) and the north of the site is within a Secondary (undifferentiated) Aquifer (superficial deposits). Measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS on the site.	Development of the site may present an opportunity to investigate the archaeological remains. The use of SuDS could help to (or maintain) recharge the groundwater aquifer.
	Geology and soils	The site contains ALC Grade 2 and 3 land. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	
Harwell (S5)	Biodiversity	The development site contains Greenfield land and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site. The East Hendred Brook is located to the northwest of the site and is classified under the WFD as having Good Ecological Status. It has the potential to contain a range of notable ecological features.	The use of SuDS could help to (or maintain) recharge the groundwater aquifer. Development of the site may present an opportunity to investigate the archaeological remains.
	Water	East Hendred Brook is located 120m northwest of the site. Appropriate site drainage measures may need to be provided to avoid any risk of an impact on the water quality of this waterbody. The site is within a Principal Aquifer (bedrock) and measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS on the site.	
	Geology and soils	The north of the site is ALC Grade 2 land. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	
	Historic environment	Harwell Conservation Area is located approximately 415m west of the site. Development of the site will need to demonstrate no adverse impact on the setting of the Conservation Area. A Vale Archaeological Constraint Area has been identified within the eastern part of the site and comprises an Iron Age and Roman Settlement. Appropriate mitigation will need to be	

Site name	Topic	Environmental risks	Environmental opportunities
		agreed with the Council and Oxfordshire County Council to protect these features.	
Monks Farm (S6)	Biodiversity	Letcombe Brook flows through the centre of the site and is classified under the WFD as having Good Ecological Status. The river has the potential to contain a range of notable ecological features. The development site is Greenfield and is likely to contain a range of biodiversity interests. Further assessment and survey will be required prior to development of the site.	The Council should aim to set back development a minimum of 6m from Letcombe Brook, providing an 8m buffer strip to 'make space for water' and allow additional capacity to accommodate climate change. Developments should look at opportunities for river restoration, de-culverting and river enhancement as part of the development. There is the opportunity to continue the green corridor through the allocation site along Letcombe Brook. Restricted development in flood zones could be used to provide flood storage areas and provide a number of other environmental opportunities such as biodiversity and recreational benefits. There may be an opportunity to enhance the setting of listed buildings and Conservation Areas through removal of intrusive features or appropriate vegetation planting. Development of the site may present an opportunity to investigate the archaeological remains.
	Historic environment	There are four Grade II listed buildings within the site and three Grade II Listed buildings within 100m of the site. Development of the site will need to demonstrate no adverse impact on the fabric or setting of these structures. Grove Conservation Area is approximately 50m south of the site. Development of the site will need to demonstrate no adverse impact on the setting of the Conservation Area. There is a Vale Constraint Area present within the site and a second area located within 100m of the site. The constraint area within the site is associated with late Bronze Age features as well as undated and medieval inhumation sites. Appropriate mitigation will need to be agreed with the Council and English Heritage to protect these features.	
	Landscape	A Green Corridor runs north-south through Wantage and Grove, ending at the southern boundary of the site. There is also an Area of Landscape Enhancement within 100m west of the site.	
	Water	Letcombe Brook flows through the centre of the site and is classified under the WFD as having Good Ecological Status. All development should assess the impact of site drainage on the WFD status of the waterbody the water will drain into. The assessment should consider both water quality and quantity. Measures may need to be provided to avoid any impact on the water quality in this	

Site name	Topic	Environmental risks	Environmental opportunities
		waterbody. The site is within a Secondary (A) Aquifer (Superficial Deposits) and measures may be required to avoid the risk of groundwater contamination. This may place restrictions on the use of SuDS on the site.	
	Geology and soils	The site is classified as containing ALC Grade 3 land. The Council will need to justify the loss of 'best and most versatile land' rather than develop poorer quality land.	

Environmental characteristics are aspects of the water environment that could be potentially affected by the development of a site i.e., surface water and groundwater quality and quantity, and aquatic biodiversity. Potential wider environmental risks considers whether development of the site could potentially have an adverse effect on other notable or sensitive environmental features such as the historic environment, landscape character and visual amenity, land use or terrestrial ecology. Potential wider environmental opportunities are benefits that development of the site could deliver to the wider environment, such as habitat creation, improvements in river water quality or the creation of new recreation or amenity opportunities.

7.5 Management options and policies

The following management options outline how the proposed strategic site allocations can minimise their impact on the neighbouring watercourses by reducing both diffuse and point sources of pollution.

New developments are required to attenuate surface water runoff and SuDS are the recommended approach as stated in NPPF, paragraph 51 of the Planning Practice Guidance and Building Regulations H. The implementation of SuDS schemes can:

- Mitigate the impact on receiving waters by holding and treating urban surface water run-off at or near to the source;
- Slow down surface runoff during heavy rain, reducing flooding problems;
- Provide new still water (i.e., ponds and ditches) and wetland habitat to benefit biodiversity;
- Offer recreational and amenity opportunities to local residents; and
- Enhance the local landscape character.

HR Wallingford's study, *'Maximising the Ecological Benefits of Sustainable Drainage Schemes'* (2003), advises that the maximum ecological benefits derived from SuDS may come from improvements to the still water aquatic environment and that the best that can often be achieved for the receiving waters is to prevent further deterioration. However, research indicates that whilst ponds and ditches may support quite rich wildlife communities, most SuDS schemes do not fulfil their ecological potential. This is due to inappropriate design features or a lack of maintenance of the structures leading to poor water quality and domination by common plant species. The design of a SuDS scheme would need to be specific to the development site and would need to meet the topographic and hydrological characteristics present there.

Riparian buffer strips can also be provided adjacent to watercourses within the development site or along its periphery. Buffer strips provide an intermediate protection zone between developed land and areas of conservation value, restricting the flow of pollutants and preventing them from being washed from the site into the watercourse. The width of the buffer strips will depend on the size of the water body. Natural England guidance[30] in relation to buffer strips adjacent to agricultural land states that *'Generally speaking, the wider the buffer the better the protection for the water body. Current evidence shows that 6m is the minimum effective width.'* Scottish Environmental Protection Agency (SEPA) guidance[31] for riparian zones for wildlife benefit states that a strip of at least 10m is recommended.

Impermeable surfaces in urban areas reduce rates of infiltration and therefore reduce rates of recharge to the underlying aquifers. Additional impermeable surfaces in areas with poor groundwater status will potentially reduce groundwater recharge further. The use of SuDS can help return water to groundwater by slowing down rainfall runoff in soakaways, permeable surfaces, ponds and wetlands. It is therefore recommended that SuDS are used wherever possible and particular in areas assessed as having poor groundwater status. SuDS can also provide ecological gain and in doing so have the potential to contribute towards the green

Water Sensitive Urban Design (WSUD)

In recent years, the convergence of droughts, frequent flooding, climate change and increasing water demand due to population growth has led to a questioning of the management of urban water in the UK. Traditional engineering practices, for example, treat water drained from urban areas or indeed wastewater effluent as "waste" rather than as a resource.

The concept of WSUD was coined in Australia, where the key drivers for change were declining water quality of urban waterbodies and the prolonged drought of the early 2000s.

The recent CIRIA scoping study[a] defined WSUD as "the process of integrating water cycle management with the built environment through planning and urban design." Whilst WSUD encompasses many aspects of SUDS, it also considers water resources and supply, wastewater reuse and the integration of water bodies into urban design.

The CIRIA study identifies that whilst some recent changes have driven more integrated water management (in particular the drive for SUDS to reduce surface water flood risk) there are significant areas which have been given little consideration, for example water efficiency in the home and integrating water into the urban environment. Barriers to application including lack of regulatory direction, lack of understanding and lack of economic incentives.

