JBA consulting

Cotswold District Council - Water Cycle Study

Phase I Study
(Incorporating Water Quality Assessment - Phase II)

August 2015

Cotswold District Council
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COTSWOLD DISTRICT COUNCIL

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Contract

This report describes work commissioned by the Cotswold District Council, by letter dated 23/01/2014. The council's representatives for the contract were Joanne Corbett and David Halkyard. Giovanni Sindoni and Paul Eccleston of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Cotswold District Council.

Acknowledgements

JBA would like to thank Cotswold District Council, the Environment Agency, Bristol Water, Severn Trent Water, Thames Water and Wessex Water for provision of data and advice.

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Executive Summary

Introduction

In January 2014, JBA Consulting was commissioned to undertake a Phase 1 Water Cycle Study (WCS) for the Cotswold District Council (CDC).

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. It is possible that allocating large numbers of new homes at some locations may result in the capacity of the existing available infrastructure being exceeded. This situation could potentially lead to service failures to water and wastewater customers, adverse impacts to the environment or high costs for the upgrade of water and wastewater assets being passed on to bill payers. Climate change presents further challenges such as increased intensive rainfall and a higher frequency of drought events that can be expected to put greater pressure on the existing infrastructure. Sustainable planning for water must take this into account. The water cycle can be seen in Figure 1 below, and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

Figure 1: Water cycle study

*Source: Environment Agency – Water Cycle Study Guidance

CDC has identified 29 housing site allocations and 16 employment site allocations proposed in the forthcoming draft Local Plan (sites remain subject to confirmation). These sites and their associated demand for water supply and wastewater services were the key focus of the WCS. It is important to note that together with committed and allocated sites, the council has requested that the WCS also considers the impact of sites held in reserve. These so-called “reserve sites” are not allocated in the draft Local Plan and they do not count towards meeting the objectively assessed housing and employment need for the plan period. Individually, they are simply potential substitutes that may be brought forward at a periodic review of the plan if circumstances warrant their inclusion.

Conclusions

The water cycle study has been carried out in co-operation with the Environment Agency (EA), Bristol Water (BW), Thames Water (TWUL), Severn Trent Water (STWL) and Wessex Water (WW). Overall, there are no issues which indicate that the planned scale, location and timing of planned development within the District is unachievable from the perspective of supplying water and wastewater services and preventing deterioration of water quality in receiving waters.

The WCS has identified where infrastructure upgrades are expected to be required to accommodate planned growth. Timely planning and provision of infrastructure upgrades will depend upon regular engagement between CDC, water companies, the EA and developers.

Development scenarios and policy issues

- Sites already with planning consent will account for virtually all planned growth up to 2019/20, after which point the additions from sites with planning permission tail off and the contribution of future allocations start to take effect. The impact of these future allocations is the focus of the study, and included:
  - 1 strategic site (Land at Chesterton Farm, Cirencester),
  - 30 preferred sites,
  - 21 reserve sites and
  - 14 economic development areas (2 classified as Reserve).
- The projected growth rate for Cotswold District, at an average of 380 per annum, is not significantly different to the annual rate of housing provision from the now defunct 2006 South West Regional Spatial Strategy and the 2009 Gloucestershire and Districts Strategic Housing Market Assessment. Consequently there are no "surprises" for water companies in the quantum of growth to be planned for in the District.
- The strategic site at Land at Chesterton Farm, Cirencester accounts for approximately 80% of all proposed housing growth in the emerging Local Plan. The capacity at Cirencester wastewater treatment works (WwTW) has already been upgraded to accommodate this and other growth in the Cirencester catchment. The remaining allocations across the District (approximately 500) are relatively modest in scale, though in small towns and villages the infrastructure will normally be sized to serve the existing population and therefore may have little spare capacity for growth.
- Legal agreements under the Town and Country Planning Act Section 106 agreement, and Community Infrastructure Levy agreements are not intended to be used to obtain funding for water or wastewater infrastructure. It is not, therefore necessary for Cotswold District Council to identify requirements for developers to contribute towards the cost of upgrades in its Local Plan.
- The Water Industry Act sets out arrangements for connections to public sewers and water supply networks, and developers should ensure that they engage at an early stage with the relevant water supplier and sewerage undertaker to ensure that site-specific capacity checks can be undertaken and where necessary additional infrastructure constructed to accommodate the development. Where permitted the water company or sewerage undertaker may seek developer contributions towards infrastructure upgrades. Upgrades to water resources, water treatment works and wastewater treatment works are funded through the company business plans.

Water resources

- Within those settlements supplied by Thames Water (including all preferred allocation sites with the exception of those in Tetbury), the Water Resource Management Plan (WRMP) makes adequate provision for the forecast growth in housing within Cotswold District and therefore water resources should not be considered to be a barrier to the planned growth in the District.
- The wider issue of an increase in the forecast demand within the Swindon and Oxfordshire (SWOX) water resource zone is being addressed jointly by Thames Water and the Environment Agency. Initially this will focus on implementing and monitoring the impacts of demand management measures which are the focus for water resource management during AMP6 (2015-2020). In parallel, Thames Water continues to investigate the timing for future development of strategic new resources, which could include reservoirs and/or large-scale water recycling. Progress on this work will be published by Thames Water in its WRMP Annual Statements and in a Statement of Common Ground to be jointly prepared by CDC, EA and TWUL.
- In Tetbury (supplied by Bristol Water), the Water Resource Management Plan and comments from BW evidence that there are no issues with water resources to serve the planned growth.
- There are no allocation sites within the small areas of the District supplied water by Severn Trent Water and Wessex Water.

Water supply

- Thames Water have confirmed that they are able to supply the planned growth in Down Ampney without infrastructure upgrade. In all other settlements supplied by Thames Water, further modelling will be required to determine the scale of the water supply infrastructure upgrades that may be needed. Whilst it is expected that infrastructure upgrades will be required to serve the planned growth within these settlements, there remains adequate time for this infrastructure to be delivered by Thames Water without restricting the timing, location or scale of planned development. Measures to address supply to the strategic development at Cirencester are further progressed by Thames Water. This development accounts for over 80% of new housing to be allocated.
- In Tetbury, Bristol Water state that there are no issues with water supply infrastructure to serve the planned growth.

Wastewater collection

- Existing sewerage infrastructure is reported to be adequate to accommodate the planned growth in Blockley, Cirencester (where the strategic development would be served by a completely new sewer connecting to the WwTW), Lechlade and Tetbury.
- In all other settlements it is anticipated that some infrastructure upgrades will be required within the sewerage systems.
- Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage and treat wastewater arising from new domestic development. The majority of future growth within the District already has planning permission, therefore the sewerage undertakers should already be aware of this forthcoming growth. However, except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption or requisition from a developer. Early developer engagement with water companies is therefore essential to ensure that sewerage capacity can be provided without delaying development.

Wastewater treatment and water quality

- WwTWs at Ampney St Peter, Blockley, Chipping Campden, Cirencester, Honeybourne and Tetbury are assessed as having capacity within their existing flow and quality consents to accommodate the proposed growth. Cirencester WwTW may, however, require further upgrade to prevent a Water Framework Directive (WFD) deterioration for Ammonia. The required standard of treatment would be achievable using current Best Available Technology (BAT) for wastewater treatment.
- WwTWs at Andoversford, Bourton-on-the-Water, Broadwell, Fairford, Lechlade, Moreton-in-Marsh and Northleach are all predicted to require some infrastructure upgrades to accommodate higher flows and/or to prevent a WFD deterioration. The required standard of treatment would be achievable using current Best Available Technology.
- The potential for accommodating additional growth beyond the preferred growth scenario was tested for Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury. Assuming standards of treatment are upgraded, additional growth above and beyond the preferred sites (up to 200 extra houses) could be accommodated at all five settlements with no deterioration effect on the receiving watercourse.
- It is not possible to reach Good Ecological Status (GES) for the watercourses receiving discharges from Broadwell, Cirencester, Moreton on Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury sewage treatment works (STW) in relation to the chemical element Phosphate. Separate assessment by the Environment Agency has confirmed that wastewater treatment solutions to address this are currently technically unfeasible, and therefore they conclude that the planned growth has very little bearing on the ability of these water bodies to meet Good Ecological Status. At Tetbury and Blockley the assessment indicated that the planned growth would prevent the water bodies achieving Good Ecological Status. However, the Environment Agency has concluded that this is due to the conservative modelling approach taken.
- In summary, the Environment Agency has confirmed that "there are no limiting factors for growth based on the levels of growth indicated within the Local Plan, subject to the

relevant mitigation measures and infrastructure upgrades stated within the Water Quality Assessment being delivered."

- Sewerage undertakers monitor flow and quality at their WwTWs and their internal planning processes monitor the growth trajectories at each WwTW to ensure that where required additional capacity can be put in place before existing permit limits are reached.
- 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. An odour screening assessment concluded that five sites (three in Moreton-in-Marsh and two in Northleach) may be at risk of experiencing odour due to their proximity to the existing WwTW. It is recommended that odour impact assessments be undertaken prior to allocation of these sites. None of the other preferred or reserve sites are likely to be impacted by odour from WwTWs.

Flood Risk

- The percentage of each site at risk from fluvial or surface water flooding was calculated. This information may be used to supplement the information presented at the settlement scale in the Strategic Flood Risk Assessment (SFRA).
- 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. The impact of increased effluent flows are not predicted to have a significant impact upon flood risk in the receiving watercourses at any of the settlements with planned growth in the District.

Environmental constraints and opportunities

- A desk study exercise to identify environmental risks and opportunities associated with the 388 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 (SEA) 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 was 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 CDC area and the potential risks and opportunities associated with the development of the proposed sites.

Climate change

- A qualitative assessment has been undertaken to assess the potential impacts of Climate Change on the assessments made in this water cycle study. This used 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.
- The capacity of the sewerage system and the water quality of receiving water bodies stand out as two elements of the assessment where the consequences of climate change are expected to be high, but no account has been made of climate impacts in the assessment. This should be addressed at detailed assessment stage.

Recommendations

Primary responsibility for the provision of water and wastewater services to new developments lies with the Water Companies and Sewerage Undertakers. Cotswold District Council should facilitate their planning by providing clear information and updates on the location, scale and timing of allocations. As the primary environmental regulator the Environment Agency has a key role in determining the environmental capacity of water resources and receiving waters in the District. Finally, site developers and promoters should ensure that they engage at an early stage with the appropriate Water Companies and Sewerage Undertakers to enable them to ascertain the capacity of existing water supply and wastewater networks and where necessary upgrade their infrastructure.

It is intended that Thames Water, the Environment Agency and Cotswold District Council will prepare a Statement of Common Ground setting out an agreed approach to ensuring provision of infrastructure to serve the strategic development in Cirencester and measures to address the future supply-demand balance in the SWOX water resource zone. Furthermore it is CDC's intention to summarise the conclusions of the Water Cycle Study in the forthcoming update of the Infrastructure Delivery Plan (IDP). This will include schedules of infrastructure upgrades and timescales required to support delivery of the Local Plan.

The study makes recommendations for planning and mitigation measures to ensure that the planned growth can be delivered to Cotswold District Council's growth trajectory, that water and wastewater services are maintained and the impacts of treated effluent to not cause deterioration of water quality.

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Abbreviations

ALC .... Agricultural Land Classification

ALS .... Abstraction Licensing Strategy

AMP .... Asset Management Plan

AONB............................. Area of Outstanding Natural Beauty

AQMA .... Air Quality Management Area

ASNW .... Ancient or Semi-Natural Woodland

BAT .... Best Available Technology

BOD .... Biochemical Oxygen Demand

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

BW .... Bristol Water

CAMS............................. Catchment Abstraction Management Strategy

CAPEX............................ Capital Expenditure

CDC .... Cotswold District Council

CfSH .... Code for Sustainable Homes

CSO .... Combined Sewer Overflow

DAP................................ Drainage Area Plan

Defra .... Department for Environment, Food & Rural Affairs

DWF............................... Dry Weather Flow

DWI................................ Drinking Water Inspectorate

EA .... Environment Agency

EFI .... Ecological Flow Indicator

EU .... European Union

FE .... Final Effluent

FEH................................ Flood Estimation Handbook

FFT .... Flow to Full Treatment

FMfSW .... Flood Map for Surface Water

FRA................................ Flood Risk Assessment

FWMA .... Flood and Water Management Act

FZ................................... Flood Zone

GCC .... Gloucestershire County Council

GES .... Good Ecological Status

GIS................................. Geographic Information Systems

GVZ................................ Groundwater Vulnerability Zone

HOF .... Hands Off Flow

IDP .... Infrastructure Delivery Plan

LLFA .... Lead Local Flood Authority

LNR................................ Local Nature Reserve

LPA .... Local Planning Authority

MLD .... Megalitres per Day
MRF .... Minimum Residual Flow
NNR .... National Nature Reserve
NPPF .... National Planning Policy Framework
NVZ................................. Nitrate Vulnerable Zone
OAN .... Objectively Assessed Need
OC................................... Occupancy Rate
OfWAT .... Water Services Regulation Authority
ONS .... Office for National Statistics
OPEX.............................. Operational Expenditure
OS................................... Ordnance Survey
P...................................... Phosphate
PCC .... Per Capita Consumption
PE .... Population Equivalent
PPG .... Planning Policy Guidance
PR .... Price Review or Periodic Review
RAU .... Royal Agricultural University
RQP .... River Quality Planning tool
RSS................................. Regional Spatial Strategy
SA .... Sustainability Appraisal
SAB................................. SuDS Approving Body
SAC................................. Special Area of Conservation
SBP................................. Strategic Business Plan
SDS................................. Strategic Direction Statement
SEA................................. Strategic Environmental Assessment
SELAA .... Strategic Employment and Land Availability Assessment
SEPA .... Scottish Environmental Protection Agency
SFRA .... Strategic Flood Risk Assessment
SHLAA .... Strategic Housing and Land Availability Assessment
SHMA.............................. Strategic Housing Market Assessment
SMP .... Sewerage Management Plan
SOLAR............................ Strategic Overview of Long term Assets and Resources
SPA................................. Special Protection Area
SPS................................. Sewage Pumping Station
SPZ................................. Source Protection Zone
SS .... Suspended Solids
SSSI................................ Site of Special Scientific Interest
STW................................ Sewage Treatment Works
STWL .... Severn Trent Water Limited
SU .... Sewerage Undertaker

SuDS............................... Sustainable Drainage System
SWA................................ Slough, Wycombe & Aylesbury
SWOX............................. Swindon and South Oxfordshire
TWUL .... Thames Water Utilities Limited
uFMfSW........................... updated Flood Map for Surface Water
UWWTD........................... Urban Wastewater Treatment Directive
WaSCs............................. Water and Sewerage Companies
WCS................................ Water Cycle Study
WFD................................ Water Framework Directive
WRMP............................. Water Resources Management Plan
WRZ................................ Water Resource Zone
WSUD............................. Water Sensitive Urban Design
WTW............................... Water Treatment Works
WW................................. Wessex Water
WwTW .... Wastewater Treatment Works

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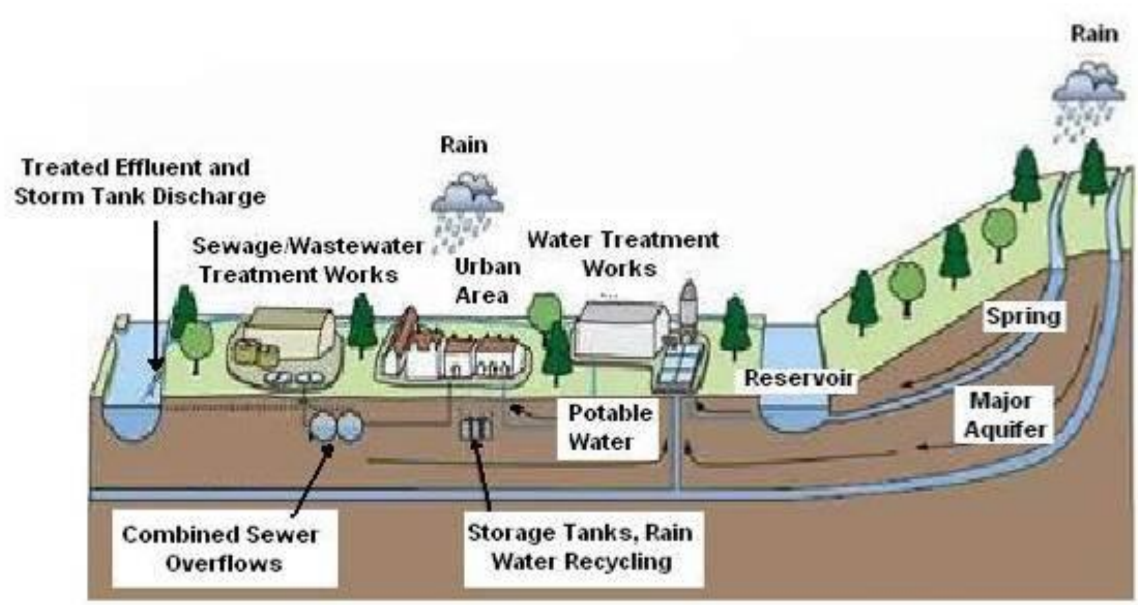
1 Introduction

1.1 Background

In January 2014, JBA Consulting was commissioned to undertake a Phase 1 Water Cycle Study (WCS) for the Cotswold District Council (CDC).

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. It is possible that allocating large numbers of new homes at some locations may result in the capacity of the existing available infrastructure being exceeded. This situation could potentially lead to service failures to water and wastewater customers, adverse impacts to the environment or high costs for the upgrade of water and wastewater assets being passed on to bill payers. Climate change presents further challenges such as increased intensive rainfall and a higher frequency of drought events that can be expected to put greater pressure on the existing infrastructure. Sustainable planning for water must take this into account. The water cycle can be seen in Figure 1-1 below, and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

Figure 1-1: Water cycle study



*Source: Environment Agency – Water Cycle Study Guidance

This study will assist the Council to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. This has been achieved by identifying areas where there may be conflict between any proposed development, the capacity of the water and wastewater assets and the requirements of the environment to determine potential measures and solutions.

The Water Cycle Study should be treated as a “dynamic document” that is periodically reviewed as further information becomes available. This will provide a better understanding of the impact of the developments on the water supply and wastewater infrastructure and water quality.

1.2 Objectives of the Water Cycle Study

CDC are in the process of identifying draft site allocations to meet their targets for housing and employment provision to 2031.

The Water Cycle Study is required in order to assess the constraints and requirements that will arise from the potential growth on the water infrastructure.

The overall objective of the Water Cycle Study is to understand the environmental and physical demands of the development and identify opportunities for more sustainable planning and improvements that may be required so that proposals don't exceed the existing water cycle capacity. This is assessed by considering the following issues:

- Water Resources
- Water Supply;
- Wastewater Collection and Treatment;
- Water Quality and the Environment;
- Flood Risk, and
- Climate Change.

This report focuses upon the proposed site allocations provided by the Council. The report outlines the current status of the environment and infrastructure, identifies the possible constraints to the development, the impacts and demands of the development, and gives recommendations as to any improvements or mitigation required including approximate costings.

1.3 Phase 1 Water Cycle Study Scope

The scope of the Phase I WCS was defined by the Environment Agency:

We recommend the following issues are scoped into the Phase 1 WCS:

Water Resources and Water Supply

Environmental capacity

- *Is there capacity in existing licenses for development?*
- *Will existing license remain valid?*
- *Can we reduce abstraction by better management practices?*

Infrastructure capacity

- *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?*

Wastewater Collection and Treatment

Environmental capacity

- *Is there volumetric capacity in existing effluent discharge permit for growth?*
- *Will discharge permit be valid to meet future standard (e.g. WFD)?*
- *Will additional discharge be allowed if there is no additional environmental capacity to assimilate it?*

Infrastructure capacity

- *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?*

Environmental Opportunities

- *Are we making the most of our new development?*
- *Are there multi-use options that will provide water resources, flood risk management and water quality benefits?*

Examples:

  - *Green roofs and permeable road surfaces for new developments*
  - *SuDS designed to provide green infrastructure and biodiversity benefits as well as surface water flood risk and water quality management*

1.4 Structure of this report

Table 1-1: Report structure

Question	Method	Link to report section
Environment Agency Issue 1: Water Resources and Water Supply		
Is there capacity in existing licences for development?	Review WRMP and CAMS to identify whether the projected growth can be accommodated for the proposed scale and locations of development.	**Water resources assessment**
Will existing licences remain valid?	Review WRMP and CAMS.	**Water resources assessment**
Can we reduce abstraction by better management practices?	Review Water Companies (WC) proposals for demand management (leakage, metering etc.) Identify opportunities to manage demand on new developments through water efficient fittings, rainwater harvesting and grey water recycling.	**Water resources assessment**
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?	Where available, use WC studies, models etc. to assess infrastructure capacity. Where these are not available, use simple indicators (size of development vs. water resources available) to assess risks.	**Water supply infrastructure assessment**
Environment Agency Issue 2: Wastewater Collection and Treatment		
Is there volumetric capacity in existing effluent discharge permit for growth?	Assessment will be undertaken at the Sewage Treatment Works (STW) level. Verify that the receiving STW has enough headroom to accommodate the extra inflow.	**Wastewater treatment works flow and quality permit assessment**
Will discharge permit be valid to meet future standard (e.g. WFD)?	Asses the water quality status of the receiving water using the data provided by the EA (e.g. WFD GIS layer, existing water quality models) Identify the likelihood of development either inhibiting improvement or downgrading existing good status.	**Water quality impact assessment**
Will additional discharge be allowed if there is no additional environmental capacity to assimilate it?	This is a question for the Environment Agency. Review EA guidance and discuss at project meetings.	None
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?	Where available, use WC studies, models etc. to assess infrastructure capacity. Where these are not available, use simple indicators (size of development vs. dimensions of receiving sewer, presences of CSOs etc.) to assess risks.	**Wastewater treatment works flow and quality permit assessment** **Wastewater treatment works odour assessment** **Sewerage system capacity assessment**
Environment Agency Issue 3: Environmental Opportunities		

Question	Method	Link to report section
Are we making the most of our new development?	Identify opportunities for improvements to the water environment as part of development e.g. channel and floodplain improvements, de-culverting, rehabilitation of contaminated land. Identify potential for SuDS, green infrastructure and Water Sensitive Urban Design (WSUD)	**Opportunities**
Are there multi-use options that will provide water resources, flood risk management and water quality benefits?	Provide examples; assess sites for potential (existing green infrastructure, housing density etc.).	

1.5 Stakeholders and consultation

It is important that a WCS brings together all partners and stakeholders knowledge, understanding and skills to help to understand the environmental and physical constraints to development. The following stakeholders were consulted during this WCS and have provided data for use within the study:

- Thames Water;
- Bristol Water;
- Severn Trent Water;
- Wessex Water;
- Environment Agency;
- Cotswold District Council.

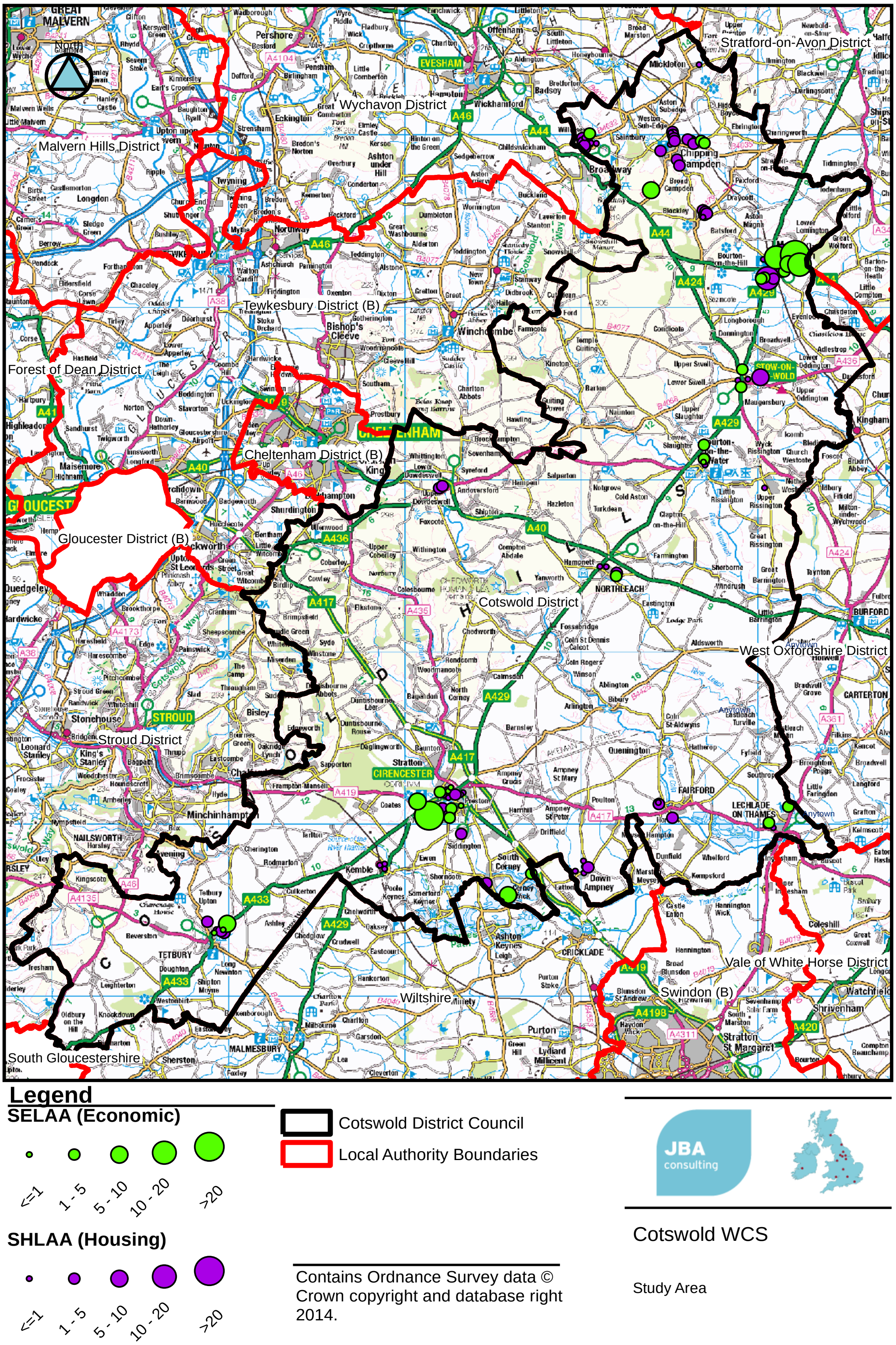
1.6 Study Area

The study area is Cotswold District Council area within the county of Gloucestershire. The District covers a largely rural area, with the main towns being Cirencester, Tetbury, Morton-in-Marsh and Chipping Campden (see Figure 1-2).

Significant watercourses within the study area are the River Thames, Coln, Churn, Evenlode, Windrush, Leach and Ampney Brook.

Some of the keys transport routes passing through the study area are the A429, A40, A417, A419 and A433.

Figure 1-2: Cotswold study area and location of Housing and Economic sites.



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2 Development Scenarios and Key Developments

2.1 Introduction

CDC initially identified 92 potential housing sites and 34 potential economic development sites which are respectively included in the Strategic Housing and Land Availability Assessment (SHLAA) and the Strategic Employment and Land Availability Assessment (SELAA). Further ongoing assessments by CDC have reduced the list of SHLAA sites to:

- 1 Strategic site (Land at Chesterton Farm, Cirencester)
- 30 Preferred sites
- 21 Reserve sites
- 14 Economic development areas (2 classified as Reserve)

Table 2-1 summarises these sites.

Table 2-1: List of SHLAA and SELAA sites assessed and potential maximum total houses planned for the period 2014-31.

Ref	Site Type	Parish	Site Name	Total Dwellings	Area (Ha.)
C_75	SHLAA - Strategic	Cirencester	Land at Chesterton Farm	2350	110
A_2	SHLAA - Preferred	Andoversford	Land to rear of Templefields & Crossfields	20	2.31
A_3A	SHLAA - Preferred	Andoversford	Land to west of Station Road	20	1.54
B_20	SHLAA - Preferred	Bourton-on-the-Water	Pulhams Bus Depot	10	0.3
BK_14A	SHLAA - Preferred	Blockley	The Limes, Station Road	16	1.51
BK_5	SHLAA - Preferred	Blockley	Land north of Sheafhouse Farm	22	2.3
BK_8	SHLAA - Preferred	Blockley	Land at Sheaf House Farm	13	0.54
C_101A	SHLAA - Preferred	Cirencester	Magistrates Court	5	0.098
C_17	SHLAA - Preferred	Cirencester	42-54 Querns Lane	6	0.184
C_39	SHLAA - Preferred	Cirencester	Austin Road Flats	9	0.287
C_97	SHLAA - Preferred	Cirencester	Memorial Hospital (Local plan ref: CIR4)	11	0.381
CC_23B	SHLAA - Preferred	Chipping Campden	Land at Aston Road	34	1.369
CC_23C	SHLAA - Preferred	Chipping Campden	Land at Aston Road	80	4.215
CC_40	SHLAA - Preferred	Chipping Campden	Barrels Pitch Wooden Bungalow, Aston Road	13	0.831
DA_2	SHLAA - Preferred	Down Ampney	Dukes Field	10	0.427
DA_5A	SHLAA - Preferred	Down Ampney	Buildings at Rooktree Farm	8	0.789
DA_8	SHLAA - Preferred	Down Ampney	Land at Broadleaze	13	0.519
K_2	SHLAA - Preferred	Kemble	Land at Station Road	12	0.977
L_18B	SHLAA - Preferred	Lechlade	Land west of Orchard Close, Downington	9	0.543
L_19	SHLAA - Preferred	Lechlade	Land south of Butler's Court	9	0.954
M_60	SHLAA - Preferred	Moreton-in-Marsh	Former Hospital Site	21	0.79
N_13B	SHLAA - Preferred	Northleach	Land north-west of Hammond Drive &	5	0.16

Ref	Site Type	Parish	Site Name	Total Dwellings	Area (Ha.)
			Midwinter Road		
N_14B	SHLAA - Preferred	Northleach	Land adjoining East End & Nostle Road	17	2.732
N_1A	SHLAA - Preferred	Northleach	Land off Bassett Road	31	1.788
S_46	SHLAA - Preferred	Stow-on-the-Wold	Ashton House, Union Street	20	0.849
S_8A	SHLAA - Preferred	Stow-on-the-Wold	Builders yard & telephone exchange	10	0.179
T_24B	SHLAA - Preferred	Tetbury	Former Matbro Site	9	0
T_51	SHLAA - Preferred	Tetbury	Northfield Garage Site, London Road	18	0.523
W_1A	SHLAA - Preferred	Willersey	Garage workshop behind The Nook and Garden, behind The Nook, Main Street	2	0.047
W_1B	SHLAA - Preferred	Willersey	Land at Broadway Road	3	0.125
W_7A	SHLAA - Preferred	Willersey	Garage workshop behind The Nook and Garden, behind The Nook, Main Street	75	3.951
B_32	SHLAA - Reserve	Bourton-on-the-Water	Countrywide Stores	32	1.29
BK_11	SHLAA - Reserve	Blockley	Land north-east of Blockley	36	1.46
C_76	SHLAA - Reserve	Cirencester	Land at Chesterton School, Somerford Road	8	2.641
C_82	SHLAA - Reserve	Cirencester	Land at Paternoster House, Watermoor Road	23	0.941
CC_23E	SHLAA - Reserve	Chipping Campden	Aston Road Allotments	21	0.86
CC_38A	SHLAA - Reserve	Chipping Campden	Land at The Hoo	8	0.262
CC_41	SHLAA - Reserve	Chipping Campden	Campden Cricket Club	43	1.74
CC_48	SHLAA - Reserve	Chipping Campden	Land adjacent to Chipping Campden School	8	1.081
DA_5C	SHLAA - Reserve	Down Ampney	Land south of Rooktree Farm Buildings	43	2.347
F_35B	SHLAA - Reserve	Fairford	Land behind Milton Farm and Bettertons Close	49	1.966
F_44	SHLAA - Reserve	Fairford	Land to rear of Faulkner Close, Horcott	28	1.14
K_1B	SHLAA - Reserve	Kemble	Land between Windmill Road and A429	13	0.54
K_5	SHLAA - Reserve	Kemble	Land to north-west of Kemble Primary School, School Road	11	0.557
M_12A	SHLAA - Reserve	Moreton-in-Marsh	Land at Evenlode Road	0	3.593
M_19A	SHLAA - Reserve	Moreton-in-Marsh	Land south-west of Fosseway Avenue	75	14.022
M_19B	SHLAA - Reserve	Moreton-in-Marsh	Land south-east of Fosseway Avenue	75	4.643
MK_4	SHLAA - Reserve	Mickleton	Land at Granbrook Lane	8	0.592
S_20	SHLAA - Reserve	Stow-on-the-Wold	Land at Bretton House	87	2.838
SC_13A	SHLAA - Reserve	South Cerney	Land rear of Berkeley Close	64	3.405
T_31B	SHLAA -	Tetbury	Land adjacent to Blind	43	2.267

Ref	Site Type	Parish	Site Name	Total Dwellings	Area (Ha.)
	Reserve		Lane		
W_5	SHLAA - Reserve	Willersey	Land north of B4632 and east of employment estate	17	1.403
BOW_E1	Economic	Bourton-on-the-Water	Land north of Bourton Business Park	0	3.38
CCN_E1	Economic	Chipping Campden	Campden Business Park (Extension)	0	0.67
CCN_E3	Economic	Chipping Campden	Campden BRI (Espansion) (not in Flood Zone)	0	1.09
CIR_E10	Economic	Cirencester	Forum Car Park	0	0.54
CIR_E11	Economic	Cirencester	Lorry Park	0	0.6
CIR_E12	Economic	Cirencester	Old Memorial Hospital Site & Car Park	0	0.38
CIR_E13	Economic	Cirencester	Sheep Street Island	0	1.29
CIR_E14	Economic	Cirencester	Waterloo Car Park	0	0.67
Strategic Allocation in PDS	Economic	Cirencester	South of Chesterton	0	9.1
CIR_E6	Economic (reserve site)	Cirencester	Land east of RAU	0	2.44
LEC_E1	Economic	Lechlade	Land north of Butlers Court	0	1.25
MOR_E11	Economic (reserve site)	Moreton-in-Marsh	Land at Evenlode Road	0	2.03
MOR_E6	Economic	Moreton-in-Marsh	Fire Service College	0	7.13
TET_E2	Economic	Tetbury	Extension to Tetbury Industrial Estate	0	6.74

The locations and number of houses at sites with planning permission but which have not yet been constructed were also collated (see Table 2-2). A total of 318 sites with planning permission were considered, with a net increase of 3528 dwellings. 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 2014-31. 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 included in the assessment process.

Parish	Planning Application Number	Site Name	Total Dwellings
Adlestrop	12/00838/FUL	Hillside Farm	1
Aldsworth	13/04294/FUL	Land at Hitchings, The Approach	4
Ampney Crucis	14/00311/FUL	Crucis Park Barnsley Road	2
Ampney St Mary	13/05350/FUL	Manor Farmyard Ampney St Marys	4
Andoversford	13/03775/FUL	Former Cattle Market, Station Road	17
Andoversford	14/01340/CLEUD	10A Crossfields	1
Ashley	11/02839/FUL	Culkerton Station (Former Goods Building), Tetbury Road	1
Ashley	12/02451/FUL	The Old Station House, Culkerton	0
Avening	13/03250/CLOPUD	Avening Mill, Mill Lane	8
Avening	13/03534/CLOPUD	Land adjacent to 23 Sandford Leaze	1
Avening	14/02252/FUL	Land adjacent 9 Pound Hill	1
Avening	11/01823/FUL	The Boat House, Gatcombe Water	1
Bagendon	12/03538/FUL	The Old School	1

Parish	Planning Application Number	Site Name	Total Dwellings
Barnsley	14/01060/CLEUD	Glebe Farm	4
Barrington	12/04562/FUL	Inn For All Seasons	1
Baunton	13/05262/OUT	Green Sleeves	1
Baunton	13/05006/FUL	The Hollies, Baunton Lane Stratton	1
Baunton	11/04205/FUL	Windrush House, The Whiteway	1
Baunton	13/04770/FUL	Land at Cirencester Golf Club	2
Beverstone	12/05146/FUL	Babdown Farm, Babdown	7
Bibury	13/00937/FUL	Jubilee Garage	1
Bibury	13/03829/FUL	Streetway House, Ready Token	1
Bibury	14/02280/FUL	Rosebank Ablington	1
Bibury	14/01342/FUL	Land adjacent Barn House, Hawkers Hill	2
Bibury	13/01371/FUL	Land adjacent to B4425, Arlington	11
Bledington	13/00433/FUL	Pebbly Hill Farm	1
Bledington	13/00428/FUL	Pebbly Hill Farm	1
Bledington	14/01416/FUL	Micklands Hill Farm Stow Road	1
Bledington	13/04552/FUL	The Old Forge adjacent to Jasmine Cottage	0
Bledington	14/00344/FUL 13/03926/FUL	Green Lane, Main Street	0
Bledington	14/03371/FUL	Bledington Grounds Bungalow, Stow Road	0
Blockley	13/00615/FUL	Oddity House, Bell Lane	1
Blockley	14/02694/FUL	Brown House, Station Road	0
Blockley	14/02977/FUL	Lower Brook House, Lower Street	0
Blockley	13/00795/FUL	British Legion Building, Bell Lane	2
Blockley	14/01454/FUL	Land Parcel opposite Cornerstone Cottage, Draycott	0
Bourton-on-the-Water	13/05036/FUL	Bourton on the Water Library	5
Bourton-on-the-Water	14/00873/OUT	Piece House, Moore Road	2
Bourton-on-the-Water	14/00061/FUL	Moore Cottage Hospital	2
Bourton-on-the-Water	13/04951/FUL	Cotswold Carp Farm, Rissington Road	1
Bourton-on-the-Water	12/05647/FUL	Tagmoor Barn	1
Bourton-on-the-Water	13/01866/FUL	Land adjacent to 2 Gorse Meadow	1
Bourton-on-the-Water	14/00654/FUL	Salmonsbury House, Station Road	-1
Bourton-on-the-Water	14/01385/FUL	Flat 1 The Garage, Station Road	1
Bourton-on-the-Water	14/01974/FUL	Halford House, Station Road	1
Bourton-on-the-Water	12/03616/OUT	Land parcel off Station Road	100
Bourton-on-the-Water	13/00818/FUL	Cotswold Carp	1
Bourton-on-the-Water	13/01708/FUL	Ebley Tyre and Auto Services, Lansdowne	5
Bourton-on-the-Water	14/00084/FUL	Bourton Croft, Victoria Street	1
Bourton-on-the-Water	11/01410/FUL	12 Salmonsbury Cottages, Station Road	1

Parish	Planning Application Number	Site Name	Total Dwellings
Bourton-on-the-Water	13/00291/OUT	Land to the north of Roman Way and to the east of Bourton Industrial Park	148
Bourton-on-the-Water	12/04453/FUL	35 Rissington Road	1
Chedworth	12/05528/FUL	Woodlands Farm	1
Chedworth	13/05075/FUL	Highfield, Fields Road	0
Cherington	12/03802/FUL	The Gastons	1
Chipping Campden	11/00881/FUL	Malt House, Broad Campden	1
Chipping Campden	10/01736/FUL	Top Farm, Blind Lane, Westington	1
Chipping Campden	13/05276/FUL	The Granary, Blind Lane	1
Chipping Campden	13/02227/OUT	Land at Berrington Mill Nurseries, Station Road	26
Chipping Campden	12/00364/FUL	Green Dragon, Backends	1
Chipping Campden	14/02151/FUL	Old Bakehouse, Lower High Street, Chipping Campden	1
Chipping Campden	13/01538/OUT	Land adjacent to Badgers Field, George Lane	16
Chipping Campden	13/00542/FUL	1 The Old Grammar School, High Street	1
Chipping Campden	12/04669/FUL	The Anchorage, Blind Lane	1
Chipping Campden	12/02809/FUL	Site between 6 and 7 Sheep Street	1
Cirencester	13/00380/CON	15 The Avenue	0
Cirencester	08/00557/FUL	The Wool Market Car Park, Dyer Street	8
Cirencester	12/05201/FUL	Land adjacent to 45 Bowling Green Road	2
Cirencester	12/05204/FUL	Land adjacent to 47 Bowling Green Road (Site 2)	2
Cirencester	11/02888/FUL	4 - 6 Black Jack Street	9
Cirencester	13/04890/FUL	17 Kingshill	1
Cirencester	13/02153/FUL	6-20 Spitalgate Lane	4
Cirencester	13/04065/FUL	60 Gloucester Road, Stratton	2
Cirencester	13/05371/FUL	Land adjacent to 32 Cotswold Avenue	1
Cirencester	12/05413/FUL	53-61 Castle Street	2
Cirencester	14/02352/FUL	35 The Whiteway	1
Cirencester	13/03578/FUL	24 Kingshill	1
Cirencester	11/03033/FUL	25 Corinium Gate	1
Cirencester	14/02224/FUL	Somerford Court, Somerford Road	35
Cirencester	12/05371/FUL	Oakley Hall Chapel, Highfield Lane	1
Cirencester	12/02905/FUL	Land adjacent to Stratton Wold	1
Cirencester	14/02593/FUL	8 Park Street	2
Cirencester	14/03155/FUL	Shepherd Smail & Co. North Way House, North Way	2
Cirencester	11/04607/FUL	105 Watermoor Road	3
Cirencester	13/02500/FUL	Land at West Way	9
Cirencester	14/02115/FUL	47 Dyer Street	1
Cirencester	10/05462/FUL	Powells C of E School, Gloucester Street	4
Cirencester	10/01954/FUL	Akeman Court, Cricklade Street	13