The role of professionals including town planners, architects, and urban designers in driving a "route map" towards WSUD is seen as more central than that of water engineers, emphasising that the WSUD approach values decentralised approaches integrated into the fabric of towns and cities.

[a] CIRIA (2013) Creating water sensitive places - scoping the potential for Water Sensitive Urban Design in the UK

Photo © www.susdrain.net

30 Natural England (2011), Protecting water from agricultural runoff: buffer strips, First edition, September 2011 http://publications.naturalengland.org.uk/publication/31003http://publications.naturalengland.org.uk/publication/31003

31 SEPA (2009), Riparian Vegetation Management Good Practice Guide http://www.sepa.org.uk/water/idoc.ashx?docid=7c4571aa-4f09-45a1-ae5d-7cca72af65bc&version=-1http://www.sepa.org.uk/water/idoc.ashx?docid=7c4571aa-4f09-45a1-ae5d-7cca72af65bc&version=-1

infrastructure network in the district. Other examples of green infrastructure include:

- Woodland;
- Watercourses;
- Playing fields;
- Nature reserves;
- Cemeteries;
- Footpaths;
- Hedgerows; and
- Amenity landscaping.

Further provision of green infrastructure in the district has the potential to achieve a number of benefits. These include:

- Creation of new wildlife habitat and benefits to a range of species;
- Improvements to the local landscape character;
- Contribution to flood risk management; and
- Provision of new amenity assets and recreational opportunities.

7.6 Opportunities

There are a number of environmental opportunities that could be considered for each of the draft allocation sites. Implementation of these opportunities would have the potential to help mitigate the environmental impacts of development of each site and deliver environmental benefits, particularly in relation to biodiversity and water quality. The nature and scale of any environmental benefits achieved would depend upon the site characteristics and sensitivity of the surrounding environment. These environmental opportunities are summarised in Table 7-4.

Table 7-4: Environmental opportunities and benefits

Environmental opportunity	Potential environmental benefits
Allocation of green space for the provision of SuDS	• Potential to provide flood risk benefits through interception of surface runoff. • Reduced sediment loading in receiving watercourses and improved water quality. • Amenity value.
Retention and enhancement of existing water features on the site i.e., ponds, ditches and streams through creation of vegetated buffer strips.	• Increased biodiversity value, particularly for amphibians, invertebrates and small mammals. • Potential to provide flood risk benefits through interception of surface runoff. • Increased amenity value.
Creation of new water features on site i.e., ponds, ditches and streams.	• Increased biodiversity value, particularly for amphibians, invertebrates and small mammals. • Potential to provide flood risk benefits through interception of surface runoff. • Provision of amenity resource.
Terrestrial and marginal vegetation planting along river corridors to increase vegetation cover and improve water quality.	• Reduced river bank erosion. • Reduced water temperatures. • Increased biodiversity value, particularly for birds, invertebrates and fish. • Reduced sediment loading in receiving watercourses and improved water quality.
Planting of native broadleaved trees and retention of existing mature trees.	• Increased rainfall interception and reduced surface runoff. • Reduced sediment loading in receiving watercourses and improved water quality. • Increased local biodiversity, particularly in relation to birds, invertebrates and small mammals. • Increased shading and reduced heat-island effect. • Improved local air quality. • Increased amenity value.

Environmental opportunity	Potential environmental benefits
Habitat creation and provision of amenity areas in location at risk of flooding.	• Maintain floodplain connectivity. • Increased biodiversity value of floodplain, particularly for birds, invertebrates and small mammals. • Reduced flood risk to people and properties. • Reduced sediment loading in receiving watercourses and improved water quality. • Increased amenity value.

7.7 Recommendations

This study has provided a high-level appraisal of the potential environmental risks and opportunities associated with each of the draft allocation sites (see Section 7.4). This should be used in conjunction with Sustainability Appraisals (SA) and/or Strategic Environmental Assessments (SEAs) when these are available. More detailed assessment of the environmental issues associated with the development of each site should be undertaken prior to the approval for development to commence. This should include a thorough desk study and site surveys as required to fully identify sensitive environmental features present on each site.

The following recommendations are proposed in relation to the draft allocation sites:

- Consultation with Vale of White Horse Council ecologist and heritage officer should be undertaken in relation to the development of each site to further identify potential environmental risks and opportunities, and to determine specific requirements for mitigation measures.
- Developers should seek to maximise the water quality and amenity/ecological benefits when installing SuDS for surface water flood management. The design of SuDS schemes should be specific to each allocation site to maximise the environmental benefits derived. Careful planning of SuDS schemes in areas identified as groundwater aquifers or sensitive to groundwater contamination would be required to ensure no adverse impact on groundwater quality. However, provision of SuDS has the potential to maintain or improve groundwater recharge.
- Watercourses should be protected through the inclusion of riparian buffer strips. These zones will increase infiltration of surface runoff with potential benefits in terms of flood risks and water quality in the receiving watercourse.
- Existing water features i.e., ponds, ditches and streams should be retained as a high priority and incorporated into SuDS schemes where appropriate to maintain the aquatic biodiversity value of the sites and to provide a local source of flora and fauna that may naturally colonise new habitats.
- The removal or modification of existing river culverts should be considered where practicable in line with Environment Agency guidance. Modification of culverts has the potential to reduce flood risk due to blockages, create a more natural river bed profile and hydromorphological process, and also benefit a range of aquatic wildlife through new habitat creation or improving access to valuable habitat. Implementation of these measures could contribute towards delivery of the requirements of the Water Framework Directive.

7.8 Summary and Conclusions

Development of the allocation sites has the potential to cause a range of adverse impacts. Further environmental surveys and more detailed assessment are required for each of the sites to determine the acceptability of their development and to inform the requirement for mitigation measures. Allocation sites with the least amount of environmental features should not necessarily be assumed suitable for development. Likewise sites with a greater amount of environmental features should not be assumed unsuitable for development, constraints could be appropriately addressed.

The potential for adverse impacts on the water environment is closely related to the presence and sensitivity of water features on or in close proximity to each site. Where such features exist, adequate protection measures should be implemented in the design of the development to ensure effective protection during both construction and operational phases. Such measures

would include the provision of wide vegetated buffer zones adjacent to watercourses, to reduce the risk of contaminated runoff affecting river water quality and to promote aquatic biodiversity. In addition, measures would be required to protect water quality and water resources in underlying aquifers. The use of SuDS systems would promote infiltration of surface runoff and contribute to groundwater recharge, whilst also offering potential biodiversity, flood risk and amenity benefits.

Development of each site may also result in other environmental risks not specifically related to the water environment. Such effects could include the loss of, or damage to, important archaeological and heritage features, adverse impacts on terrestrial biodiversity, impacts on the setting of landscape or historic environment features, and the loss of high quality agricultural land. Development proposals for these sites would need to consider the sites wider context and planning policy.

There are also a range of potential environmental opportunities that could be delivered through any development proposals. Opportunities include enhancement of existing ecological features, such as watercourses, field margins and trees, the provision of new biodiversity habitats, and the creation of new recreational and amenity areas.

8 Climate Change Impact Assessment

8.1 Methodology

A qualitative assessment has been undertaken to assess the potential impacts of Climate Change on the assessments made in this water cycle study. This has been done using a matrix which considers both the potential impact of climate change on the assessment in question, and also the degree to which climate change has been considered in the information used to make the assessments contained within the WCS (see Table 8-1).

The impacts have been assessed on a district-wide basis; the available climate models are generally insufficiently refined to draw different conclusions for different parts of the District, or doing so would require a degree of detail beyond the scope of this study.