Parish	Planning Application Number	Site Name	Total Dwellings
Cirencester	13/04935/FUL	Baldwins Bed Shop, 103 Cricklade Street	6
Cirencester	13/02942/OUT	Kingshill Development, London Road	100
Cirencester	11/05444/FUL	Le Spa, 42 Gloucester Road, Stratton	1
Cirencester	11/05830/FUL	Stratton Place, 42 Gloucester Road, Stratton	7
Cirencester	14/00825/FUL	51 Dollar Street	2
Cirencester	14/02037/FUL	21 West Way	2
Cirencester	13/01043/OUT	Earle & Ludlow ltd., 77 Victoria Road	4
Cirencester	13/03752/FUL	54 Somerford Road	1
Cirencester	13/01384/FUL	62 Kemble Drive	1
Cirencester	10/03034/REM 10/04185/FUL	Land at Kingshill South Phases 5 6 & 7	27
Cirencester	12/05656/FUL	24 Queen Street	6
Cirencester	11/05030/OUT	Southleigh, 48 Somerford Road	1
Cirencester	11/01774/OUT	Land west of Siddington Road and south of North Hill Road	55
Cirencester	14/00730/FUL	26 Weavers Road	1
Clapton	14/02143/CLPUD	Craycombe Cottage	1
Coberley	14/02559/FUL	Severn Springs House, formerley Sandford School, Coberley	1
Coberley	14/01134/OUT	Honeyacre, Ullenwood Manor Road	1
Coberley	13/01348/FUL	New Farm Bungalow, Upper Coberley	0
Cold Aston	14/03012/FUL	The Ridge, Fosseway	5
Colesbourne	13/03260/FUL	Land at the Walled Garden, Colesbourne Park	1
Colesbourne	11/03914/FUL	The Old Post Office	1
Coln St Aldwyn	13/03215/FUL	Akeman Barns, Cockrup Farm, Bibury Road	2
Coln St Dennis	13/05269/FUL	Glebe Farm	1
Coln St Dennis	13/03576/OUT	Black Barns	1
Compton Abdale	14/03089/FUL	Manor Farm	1
Compton Abdale	13/03681/FUL	Beechwood Farm	1
Cowley	14/01714/FUL	Old Neuk, Birdlip	1
Cowley	12/04062/FUL	Rushwood Kennels	1
Cowley	14/03269/FUL	Barn at Ivy Lodge, Stroud Road	1
Cowley	13/00738/FUL	Barn adjacent to Royal George Hotel, Cirencester Road	1
Daglingworth	12/05190/FUL	Manor Farm Barn, Lower End	2
Daglingworth	13/00250/FUL	Manor Farm Stables, Lower End	1
Dowdeswell	13/00039/CON	Dowdeswell Court	-1
Dowdeswell	12/05152/FUL	Dowdeswell Court	1
Down Ampney	13/01667/OUT	Land at Broadway Farm	22
Duntisbourne Abbotts	09/04265/FUL	Homefield	1
Duntisbourne Abbotts	12/00650/FUL	Newbold Farm	1
Eastleach	12/05463/FUL	Old School House, Eastleach Martin	2
Eastleach	06/03029/FUL	16 Eastleach	2
Ebrington	12/03690/FUL	Ebrington Hill	1

Parish	Planning Application Number	Site Name	Total Dwellings
Ebrington	10/02797/FUL	Barns at Charingworth Farm	1
Ebrington	13/01665/FUL	Orchard Cottage, Charingworth Grange	0
Ebrington	12/04267/FUL	Orchard Rise, Charingworth Road, Charingworth	1
Ebrington	13/01168/FUL	The Barn, Hidcote Boyce	1
Ebrington	13/05096/FUL	Little Charingworth	0
Ebrington	14/01175/FUL	The Washbrook	1
Ebrington	14/00553/FUL	Oakham Farm, Nashs Lane	1
Edgeworth	14/00018/FUL	Stonewell Place, School Lane	1
Elkstone	14/01514/FUL	The Bungalow, Butlers Farm, Colesbourne	1
Elkstone	12/03032/FUL	The Timber Yard, High Cross	1
Evenlode	12/02435/CON	Bell Orchard, Horn Lane	0
Evenlode	11/03962/FUL	Manor Farm, Church Lane	1
Evenlode	13/04281/FUL	The Stables, Manor Farm	1
Evenlode	14/03015/FUL	Grange Farm Barn, Horn Lane	2
Fairford	13/02558/FUL	2 High Street	1
Fairford	13/03793/OUT	Land at London Road	120
Fairford	13/05181/OUT	Land parcel to the south-west of Saxon Way	22
Fairford	13/00792/REM	Pips Field	34
Fairford	12/02133/FUL	Land west of Pips Field, Cirencester Road	99
Fairford	11/05694/FUL	The Old Post Office, Bridge Street	2
Fairford	10/05337/FUL	Land at Back Lane	1
Fairford	14/0122/OUT	Land at Waiten Hill Farm, Coronation Street	4
Fairford	13/05307/REM	The Gables, Horcott Road	1
Fairford	12/00520/FUL	Rhymes Barn Farm, Rhymes Lane	1
Fairford	13/03097/OUT	Land south of Cirencester Road	120
Farmington	12/01998/FUL	Hill House	1
Farmington	13/05254/FUL	Foxbury Cottage	0
Farmington	11/01918/LBC	Farmington Lodge	1
Farmington	13/05198/FUL	Furzehill Farm	1
Guiting Power	13/00998/FUL	Yoicks, Tally Ho Lane	1
Guiting Power	14/00676/FUL	Pemeister Cottage, Piccadily, Guiting Power	1
Hazelton	12/03153/FUL	Red House, Salperton	1
Icomb	14/03261/FUL	The Granary, Icomb Proper	1
Icomb	13/04880/FUL	Lower Farm, House	1
Kemble	11/05872/FUL	Dutch Barn, Mill Farm, Main Street, Ewen	1
Kemble	12/00425/FUL	Forge House, Limes Road	0
Kemble	12/01261/FUL	Grey Gables, School Road	0
Kemble	11/04236/OUT	Land at Top Farm, West Lane	50
Kemble	13/03599/FUL	Bradley Cottage, Windmill Road	1
Kemble	13/01372/FUL	Stanmore House, Main Street, Ewen	0
Kemble	11/01062/FUL	Morning Dew, Kemble Road	0
Kemble	14/02519/FUL	Land south of Washpool House, Washpool Lane	1
Kempsford	13/03685/FUL	Mill Farm, Whelford	1

Parish	Planning Application Number	Site Name	Total Dwellings
Kempsford	12/01469/FUL	Land between the High Street and Top Road	29
Kingscote	05/01935/FUL	The Byre and Stable Barn, Barnhill Court Farm	2
Kingscote	12/03387/FUL	St Bartholomews Church	1
Kingscote	12/00583/FUL	3 Windmill Cottages, Windmill Lane	1
Lechlade	13/00262/FUL	Downham Fields, Fairford Road, Downington	0
Lechlade	13/00557/FUL	Lechlade Methodist Chapel, High Street	1
Lechlade	14/01463/FUL	Waldron Villa, Oak Street	1
Lechlade	12/00528/OUT	Old Station Site	61
Lechlade	13/02642/OUT	Land off Moorgate Downington	19
Long Newton	11/03435/CLEUD	Cotswold View	1
Long Newton	10/01370/FUL	Nursery Farm	1
Longborough	10/04362/FUL	The Gables, Ganborough Road	1
Longborough	10/05301/FUL	Upper Town House, Moreton Road	0
Lower Slaughter	13/00521/FUL	Church Farm House, Copse Hill Road	1
Lower Slaughter	12/04149/FUL	Land Parcel Dikler Farm	1
Lower Slaughter	13/03255/FUL	Bourton Vale Equine Clinic, Wyck Road	1
Maugersbury	14/00017/FUL	Crescent Hill, The Crescent	1
Maugersbury	13/03432/FUL	Willow Barn, Barn At Maugersbury Court	1
Mickleton	13/03539/OUT	Former Meon Hill Nurseries, Canada Lane	78
Mickleton	14/02685/FUL	Cotsvale, Broadway Road	2
Mickleton	13/04237/OUT	Land adjacent to Arbour Close and Cotswold Edge	70
Mickleton	12/01510/FUL	Paddock adj. Glyde House, Stratford Road	1
Moreton-in-Marsh	10/03807/FUL	The Crossing Cottage, Todenham Road	1
Moreton-in-Marsh	13/03353/FUL	Electricity Sub Station, London Road	2
Moreton-in-Marsh	11/01765/FUL	168 Fosseway Avenue	1
Moreton-in-Marsh	13/01379/FUL	Stoneleigh, Todenham Road	1
Moreton-in-Marsh	13/02901/FUL	White Roses, Hospital Road	-1
Moreton-in-Marsh	13/01694/FUL	Glenesk, High Street	1
Moreton-in-Marsh	12/02678/FUL	Former Moreton Bowls Club, Hospital Road	34
Moreton-in-Marsh	11/05518/FUL	Laundercentre, New Road	2
Moreton-in-Marsh	14/01483/OUT	Land west of 7th Avenue and south of 5th Avenue, Fire Service College Campus (Site 1)	250
Moreton-in-Marsh	11/00940/REM	Land at Fire Service College, London Road	54
Moreton-in-Marsh	13/02936/FUL	Land at Moreton Park, London Road	36
Moreton-in-Marsh	14/00169/FUL	6 Errington Road	1
Moreton-in-Marsh	12/02967/FUL	Post Office, New Road	2

Parish	Planning Application Number	Site Name	Total Dwellings
Moreton-in-Marsh	12/02967/FUL	Post Office, New Road	6
Moreton-in-Marsh	14/01492/FUL	The Old Curiosity Shop, The Workshop, Corders Lane	1
Moreton-in-Marsh	09/00190/FUL	Queenshead House, High Street	1
Moreton-in-Marsh	14/02528/FUL	Flower House, Hospital Road	1
Moreton-in-Marsh	14/00948/OUT	Land off Todenham Road, Moreton in Marsh	140
Naunton	13/05291/FUL	Springfield	0
Naunton	13/03603/FUL	Spring Barn	1
Naunton	13/01425/FUL	Baptist Chapel, Naunton	2
North Cerney	13/04199/FUL	Scrubditch Farm	1
Northleach with Eastington	13/02211/OUT	Chequers, West End	8
Northleach with Eastington	14/00104/FUL	Forety House	-11
Northleach with Eastington	14/00104/FUL	Forety House	22
Northleach with Eastington	12/01236/FUL	25 Macarthur Road	1
Northleach with Eastington	13/02686/FUL	18 Macarthur Road	1
Northleach with Eastington	13/02796/FUL 12/01980/FUL	Field Fair, West End	1
Northleach with Eastington	13/05292/FUL	Cotteswold House and Cottage, Market Place	-1
Northleach with Eastington	13/00651/FUL	QLM Ltd. The Old Bakery, The Green	2
Northleach with Eastington	14/01695/FUL	The Old Grammar School, High Street	1
Northleach with Eastington	11/04752/FUL	Flat 1 & 3 The Glebe House, Mill End	-1
Northleach with Eastington	13/02225/FUL	Outbuilding 1 to rear of Tudor House, The Green	1
Northleach with Eastington	14/02823/FUL	Tudor House, The Green	2
Northleach with Eastington	11/05804/FUL	Land to the rear of Wheelwrights, West End	6
Oddington	14/01581/FUL	The Manor, Lower Oddington	-1
Oddington	11/05796/FUL	Oddington House Lodge, Lower Oddington	1
Ozleworth	12/01582/FUL	Bulkland Barn	1
Pool Keynes	12/05507/FUL	Mary's Cottage, 100 Poole Keynes	0
Poulton	13/04550/FUL	Bell Lane Farm	1
Poulton	11/01496/FUL	Land at Poulton Gorse	2
Preston	11/05716/OUT	Land at Siddington Park Farm	114
Quenington	11/03743/FUL	Windrush, Welsh Way, Honeycombe Leaze	1
Rodmarton	12/01150/FUL	Jackaments Bottom Farm, Tetbury Road	1
Sapperton	13/02357/FUL	The White Horse Inn, Stroud Road, Frampton Mansell	4
Sapperton	14/01048/FUL	Puck Mill Barn, Frampton Mansell	1
Sapperton	12/04390/FUL	Former Grain Store, Beacon Farm, Stroud Road, Frampton Mansell	1
Sevenhampton	12/05501/FUL	Puckham Farmhouse	1

Parish	Planning Application Number	Site Name	Total Dwellings
Sherborne	13/02222/FUL	The Oranges	0
Sherborne	11/03119/FUL	Park Farm	1
Shipton	09/01923/FUL	Birchwood (Formerley Eilian), Shipton Oliffe	1
Shipton Moynes	11/01973/CON	The Rectory, Church Lane	1
Shipton Moynes	14/01664/FUL	Hollywell, 11&13 The Street	2
Siddington	11/00055/CLEUD	The Coach House Stables, Upper Siddington	1
Siddington	06/00891/FUL	Barton Farm	1
Siddington	13/02803/FUL	3 Nursery View	1
Siddington	14/01473/FUL	Land Parcel to the East of School House, Parkway	1
Somerford Keynes	13/02877/FUL	Land adjoining Thameside House	1
Somerford Keynes	14/01838/FUL	Land parcel off Mill Lane	1
South Cerney	12/01556/REM	Land at former Aggregate Industries Site, The Mallards	97
South Cerney	14/02281/FUL	45 Berkeley Close	1
South Cerney	12/05093/FUL	The Homestead, Silver Street	2
South Cerney	13/00546/FUL	Kingfisher, Station Road	1
South Cerney	12/00138/FUL	Fosse Dogotel and Cattery, Cricklade Road	2
South Cerney	14/00060/FUL	The Cottage, High Street	1
South Cerney	13/04831/FUL	Barnside	1
South Cerney	06/01201/FUL	Revised scheme The Ferns, Clarks Hay	1
South Cerney	10/03458/FUL	Land at Ham Cottage, Ham Lane	1
Southrop	14/00099/OUT	Cottenborough Bunglow, Lechlade Road	1
Southrop	14/01444/FUL	Wychwood House, Wadham Close	1
Stow-on-the-Wold	13/05360/OUT	Triangle site north of Tesco Store	44
Stow-on-the-Wold	13/02758/FUL	Rear garden of Little Dormers	1
Stow-on-the-Wold	13/05018/FUL	North Cotswold Bookmakers, Well Lane	1
Stow-on-the-Wold	14/00894/FUL	Chantry House, Sheep Street	1
Stow-on-the-Wold	14/00763/FUL	84 King Georges Field	1
Stow-on-the-Wold	07/03159/FUL 11/03651/FUL	Land adjacent to Well Lane & White Hart Lane	7
Stow-on-the-Wold	14/01809/FUL	The Cottage Tea Rooms, 7 Sheep Street	1
Stow-on-the-Wold	13/04911/FUL	2 Beech Croft, Oddington Road	1
Stow-on-the-Wold	14/01987/FUL	Hartwells Cottage, Digbeth Street	1
Stow-on-the-Wold	12/01045/FUL	Fayrefields, Lower Swell Road	0
Stow-on-the-Wold	14/01633/FUL	Churchill, Aston Road	1
Stow-on-the-Wold	14/00768/FUL	Stuart House, Digbeth Street	-1
Stow-on-the-Wold	13/05022/FUL	Storage building, Lower Park Street	1

Parish	Planning Application Number	Site Name	Total Dwellings
Swell	11/00606/FUL	Buildings at Bowl Farm, Lower Swell	4
Swell	12/05337/OUT	Pipers Hill, Moreton Road	1
Swell	13/00508/FUL	South Hill Farm House, Station Road	1
Temple Guiting	11/02825/FUL	Farmcote Wood Farm, Winchcombe	1
Tetbury	14/00110/FUL	55 Long Street	1
Tetbury	13/02727/OUT	The Dormers	25
Tetbury	12/00219/OUT	Land parcel south of Berrells Road and west of Bath Road	39
Tetbury	13/03688/FUL	Garden adjoining Lyndhurst, Bath Road	1
Tetbury	12/05030/OUT	Wells Masonry Group Ltd. Ilsom Farm, Cirencester Road	12
Tetbury	11/00859/FUL	Peglers Garage, 9 London Road	4
Tetbury	13/05306/FUL	Land north of Cirencester Road	114
Tetbury	11/01135/FUL	6 Hampton Street	1
Tetbury	13/01494/FUL	25 Long Street	1
Tetbury	11/05457/FUL	18-22 Church Street	3
Tetbury	14/00125/FUL	Land rear of 19 Market Place	7
Tetbury	13/04899/OUT	Land parcel at Quercus Park	45
Tetbury	12/04932/OUT	Old Forge , Wisteria Farm, Hampton Street	1
Tetbury	12/03027/FUL	Land adjacent to 24 Cirencester Road	1
Tetbury	12/00180/FUL	Tetbury Youth and Community Centre, Chipping Street	6
Tetbury	13/02391/OUT	Highfield Farm	250
Tetbury	12/01792/OUT	Land parcel south of Quercus Road, Quercus Road (Matbro SIAC)	180
Tetbury	13/04451/REM	Land parcel south of Quercus Road	38
Tetbury	13/03759/FUL	Police House, Priory Way	3
Tetbury	14/01943/FUL	Wiltshire Bridge, Fox Hill, Tetbury	1
Tetbury Upton	02/02877/FUL 08/02496/COMPLY	Manor Farm, Doughton	2
Tetbury Upton	12/00705/FUL	Upton House	1
Todenham	14/02991/FUL	Todthatch	1
Upper Rissington	14/01418/FUL	The Firs, Avro Road	1
Upper Rissington	12/03810/REM	Land parcel at Upper Rissington	332
Upper Rissington	14/01403/OUT	Land adjacent South Gate Court	26
Upper Slaughter	13/05340/FUL	Apricot Cottage	-1
Westcote	12/02140/FUL	The Quarry, Nether Westcote	1
Weston Subedge	13/00164/FUL	Foxborough	1
Weston Subedge	13/01840/FUL	The Post Office	1
Weston Subedge	03/02858/FUL	Manor Farm	2
Whittington	12/02351/FUL	Dancers Cottage	1
Willersey	14/01880/FUL	Willersey Fields Farm, Badsey Lane	1
Willersey	13/05192/FIL	Rex House	1
Willersey	13/0512/FUL	1 The Long House, Main Street	1

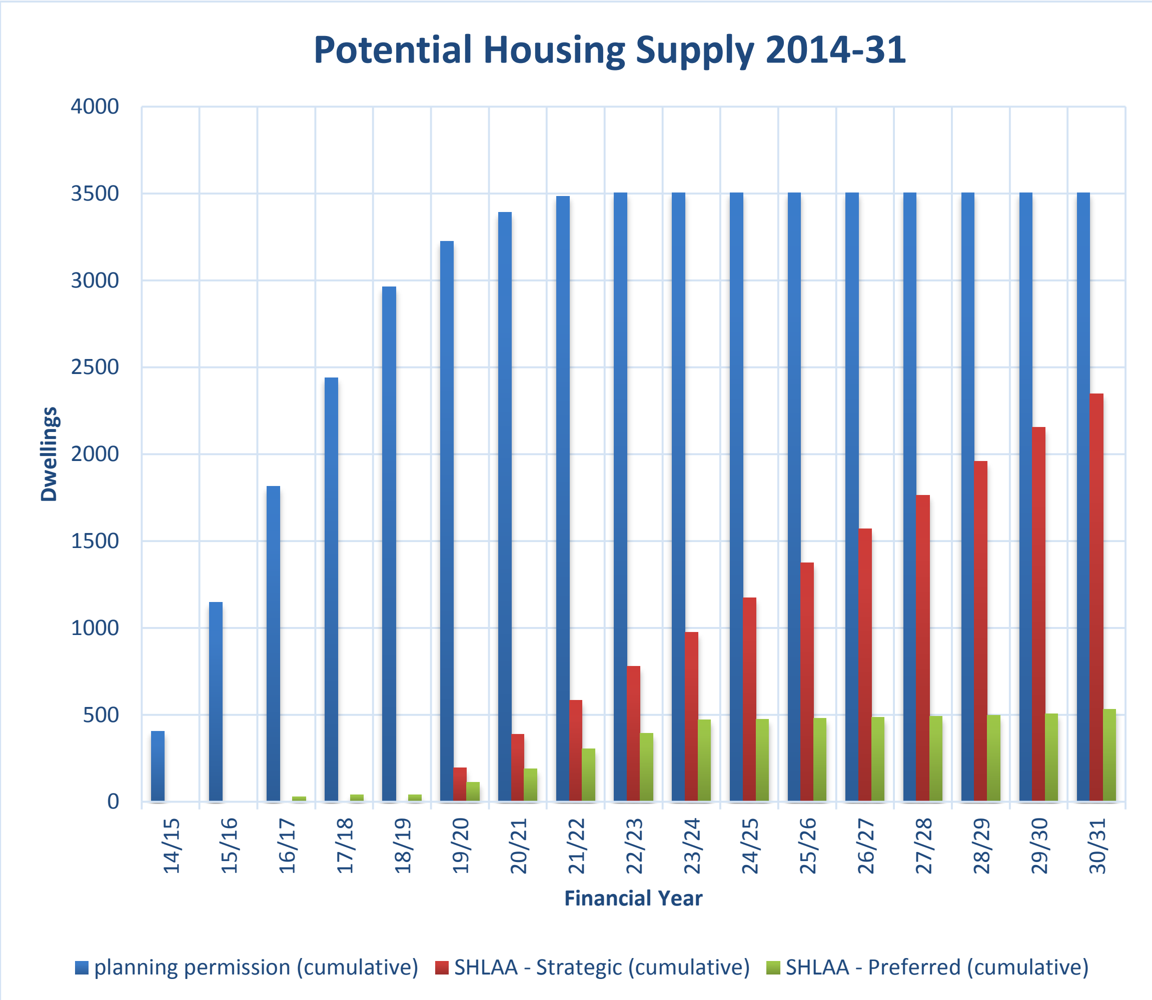
Parish	Planning Application Number	Site Name	Total Dwellings
Willersey	13/03975/FUL	Willersey Stores, Main Street	1
Windrush	13/02463/OUT	Filling Station on the A40, A40 Windrush Section	16
Withington	13/05245/FUL	Thorndale Farm	-2

Note: Sites with a negative total dwellings represent developments that will result in a net reduction of dwellings on that site.

Year-by-year projections of dwelling completions were supplied for all sites. Analysis of these indicates that sites already with planning consent will account for virtually all growth up to 2019/20, after which point the additions from sites with planning permission tail off and the contribution of future allocations start to take effect (see Figure 2-1). This is significant as it indicates that virtually all of the growth projected to be completed during the water industry's Asset Management Plan 6 (AMP6) period covering 2015 to 2020 already has planning permission and hence should have been reviewed and allowed for by the water companies.

The vast majority of growth from 2019/20 (3550 dwellings) would come from the single strategic site at Land at Chesterton Farm, Cirencester.

Figure 2-1: Potential housing supply 2014 to 2031



As site numbers and locations have evolved during the preparation of this Phase I Water Cycle Study, the following approach was taken to ensure that the assessments were robust but did not require unnecessary repetition with revised numbers:

- Where an assessment was initially undertaken using the SHLAA numbers and the conclusion indicated no significant concerns, so long as the number of dwellings for the revised (strategic, preferred and reserve) sites did not exceed the original SHLAA numbers, the assessment was not repeated.

- Elsewhere, the assessments were carried out (or repeated) initially using only the strategic and preferred sites.

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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 Planning 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 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 (SFRA) 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 (LLFAs) and Internal Drainage Boards (IDBs). 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:

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], Sequential Test[5] and when appropriate the Exception Test.

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 Cotswold District Council (2014) Strategic Flood Risk Assessment

5 Cotswold District Council (2014) Sequential Test

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

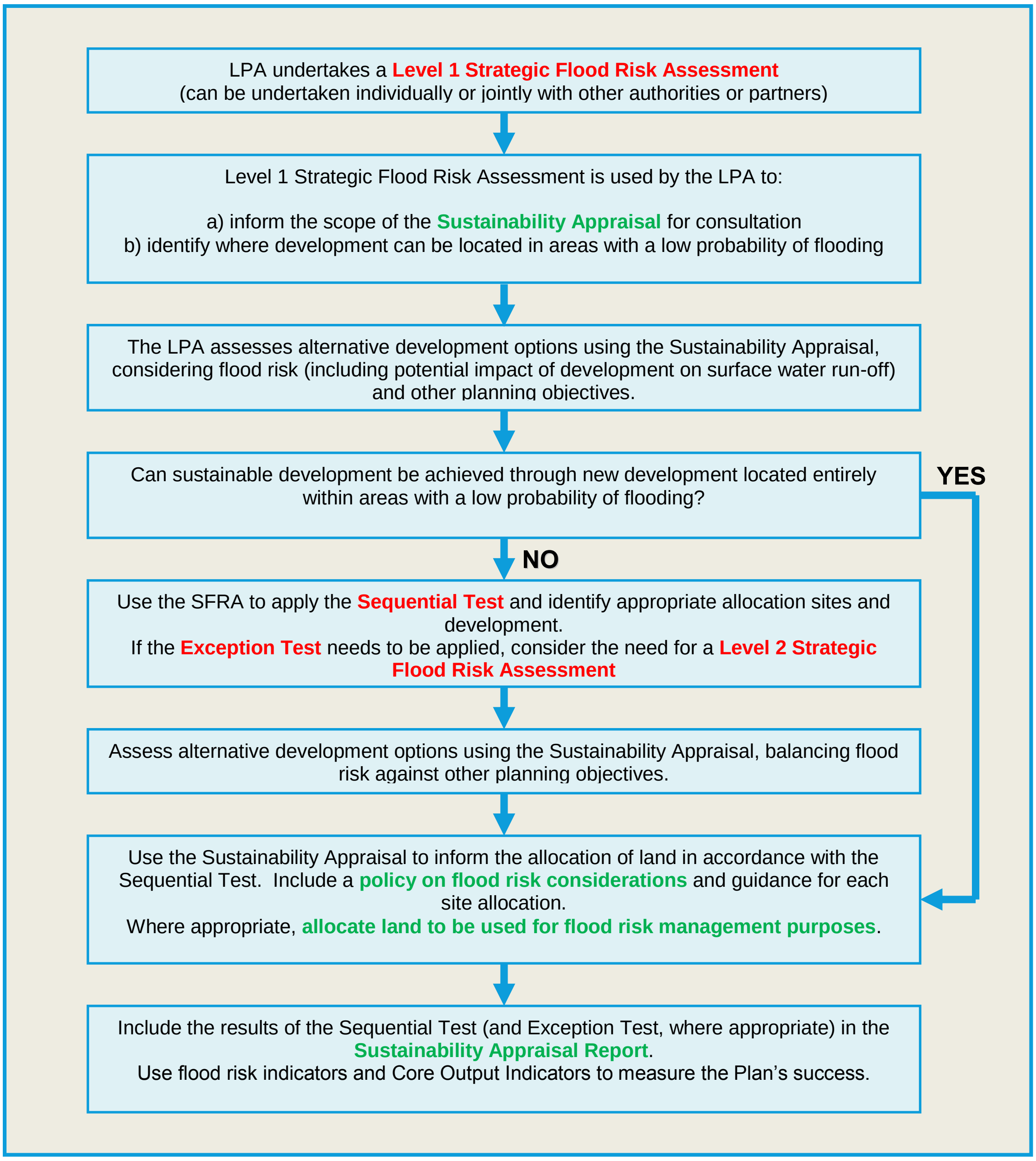

Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-021-20140306) March 2014

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 specific guidance issued on planning for water supply, wastewater and water quality issues.

The 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 on 14/08/2015.

- 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 plant 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.

Building Regulations and Code for Sustainable Homes

Part L of the Building Regulations requires that all new homes be designed to ensure that average per capita water consumption does not exceed 125 litres/person/day. Changes due to be introduced in October 2015 are expected to include an optional, more restrictive standard (110 litres/person/day) which can be set by local authorities in areas defined as water stressed. The definition of water stressed is being decided by Government.

Local authorities are not permitted to require higher standards than the above through planning policy. Cotswold District Council currently requires new developments to meet the Building Regulations G2 for Water Efficiency[10] which for new dwellings require "the potential consumption of wholesome water… must not exceed 125 litres per person per day."

The Code for Sustainable Homes (CfSH) was the Government's optional national standard for new housing, and was in place from 2007 to March 2015. The code included six star rating levels requiring increasingly stringent sustainability measures to be met, including for water consumption, ranging from 120l/person/day for 1 and 2 star to 80l/person/day for 5 and 6 stars. Whilst CfSH has now been withdrawn and will not apply to new allocations, it is still applied in some legacy cases, including where residential developments are legally contracted to apply a code policy (e.g. affordable housing funded through the National Affordable Housing Programme 2015 to 2018) and where planning permission has been granted subject to a condition stipulating discharge of a code level.

3.1.2 Sustainable Drainage Systems (SuDS)

From April 2015, Local Planning Authorities have been given the responsibility for ensuring through the planning system that sustainable drainage is implemented on developments of 10 or more homes or other forms of major development. This constitutes a significant change to the previous government policy that Schedule 3 of the Flood and Water Management Act (FWMA) would be enacted, requiring the establishment of a SuDS Approving Body (SAB) to be set up within Lead Local Flood Authorities (LLFAs).

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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.

10 Personal communication from AJ, Cotswold District Council, 08/07/2014.

Under the new arrangements established in April 2015, the key policy and standards relating to the application of SuDS to new developments are:

- National Planning Policy Framework which requires that development in areas already at risk of flooding should give priority to sustainable drainage systems.
- The House of Commons written statement[11] setting out the governments intentions that LPAs should "ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate" and "*clear arrangements in place for ongoing maintenance over the lifetime of the development.*" In practice this has been implemented by making Lead Local Flood Authorities (LLFAs) statutory consultees on the drainage arrangements of major developments.
- The Defra Non-statutory technical standards for sustainable drainage systems[12] These set out the government's high level requirements for managing peak flows and runoff volumes, flood risk from drainage systems and the structural integrity and construction of SuDS. This very short document is not a design manual and makes no reference to the other benefits of SuDS, for example water quality, habitat and amenity. Neither does it address adoption and maintenance.

Gloucestershire County Council (GCC) is the LLFA covering Cotswold District, and in response to its new role as a statutory consultee on drainage matters has issued guidance on what it expects to see in a Flood Risk Assessment (FRA) accompanying a major development[13]. GCC also has a detailed SuDS design guide[14] which includes its position on adoption and maintenance of SuDS. GCC Highways may adopt SuDS serving and located within the roads of a development, and will consider adopting SuDS within public open spaces.

Severn Trent Water[15], Thames Water[16] and Wessex Water[17] will currently only adopt storage tanks constructed of standard sewerage materials (concrete pipes and tanks) and will not adopt any other SuDS features.

SuDS features not adopted by GCC will need to be maintained by householders (in the case of SuDS on private land) and by management companies for other SuDS on public open spaces and highways.

3.1.3 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

11 Sustainable drainage systems: Written statement - HCWS161. Accessed online at http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/ on 14/08/2015.

12 Defra (2015) Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems

13 Gloucestershire County Council (2015) FRA Guidance: for Surface Water in all developments (excluding minor developments). Accessed online at http://www.gloucestershire.gov.uk/extra/CHttpHandler.ashx?id=63335&p=0 on 06/08/2015.

14 Gloucestershire County Council (2015) Gloucestershire SUDS Design and Maintenance Guide: Draft Report. Accessed online at http://www.gloucestershire.gov.uk/extra/CHttpHandler.ashx?id=63334&p=0 on 06/08/2015.

15 Severn Trent Water. Accessed online at http://www.stwater.co.uk/developers/application-forms-and-guidance-notes/ on 14/08/2015.

16 Thames Water (2012) Thames Water - Addendum to Sewers for Adoption 7th Edition. Access online at http://www.thameswater.co.uk/tw/common/downloads/your-business-developer-services/tw-addendum-to-sewers-for-adoption-7th-edition.pdf on 08/06/2015.

17 Wessex Water (2015) Sewer adoption – new sewers and pumping stations. Accessed online at https://www.wessexwater.co.uk/uploadedFiles/Main_Site/Developers/3553%20DEV011G_Sewer%20adoption.pdf on 06/08/2015.

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

Cotswold District Council is preparing a replacement Local Plan covering the period 2011 to 2031. The Council will be consulting on the draft Plan during 2015 and, following a further period of public consultation, intends to submit the document for Examination in 2016.

The Preferred Development Strategy[18] went to consultation in May 2013. It set out the following vision for the District:

Statement 1

VISION FOR COTSWOLD DISTRICT

By 2031 Cotswold District will be a place where the needs of all its residents are met within a network of sustainable, safe, socially balanced and inclusive, thriving, settlements, with access to services and facilities that meet residents' day-to-day needs. This will be within a high quality natural and built environment that supports the local economy, including tourism, and delivers housing (including affordable housing) which meets the needs of residents.

The towns, and larger villages will work together with their hinterlands to provide services and facilities for a sustainable future, meeting the needs of business, communities and visitors. Much of the planned change will occur in the main settlements to meet the needs of the existing and future residents, together with rural economies, to offer a diverse range of opportunities.

This will occur in an environment that adapts to climate change, avoids flood risk, promotes local food production and sustainable living. The character and quality of the area's outstanding natural, built and historic environment will be maintained and enhanced through the careful promotion of the economy, and safeguarding of the landscape, biodiversity and green infrastructure.

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

Table 3-1: Local Plan Strategic Objectives relevant to the Water Cycle Study

Strategic Objective	Aspects this WCS should contribute to:
B: Address environmental sustainability	• Designing new developments (including extensions and alterations) to minimise the use of water. • Designing new developments to ensure that they are capable of meeting the impacts of climate change, such as flooding, storm events, hotter weather etc.
G: Natural resources	• Ensuring that new developments are located in appropriate locations where they will not impact on biodiversity, landscape quality, ecosystems services (including areas that provide flood storage). • Protecting sites designated for their biodiversity value.

18 Cotswold District Council (2013) Local Plan Consultation Paper: Preferred Development Strategy. Accessed online at http://consult.cotswold.gov.uk/portal/fp/local_plan_2011-2031/development_strategy on 25/09/2014

Strategic Objective	Aspects this WCS should contribute to:
	• Allocating new developments so that flood risk is minimised for the development, as well as not exacerbating risk for surrounding areas. • Working with partners to plan for green infrastructure to enhance access to green (and water) spaces for leisure and recreation. • Improving air, soil and water quality.
H: Infrastructure	• Ensuring that new infrastructure is in place for new developments where and when it is needed. • Ensuring opportunities are utilised to enhance green infrastructure, including green and water corridors.

The consultation document also notes two issues where CDC needs to co-operate with other organisations, which are of relevance to the WCS:

- Restoration of the Thames and Severn Canal, linked with the Stroudwater Navigation, is an on-going cross-boundary project, which the Council will support, and work with partners and organisations to deliver. This includes the possibility of water transfer from Severn Trent to Thames Water via the canal route.
- The District Council will need to work with partners when addressing water resources, to ensure development proposals and their location do not adversely impact on future water provision and sewage treatment.

3.2.2 Infrastructure Delivery Plan

The purpose of the Infrastructure Delivery Plan (IDP) is to evaluate various services to determine if there is sufficient infrastructure to support the future levels of housing and employment in the District. The IDP presents sources of funding to assist in the delivery of infrastructure to help upgrade facilities, promote economic growth to ultimately increase the quality of life. The plan aims to sustainably develop towns and districts whilst maintaining a high quality environment.

The vision for the Cotswold District is to meet the needs of all the residents by creating safe, sustainable and socially balanced settlements, with sufficient services and facilities available. This plan is intended to apply to various areas throughout the district including Cirencester, Bourton-on-the-Water and Moreton-in-Marsh. The plan will also help support the local economy through tourism, whilst adapting to climate change by promoting food production and sustainable living along with reducing flood risks in order to safeguard the landscape. A development cost of up to £17,000 has been calculated to be required for each dwelling in the district[19] to make the appropriate contribution to the required infrastructure.

Cotswold District was affected by the 2007 floods, which affected in the order of 900 properties. Following this event flood risk management schemes have been undertaken to assess the local flood risk, investigating flooding incidents and developing emergency planning and flood recovery. Flood risk assessments are vital to understand the implications of new development as it is essential that new dwellings are not built on high risk flood areas, and do not increase the flood risk in other locations. Flood prevention measures have been implemented to previously affected areas, including highway drainage, repairing culverts, improving drainage systems and replacing drainage pipes.

The Environment Agency has provided flood maps which have indicated areas with significant flooding near to the River Churn and other areas prone to surface water flooding. Flood risk reassessments are currently being undertaken and this remains a high priority for the local council. However, the lack of maintenance funds needed for long term flood defences remain a concern for the area.

The wastewater companies in the district are currently in progress of reviewing the current demand and supply requirements for the future, and have proposed that the current sewer systems will be efficient with the proposed level of new development. There are a few exceptions to this that require an upgrade to the network in Cirencester, Upper Rissington,

19 Cotswold District Council (2013) Infrastructure Delivery Plan Arup: Bristol

Moreton-in-Marsh and Willersey. The companies also plan to reduce leakage, use water efficiently and utilise their resources and treatment capacity.

CDC anticipate that the IDP will be updated and will take into account the conclusions and recommendations of this study.

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 from urban wastewater treatment plants to sensitive areas which are subject to eutrophication. One or both parameters may be applied depending on the local situation. The values for concentration or for the percentage reduction shall apply. For specific information regarding concentration limits please refer to the UWWTD[20]. 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).
- 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 1,000 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. Cotswold District is covered by the Thames[21] and Severn District[22] 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

20 Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. Accessed online at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31991L0271 on 14/08/2015.

21 Environment Agency (2009) Thames River Basing Management Plan

22 Environment Agency (2009) Severn District River Basing Management Plan

- 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:

- 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 Abstraction Licensing 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.

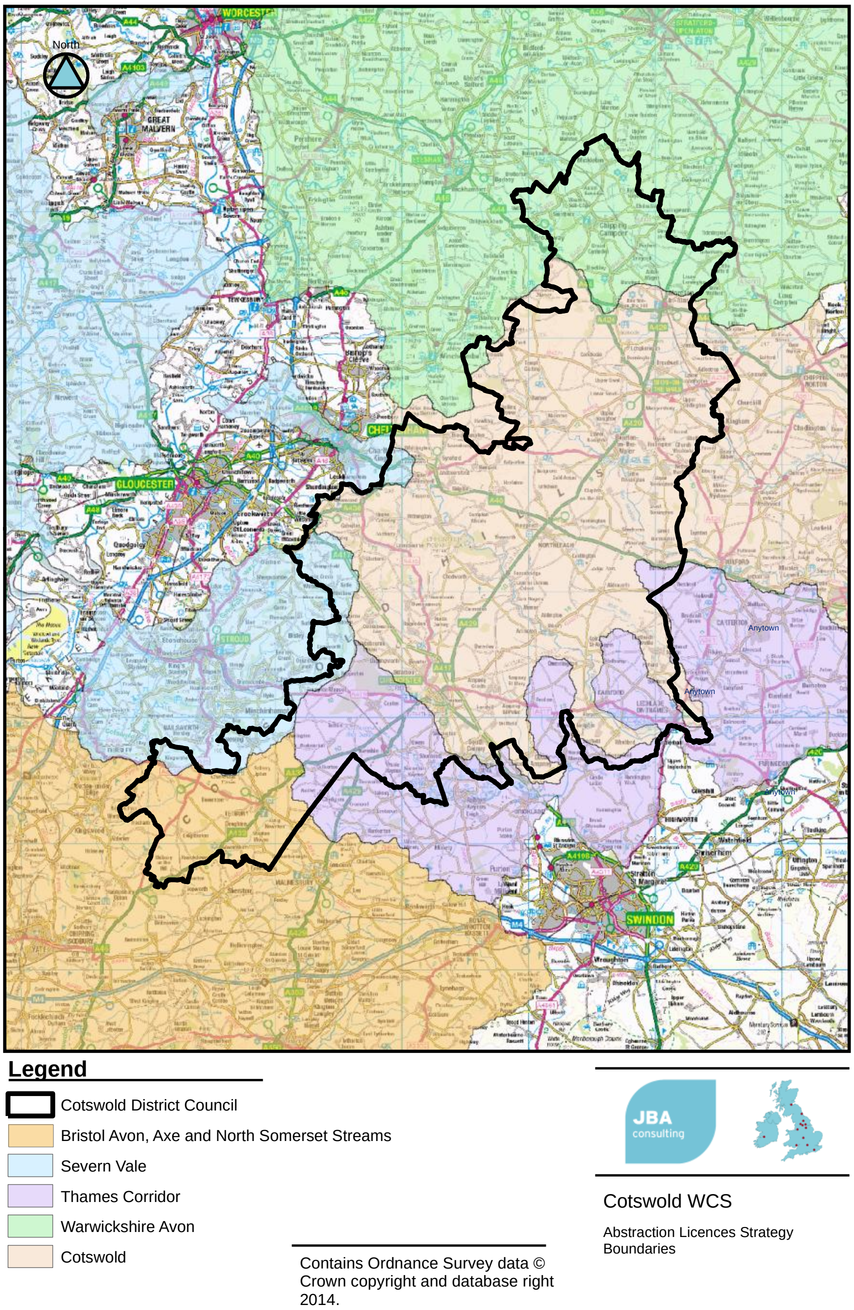
New and varied licences are normally time limited, which allows time for a periodic review of the area as circumstances may have changed since the licences were granted. These are generally given for a twelve year duration, but shorter or longer duration licences can be accepted. This is dependent on 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.[23]

The Cotswold District is covered by three CAMS areas; the Cotswolds, part of the Thames Corridor and the Warwickshire Avon, shown in Figure 3-2.