Table 8-1: Climate Change Pressures Scoring Matrix

		Impact of pressure		
		Low	Medium	High
Have climate change pressures been considered in the assessment?	Yes - quantitative consideration			
	Some consideration but qualitative only			
	Not considered			

8.2 Results

Table 8-2: Scoring of Climate Change Consequences for the Water Cycle Study

Assessment	Impact of Pressure	Have climate change pressures been considered in the assessment?	Climate Change Score
Water Resources	High (1) and (2)	Yes - qualitative consideration within WRMPs	
Water Supply	Medium - some increased demand during hot weather (2), (3)	Yes - qualitative consideration within WRMPs	
Sewerage system	High (3) - Intense summer rainfall and higher winter rainfall increases flood risk	No - not considered in company assessments	
Wastewater treatment	Medium (3) - Increased winter flows reduces flow headroom	No - not considered	
WwTW odour	Low	No - not considered	
Water quality	Medium (1, Sanitary Determinands) High (1, Nutrients)	No - not considered	
Flood risk	High (4)	Yes - climate change modelling and mapping	

Sources:

(1) Thames River Basin Management Plan

(2) Thames Water's Water Resource Management Plan

(3) Thames Water's Business Plan 2015-20

(4) VoWHDC Strategic Flood Risk Assessment

8.3 Recommendations

Table 8-3: Climate change actions

Action	Responsibility	Timescale
When undertaking detailed assessments of environmental or asset capacity, consider how climate change can be considered	EA, TWUL	As required
Take "no regrets" decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts	VoWHDC, developers	

9 Summary and Recommendations

9.1 Summary of conclusions

Table 9-1: Summary of Conclusions

Question	Conclusion
Water Resources and Water Supply	
Is there capacity in existing licences for development?	There is scope for abstraction from the Cole and the Ock but there is no additional water (surface or groundwater) available for licensing in the majority of the District.
Will existing licences remain valid?	Due to abstraction, several water bodies in the district have fallen below the Ecological Flow Indicator (EFI) which may lead the EA to change or revoke some abstraction licenses. This underlines the need to reduce abstraction by using more efficient management practices.
Can we reduce abstraction by better management practices?	Improving water efficiency is recommended by the Abstraction Licensing Strategies and Thames Waters' Water Resource Management Plan. However, the removal of Code for Sustainable Homes and the proposed amendment to only allow LPAs to impose a lower limit of 110l/person/day in water stressed areas may limit the District's ability to manage water demand through the planning system. Likewise uncertainties over delivery of SuDS may inhibit uptake of measures such as rainwater harvesting.
If new major infrastructure (reservoirs, water treatment works, boreholes) are needed, can they be provided in time, can they be funded, and are they sustainable?	The WCS has highlighted a significant change in the number of housing units currently being considered in the District compared to when Thames Water's Water Resource Management Plan was prepared. Therefore until the WRMP is updated in 2015 there isn't a plan which accommodates all of the predicted growth. The Local Plan Viability Study factors in a cost for accelerating work on capacity upgrades to water and wastewater assets where needed.
Wastewater Collection and Treatment	
Is there volumetric capacity in existing effluent discharge consent for growth?	This has been assessed at each of the WwTWs planned to receive additional flows. Drayton, Faringdon, Kingston Bagpuize, Oxford and Shrivenham WwTWs are particular constrained as upgrades would be required by 2021 to enable them to accommodate expected growth without failing their consents.
Will discharge consent be valid to meet future standard (e.g. WFD)?	With the exception of Abingdon WwTW's Lagoon Stream discharge to the River Thames, all of the WwTWs receiving significant additional flows due to growth would require a tightening of their treatment consents to either meet Water Framework Directive Good Status or to prevent a deterioration of greater than 10%. At several WwTWs, the revised consents required would be tighter than could be achieved using the existing treatment processes and therefore may require additional more expensive treatment processes rather than a simple extension of the WwTW.
Will additional discharge be allowed if there is no additional environmental capacity to assimilate it?	EA have confirmed that this question falls beyond the scope of the WCS.

Question	Conclusion
If new major infrastructure (wastewater treatment works, major pumping mains or sewer mains) are needed, can they be provided in time, and can they be funded?	This issue is very specific to individual catchments or locations within catchments. Virtually all of the larger site allocations would require upgrading of existing or new sewerage systems to be provided, therefore phasing within developments and within settlements may need to be considered carefully.
Environmental Opportunities	
Are we making the most of our new development?	Currently a number of drivers mitigate against the use of SuDS and Water Sensitive Urban Design (WSUD) within new developments. Principle among these are: • Uncertainties regarding the funding, adoption and maintenance of SuDS. • Proposed changes to the Building Regulations will restrict the ability of LPAs to require water efficient design standards. • A lack of appreciation amongst developers and buyers of the whole-life cost of a house, and a lack of incentivisation to developers to adopt any efficiency measures which may increase the construction costs, even where these may significantly reduce the running costs of that house.
Are there multi-use options that will provide water resources, flood risk management and water quality benefits?	

9.2 Summary of results by site

Table 9-2 provides a summary of the Red / Amber / Green analysis results for each allocation site.

Table 9-2: Summary of results by site

	Water		Wastewater			Flood Risk			
Site	Water resources	Water supply	WwTW capacity	Water quality	Sewerage infrastructure	Odour	WwTW flows	Fluvial	Pluvial
Land South of Park Road, Faringdon									
Crab Hill									
Valley Park									
Harwell									
Monks Farm Phase I & II									
East Harwell Oxford Campus									
South Faringdon									
North Abingdon									
South Valley Park									
North West Valley Park									
North Shrivenham									
South Kennington									
North West Radley									
Residential development on Didcot A site									

Site	Water		Wastewater			Flood Risk			
	Water resources	Water supply	WwTW capacity	Water quality	Sewerage infrastructure	Odour	WwTW flows	Fluvial	Pluvial
Increase density on current Valley Park allocation site									
West Stanford in the Vale									
Milton Heights									
North West Abingdon									
Land south of East Hanney									
Land west of Harwell Village									
East Sutton Courtenay									
South West Faringdon									
Kingston Bagpuize East									

9.3 Recommendations

Table 9-3 summarises the recommendations from throughout the Water Cycle Study:

Table 9-3: Summary of all recommendations

Aspect	Action	Responsibility	Timescale
Water resources	Take account of the updated housing growth projections across SWOX in the growth study. Use the Housing Supply Statements published by each LPA.	TWUL	Early 2015
	Consider potential for phasing development beyond 2020	VoWHDC	TBC
	Consider the contribution to water resource management that can be made through spatial planning, in particular when the revised building regulations emerge consider using the optional building regulations requiring greater water efficiency	VoWHDC	TBC - dependent on release of revised building regulations and their content.
Water supply infrastructure	Undertake a technical study to understand options to provide sufficient bulk and local transfer capacity and communicate findings to VoWHDC.	TWUL	Early 2015
	Consider potential for phasing development beyond 2020 in Abingdon, Faringdon and Wantage	VoWHDC	TBC
Foul sewerage infrastructure	Take into account the existing sewerage infrastructure constraints when allocating and phasing development sites	VoWHDC	Ongoing
	Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to VoWHDC where concerns arise.	TWUL,	Ongoing