23 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: Abstraction Licences Strategy Boundaries for the Cotswold District



Cotswold District is covered by five ALSs, Cotswolds, Warwickshire Avon, Thames, Bristol Avon and the Severn Vale and consequently the abstraction licenses are slightly different 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.

3.3.4.1 Cotswold

Within the Cotswold region, the licence can alter between six to eighteen years dependent on the common end date, to avoid short duration licences. However, a short licence can be given if future impacts of abstractions are uncertain.

The majority of abstraction licences within this part of the district are for non-consumptive use, such as fishing and mineral works, which return the water used. The consumptive abstractions provide 90% of the local public water supply; however this consequently reduces the flow in the tributaries of the River Thames. The Thames' water level needs to be maintained by limiting the amount of abstraction through this area, by constraining new licences including a 'Hands Off Flow' (HOF). This prevents abstraction if the river level falls below an agreed threshold[24] .

The licences in place are presumed to be renewed, taking into account local considerations, which will apply stricter terms and conditions. The licences will be restored if the renewal criterion is met; if there is a continued need for abstraction, there is efficient water use and there is no environmental damage. The Cotswolds CAMS will have an end date of 31 March 2015 and 2027.

As there are abstraction restrictions due to the flow requirements in the Thames, this limits the water resource availability in the district. There are limited water resources available for future abstraction in low flow, but when the river flow is high, water will be available for licensing, particularly in the Q30 and Q50 circumstances. Groundwater abstractions will be permitted all year if there is no direct impact to the river flow, and the groundwater level remains the same.

3.3.4.2 Warwickshire Avon

In the Warwickshire Avon region, 10.5% of the licences are time limited and the next common end date will be on the 21 March 2025. These licences are renewed every twelve years and are likely to be renewed again if they fulfil the renewal criteria.

Across this catchment, the water resource strategies are driven by the need to protect the flows near the mouth of the River Severn at Deerhurst gauging station. A HOF has been set here, for flows equivalent or higher than 1800Ml/day. If other watercourses need further protection, the HOF has been set at a higher flow. There is water available for licensing in the thirtieth percentile (Q30), fiftieth percentile (Q50) and seventieth percentile (Q70) flows.

Groundwater is also available for licensing due to the small impact on the local surface water bodies, particularly at the Cotswold Northern edge, consisting of Jurassic Limestones. If this impact increases in the future, a HOF restriction will be applied[25].

3.3.4.3 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 due to a 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 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[26].

3.3.4.4 Bristol Avon, Axe and North Summerset Streams

In the Bristol region, the ALS has several time limited licences, with two expected to be renewed in 2015 and 2017. The subsequent common end dates have been granted for twelve years, with the earliest licence expiring in 2025, and the latest expiring in 2029. Abstractions are restricted in low flows, where a Minimum Residual Flow (MRF) may be applied to protect the river. In the circumstances of high flow, such as the Q30 and Q50, water is available for abstraction. There are also areas of groundwater available for abstraction, but this is only permitted if there is no impact to the surface flow.[27]

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24 Environment Agency (2012) Cotswolds Catchment Abstraction Licensing Strategy. Accessed online at https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process on 24/09/2014.

25 Environment Agency (2013) Warwickshire Avon Abstraction Licensing Strategy. Accessed online at https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process on 25/09/2014.

26 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.

27 Environment Agency (2012) Bristol Avon and North Summerset Streams WFD Management Area Abstraction Licensing Strategy. Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292758/LIT_7605_cbc33b.pdf on 26/09/2014.

3.3.4.5 Severn Vale

In the Severn Vale region, the majority of the demand for water comes from agriculture as well as the public water supply. The high use of agriculture has added water quality pressures to the licences due to fertilisers and sewage treatment discharges. The abstraction licences are based on a twelve year duration period, with the next licence expiring in 2015, followed by 2027 for the following licence. There are restricted water abstractions in both high and low flows particularly due to historic over abstractions. Groundwater abstractions have also been limited to protect the surface water and there are current licences that are reducing the annual abstractions to increase the surface water levels in the long term[28].

Table 3-2 summarises the resource availability at low flows around the district. The assessment points are also shown on Figure 3-2.

Table 3-2: Resource Availability for the Assessment Points within the Cotswold District

Assessment Point No.	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	Upper Churn	Cotswold	No water available for licensing	Q39	56	142	11.9	Cirencester	Thames Q50 HOF abstraction restricted to 182 days per annum
2	Lower Churn	Cotswold	No water available for licensing	Q56	51.6	204	3.7	Cerney Wick	Thames Q50 HOF abstraction restricted to 182 days per annum
3	Ampney Brook	Cotswold	No water available for licensing	Q66	24	240	2.3	Sheeppen Bridge	Thames Q50 HOF abstraction restricted to 182 days per annum
4	Upper Coln and unconfined Oolites	Cotswold	No water available for licensing	Q73	51.5	266	2.1	Bibury	Thames Q50 HOF abstraction restricted to 182 days per annum
5	Lower Coln	Cotswold	No water available for licensing	Q75	69.8	273	4.9	No	Thames Q50 HOF abstraction restricted to 182 days per annum
6	Leach	Cotswold	Water available for licensing	No local HOF		365	1	Leachlade	Thames Q50 HOF abstraction restricted to 182 days per annum
7	Upper Windrush and unconfined oolites	Cotswold	Restricted water available for licensing	Q89	46.6	324	4.4	Bourton on the Water	Thames Q50 HOF abstraction restricted to 182 days per annum
8	Alscot Park	Warwickshire Avon	Water available for licensing		34	263	4.5	Alscot Park	
9	Inglesham	Thames Corridor	No water available for licensing	Q21 at King		77	605	No	

28 Environment Agency (2013) Severn Vale Abstraction Licensing Strategy. Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291759/LIT_3254_9f2621.pdf on 26/09/2014.

Assessment Point No.	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)
				ston if <2 MLD					
10	Upper Little Avon at Damery Bridge	Bristol Avon, Axe and North Summer set Streams	Restricted water available for licensing	Q5	37		5	No	
11	Painswick Stream	Severn Vale	Restricted water available for licensing		260	110	20.6	No	

(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 is 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.

3.3.4.6 Recommendations for better management practices

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. 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 in both the quality and quantity of water, and consequently restricts the ability of a watercourse from achieving "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 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).

The Wessex Water and Severn Trent Water areas are designated as "Not Serious", although this does not mean that these companies do not need to consider how to manage and reduce water demand in their 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[29]. 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.

Every five years the industry submits a Business Plan to OfWAT for a Price Review (PR). These plans set out the company's 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 five years. In reality companies prepare regular 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

29 Water Industry Act 1991. Accessed online at http://www.legislation.gov.uk/ukpga/1991/56/contents on 14/08/2015.

- 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 WRMPs for Thames Water and Bristol Water are reviewed in section 4.1.3.

3.4.4 Developer contributions

Developments with planning permission have a right, under the Water Industry Act, to connect to the public water and sewerage systems with 21 days' notice. To best manage this process, water companies seek the support of local planning authorities to attach Grampian style planning conditions to any approvals. Where such conditions are attached this ensures that development does not outpace the delivery of infrastructure. Schedule 3 of the Floods and Water Management Act proposed to remove the automatic right to connect surface water to sewerage systems however this has yet to be enacted and uncertainty exists on if and when this will be put in place.

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 agreement, and Community Infrastructure Levy agreements may not be used to obtain funding for water or wastewater infrastructure.

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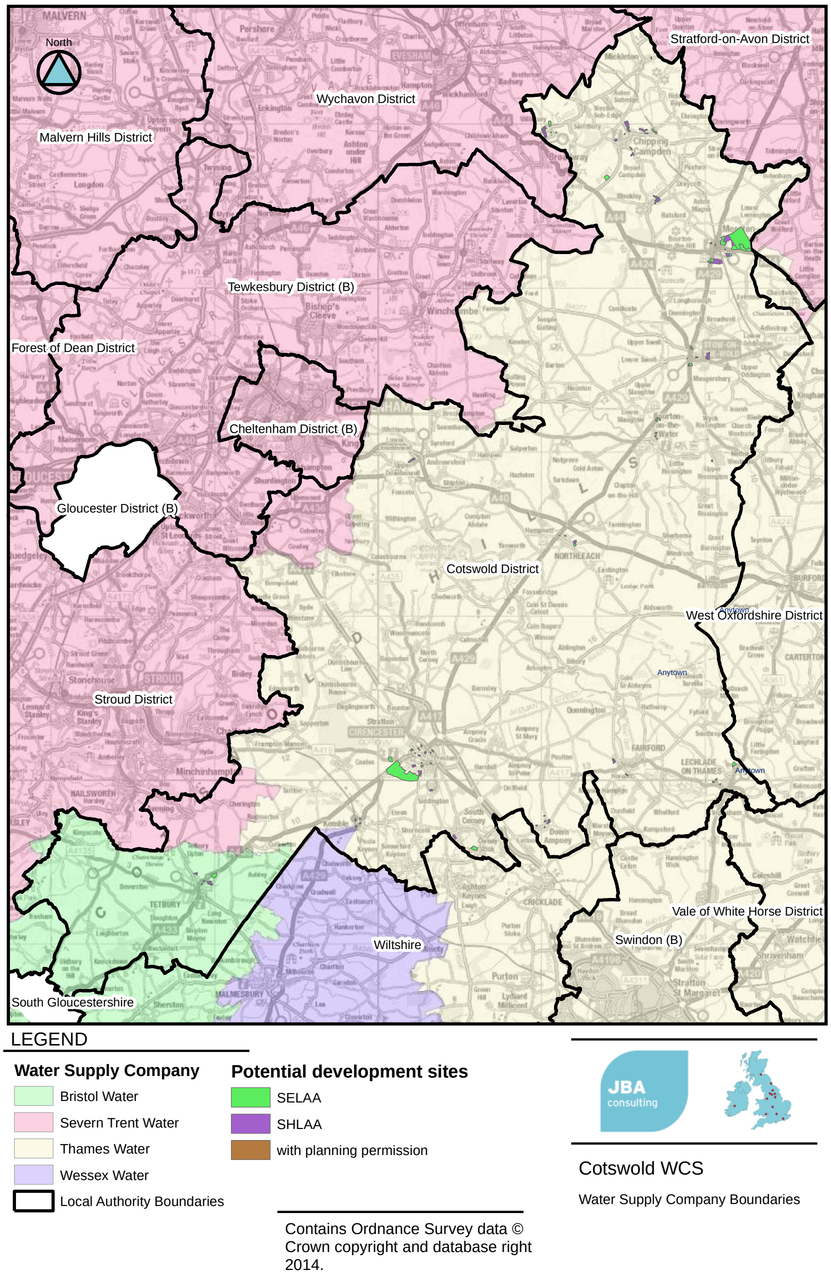
4 Water Resources and Water Supply

Thames Water (TWUL) is responsible for supplying water for most of the District, with small areas being served by Bristol Water (BW), Severn Trent Water (STWL) and Wessex Water (WW), as illustrated in Figure 4-1:

Figure 4-1: Water Supply Company Boundaries



The proposed development sites are within the supply zones of TWUL and Bristol Water; none are located within the supply zones of Severn Trent Water or Wessex Water.

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 CDC exceeds what TWUL and BW have 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 and BW Water Resource Management Plans (WRMPs) were 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.

4.1.2 Data collection

The datasets used to assess the water resource capacity were:

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

4.1.3 Results

Bristol Water

Bristol Water serves the south west of the District around the town of Tetbury. Following the Water Cycle Study request for information, Bristol Water made reference to their WRMP and provided the following response:

> "We have no issues with water supply or resource availability in the Tetbury zone on current planning totals. Where local distribution mains and minor services are required, these will be paid for by developer contributions."

The Water Resource Management Plan[30] predicts that the BW supply area will fall into a supply-demand deficit during AMP7 (2020-2025), primarily as a result of population growth and uncertainties due to climate change. BW proposes to address this initially through a programme of demand management measures including mains and customer-side leakage and promoting water efficiency. From 2023 the company are considering a number of supply-side improvements including bulk transfers, a reservoir and bringing back disused sources.

The WRMP contains the following headlines with respect to population and housing growth:

- Current projections for regional population and housing growth result will increase the demand for water by 15% by 2045.
- Sustained growth in population of 20% by 2040
- 30% growth in new housing over the same period.
- Cotswold District accounted for 0.7% or 3,310 of the 492,220 properties supplied by Bristol Water in 2011.

In order to identify whether there has been any significant change in predicted housing growth since the WRMP data was gathered, Table 4-1 summarises a comparison of WRMP and recent housing projections. A review of the planning websites of the four planning authorities with the largest numbers of dwellings in the Bristol Water area did not identify any more recent evidence for housing demand than that used by the Bristol Water WRMP.

30 Bristol Water (2014) Water Resources Management Plan 2014. Final.

Table 4-1: Comparison of Bristol Water WRMP projections with recent evidence

Local Planning Authority	Additional dwellings 2010/11 to 2025/26 (WRMP table p71)	Recent housing projections to 2030/31	Notes
City of Bristol	16856	x	No more recent information identified on Bristol City website. Core Strategy dated 2011, SHMA dated 2009.
North Somerset	9988	x	No more recent information identified on South Gloucestershire website. SHMA dated 2009.
South Gloucestershire	23449	x	No more recent information identified on North Somerset website. SHMA dated 2009.
Mendip	6840	x	No more recent information identified on Mendip website. SHMA dated 2009.
Bath and North East Somerset	5425		Not checked
Sedgemoor	2522		Not checked
Stroud	0		Not checked
Cotswold	483	825 (70 excluding sites with planning permission)	Site information provided by Cotswold District Council
Wiltshire	0		Not checked

Bristol Water have also provided this comment:

> "In our strategic plan, we used the ONS SNP for the portion of the Local Authority inside supply area to inform our plan… this calculated at that time to be approximately 480 properties to 2026. We note your latest revised projection of over 800 properties for the Tetbury area by 2026. This is unlikely to cause any issue with the strategic supply system or water availability, assuming the deployable output set out in our WRMP."

Severn Trent Water

The Severn Trent Water supply boundary covers small areas of Cotswold District including the villages of Avening, Cherington, Coberley and Cowley. There are no draft site allocations (either preferred or reserve) within this area and only 11 units with planning applications approved. Consequently there will be no significant change in demand for water supplied by Severn Trent Water within the District. Severn Trent Water's WRMP has not been reviewed.

Thames Water

Thames Water manage water resources in six Water Resource Zones (WRZs). Their Swindon and Oxfordshire (SWOX) zone covers the majority of Cotswold District, along with Swindon, north Wiltshire and the majority of Oxfordshire. The extents of the SWOX zone are illustrated in Figure 4-2.

TWUL Draft Water Resources Management Plan 2015-2040 (WRMP)[31] 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.

31 Thames Water (2014) Final Water Resource Management Plan 2015-2040, Accessed online at http://www.thameswater.co.uk/about-us/5392.htm on 23/06/2015

The SWOX zone was estimated to have a supply-demand credit of 26MLD in 2011, but is forecast to decline and to become a deficit of -21MLD by 2030 and -32MLD by 2040. Thames Water intends to address this through:

Short-term (2015-2020)

- Promotion of water efficiency activity to help customers use water wisely (direct response to the customer research findings) and promote behavioural change that will stem the underlying increase in water use in our baseline forecast. We will also undertake trials of innovative tariffs to inform the planned roll out across our water supply area commencing in 2022/23.

Medium to Long-term (2020-2040)

- Start rollout of 'full' meter penetration of household customers from 2020. Install 82,531 progressive household meters in the period 2020-30. Achieve total SWOX household meter penetration of 92.7% by 2030. We propose to use smart meter technology as this gives the best ratio of cost to benefit.
- Rollout innovative tariffs during 2020-2025 to promote water efficiency.
- Transfer from SWA (Slough, Wycombe & Aylesbury) WRZ.

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.

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

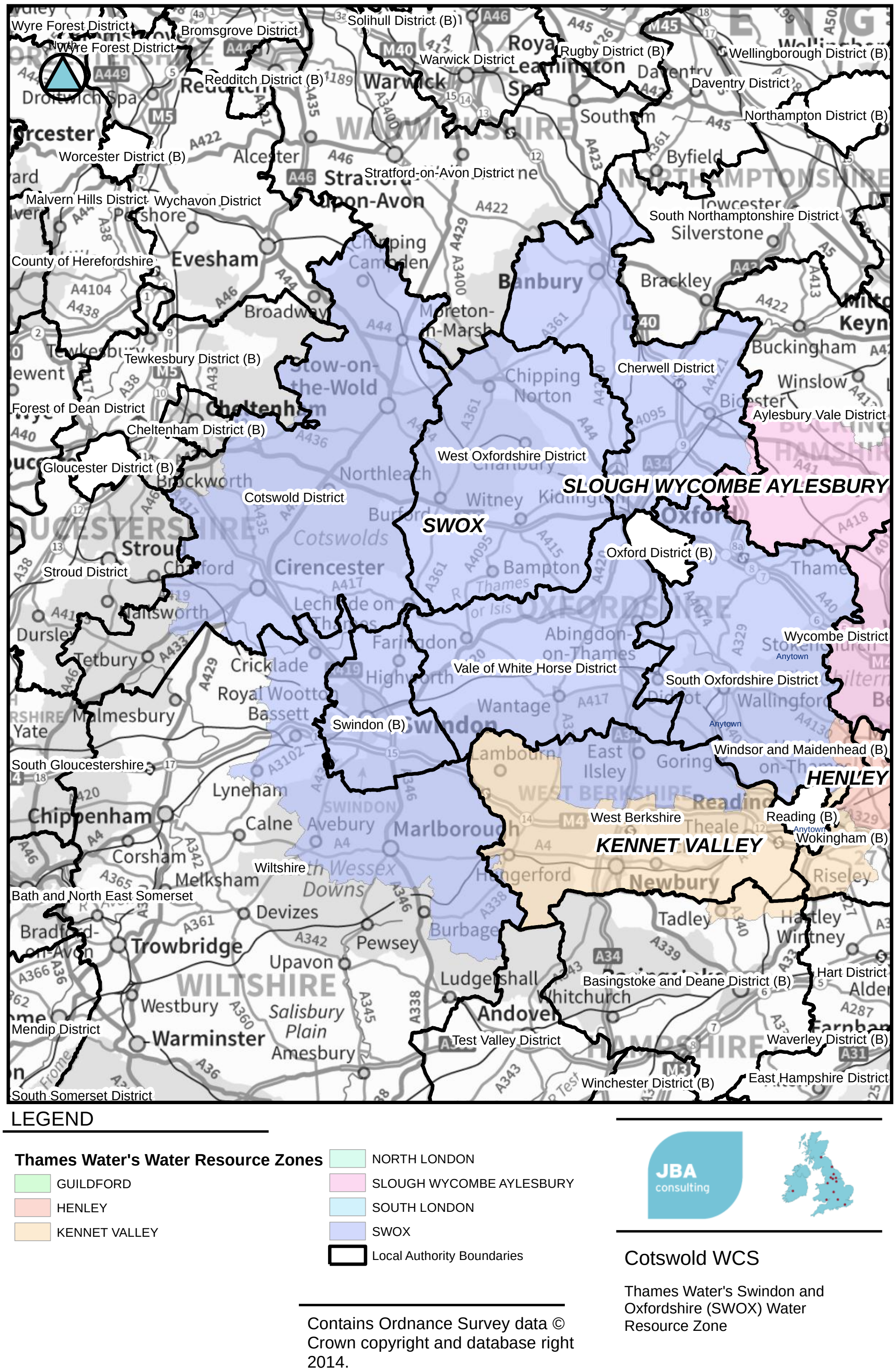
Thames Water selected to base both their population and property forecasts upon the Plan-based scenario and this was confirmed with the Environment Agency. The final growth forecasts are summarised below in Table 4-2.

Table 4-2: 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	478.0	459.9	441.8	421.6	402.3	383.8	363.2
	Measured	473.2	519.5	598.2	659.4	702.9	743.0	786.3
	Non Household	48.8	48.8	48.8	48.8	48.8	48.8	48.8
	Total	1000	1028.2	1088.8	1129.8	1154	1175.6	1198.3
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	393.5	419.8	442.5	456.9	469.4	482.3
Occupancy	Unmeasured	2.7	2.8	2.9	2.9	3.0	3.1	3.1
	Measured	2.3	2.2	2.2	2.2	2.2	2.2	2.2

In summary, the WRMP is based on a forecast of 77,900 additional properties in the SWOX zone between 2011/12 and 2029/30.

Figure 4-2: Thames Water's Swindon and Oxfordshire (SWOX) Water Resource Zone



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 4-3:

Table 4-3: 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/services-and-advice/planning-and-building/planning-policy/evidence-studies/strategic-housing-market-)
Swindon	22,000 (2011-26)	2012 pre-submission Local Plan (http://www.swindon.gov.uk/ep/ep-planning/planningpolicy/ep-planning-localdev/Documents/Local%20Plan%20Pre-Submission%20draft.pdf)
Cotswold District	7,600 (2011-31)	Local Plan Reg. 18 Consultation: Development Strategy and Site Allocations January 2015 (http://consult.cotswold.gov.uk/portal/fp/local_plan_2011-2031/lpr18/local_plan_reg_18_consultation_development_strategy_and_site_allocations_january_2015?pointId=s1413287433661#section-s1413287433661)
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 do not take constraints (including water resource constraints) into account. However, it is important to point out here that the projected growth rate for Cotswold District, at an average of 380 per annum, is not significantly different to the annual rate of housing provision from the now defunct 2006 South West Regional Spatial Strategy and the 2009 Gloucestershire and Districts Strategic Housing Market Assessment,[32] which was in place prior to preparation of the WRMP. It is possible that the significant increase in projections across the SWOX Zone is a result of changes made by other LPAs rather than by Cotswold District Council.

In response, Thames Water supplied an assessment of water resource and supply in Cotswold District[33]. In summary:

- Housing growth for the period 2015 to 2035 from the supplied site information (7,193 properties in Cotswold District) is significantly higher than that allowed for in the latest Water Resource Management Plan (5,266).
- From an overall water resources position, based on TWs forecast growth number, there remains sufficient water resources within the over Swindon Oxfordshire Water Resource Zone (WRZ).
- However the proposed increase in demand identified within the Cotswolds area 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.

Following discussion of these findings, it was agreed between Cotswold District Council, Thames Water and the Environment Agency that the WRMP makes adequate provision for the forecast growth in housing within Cotswold District and therefore water resources should not be considered to be a barrier to the planned growth in the District. The wider issue of an increase in the forecast demand within the SWOX zone is being addressed jointly by Thames Water and the Environment Agency. Initially this will focus on implementing and monitoring the impacts of demand management measures which are the focus for water resource management during AMP6 (2015-2020). In parallel, Thames Water continues to investigate the timing for future development of strategic new resources, which could include reservoirs and/or large-scale water recycling. Progress on this work will be published by Thames Water in its WRMP Annual Statements and in a Statement of Common Ground to be jointly prepared by CDC, EA and TWUL. Cotswold District Council will publish updates on delivering of planned development in

32 Gloucestershire County Council (2009) Strategic Housing Market Assessment

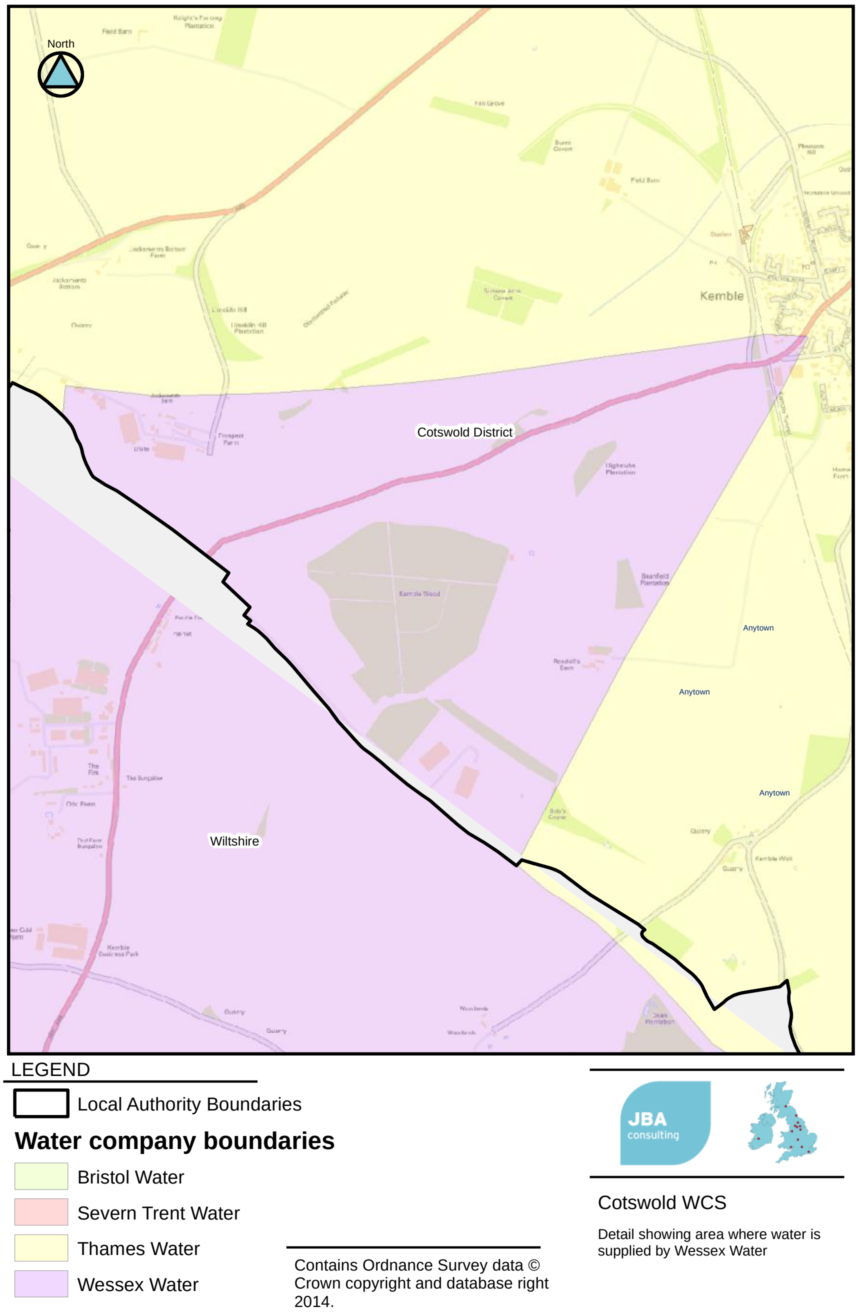
33 North Swindon / Cotswolds Supply/Demand and Development Review by Thames Water received 01/08/2014

its annual Authority Monitoring Report. Relevant Information will also be electronically available in revisions of other evidence documents such as the Strategic Housing Market Assessment (SHMA) and Strategic Housing Land Availability Assessment (SHLAA) which will also refer to any amendments to projected growth over the plan period. These reports should be monitored by the water companies to keep their records of forecast and actual housing growth up to date. Liaison with the Planning Authority's Forward Planning team is encouraged.

Wessex Water

The Wessex Water supply boundary covers a very small triangle of land within Cotswold District, to the south west of the village of Kemble (see Figure 4-3). There are no draft site allocations (either preferred or reserve) within this area. Consequently there will be no significant change in demand for water supplied by Wessex Water within the District. Wessex Water's WRMP has not been reviewed.

Figure 4-3: Detail showing area where water is supplied by Wessex Water



4.1.4 Conclusions

Table 4-4: Water resource summary

Parish	Assessment
All parishes supplied by Thames Water: Andoversford Blockley Bourton-on-the-Water Broad Campden Chipping Campden Cirencester Down Ampney Fairford Kemble Lechlade Mickleton Moreton-in-Marsh Northleach Siddington South Cerney Stow-on-the-Wold Upper Rissington Willersey	The WRMP makes adequate provision for the forecast growth in housing within Cotswold District and therefore water resources should not be considered to be a barrier to the planned growth in the District. The wider issue of an increase in the forecast demand within the SWOX zone is being addressed jointly by Thames Water and the Environment Agency. Progress on this work will be published by Thames Water in its WRMP Annual Statements and in a Statement of Common Ground to be jointly prepared by CDC, EA and TWUL.
Parishes supplied by Bristol Water: Tetbury	WRMP evidences that the planned increase in demand can be met

4.1.5 Recommendations

Table 4-5: Water resource actions

Action	Responsibility	Timescale
Take account of the updated housing growth projections across SWOX in the WRMP Annual Reviews.	TWUL	2015 and annually
Provide annual updates of projected housing growth to water companies via the Authority Monitoring Report	CDC and other LPAs in the SWOX zone	Annually
Require new developments to be designed to Building Regulations water consumption standard for water scarce areas (110 litres per person per day) Apply demand management measures as per Water Resource Management Plans	CDC	TBC - dependent on Local Plan timetable and the release of revised building regulations and their content.

4.2 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.

4.2.1 Methodology

TWUL and BW were provided with the list of sites including:

- the number of houses planned each year

- the population equivalent

TW and BW assessed each site using the different data sets they hold.

4.2.2 Data collection

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

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

4.2.3 Results

Bristol Water

Bristol Water serves the south west of the District around the town of Tetbury. Following the Water Cycle Study request for information, Bristol Water provided the following response:

> "We note your latest revised projection of over 800 properties for the Tetbury area by 2026. This is unlikely to cause any issue with the strategic supply system or water availability, assuming the deployable output set out in our WRMP. However, depending upon location and density, there are likely to be issues with the local distribution infrastructure. In these circumstances, it is usual for individual developers to contribute to whatever replacements or reinforcements may be required (if their project would cause the available capacity of the system to be exceeded or mean we could not maintain system levels of service)."

No further evidence has been supplied. However, working on the principle of the Water Cycle Study providing an opportunity for Bristol Water to indicate where infrastructure limitations exist or are predicted, it is concluded that there are no strategic water supply infrastructure constraints to serving the forecast growth in Cotswold District within the area supplied by Bristol Water.

Thames Water

Thames Water supplied an assessment of water resource and supply in Cotswold District. In summary:

- The overriding principal of water supply into the North Cotswolds is by bulk transfer from Latton water treatment works (WTW) near to Cricklade, supplemented by relatively low output, local abstraction and treatment at Baunton, Bibury, Syreford, Seven Springs, Upper Swell and Sheafhouse WTW's.
- Housing growth for the period 2015 to 2035 from the supplied site information (7,193 properties in Cotswold District) is significantly higher than that allowed for in the latest Water Resource Management Plan (5,266).
- 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. Latton WTW to Gloucester Road reservoir
    - b. Baunton WTW to Stowell Park reservoir
    - c. Stowell Park reservoir to Donnington reservoir
    - d. Stowell Park reservoir to Penhill reservoir
- Routes a, b and c are presently at, or are very close to, peak transfer capacity. Route d is also a concern but only serves Andoversford.

Thames Water's assessment of the water supply status is summarised below:

"Based on the current limitations on hydraulic capacity of the principal bulk transfer supplies into the north Swindon area, Thames Water have limited ability to support the proposed growth, with the exception of Down Ampney. This is primarily because all of the parish development (exception of Down Ampney) ultimately results in increased demand on the system within the south of the supply area, which is already at or very close to peak operating capability."

Thames Water has initiated a technical study to understand options to provide sufficient bulk and local transfer capacity, with any required solutions to be progressed through Thames Water's investment governance process for expected delivery within the early part of the AMP6 investment programme (during 2015 to 2020).

Thames Water has requested that until this study is complete, Cotswold District Council consider phasing development without current planning permission to beyond 2020. The Council currently is able to demonstrate a 5-year supply of deliverable housing sites. The effect of this is that none of the allocated (preferred) sites in the draft Local Plan are required to come forward prior to 2020. Consequently, although it is expected that infrastructure upgrades will be required to serve the planned growth within that part of the District served by Thames Water (with the exception of Down Ampney), there remains adequate time for this infrastructure to be delivered without restricting the timing, location or scale of planned development.

Measures to address supply to the strategic development at Cirencester are further progressed by Thames Water. This development accounts for over 80% of new housing to be allocated.

4.2.4 Conclusions

Table 4-6: Water supply and distribution summary

Parish	Assessment
Andoversford Blockley Bourton-on-the-Water Broad Campden Chipping Campden Cirencester Fairford Kemble Lechlade Mickleton Moreton-in-Marsh Northleach Siddington South Cerney Stow-on-the-Wold Upper Rissington Willersey	Further modelling will be required to determine the scale of the water supply infrastructure upgrades that may be needed. Whilst it is expected that infrastructure upgrades will be required to serve the planned growth within these settlements, there remains adequate time for this infrastructure to be delivered by Thames Water without restricting the timing, location or scale of planned development. Measures to address supply to the strategic development at Cirencester are further progressed by Thames Water. This development accounts for over 80% of new housing to be allocated.
Down Ampney Tetbury	Can accommodate the proposed site allocations without upgrades

Table 4-7 summarises for each parish the percentage of future growth due to sites with planning permission (committed development), strategic and preferred sites (draft allocations) and reserve sites (which may be required only if some preferred sites are later found to be undeliverable). The table highlights that for most settlements, the majority of growth over the period to 2030/31 already has planning permission. This is an important aspect to consider when using the assessment carried out by the water companies because, where the majority of the future growth already has planning permission, the Water Companies should already have commented on planning applications and where necessary planned to upgrade the water supply infrastructure during AMP6 (2015-20). In 6 of the 18 parishes, more than 60% of housing growth already has planning permission. Water companies have a duty to provide connection to the water supply network under the Water Industry Act 1991 Section 41[34].

Table 4-7: Percentage of future housing growth by Parish and current site status

Parish	Planning Permission	Preferred
Bristol Water		
Tetbury	96%	4%
Thames Water		
Andoversford	31%	69%
Blockley	6%	94%
Bourton-on-the-Water	96%	4%
Chipping Campden	28%	72%
Cirencester	12%	88%
Down Ampney	42%	58%
Fairford	100%	0%
Kemble	82%	18%
Lechlade	82%	18%
Mickleton	100%	0%
Moreton-in-Marsh	96%	4%
Northleach	0%	100%
Siddington	100%	0%
South Cerney	100%	0%
Stow-on-the-Wold	66%	34%
Upper Rissington	100%	0%
Willersey	5%	95%

4.2.5 Recommendations

Table 4-8: 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 CDC.	TWUL	2015 and beyond
Provide annual updates of projected housing growth to water companies via the Authority Monitoring Report	CDC	Annually
Seek early consultation with the water supplier in order to ensure adequate time is available to provide local distribution main upgrades to meet additional demand.	Developers	Ongoing

34 Water Industry Act 1991. Accessed online at http://www.legislation.gov.uk/ukpga/1991/56/section/41 on 14/08/2015.

5 Wastewater Collection and Treatment

Thames Water (TWUL) is the Sewerage Undertaker (SU) across most of the District, with areas around Chipping Campden and Avening being served by Severn Trent Water Limited (STWL) and the Tetbury area being served by Wessex Water (WW), as shown in Figure 5-1: Sewerage Undertaker Boundaries. 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 TWUL, 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 permitted effluent permits 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.

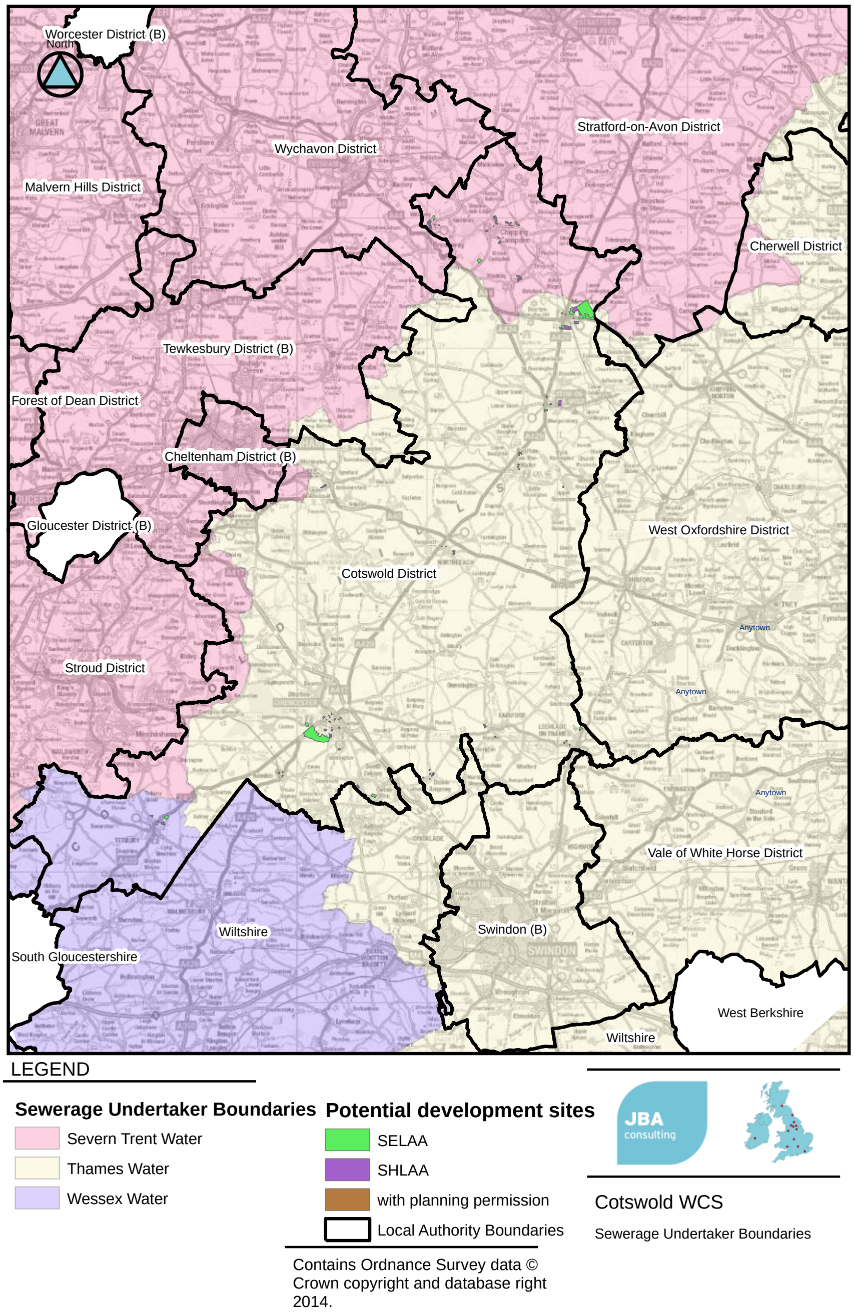
Sewerage undertakers must consider growth in demand for wastewater services when preparing their five-yearly Strategic Business Plans (SBPs) which set out investment for the next Asset Management Plan (AMP) period. Typically, investment is committed to provide new or upgraded sewerage capacity to support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

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

- Sites location in GIS format (provided by the CDC)
- Assign sites to a specific sewerage undertaker and WwTW. For small developments not with or adjacent to an existing sewered catchment area it was assumed that no public sewerage system is available and that wastewater collection and treatment on site using septic tanks or package plants would be necessary. These sites were not included within the assessment of sewerage system capacity.
- Number of planned houses for each year for each site (provided by the CDC)
- Occupancy rate, water demand and % of water that reach the WwTW (agreed with STWL, TWUL and WW)

Figure 5-1: Sewerage Undertaker Boundaries



5.1.2 Methodology

STWL, TWUL and WW were provided with the list of sites including:

- the number of houses planned each year
- the population equivalent
- the increase in dry weather flow

STWL, TWUL and WW assessed each site using the different data sets they hold including models, Drainage Area Plans (DAPs) and Sewerage Management Plans (SMPs).

5.1.3 Results

Severn Trent Water

STWL provided the following statement:

"Severn Trent Water has a general duty under section 94 (clauses 1a and 1b) of the Water Industry Act 1991:
(a) to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so to cleanse and maintain those sewers and any lateral drains which belong to or vest in the undertaker as to ensure that that area is and continues to be effectually drained; and
(b) to make provision for the emptying of those sewers and such further provision (whether inside its area or elsewhere) as is necessary from time to time for effectually dealing, by means of sewage disposal works or otherwise, with the contents of those sewers.
In effect, this places an absolute obligation upon Severn Trent Water to provide such additional capacity as may be required to treat additional flows and loads arising from new domestic development."