Aspect	Action	Responsibility	Timescale
	Developers should consult with the relevant sewerage undertaker at an early stage to identify capacity for connection, any upgrading works required, phasing and timescales.	Developers	Ongoing
WwTW flow and quality	Take into account the existing WwTW constraints when allocating and phasing development sites	VoWHDC	Ongoing
	TWUL to assess growth demands as part of their wastewater asset planning activities and feedback to VoWHDC where concerns arise.	TWUL	Ongoing
WwTW odour	Consider odour risk in selection of site allocations	VoWHDC	
	Carry out an odour assessment for Monks Farm, Grove and South Drayton sites	TBC	
Water quality	Where possible, take into account the water quality constraints when allocating and phasing development sites	VoWHDC	Ongoing
	Take into account the findings of the water quality assessment when considering requirements for WwTW upgrades and feedback to EA and VoWHDC where concerns arise.	TWUL	Ongoing
	Where the water quality assessment indicates that consents may require a higher standard of treatment than currently achievable using Best Available Technologies, provide clear guidance to TWUL and VoWHDC on: • the approach to consenting, • requirements for any additional studies (for example additional water quality sampling, modelling, macro-invertebrate surveys etc.), • advise VoWHDC where water quality constraints may limit the potential for growth.	EA	Ongoing
Protecting and enhancing the water environment	Consultation with VoWHDC ecologist and heritage officer should be undertaken in relation to the development of each site to further identify potential environmental risks and opportunities, and to determine specific requirements for mitigation measures.	VoWHDC	
	Developers should seek to maximise the water quality and amenity/ecological benefits when installing SuDS for surface water flood management. The design of SuDS schemes should be specific to each allocation site to maximise the environmental benefits derived. Careful planning of SuDS schemes in areas identified as groundwater aquifers or sensitive to groundwater contamination would be required to ensure no adverse impact on groundwater quality. However,	VoWHDC / Developers	

Aspect	Action	Responsibility	Timescale
	provision of SuDS has the potential to maintain or improve groundwater recharge.		
	Watercourses should be protected through the inclusion of riparian buffer strips. These zones will increase infiltration of surface runoff with potential benefits in terms of flood risks and water quality in the receiving watercourse.	VoWHDC / Developers	
	Existing water features i.e., ponds, ditches and streams should be retained as a high priority and incorporated into SuDS schemes where appropriate to maintain the aquatic biodiversity value of the sites and to provide a local source of flora and fauna that may naturally colonise new habitats.	VoWHDC / Developers	
	The removal or modification of existing river culverts should be considered where practicable in line with Environment Agency guidance. Modification of culverts has the potential to reduce flood risk due to blockages, create a more natural river bed profile and hydro-morphological process, and also benefit a range of aquatic wildlife through new habitat creation or improving access to valuable habitat. Implementation of these measures could contribute towards delivery of the requirements of the Water Framework Directive.	VoWHDC / Developers	
	Good design principles should be applied to all developments, particularly those located in sensitive or protected landscapes so as to minimise the impact on landscape character and visual amenity. Design advice provided by CDC should be applied and consultation with the Council's landscape officer should be undertaken to inform the design of the development of a site.	VoWHDC / Developers	
Climate Change	When undertaking detailed assessments of environmental or asset capacity, consider how climate change can be considered	EA, TWUL	As required
	Take "no regrets" decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts	VoWHDC, developers	

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Appendices

A Site assessment table

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Supplied site information				Calculated site information				
JBA_ID	VoWH_ID	Site classification	Site	Area_ha	Settlement	Type	Housing_Units x ha	Potential Housing Units
S1		strategic	Land South of Park Road, Faringdon	30.03			25	751
S2		strategic	Crab Hill	52.22			25	1306
S3-S4		strategic	Valley Park	170.00			25	4250
S5		strategic	Harwell	13.81			25	345
S6		strategic	Monks Farm Phase I & II	48.25			25	1206
C1	17	contingency	East Harwell Oxford Campus	139.56			25	3489
C2	6	contingency	South Faringdon	32.08			25	802
C3	1	contingency	North Abingdon	69.37			25	1734
C4	10	contingency	South Valley Park	22.93			25	573
C5	11	contingency	North West Valley Park	46.95			25	1174
C6	31	contingency	North Shrivenham	31.47			25	787
C7	22	contingency	South Cumnor	11.73			25	293
C8	25	contingency	South Kennington	11.79			25	295
C9	28	contingency	North West Radley	12.66			25	317
C10	30	contingency	South Shrivenham	11.62			25	291
C11	13	contingency	Residential development on Didcot A site	46.17			25	1154
C12	12	contingency	current Valley Park allocation site	147.07			5	735
C14	38	contingency	West Stanford in the Vale	11.62			25	291
C15	23	contingency	North West East Challow	12.71			25	318
C17	40	contingency	Milton Heights	53.44			25	1336
C18	43	contingency	East Wootton	7.85			25	196
C19	42	contingency	North West Abingdon	12.60			25	315
C20	45	contingency	Land south of East Hanney	50.12			25	1253
C22	44	contingency	Land west of Harwell Village	50.00			25	1250
C26	21	contingency	South Drayton	20			25	500
C27	27	contingency	South Marcham	8.59			25	215
C28	29	contingency	North Radley	18.53			25	463
C29	33	contingency	East Sutton Courtenay					200
C30	5	contingency	South West Faringdon					200
C31	48	contingency	Kingston Bagpuize East	11.85			25	296
C32	49	contingency	Kingston Bagpuize South	8			25	200
P1	P04/V2030	Completed	Land adj to police HQ, Colwell Drive					
P2	P10/V1301	Completed	Land opp Shepherds Hey & Southbourne, Bessels Way					
P3	P03/V0247	Completed	Manor Farm, Fernham					
P4	P10/V1846	Completed	St Johns Court, Oxford Ln					
P5	P10/V2032	Completed	Amey Plc, Appleford Rd					
P6	P08/V1739	Completed	Abbey House, Stirlings Rd					
P7	P05/V1700; P05/\	Completed	Former bus depot site, Grove St & Limborough Rd					
P8	P08/V0694	Completed	St Marys School, Newbury St					
P9	P08/V1237	Under construction	The Old Gaol Leisure Centre					
P10	P11/V1557/RM	Under construction	Land to the South of Chilton Field					
P11	P08/V0325/RM	Under construction	Timbmet Ltd, Cumnor Hill					
P12	P08/V1078/RM	Under construction	Former Tree Nursery & Cricket Club & Jespers Hill, Park Rd					
P13	P10/V1614	Under construction	Land adj 31 & 34 Simpsons Way					
P14	P12/V2196/FUL	Planning permission gra	33 West, St Helen					
P15	P12/V0870	Planning permission gra	Champion House, 12 Wootton Rd					
P16	P11/V1960/EX	Planning permission gra	Challow Country Club, Woodhill Ln					
P17	P12/V1261/FUL	Planning permission gra	Nalder Estate & The Old Canal Building, Main St					
P18	P11/V2103	Planning permission gra	Land South of Alfreds Place					
P19	P13/V0344/FUL	Planning permission gra	Land adj to Folly Park, Park Rd					
P20	P07/V1772/RM	Planning permission gra	Land adj Coxwell House & Winslow House, Coxwell Rd					
P21	P12/V1240/FUL	Planning permission gra	Land at Stockham Farm, Denchworth Rd					
P22	P12/V1410/FUL	Planning permission gra	98-100 West Way, Botley					
P23	P12/V2582/FUL	Planning permission gra	East of Highworth Rd					
P24	P12/V0324	Planning permission gra	Land between Station Rd & Townsend Rd					
P25	P12/V1329/FUL	Planning permission gra	Land Opp Shrivenham Hundred Business Park					
P26	P11/V1520	Planning permission gra	46 Newbury Street					
P27	P12/V0270/EX	Planning permission gra	Ambulance Station, Ormond Rd					
P28	P12/V1836/O	Planning permission gra	Land West of Witney Road and South of A420					
P29	P12/V1302/O	Planning permission gra	Land South of Faringdon Rd, Southmoor					
P30	P07/V0741/O	Planning permission gra	Land adj NE & NW of Tilbury Ln, Botley					
P31	P13/V0094/O	Planning permission gra	Land off Barnett Rd					
P32	P02/V1594/O	Planning permission gra	Land at Didcot Road, Great Western Park					
P33	P11/V1453/O	Planning permission gra	Broadwater, Manor Rd					
P34	P12/V2283/O	Planning permission gra	Cowan's Camp Depot, High St					
P35	P13/V0497/RM	Planning permission gra	Land off Lime Rd, Botley					
P36	P10/V1907/O	Planning permission gra	Major Amey's Site					
P37	P12/V0958	Planning permission gra	17 to 20 Millbrook Sq					
P38	P11/V0086	Resolution to grant	Christ Church, Hobbyhorse Ln					
P39	P12/V0845	Resolution to grant	Anson Field, Morland Rd, Hyde Copse, Howard Cornish Rd					
P40	P13/V0145/O	Resolution to grant	South of Lamb Ave					
P41	P12/V2316/O	Resolution to grant	Land east of Chainhill Rd					
P42	P12/V2429/O	Resolution to grant	Land off Rectory Farm Cl					
P43	P12/V0299/O	Application under consi	Land at Grove Air Field, Denchworth Rd					
P44	P13/V0401/O	Resolution to grant	Milton Road, Sutton Courtenay					
P45	P13/V0692/FUL	Resolution to grant	Land at Causeway Farm, The Causeway					
P46	P13/V0859/FUL	Planning permission gra	Land North of Priory Lane					
P47	P13/V0467/O	Resolution to grant	Land at Milton Hill, Milton					
P48	P12/V2048/FUL	Planning permission gra	Land off Walnut Trees Hill					
P49	P13/V0381/FUL	Planning permission gra	Land East of A338, Crown Meadow, East Hanney					
P50	P12/V2653/FUL	Planning permission gra	Land off Draycott Road					
P51	P12/V2266/FUL	Planning permission gra	Land East of Drayton Road					
P52	P13/V0575/O	Resolution to grant	King's Field, Sheepstead Rd, Marcham					
P53	P13/V1040/O	Resolution to grant	Alder View, Land South of Grove Road, Harwell					
P54	P13/V0458/O	Planning permission gra	Chailey House, Bessels Way, Blewbury					
P55	P13/V1543/O	Resolution to grant	Land North of 92-112 Milton Rd					
P56	P13/V0139/O	Resolution to grant	Fernham Fields, Land East of Coxwell Rd					
P57	P12/V1878/FUL	Planning permission gra	Land West of Portway Villas, Reading Rd					
P58	P13/V0146/FUL	Permissions since Apr 2	Land West of the A417					
P59	P13/V0339/O	Resolution to grant	Land off Colton Road					
P60	P13/V1826/FUL	Resolution to grant	Land South of Downsview Road (Stockham Farm Phase 2)					
na	na	Remainder of dwellings	LPP2 villages					
na	na	permissions under 10 d	Small sites					
na	na	Assumptions based on	Windfall					

	Completions																						
JBA_ID	Housing Completions 2011/12 -2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	Total houses 2013-31	Planned Housing 2013/14-2020/211	Planned Housing 2021/22-2030/31	Planned housing total 2013/14 - 2030/31
S1				80	80	80	80	60												380	380	0	380.0
S2				50	100	100	100	100	132	134	134	162	162	162	164					1500	582	784	1366.0
S3-S4					50	175	175	175	175	175	175	175	175	175	175	175	175			2150	750	1225	1975.0
S5			35	80	80	80	80	45												400	400	0	400.0
S6					14	59	59	59	59	59	59	59	59	52	45	45	45			673	250	364	614.0
C1				50	50	50	50	100	100	100	100	100	100	100	100	100	100	100	100	1400	400	900	1300.0
C2				50	50	50	50													200	200	0	200.0
C3				50	50	50	50	50	50	50	50	10								410	300	60	360.0
C4																33	33	33	33	132	0	132	132.0
C5																33	33	33	33	132	0	132	132.0
C6				50	50	50	50	50	50	50	50									400	300	50	350.0
C7				50	50	50	50													200	200	0	200.0
C8				50	50	50	50	50	20											270	270	0	270.0
C9				50	50	50	50	40												240	240	0	240.0
C10				50	50	50	50													200	200	0	200.0
C11																				0	0	0	0.0
C12																34	34	34	34	136	0	136	136.0
C14				50	50	50	50	50	40											290	290	0	290.0
C15				50	50	50	50													200	200	0	200.0
C17				50	50	50	50	100	100	100	100	100	100	100	100	100	100	100	100	1400	400	900	1300.0
C18				50	50	50	50													200	200	0	200.0
C19				50	50	50	50													200	200	0	200.0
C20				50	50	50	50													200	200	0	200.0
C22				50	50	50	50													200	200	0	200.0
C26				50	50	50	50													200	200	0	200.0
C27				50	50	50	50													200	200	0	200.0
C28				50	50	50	50													200	200	0	200.0
C29				50	50	50	50	20												220	220	0	220.0
C30				50	50	50	50													200	200	0	200.0
C31				17	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	280	102	161	263.0
C32				12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	200	72	116	188.0
P1	9																			0	0	0	0.0
P2	14																			0	0	0	0.0
P3	4																			0	0	0	0.0
P4	10																			0	0	0	0.0
P5	15																			0	0	0	0.0
P6	10																			0	0	0	0.0
P7	30																			0	0	0	0.0
P8	56																			0	0	0	0.0
P9	20	14	14	13																41	41	0	41.0
P10	76	75	93	31																199	199	0	199.0
P11	35	157																		157	157	0	157.0
P12	219		58																	58	58	0	58.0
P13	15	1																		1	1	0	1.0
P14		10																		10	10	0	10.0
P15		24																		24	24	0	24.0
P16				14																14	14	0	14.0
P17		10	20	20	21															71	71	0	71.0
P18		7	8																	15	15	0	15.0
P19			28																	28	28	0	28.0
P20			35																	35	35	0	35.0
P21		48	48	48	48	8														200	200	0	200.0
P22		10																		10	10	0	10.0
P23			36																	36	36	0	36.0
P24		30																		30	30	0	30.0
P25		40	40	40																120	120	0	120.0
P26			23																	23	23	0	23.0
P27			11																	11	11	0	11.0
P28				14	14	14	14	14	14	14	10									108	84	10	94.0
P29		11	39																	50	50	0	50.0
P30			50	50	50															150	150	0	150.0
P31						50														50	50	0	50.0
P32				100	100	100	100	100	100	100										700	600	0	600.0
P33			14																	14	14	0	14.0
P34			30	50	20															100	100	0	100.0
P35		16	40	40	40															136	136	0	136.0
P36			50	50	40															140	140	0	140.0
P37					11															11	11	0	11.0
P38			15																	15	15	0	15.0
P39			25	26																51	51	0	51.0
P40			18																	18	18	0	18.0
P41			28	57																85	85	0	85.0
P42			13																	13	13	0	13.0
P43					100	200	200	200	200	200	200	200	200	200	200	200	200			2500	900	1400	2300.0
P44				5	5	5	5	5	5	5	5	5	5	5	5	5	5			70	30	35	65.0
P45				5	5	5	5	5	5	1										31	30	0	30.0
P46				5	5	5	3													18	18	0	18.0
P47							5	5	5	5	5	5	5	5	5	3				48	15	28	43.0
P48				5	5	5	3													18	18	0	18.0
P49				5	5	5	5	5												25	25	0	25.0
P50				14	14	14	14	14	14	14										98	84	0	84.0
P51				14	14	14	14	14	14	14	14	14	14	14	6					160	84	62	146.0
P52					5	5	5	5	5	5	5	5	3							43	25	13	38.0
P53							5	5	5	5	5	5	5	5	5	5	5			55	15	35	50.0
P54							5	5	5	5	5	5								30	15	10	25.0
P55				5	5	5	5	5	5	4										34	30	0	30.0
P56							14	14	14	14	14	14	14	14	14	14	14			154	42	98	140.0
P57				5	5	5	5	1												21	21	0	21.0
P58				5	5	5	5	5	5	5	5	5	5	5	5	5	5			70	30	35	65.0
P59							5	5	5	5	5	5	5	5	5	5	5			55	15	35	50.0
P60						5	5	5	5	5	5	5	5	5	5	5	5			60	20	35	55.0
na							96	96	96	96	96	96	96	96	96	96	95			1055	288	671	959.0
na	189	102	102	102	102	102														510	510	0	510.0
na							65	65	65	65	65	65	65	65	65	65	65	65	65	845	195	585	780.0