STWL undertook a desktop assessment of sites and WwTW catchments, taking into consideration issues such as size of the receiving sewers, known sewer flooding downstream, local topography and the presence of pumping stations downstream. STWL commented on existing or future capacity issues within the catchments. Where no issues were identified, their comments included the provisos that:

- surface water is managed sustainably (no surface water connected to foul or combined sewers), and
- hydraulic modelling is undertaken once a proposed point of connection to the wastewater system is established.

Thames Water

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.

Wessex Water

Wessex Water provided an assessment of each development site along with comments on the known capacity of the wastewater collection system.

5.1.4 Conclusions

Table 5-1: Sewerage system summary for preferred sites

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
Severn Trent Water	BLOCKLEY	There are no known downstream hydraulic flooding problems. Provided surface water is dealt with sustainably and foul only flows are connected into the network, subject to hydraulic modelling, from a desktop assessment of the area, these sites do not appear to cause any adverse impact on the downstream network capacity	BK_14A
			BK_5
			BK_8
	CHIPPING CAMPDEN	There is some known external flooding incidents near by the treatment works. Flows from these sites will impact on these. However, provided surface water flows are dealt with sustainably and foul only flows are connected into the network, these sites are not anticipated to cause any adverse impact on the downstream network (subject to hydraulic modelling).	CC_23B
			CC_23C
			CC_40

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
	HONEYBOURNE	There are known downstream external flooding incidents that flows from these sites could impact on. Flows from these sites will also pass through pumping stations where capacity could be limited. Hydraulic modelling is recommended in order to ascertain the impact of flows on the known external flooding incidents and to assess the capacity of the downstream pumping stations.	W_1A W_1B W_7A
Thames Water	AMPNEY ST PETER	Down Ampney is a very small village predominately served by 150mm foul water sewers transferring flow to the only public pumping station to the West of the village. From here flows are pumped 4km to Ampney St Peter STW. Due to the length of the rising main it is likely any development site over 10 units will require some form of local upgrade or onsite storage to hold back flows. Ampney St Peter STW has recently been upgraded to cope with all proposed development.	DA_2 DA_5A DA_5C DA_8
Thames Water	ANDOVERSFORD	Andoversford Village is predominately served by 150mm foul water sewers transferring flow to the only public pumping station in the centre of the village. The pumping station pumps all the flows 1km North to Andoversford sewage treatment works. The sewage treatment works and the pumping station have recently been upgraded to handle additional flows. The STW could cope with the proposed development up to 50 dwellings however it is likely flows from development sites larger than 10 dwellings may require the local network and pumping station to be upgraded further.	A_2 A_3A
Thames Water	BOURTON ON THE WATER	There are 6 public pumping stations within Bourton-on-the-water. 5 of these end up pumping flows from the west towards the east end of the village to the final pumping station (Bourton-on-the-water SPS) which pumps the majority of flows from Bourton to Bourton-on-the-water WwTW. Development sites over 10 units may likely require some form of local network upgrade (attenuation or upsizing) to handle the additional flows. Larger strategic upgrades will be required on sites larger than 100 units, the current infrastructure will unlikely handle the flows without the need for new assets. The WwTW is currently part of the AMP6 programme for upgrade to cater for all development up to 2026, however this is yet to be approved by our regulator, OFWAT.	B_20
Thames Water	BROADWELL	There is one small pumping station to the west however all the flows gravitates eastwards towards Broadwell WwTW. There is currently a hydraulic incapacity at a downstream section in Stow-on-the-Wold which causes property flooding. Any development over 5 units may have a detrimental impact and therefore require local improvements to offset the impact. Larger sites (40+) may need to bypass the flooding or require larger infrastructure improvements. Broadwell WwTW upgrade almost completed. This will have the capacity to treat additional flows from the proposed development sites.	S_8A

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		There is one small pumping station to the west however all the flows gravitates eastwards towards Broadwell WwTW. There is currently a hydraulic incapacity at a downstream section in Stow-on-the-Wold which causes property flooding. Any development over 5 units may have a detrimental impact and therefore require local improvements to offset the impact. Larger sites (40+) may need to bypass the flooding or require larger infrastructure improvements. Broadwell WwTW upgrade almost completed. This will have the capacity to treat additional flows from the proposed development sites.	S_46
	CIRENCESTER	Cirencester runs within the churn valley and therefore has very few pumping stations. The network runs from North to South towards Cirencester WwTW. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 10 dwellings will likely have an impact or be impacted by this issue. We are currently putting together an Infiltration reduction plan however until we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The WwTW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	C_101A C_17 C_39
		A small village which drains via 2 pumping stations to Cirencester STW. The scale of sewage infrastructure is in line with the scale of the village and therefore any development sites over 10 dwellings is likely to require local network improvements, particularly around Ewen pumping station. Development sites 50 dwellings or over may require catchment solutions to handle the additional flow. Cirencester WwTW has recently been upgraded to handle all proposed development.	K_2
		Cirencester runs within the churn valley and therefore has very few pumping stations. The network runs from North to South towards Cirencester WwTW. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 10 dwellings will likely have an impact or be impacted by this issue. We are currently putting together an Infiltration reduction plan however until we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The WwTW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	C_97
		Cirencester runs within the churn valley and therefore has very few pumping stations. The network runs from North to South towards Cirencester WwTW. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 10 dwellings will likely have an impact or be impacted by this issue.	C_75

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		We are currently putting together an Infiltration reduction plan however until we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The WwTW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	
	LECHLADE	Lechlade has 5 public pumping stations which mainly lift flows from more modern housing estates towards 1 terminal pumping station to the South. From here flows are pumped direct to Lechlade WwTW to the East of the village. Development sites in the region of 30 units will likely require local network improvements, while anything over 70-80 may require larger capital schemes. Lechlade WwTW is currently in our draft business plan which was submitted to OfWAT in December 2013. We will not know the outcome of this submission until the end of 2014. Lechlade STW is nearing its theoretical treatment capacity. All development sites coming forwards through the planning process will be assessed in detail to understand the impact on both the network and the treatment works. The latest model for Lechlade WwTW allows for approximately 5-10% growth to 2026, this indicates the site would requirement upgrades. 20% additional population would likely mean further upgrades.	L_18B L_19
	MORETON-IN-MARSH	There are 5 small public pumping stations in Moreton-in-Marsh, leading to one larger terminal station (Primrose Court SPS) in the centre of the village. All flows received at Moreton in Marsh STW come from Primrose Court. Development sites can be accepted up to 100 units with local improvements, over this they are unlikely to work and a strategic upgrade may be required (or pump direct to the WwTW). We are currently in the progress of studying the catchment to understand long term how we should manage the network for all the proposed growth. Moreton in the Marsh WwTW has been assessed against previous levels of proposed growth which it can accept in the next 5 years without the need for an upgrade, however some of the new larger sites will need to be included in the process model to assess headroom and if upgrades need to happen sooner. This will be done over the next couple of months.	M_60
	NORTHLEACH	Northleach is served by 1 pumping station which transfers all the flows to Northleach WwTW to the East. Development over 15 units is likely to have an impact of the network which is nearing capacity. Sites larger than 60 units may need larger improvements or pump direct to the WwTW. The WwTW is currently being modelled to understand its performance and remaining	N_13B

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		headroom. This is expected within 3 months.	
		Northleach is served by 1 pumping station which transfers all the flows to Northleach WwTW to the East. Development over 15 units is likely to have an impact of the network which is nearing capacity. Sites larger than 60 units may need larger improvements or pump direct to the WwTW. The WwTW is currently being modelled to understand its performance and remaining headroom. This is expected within 3 months.	N_14B
			N_1A
Wessex Water	TETBURY	Marginal increase in flows - local capacity available	T_24B
			T_51

Table 5-2: Sewerage system summary for reserve sites

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
Severn Trent Water	BLOCKLEY	There are no known downstream hydraulic flooding problems. Provided surface water is dealt with sustainably and foul only flows are connected into the network, subject to hydraulic modelling, from a desktop assessment of the area, these sites do not appear to cause any adverse impact on the downstream network capacity	BK_11
	CHIPPING CAMPDEN	There is some known external flooding incidents near by the treatment works. Flows from these sites will impact on these. However, provided surface water flows are dealt with sustainably and foul only flows are connected into the network, these sites are not anticipated to cause any adverse impact on the downstream network (subject to hydraulic modelling).	CC_23E
			CC_38A
			CC_41
			CC_48
	HONEYBOURNE	There is one known external flooding incident downstream of this location. However, due to the size of the site and the expected volume of foul only flows, it is not anticipated that it would exacerbate the situation. Provided surface water is dealt with sustainably and foul only flows are connected into the network, subject to hydraulic modelling, it is not anticipated that this site will have an adverse impact on the downstream network capacity.	MK_4
		There are known downstream external flooding incidents that flows from these sites could impact on. Flows from these sites will also pass through pumping stations where capacity could be limited. Hydraulic modelling is recommended in order to ascertain the impact of flows on the known external flooding incidents and to assess the capacity of the downstream pumping stations.	W_5
Thames Water	BOURTON ON THE WATER	Andoversford Village is predominately served by 150mm foul water sewers transferring flow to the only public pumping station in the centre of the village. The pumping station pumps all the flows 1km North to Andoversford sewage treatment works. The sewage treatment works and the pumping station have recently been upgraded to handle additional flows. The STW could cope with the proposed development up to 50 dwellings however it is likely flows from development sites	B_32

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		larger than 10 dwellings may require the local network and pumping station to be upgraded further.	
	BROADWELL	There is one small pumping station to the west however all the flows gravitates eastwards towards Broadwell STW. There is currently a hydraulic incapacity at a downstream section in Stow-on-the-Wold which causes property flooding. Any development over 5 units may have a detrimental impact and therefore require local improvements to offset the impact. Larger sites (40+) may need to bypass the flooding or require larger infrastructure improvements. Broadwell STW upgrade almost completed. This will have the capacity to treat additional flows from the proposed development sites.	S_20
	CIRENCESTER	Cirencester runs within the churn valley and therefore has very few pumping stations. The network runs from North to South towards Cirencester STW. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 10 dwellings will likely have an impact or be impacted by this issue. We are currently putting together an Infiltration reduction plan however until we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The STW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	C_76
		A small village which drains via 2 pumping stations to Cirencester STW. The scale of sewage infrastructure is in line with the scale of the village and therefore any development sites over 10 dwellings is likely to require local network improvements, particularly around Ewen pumping station. Development sites 50 dwellings or over may require catchment solutions to handle the additional flow. Cirencester STW has recently been upgraded to handle all proposed development.	K_1B K_5
		Cirencester runs within the churn valley and therefore has very few pumping stations. The network runs from North to South towards Cirencester STW. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 10 dwellings will likely have an impact or be impacted by this issue. We are currently putting together an Infiltration reduction plan however until we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The STW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	C_82
		South Cerney has 5 public pumping stations with many more private stations. They all pump towards Station Road pumping station which then pumps direct to Cirencester STW to the West. The network suffers from large volumes of unplanned flows/infiltration and therefore any development over 5 dwellings may have an impact or be impacted by this issue. We are currently putting together an Infiltration reduction plan however until	SC_13A

Sewer-age Under-taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		we fully understand the extent and scale of the problems in the area we will raise drainage concerns when consulted. The STW has recently been upgraded to handle the large amounts current flow and all the proposed sites listed.	
	FAIRFORD	Fairford has 2 terminal pumping stations that pump flow from the west (Horcott SPS) and from the North (Moor Farm SPS) towards Fairford STW to the South. Development sites greater than 15 units are likely to require local network improvements and sites larger than 40 may require catchment improvements downstream towards the pumping stations as they are nearing capacity. Fairford STW limited spare capacity without the need for an upgrade. The sites proposed may require minor improvements to the works in the interim, further proposed development (in the region of 50-100 units) may trigger the need for larger upgrades at the STW.	F_44
		Fairford has 2 terminal pumping stations that pump flow from the west (Horcott SPS) and from the North (Moor Farm SPS) towards Fairford STW to the South. Development sites greater than 15 units are likely to require local network improvements and sites larger than 40 may require catchment improvements downstream towards the pumping stations as they are nearing capacity. Fairford STW limited spare capacity without the need for an upgrade. The sites proposed may require minor improvements to the works in the interim, further proposed development (in the region of 50-100 units) may trigger the need for larger upgrades at the STW.	F_35B
	MORETON-IN-MARSH	There are 5 small public pumping stations in Moreton-in-Marsh, leading to one larger terminal station (Primrose Court SPS) in the centre of the village. All flows received at Moreton in Marsh STW come from Primrose Court. Development sites can be accepted up to 100 units with local improvements, over this they are unlikely to work and a strategic upgrade may be required (or pump direct to the STW). We are currently in the progress of studying the catchment to understand long term how we should manage the network for all the proposed growth. Moreton in the Marsh STW has been assessed against previous levels of proposed growth which it can accept in the next 5 years without the need for an upgrade, however some of the new larger sites will need to be included in the process model to assess headroom and if upgrades need to happen sooner. This will be done over the next couple of months.	M_12A
		There are 5 small public pumping stations in Moreton-in-Marsh, leading to one larger terminal station (Primrose Court SPS) in the centre of the village. All flows received at Moreton in Marsh STW come from Primrose Court. Development sites can be accepted up to 100 units with local improvements, over this they are unlikely to work and a strategic upgrade may be required (or pump direct to the STW). We are currently in the progress of studying the catchment to understand long term how we should manage the network for all the proposed growth. Moreton-in-Marsh STW	M_19A M_19B

Sewer -age Under -taker	Receiving WwTW	Sewerage Undertaker comment on sewerage infrastructure assessment	Site
		has been assessed against previous levels of proposed growth which it can accept in the next 5 years without the need for an upgrade, however some of the new larger sites will need to be included in the process model to assess headroom and if upgrades need to happen sooner. This will be done over the next couple of months.	
Wessex Water	TETBURY	Downstream capacity restrictions may require local improvements	T_31B

Table 5-3 summarises for each WwTW the percentage of future growth due to sites with planning permission (committed development), strategic and preferred sites (draft allocations) and reserve sites (which may be required only if some preferred sites are later found to be undeliverable). The table highlights that for most WwTWs, the majority of growth over the period to 2030/31 already has planning permission. This is an important aspect to consider when using the assessment carried out by the water companies because, where the majority of the future growth already has planning permission, the Water Companies should already have commented on planning applications and where necessary planned to upgrade the sewerage infrastructure during AMP6 (2015-20). As an example, the assessment for Fairford reports that an upgrade is needed in order to accommodate the future growth. Because 91% of growth to 2031 already has planning permission this should have already been accounted for and if necessary growth built into the AMP6 business plan. The Water Industry Act 1991 – Section 106[35] states that the developer has the right to connect to the sewer system. Furthermore, as identified in section 4.1.3, the annual housing growth trajectory for Cotswold District has remained virtually unchanged since 2006.

In summary, the majority of future growth within the District already has planning permission. However, except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption or requisition from a developer. Early developer engagement with water companies is therefore essential to ensure that sewerage capacity can be provided without delaying development.

35 Water Industry Act 1991. Accessed online at http://www.legislation.gov.uk/ukpga/1991/56/section/106 on 14/08/2015.

Table 5-3: Percentage of future housing growth by WwTW catchment and current site status

WwTW	Planning Permission	Preferred
Severn Trent Water		
Blockley	15%	85%
Chipping Campden	28%	72%
Honeybourne	67%	33%
Thames Water		
Ampney St Peter	45%	55%
Andoversford	38%	63%
Bourton on the Water	98%	2%
Broadwell	69%	31%
Cirencester	20%	80%
Fairford	100%	0%
Lechlade	82%	18%
Moreton-in-Marsh	96%	4%
Northleach	16%	84%
Wessex Water		
Tetbury	96%	4%

5.1.5 Recommendations

Table 5-4: Sewerage system actions

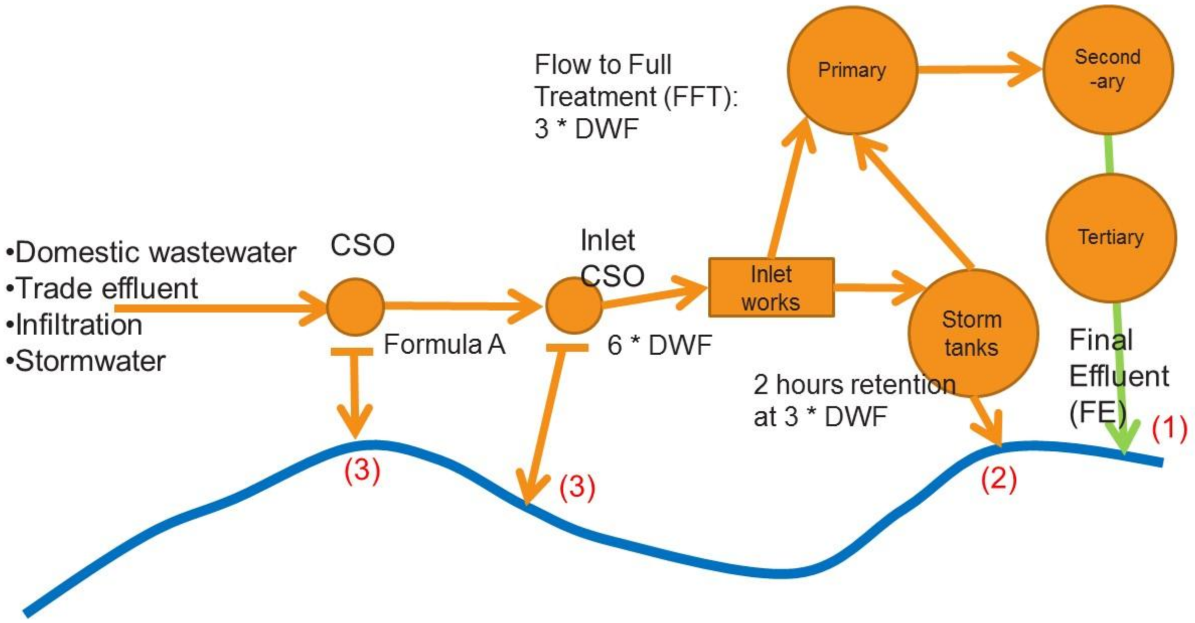
Action	Responsibility	Timescale
Provide annual updates of projected housing growth to water companies via the Authority Monitoring Report	CDC	Annually
Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to CDC where concerns over the timing of development arise.	STWL, TWUL, WW	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 permit assessment

The EA is responsible for regulating sewage discharge releases via a system of Environmental Permits. Monitoring for compliance with these permits is the responsibility of both the EA and the plant operators. Figure 5-2 summarises the different types of WwTW release 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 5-2: Overview of typical combined sewerage system and sewage treatment works discharges



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 permits. As a works operates closer to its capacity the quality of treated effluent may decline, leading the works to breach its quality permits.

5.2.1 Methodology

The sewerage undertakers were provided with the total extra flow due to the future developments for each WwTW.

The extra flow has been calculated by:

- Grouping the sites that are served by the same WwTW using the sewerage drainage area boundaries. For small developments not with or adjacent to an existing sewered catchment area it was assumed that no public sewerage system is available and that wastewater collection and treatment on site using septic tanks or package plants would be necessary. These sites were not included within the assessment of WwTW capacity.
- 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 reach 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 CDC)
- Number of planned houses for each year for each site (provided by the CDC)
- Sewerage drainage area boundaries (provided by STWL, TWUL and WW)

- Occupancy rate, water demand and % of water that reach the WwTW (agreed with STWL, TWUL and WW)

5.2.3 Results

Severn Trent Water

STWL provided the following statement:

> "Severn Trent Water is also under a legal duty to comply with its sewage treatment works discharge permits, issued by the Environment Agency under the Water Resources Act 1991 (as amended by the Environment Act 1995 and the Environmental Permitting Regulations of 2010). Should we be in a position of being unable to comply with a permit to discharge as a consequence of growth within the sewerage catchment, we are obliged to remedy the situation using our own resources.
>
> The current position with regards to spare capacity isn't therefore a material consideration. If additional capacity is required to cater for the development, we will provide it, and cater for any permit changes as issued by the EA (in the event that DWF permit is exceeded"

STWL have provided an assessment and comments on each of their WwTWs that could receive additional flows due to growth in Cotswold District. The assessment was limited to addressing the flow permit - the potential for a separate breach of quality permits has not been considered.

STWL has also commented on the availability of space on WwTW sites should the works require upgrading in the future.

Thames Water

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 Cotswold District. The model assesses the current and future status of the flow and quality permits at each works. The assessment was undertaken using growth figures up to 2021.

Wessex Water

Wessex Water provided an assessment and the following comment for Tetbury WwTW: "Hydraulic capacity available for plan period. Permit changes for P (phosphate) removal planned between 2020 - 2025."