	Water resources and supply									
JBA_ID	Population equivalent increase	Employment Land	Water Company	Demand_MLD 2.4p/h*134l/p/h	Water Resource Zone	Flow monitoring Zone	Water resources assessment	Comment on: Water resources assessment	Water supply infrastructure assessment	Comment on: Water supply infrastructure assessment
S1	912	0	Thames Water	0.122	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
S2	3600	0	Thames Water	0.482	SWOX	Wantage	A		R	Cannot accommodate all site allocations
S3-S4	5160	0	Thames Water	0.691	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
S5	960		Thames Water	0.129	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
S6	1615	0	Thames Water	0.216	SWOX	Wantage	A		R	Cannot accommodate all site allocations
C1	3360	0	Thames Water	0.450	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C2	480	0	Thames Water	0.064	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
C3	984	0	Thames Water	0.132	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
C4	317	0	Thames Water	0.042	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C5	317	0	Thames Water	0.042	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C6	960	0	Thames Water	0.129	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
C7	480	0	Thames Water	0.064	SWOX	Boars Hill	A		G	Can accommodate sites without upgrades
C8	648	0	Thames Water	0.087	SWOX	Boars Hill	A		G	Can accommodate sites without upgrades
C9	576	0	Thames Water	0.077	SWOX	Brasenose	A		G	Can accommodate sites without upgrades
C10	480	0	Thames Water	0.064	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
C11	0	0	Thames Water	0.000	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C12	326	0	Thames Water	0.044	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C14	696	0	Thames Water	0.093	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
C15	480	0	Thames Water	0.064	SWOX	Wantage	A		R	Cannot accommodate all site allocations
C17	3360	0	Thames Water	0.450	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C18	480	0	Thames Water	0.064	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
C19	480	0	Thames Water	0.064	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
C20	480	0	Thames Water	0.064	SWOX	Wantage	A		R	Cannot accommodate all site allocations
C22	480	0	Thames Water	0.064	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C26	480	0	Thames Water	0.064	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C27	480	0	Thames Water	0.064	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
C28	480	0	Thames Water	0.064	SWOX	Brasenose	A		G	Can accommodate sites without upgrades
C29	528	1	Thames Water	0.071	SWOX	Hagbourne Hill	A		G	Can accommodate sites without upgrades
C30	480	2	Thames Water	0.064	SWOX	Faringdon	A		R	Cannot accommodate all site allocations
C31	672		Thames Water	0.090	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
C32	480		Thames Water	0.064	SWOX	Abingdon	A		G	Can accommodate sites without upgrades
P1	0	3	Thames Water	0.000	SWOX					
P2	0	4	Thames Water	0.000	SWOX					
P3	0	5	Thames Water	0.000	SWOX					
P4	0	6	Thames Water	0.000	SWOX					
P5	0	7	Thames Water	0.000	SWOX					
P6	0	8	Thames Water	0.000	SWOX					
P7	0	9	Thames Water	0.000	SWOX					
P8	0	10	Thames Water	0.000	SWOX					
P9	98	11	Thames Water	0.013	SWOX					
P10	478	12	Thames Water	0.064	SWOX					
P11	377	13	Thames Water	0.050	SWOX					
P12	139	14	Thames Water	0.019	SWOX					
P13	2	15	Thames Water	0.000	SWOX					
P14	24	16	Thames Water	0.003	SWOX					
P15	58	17	Thames Water	0.008	SWOX					
P16	34	19	Thames Water	0.005	SWOX					
P17	170	20	Thames Water	0.023	SWOX					
P18	36	21	Thames Water	0.005	SWOX					
P19	67	22	Thames Water	0.009	SWOX					
P20	84	24	Thames Water	0.011	SWOX					
P21	480	25	Thames Water	0.064	SWOX					
P22	24	26	Thames Water	0.003	SWOX					
P23	86	27	Thames Water	0.012	SWOX					
P24	72	28	Thames Water	0.010	SWOX					
P25	288	29	Thames Water	0.039	SWOX					
P26	55	30	Thames Water	0.007	SWOX					
P27	26	31	Thames Water	0.004	SWOX					
P28	259	32	Thames Water	0.035	SWOX					
P29	120	34	Thames Water	0.016	SWOX					
P30	360	35	Thames Water	0.048	SWOX					
P31	120	36	Thames Water	0.016	SWOX					
P32	1680	37	Thames Water	0.225	SWOX					
P33	34	38	Thames Water	0.005	SWOX					
P34	240	39	Thames Water	0.032	SWOX					
P35	326	40	Thames Water	0.044	SWOX					
P36	336	41	Thames Water	0.045	SWOX					
P37	26	42	Thames Water	0.004	SWOX					
P38	36	44	Thames Water	0.005	SWOX					
P39	122	45	Thames Water	0.016	SWOX					
P40	43	46	Thames Water	0.006	SWOX					
P41	204	47	Thames Water	0.027	SWOX					
P42	31	48	Thames Water	0.004	SWOX					
P43	6000	49	Thames Water	0.804	SWOX					
P44	168	50	Thames Water	0.023	SWOX					
P45	74	51	Thames Water	0.010	SWOX					
P46	43	52	Thames Water	0.006	SWOX					
P47	115	53	Thames Water	0.015	SWOX					
P48	43	54	Thames Water	0.006	SWOX					
P49	60	55	Thames Water	0.008	SWOX					
P50	235	56	Thames Water	0.032	SWOX					
P51	384	57	Thames Water	0.051	SWOX					
P52	103	58	Thames Water	0.014	SWOX					
P53	132	59	Thames Water	0.018	SWOX					
P54	72	60	Thames Water	0.010	SWOX					
P55	82	61	Thames Water	0.011	SWOX					
P56	370	62	Thames Water	0.050	SWOX					
P57	50	63	Thames Water	0.007	SWOX					
P58	168	64	Thames Water	0.023	SWOX					
P59	132	65	Thames Water	0.018	SWOX					
P60	144	66	Thames Water	0.019	SWOX					
na	2532	67	Thames Water	0.339	SWOX					
na	1224		Thames Water	0.164	SWOX					
na	2028		Thames Water	0.272	SWOX					

	Wastewater											Flood risk		
JBA_ID	Receiving WwTW	Receiving_WwTW_ID	Alternative WwTW	Flow increase l/s (1*DWF)	Flow increase m3/d (1*DWF)	WwTW capacity assessment	Comment on: WwTW capacity assessment	Water quality assessment	Sewerage infrastructure assessment	Comment on: Sewerage infrastructure assessment	Odour Assessment	WwTW additional flow flood risk	Fluvial Flood Risk	Pluvial Flood Risk
S1	FARINGDON STW	PUTE0073		1.344	116.098	R	Cannot accommodate all pro	A	R		G	G	G	G
S2	WANTAGE STW	POCE0025		5.304	458.280	R	Can accommodate the propo	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
S3-S4	DIDCOT STW	PTHE0052		7.603	656.868	G	No Upgrades Needed	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	A	A
S5	DIDCOT STW			1.414	122.208	G	Upgrades Needed	R			G	G	G	A
S6	WANTAGE STW	POCE0025		2.380	205.615	R	Can accommodate the propo	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	A	G	R	A
C1	DIDCOT STW	PTHE0052		4.951	427.728	G	Upgrades Needed	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C2	FARINGDON STW	PUTE0073		0.707	61.104	R	Cannot accommodate all pro	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, current wastewater treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. In the first instance a drainage strategy would be required from the developer to determine the exact impact on our infrastructure and the significance of the infrastructure to support the development. It should be noted that in the event of an upgrade to our assets being required, up to three years lead in time will be potentially necessary for the delivery of the infrastructure, alternatively the developer may wish to requisition the infrastructure to deliver it sooner. We are also likely to request a Grampian planning condition to ensure the infrastructure is in place ahead of occupation of the development.	G	G	G	G
C3	ABINGDON STW	PTHE0252		1.450	125.263	G	Upgrades Needed	G	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	A
C4	DIDCOT STW	PTHE0052		0.467	40.329	G	No Upgrades Needed	R	R		G	G	G	G
C5	DIDCOT STW	PTHE0052		0.467	40.329	G	No Upgrades Needed	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	R	A
C6	SHRIVENHAM STW	PUTE0115		1.414	122.208	R	Upgrades Needed	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	A
C7	APPLETON STW	POCE0003		0.707	61.104	A	No Upgrades Needed	R			G	G	G	A
C8	OXFORD STW	PTHE0144		0.955	82.490	R	Cannot accommodate all pro	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	A
C9	OXFORD STW	PTHE0144	ABINGDON STW	0.849	73.325	R	Cannot accommodate all pro	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	A
C10	SHRIVENHAM STW	PUTE0115		0.707	61.104	R	Cannot accommodate all pro	R			G	G	G	G
C11	DIDCOT STW	PTHE0052		0.000	0.000	R	Cannot accommodate all pro	R			G	G	G	A
C12	DIDCOT STW	PTHE0052		0.481	41.551	R	Cannot accommodate all pro	R			G	G	A	A
C14	STANFORD IN THE \	POCE0021		1.025	88.601	G	Can accommodate the propo	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C15	WANTAGE STW	POCE0025		0.707	61.104	R	Can accommodate the propo	A			G	G	G	G
C17	DIDCOT STW	PTHE0052		4.951	427.728	R	Cannot accommodate all pro	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C18	ABINGDON STW	PTHE0252		0.707	61.104	G	Can accommodate the propo	G			G	G	G	A
C19	ABINGDON STW	PTHE0252		0.707	61.104	G	Can accommodate the propo	G	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	A
C20	WANTAGE STW	POCE0025		0.707	61.104	R	Can accommodate the propo	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C22	DIDCOT STW	PTHE0052		0.707	61.104	R	Cannot accommodate all pro	R	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C26	DRAYTON STW			0.707	61.104	G	No Upgrades Needed	A			A	G		
C27	APPLETON STW	POCE0003		0.707	61.104	A	Can accommodate the propo	R			G	G		
C28	OXFORD STW	PTHE0144		0.707	61.104	R	Cannot accommodate all pro	R	R	Note TWUL call this North West Radley: We have concerns regarding Wastewater Services in relation to this site. Specifically, current wastewater treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. In the first instance a drainage strategy would be required from the developer to determine the exact impact on our infrastructure and the significance of the infrastructure to support the development. It should be noted that in the event of an upgrade to our assets being required, up to three years lead in time will be potentially necessary for the delivery of the infrastructure, alternatively the developer may wish to requisition the infrastructure to deliver it sooner. We are also likely to request a Grampian planning condition to ensure the infrastructure is in place ahead of occupation of the development.We have concerns regarding Wastewater Services in relation to this site. Specifically, current wastewater network in this area is unlikely to be able to support the demand anticipated from this development. Drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. In the first instance a drainage strategy would be required from the developer to determine the exact impact on our infrastructure and the significance of the infrastructure to support the development. It should be noted that in the event of an upgrade to our assets being required, up to three years lead in time will be potentially necessary for the delivery of the infrastructure, alternatively the developer may wish to requisition the infrastructure to deliver it sooner. We are also likely to request a Grampian planning condition to ensure the infrastructure is in place ahead of occupation of the development.	G	G		
C29	DRAYTON STW			0.778	67.214	R	Cannot accommodate all pro	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	R
C30	FARINGDON STW			0.707	61.104	R	Cannot accommodate all pro	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C31	KINGSTON BAGPUIZE STW			0.990	85.546	R	Cannot accommodate all pro	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
C32	KINGSTON BAGPUIZE STW			0.707	61.104	R	Cannot accommodate all pro	A	R	We have concerns regarding Wastewater Services in relation to this site. Specifically, curr	G	G	G	G
P1	ABINGDON STW			0.000	0.000									
P2	DIDCOT STW			0.000	0.000									
P3	SHRIVENHAM STW			0.000	0.000									
P4	WANTAGE STW			0.000	0.000									
P5	DRAYTON STW			0.000	0.000									
P6	WANTAGE STW			0.000	0.000									
P7	WANTAGE STW			0.000	0.000									
P8	WANTAGE STW			0.000	0.000									
P9	ABINGDON STW			0.145	12.526									
P10	DIDCOT STW			0.704	60.798									
P11	OXFORD STW			0.555	47.967									
P12	FARINGDON STW			0.205	17.720									
P13	OXFORD STW			0.004	0.306									
P14	ABINGDON STW			0.035	3.055									
P15	ABINGDON STW			0.085	7.332									
P16	WANTAGE STW			0.050	4.277									
P17	WANTAGE STW			0.251	21.692									
P18	WANTAGE STW			0.053	4.583									
P19	FARINGDON STW			0.099	8.555									
P20	FARINGDON STW			0.124	10.693									
P21	WANTAGE STW			0.707	61.104									
P22	OXFORD STW			0.035	3.055									
P23	SHRIVENHAM STW			0.127	10.999									
P24	SHRIVENHAM STW			0.106	9.166									
P25	SHRIVENHAM STW			0.424	36.662									
P26	WANTAGE STW			0.081	7.027									
P27	WANTAGE STW			0.039	3.361									
P28	KINGSTON BAGPUIZE STW			0.382	32.996									
P29	KINGSTON BAGPUIZE STW			0.177	15.276									
P30	OXFORD STW			0.530	45.828									
P31	DRAYTON STW			0.177	15.276									
P32	DIDCOT STW			2.475	213.864									
P33	WANTAGE STW			0.050	4.277									
P34	SHRIVENHAM STW			0.354	30.552									
P35	OXFORD STW			0.481	41.551									
P36	DRAYTON STW			0.495	42.773									
P37	WANTAGE STW			0.039	3.361									
P38	DRAYTON STW			0.053	4.583									
P39	ABINGDON STW			0.180	15.582									
P40	DIDCOT STW			0.064	5.499									
P41	WANTAGE STW			0.301	25.969									
P42	WANTAGE STW			0.046	3.972									
P43	WANTAGE STW			8.840	763.800									
P44	DRAYTON STW			0.248	21.386									
P45	DRAYTON STW			0.110	9.471									
P46	APPLETON STW			0.064	5.499									
P47	DIDCOT STW			0.170	14.665									
P48	SHRIVENHAM STW			0.064	5.499									
P49	WANTAGE STW			0.088	7.638									
P50	KINGSTON BAGPUIZE STW			0.347	29.941									
P51	ABINGDON STW			0.566	48.883									
P52	APPLETON STW			0.152	13.137									
P53	DIDCOT STW			0.194	16.804									
P54	DIDCOT STW			0.106	9.166									
P55	DRAYTON STW			0.120	10.388									
P56	FARINGDON STW			0.545	47.050									
P57	WANTAGE STW			0.074	6.416									
P58	STANFORD IN THE VALE STW			0.248	21.386									
P59	SHRIVENHAM STW			0.194	16.804									
P60	WANTAGE STW			0.212	18.331									
na	N/A			3.731	322.324									
na	N/A			1.803	155.815									
na	N/A			2.988	258.164									

B Water Quality Assessment

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B Water quality assessment

B.1 Introduction

The increased discharge of effluent due to an increase in the population served by a Sewage Treatment Works (STW) may impact on the quality of the receiving water. The Water Framework Directive (WFD) does not allow a watercourse to deteriorate from its current class (either water body or element class).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourse. Where the scale of development is such that a deterioration is predicted, a new consent may be required for the STW to improve the quality of the final effluent, so that the extra pollution load will not result in a deterioration in the water quality of the watercourse. This is known as a “no deterioration” or “load standstill".

EA guidance states that a 10% deterioration in the receiving water can be allowed in some circumstances as long as this does not cause a class deterioration to occur.

If a watercourse fails the 'good status' target, further investigations are needed in order to define the 'reasons for fail' and which actions could be implemented to reach such status.

During the preparation of the phase I Water Cycle Study (WCS) the EA advised that it would be necessary to undertake an assessment of the water quality impact of development in the 11 STW catchments which will receive the majority of additional flows in the Vale of White Horse District (12 outfalls as Abingdon has 2 outfalls to different watercourses).

This report assesses the potential water quality impacts due to growth in STW effluent flows and loads at those 11 STW discharge points.

B.2 Standards

The WFD targets for Biological Oxygen Demand (BOD), Ammonia (NH_4) and Phosphate (P) set by the EA are shown in Table 1 and Table 2 below:

Table 1: WFD targets

Determinand	Statistic	1st cycle (2009)	2nd cycle (2013)
BOD	90 percentile	5mg/l	5mg/l
NH_4	90 percentile	0.6mg/l	0.6mg/l
P	Mean	0.12 mg/l	See Table 2 below for reach-specific targets

For cycle 2 (2013 onwards) the EA has set reach-specific targets for P based on environmental modelling using SIMCAT. The EA has advised that for unlisted sites a target of 0.08 mg/l as an annual average orthophosphate (PO4-P) should be used.

Table 2: Targets for Mean Phosphate, 2013

SIMCAT model node	Site Name	2nd cycle standard (mg/l)
POCR0006	LETCOMBE BROOK AT WEIR FARM, EAST HANNEY	0.08
POCR0071	PORTOBELLO DITCH BELOW RAILWAY	0.083
POCR0019	OCK AT STANFORD IN THE VALE ROAD BRIDGE, STANFORD IN THE VALE	0.081
POCR0011	MARCHAM BROOK AT MILL ROAD, MARCHAM	0.084
POCR0013	OCK ABOVE THAMES	0.086
POCR0016	OCK AT MILL ROAD, MARCHAM	0.085
POCR0017	OCK AT OCK BRIDGE, LYFORD	0.083
PTHR0065	THAMES 400M BELOW BOVENEY DITCH	0.09
PTHR0075	THAMES ABOVE NSWC INTAKE, EGHAM	0.092
PTHR0079	THAMES AT BOVENEY WEIR	0.09
PTHR0108	THAMES AT THREE VALLEYS WATER INTAKE, SUNNYMEADS	0.092
PTHR0074	THAMES ABOVE NSWC INTAKE, WALTON	0.09
PTHR0076	THAMES AT RAVENS AIT, SURBITON	0.088
PTHR0094	THAMES AT MWD INTAKE, WALTON	0.09
PTHR0096	THAMES AT NSWC INTAKE, CHERTSEY	0.092
PTHR0107	THAMES AT TEDDINGTON WEIR	0.09
PTHR0082	THAMES AT COOKHAM BRIDGE	0.089
PTHR0088	THAMES AT HENLEY BRIDGE	0.087
PTHR0102	THAMES AT SONNING WEIR	0.087
PTHR0104	THAMES AT SPADE OAK	0.089
PTHR0204	FAWLEY COURT STREAM AT GARDEN CENTRE ROAD BRIDGE, HENLEY	0.091
PTHR0054	PORTLANE BROOK ABOVE THAMES	0.088
PTHR0265	LONGFORD RIVER AT HIGH STREET, HAMPTON	0.093
PTHR0014	CHALVEY DITCH ABOVE THAMES	0.087
PTHR0005	ASH ABOVE THAMES	0.094
PTHR0124	CUT ABOVE THAMES	0.089
PTHR0125	CUT AT BUCK BRIDGE, BINFIELD	0.077
PTHR0223	HEYWOOD STREAM ABOVE THE CUT	0.093
PTHR0008	BOVENEY DITCH ABOVE THAMES	0.095

SIMCAT model node	Site Name	2nd cycle standard (mg/l)
PTHR0016	CHOLSEY BROOK 500M BELOW CHOLSEY STW	0.087
PTHR0041	MOOR DITCH ABOVE DIDCOT STW	0.084
PTHR0043	MOOR DITCH AT B4016, APPLEFORD	0.086
PTHR0029	GINGE BROOK AT B4016, SUTTON COURTENAY	0.086
PTHR0048	NORTHFIELD BROOK AT SANDFORD	0.08
PTHR0026	FILCHAMPSTEAD BROOK ABOVE THAMES	0.079
PTHR0216	HARCOURT BROOK ABOVE LIMB BROOK	0.083
PTHR0080	THAMES AT CAVERSHAM WEIR	0.086
PTHR0111	THAMES AT WALLINGFORD BRIDGE	0.084
PTHR0120	THAMES JUST ABOVE GORING WEIR	0.084
PTHR0121	THAMES ABOVE MAPLEDURHAM WEIR	#VALUE!
PTHR0113	THAMES AT WATER INTAKE, FARMOOR	0.079
PTHR0077	THAMES AT ABINGDON WEIR	0.08
PTHR0081	THAMES AT CLIFTON HAMPDEN BRIDGE	0.081
PTHR0083	THAMES AT DAYS LOCK	0.083
PTHR0085	THAMES AT FOLLY BRIDGE, OXFORD	0.08
PTHR0098	THAMES AT RADLEY COLLEGE BOATHOUSE, RADLEY	0.082
PTHR0099	THAMES AT SANDFORD	0.081
PTHR0105	THAMES AT SUTTON BRIDGE, CULHAM	0.083
PTHR0110	THAMES AT TROUT INN, GODSTOW	0.08
PTHR0152	ODHAY HILL DITCH ABOVE GINGE BROOK	0.085
PTHR0186	THAMES AT DONNINGTON BRIDGE, OXFORD	0.08
PTHR0221	CLIFTON HAMPDEN DITCH ABOVE THAMES	0.081
PUTR0249	LENTA BROOK AT HINTON MARSH FARM	0.074
PUTR0116	TUCKMILL BROOK BELOW SHRIVENHAM STW	0.075
PUTR0024	COLE AT B4000, SEVENHAMPTON	0.073
PUTR0108	THAMES AT WATERHAY BRIDGE, ASHTON KEYNES	0.071
PUTR0002	AMPNEY BROOK AT SHEEPPEN BRIDGE	0.077
PUTR0090	THAMES AT CASTLE EATON	0.075
PUTR0091	THAMES AT CRICKLADE	0.073
PUTR0093	THAMES AT EYSEY	0.074