5.2.4 Conclusions

Table 5-5: Wastewater treatment works flow and quality permit summary

Sewerage Undertaker	Receiving WwTW	Comment on WwTW capacity assessment
Severn Trent Water	BLOCKLEY	Comparison of current measured dry weather flow against the permitted dry weather flow indicates there is reasonable spare capacity at this treatment works. Should additional treatment capacity be required in order to accommodate future development above the existing capacity then we do not envisage any issues as there are no land or other physical constraints preventing expansion.

Sewerage Undertaker	Receiving WwTW	Comment on WwTW capacity assessment
	CHIPPING CAMPDEN	Comparison of current measured dry weather flow against the permitted dry weather flow indicates there is reasonable spare capacity at this treatment works. Should additional treatment capacity be required in order to accommodate future development above the existing capacity then we do not envisage any issues as there are no land or other physical constraints preventing expansion
	HONEYBOURNE	Comparison of current measured dry weather flow against the permitted dry weather flow indicates there is reasonable spare capacity at this treatment works. Should additional treatment capacity be required in order to accommodate future development above the existing capacity then we do not envisage any issues as there are no land or other physical constraints preventing expansion.
Thames Water	AMPNEY ST PETER	Can accommodate the proposed site allocation without upgrades
	ANDOVERSFORD	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit on its Ammonia permit by 2034.
	BOURTON ON THE WATER	Further modelling will be required to determine the scale of the WwTW upgrades that may be needed. Capacity can be provided given sufficient time to implement upgrades. Predicted to fail on Ammonia permit by 2021.
	BROADWELL	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit on its Ammonia permit by 2021.
	CIRENCESTER	Can accommodate the proposed site allocation without upgrades
	FAIRFORD	Further modelling will be required to determine the scale of the WwTW upgrades that may be needed. Capacity can be provided given sufficient time to implement upgrades. Predicted to fail on BOD and Ammonia permits by 2021.
	LECHLADE	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit for Ammonia by 2034.
	MORETON-IN-MARSH	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit for Flow by 2021. However this is predicted to improve by 2034 as per capita water consumption is predicted to decrease.
	NORTHLEACH	Can accommodate the proposed site allocation without upgrades but will bring the works close to its current capacity limit for Ammonia by 2034.
Wessex Water	TETBURY	Hydraulic capacity available for plan period. Permit changes for P removal planned between 2020 - 2025. We will be monitoring performance at all our sites to ensure that we remain in compliance with discharge

Sewerage Undertaker	Receiving WwTW	Comment on WwTW capacity assessment
		permits. If any changes become necessary owing to the rate of development or performance of the Tetbury works we may bring forward compliance measures.

The conclusions made for the sewerage network regarding the relative contribution of sites already with planning permission versus preferred and reserve site allocations (see section 5.1.4 and Table 5-3) also apply wastewater treatment. Taking again Fairford as an example, the assessment reports that this WwTW cannot accommodate the predicted growth and upgrades may be needed. However, as Table 5-3 shows 91% of the future housing growth already has planning permission.

5.2.5 Recommendations

Table 5-6: Wastewater treatment works flow and quality permit actions

Action	Responsibility	Timescale
Provide annual updates of projected housing growth to water companies via the Authority Monitoring Report	CDC	Annually
Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to CDC where concerns arise.	STWL, TWUL, WW	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 STW and is encroaching closer to the WwTW than existing urbanised areas. This screening approach has also been followed for WwTWs in the STWL and WW 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 not 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 STW because the prevailing winds blow from the south west.

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 CDC)
- WwTWs location in GIS format (provided by sewerage undertakers)
- OS maps

5.3.3 Results

Table 5-7 list those development sites where it is recommended that an odour assessment be undertaken.

Table 5-7: Sites where an odour assessment is recommended

Site Ref	WwTW (Company)	Encroachment?	Direction of the WwTW from site	Site boundary distance from STW (m)
M_12A	Moreton-in-Marsh (TWUL)	Yes	East	250
MOR_E11	Moreton-in-Marsh (TWUL)	Yes	East	130
MOR_E6	Moreton-in-Marsh (TWUL)	Yes	South	280
NOR_E3A	Northleach (TWUL)	Yes	South East	300
N_14B	Northleach (TWUL)	Yes	South East	200

5.3.4 Conclusions

Table 5-8: Wastewater treatment odour summary

Sites	Assessment
M_12A (SHLAA – Reserve) MOR_E11 (Economic) MOR_E6 (Economic) NOR_E3A (Economic) N_14B (SHLAA – Preferred)	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 5-9: Wastewater treatment odour actions

Action	Responsibility	Timescale
Consider odour risk in selection of site allocations	CDC	
Carry out an odour assessment for those 5 sites identified as at potential risk. In reality this could be done as 2 odour assessments for Moreton-in-Marsh and Northleach WwTWs	Site proposer	

5.4 Water quality impact assessment

The increased discharge of effluent due to an increase in the population served by a Wastewater Treatment Works (WwTW) may impact on the quality of the receiving water body. The Water Framework Directive (WFD) does not allow a water body to deteriorate from its current 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 permit may be required for the WwTW 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.

Many of the WwTWs in the District outfall to headwaters, in other words they discharge to relatively short rivers with small upstream catchments and relatively low flows. This means that the potential dilution of pollutant loads from wastewater effluents may be limited, particularly during periods of low river flows.

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 13 WwTW catchments which will receive the majority of additional flows in Cotswold District.

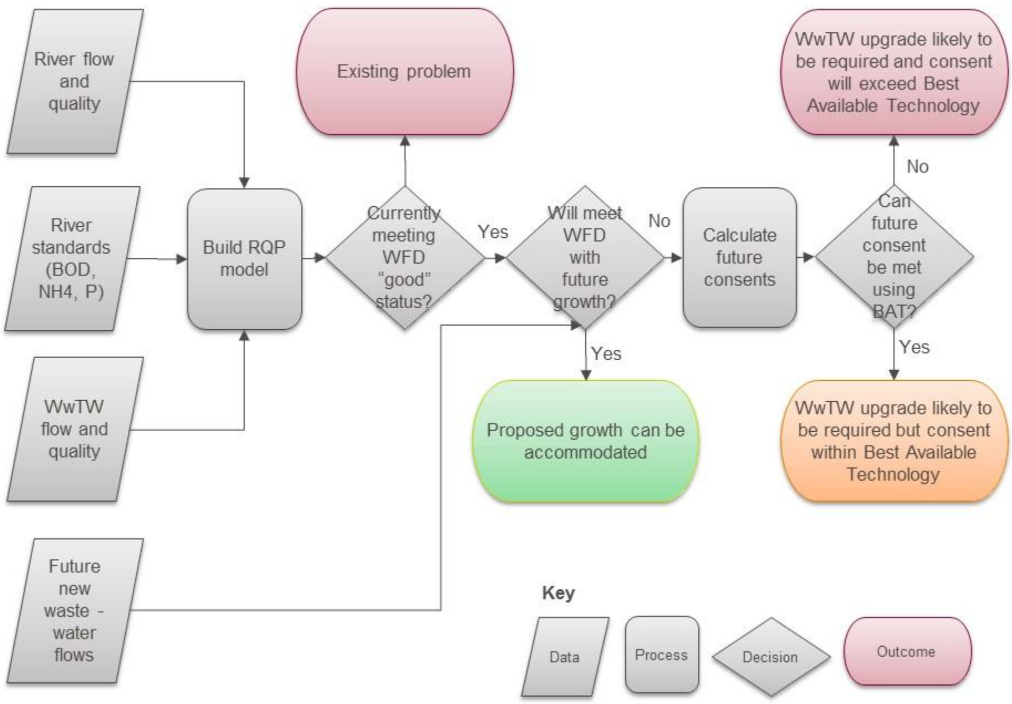
The full water quality assessment is included in Appendix A. This section provides a summary of the methodology, results and conclusions.

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) are set by the EA and are specific to individual water bodies.
- Initially the water quality impact of the increase in effluent due to preferred sites only (scenario 1) was tested.
- If a water quality failure was not predicted in scenario 1, additional testing was undertaken to identify how many additional houses could be permitted before a WwTW upgrade is likely to be triggered.
- Where a treatment works was predicted to lead to a WFD class deterioration, or a deterioration of greater than 10%, or a Good status failure it was necessary to determine a possible future permit value which would prevent a class deterioration or a >10% deterioration or the Good status targets failure. The value was determined using the RQP tool function that calculates the required discharge quality according to the specified river target.
- Where necessary, discharges were modelled with permit conditions up to Best Available Technology (BAT). This is the best standard of treatment considered to be currently achievable using established technologies available to water companies, and for this study was defined as
    - BOD (95%ile) = 5mg/l
    - Ammonia (95%ile) = 1mg/l
    - Phosphate (mean) = 0.5mg/l

The methodology followed is summarised in the flow chart below:

Figure 5-3: Water quality assessment methodology flow chart



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 (sewerage undertaker)
- Assessment of achievable treatment standards for current wastewater treatment technologies (sewerage undertaker).

Housing scenarios:

- Table 5-10: Number of houses served by each WwTW divided by categories and for the period 2014/20 and 2014/34. those with planning permission, strategic, preferred and reserve sites for the period 2014-20 and 2014-34 that will be served by each WwTW. Reserve sites were not included in the baseline scenarios for 2019/20 and 2033/34, but were included for the additional housing scenario.

The scenarios 2019/20 and 2033/34 used for the water quality assessment refer respectively to the period 2014-20 and 2014-34.

Table 5-10: Number of houses served by each WwTW divided by categories and for the period 2014/20 and 2014/34.

Sewerage Undertaker	Receiving WwTW	Total Planning Permission 2014/20	Total Planning Permission 2014-34	Total SHLAA Preferred 2014/20	Total SHLAA Preferred 2014-34	Total SHLAA Reserve 2014/20	Total SHLAA Reserve 2014-34	Total 2014/20 (Excluding Reserve)	Total 2014/34 (Excluding Reserve)	Total 2014/20	Total 2014/34
Private											
	Septic tank	85	85	0	0	0	0	85	85	85	85
Private Total		**85**	**85**	**0**	**0**	**0**	**0**	85	85	**85**	**85**
Severn Trent Water	AVENING STW	12	12	0	0	0	0	12	12	12	12
	BLOCKLEY (STW)	**9**	**9**	**7**	**51**	**7**	**36**	**16**	**60**	**23**	**96**
	CHIPPING CAMPDEN (STW)	**50**	**50**	**23**	**127**	**1**	**80**	**73**	**177**	**74**	**257**
	HONEYBOURNE STW	**159**	**159**	**15**	**80**	**4**	**25**	**174**	**239**	**178**	**264**
	Nethercote STW	1	1	0	0	0	0	1	1	1	1
Severn Trent Water Total		**231**	**231**	**45**	**258**	**12**	**141**	**276**	**489**	**288**	**630**
Thames Water	**AMPNEY ST PETER STW**	**25**	**25**	**3**	**31**	**0**	**43**	28	56	**28**	**99**
	ANDOVERSFORD STW	**24**	**24**	**8**	**40**	**0**	**0**	32	64	**32**	**64**
	Bibury STW	16	16	0	0	0	0	16	16	16	16
	Bledington STW	6	6	0	0	0	0	6	6	6	6
	Bourton on the Water STW	**632**	**632**	**10**	**10**	**0**	**32**	**642**	**642**	**642**	**674**
	BROADWELL STW	**66**	**66**	**30**	**30**	**0**	**87**	**96**	**96**	**96**	**183**
	CIRENCESTER STW	**603**	**603**	**198**	**2393**	**4**	**119**	**801**	**2996**	**805**	**3115**
	COBERLEY STW	2	2	0	0	0	0	2	2	2	2
	Fairford STW	**362**	**412**	**0**	**0**	**0**	**77**	**362**	**412**	**362**	**489**
	GUITING POWER STW	2	2	0	0	0	0	2	2	2	2
	KEMPSFORD STW	30	30	0	0	0	0	30	30	30	30
	LECHLADE STW	**82**	**82**	**1**	**18**	**0**	**0**	**83**	**100**	**83**	**100**
	LONGBOROUGH STW	1	1	0	0	0	0	1	1	1	1
	Lower Swell STW	6	6	0	0	0	0	6	6	6	6
	MORETON-IN-MARSH STW	**378**	**533**	**0**	**21**	**15**	**150**	**378**	**554**	**393**	**704**
	NAUNTON STW	3	3	0	0	0	0	3	3	3	3
	NORTHLEACH STW	**10**	**10**	**9**	**53**	**0**	**0**	**19**	**63**	**19**	**63**
	TEMPLE GUITING STW	1	1	0	0	0	0	1	1	1	1
	Whittington STW	1	1	0	0	0	0	1	1	1	1
	Withington STW	-2	-2	0	0	0	0	-2	-2	-2	-2
	GREAT RISSINGTON STW	1	1	0	0	0	0	1	1	1	1
Thames Water Total		**2249**	**2454**	**64**	**246**	**19**	**508**	**2508**	**5050**	**2527**	**5558**
Wessex Water	**Tetbury STW**	**661**	**736**	**3**	**27**	**8**	**43**	**664**	**763**	**672**	**806**
Wessex Water Total		**661**	**736**	**3**	**27**	**8**	**43**	**664**	**763**	**672**	**806**

5.4.3 Results and conclusions

Appendix A contains all the modelling results and detailed results. Table 5-11 shows the WwTWs that require an upgrade to Best Available Technology (BAT) in order to meet the WFD river targets. BAT is defined as treatment technology which treats to the highest standards whilst also being currently available, practicable and not entailing excessive cost.

- WwTWs at Ampney St Peter, Blockley, Chipping Campden, Cirencester, Honeybourne and Tetbury are assessed as having capacity within their existing flow and quality consents to accommodate the proposed growth. Cirencester WwTW may, however, require further upgrade to prevent a Water Framework Directive (WFD) deterioration for Ammonia. The required standard of treatment would be achievable using current Best Available Technology (BAT) for wastewater treatment.
- WwTWs at Andoversford, Bourton-on-the-Water, Broadwell, Fairford, Lechlade, Moreton-in-Marsh and Northleach are all predicted to require some infrastructure upgrades to accommodate higher flows and/or to prevent a WFD deterioration. The required standard of treatment would be achievable using current Best Available Technology.
- The potential for accommodating additional growth beyond the preferred growth scenario was tested for Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury. Assuming standards of treatment are upgraded, additional growth above and beyond the preferred sites (up to 200 extra houses) could be accommodated at all five settlements with no deterioration effect on the receiving watercourse.
- It is not possible to reach Good Ecological Status (GES) for the watercourses receiving discharges from Broadwell, Cirencester, Moreton on Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury sewage treatment works (STWs) in relation to the chemical element Phosphate. A separate assessment by the Environment Agency has confirmed that wastewater treatment solutions to address this are currently technically infeasible, and therefore they conclude that the planned growth has very little bearing on the ability of these water bodies to meet Good Ecological Status. At Tetbury and Blockley the assessment indicated that the planned growth would prevent the water bodies achieving Good Ecological Status. However, the Environment Agency has concluded that this is due to the conservative modelling approach taken.

Appendix B reports the EA's full response to the water quality results. They conclude that:

> *"We consider that the revised WQA is now considered appropriate and accurate for use within the WCS. Its conclusions highlight the potential risks posed to water quality deterioration from significant levels of growth. Notwithstanding this there are no limiting factors for growth based on the levels of growth indicated within the Local Plan, subject to the relevant mitigation measures and infrastructure upgrades stated within the WQA being delivered."*

Table 5-11: Summary of WwTW upgrade requirements

WwTW	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Ampney St Peter	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
Andoversford	No DWF permit exceedance is predicted	10 % deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
Blockley	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for NH4 and P. Upgrade to the WwTW is needed but it is not achievable with BAT for NH4 and P also assuming GES upstream for P (NH4 has GES in the actual situation).
Bourton on the Water	No DWF permit exceedance is predicted	10 % deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with the best technology availablebest available technology	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT. The mean requested is within the 10% model tolerance/variability

WwTW	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Broadwell	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.
Chipping Campden	DWF permit exceedance is predicted for 20033/34 scenario	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.
Cirencester	No DWF permit exceedance is predicted	10 % deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for NH4 and P. Upgrade to the WwTW is needed but it is not achievable with BAT for P also assuming GES upstream. For NH4 it is possible to reach GES with BAT also in the current upstream condition.
Fairford	No DWF permit exceedance is predicted	10 % deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with the best technology availablebest available technology	No class deterioration is predicted. No WwTW upgrade is required	Good status achieved. No upgrade is required

WwTW	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Honeybourne	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.
Lechlade	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
Moreton–in-Marsh	No DWF permit exceedance is predicted	10 % deterioration is predicted for NH4 and BOD. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for BOD. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for NH4 and P. Upgrade to the WwTW is needed but it is not achievable with BAT for P also assuming GES upstream. For NH4 it is possible to reach GES with BAT also in the current upstream condition.
Northleach	DWF permit capacity is predicted to be achieved for 2019/20 scenario	10 % deterioration is predicted for NH4. Upgrade to the WwTW is needed and it is achievable with BAT	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
Tetbury	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for NH4 or P. Upgrade to the WwTW is needed but it is not achievable with BAT for both determinands.

In conclusion, the proposed development at all settlements within the District can be accommodated without leading to a deterioration of water quality, subject to provision of treatment upgrades.

5.4.4 Additional Housing Scenario

The approach was as follows:

- If a settlement's WwTW does not cause a water quality failure in the preferred only scenario, test how many additional houses could be permitted before a WwTW upgrade is likely to be triggered. In other words how much additional headroom is available at the WwTW and in the receiving watercourse?
- Where the settlement's WwTW is likely to require an upgrade to accommodate the preferred-only scenario, test how many additional houses could be permitted before permitted levels of treatment would be required that are beyond the "Best Available Technology" (BAT) for wastewater treatment.

The WwTWs were divided into three groups:

- Group 1: those that do not present a deterioration or target failure with the preferred-only growth scenario: There are no WwTWs that meet this criteria.
- Group 2: those that present a deterioration or target failure with the preferred-only growth scenario but which could achieve good status if upgraded to use BAT: Ampney St Peter, Andoversford, Fairford, Lechlade and Northleach. These works were then tested to see how many additional houses above and beyond the preferred development sites could be accommodated if the WwTW were achieving BAT. To provide a realistic limit to the number of houses tested, the current reserve number was tested, was then rounded to the nearest 100 and tested, then this was doubled and tested;
- Group 3: those that cannot achieve good status even with BAT for the preferred-only development scenario: Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury. Development beyond the preferred option scenario is not recommended in these settlements and therefore no further modelling was undertaken for these.

The results for Group 2 predict that the use of BAT would enable additional growth above and beyond the preferred sites (up to 200 extra houses) at all five settlements with no deterioration effect on the receiving watercourse, and actually predicts an improvement on the water quality.

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	CDC	Ongoing
Take into account the findings of the water quality assessment when considering requirements for WwTW upgrades to ensure that additional treatment capacity and permit changes can be met without delaying development. Feedback to EA and CDC where concerns arise.	STW, TWUL, WW	Ongoing
Where the water quality assessment indicates that permits may require a higher standard of treatment than currently achievable using Best Available Technologies, provide clear advice to sewerage undertakers and CDC on: • the approach to permitting, • requirements for any additional studies (for example additional water quality sampling, modelling, macro-invertebrate surveys etc.), • advise CDC 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 CDC Strategic Flood Risk Assessment (SFRA)[36] along with the accompanying Sequential Test[37] 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. The percentage of site inside the fluvial Flood Zone (FZ) 1 (risk of flooding lower that 1 in 1000 year) and inside the pluvial Flood Map for Surface Water 1 in 1000 year outline was calculated for each site. This gives an indication of potential risk from these two sources of flooding. For further information consult the SFRA.

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

Table 6-1 below shows the percentage of the site inside fluvial FZ1 and pluvial FMfSW 1000yr. For fluvial higher is the percentage lower is the risk of flooding whilst the opposite apply for the pluvial.

Table 6-1: Percentage of site in FZ1 (fluvial) and in FMfSW1000 (pluvial)

Site	Site Type	Percentage of site in FZ1 (fluvial)	Percentage of site in FMfSW 1000yr (pluvial)
C_75	Strategic	100	3.44
T_24B	Preferred	100	0.08
A_3A	Preferred	100	0
A_2	Preferred	100	0
BK_11	Reserve	100	0
BK_8	Preferred	100	0
BK_5	Preferred	88.45	11.76
BK_14A	Preferred	87.05	12.25
B_32	Reserve	100	5.52
B_20	Preferred	100	0
CC_48	Reserve	100	3.42

36 Cotswold District Council (2014) Strategic Flood Risk Assessment
37 Cotswold District Council (2014) Sequential Test

Site	Site Type	Percentage of site in FZ1 (fluvial)	Percentage of site in FMfSW 1000yr (pluvial)
CC_41	Reserve	100	10.55
CC_40	Preferred	100	0.02
CC_38A	Reserve	100	3.98
CC_23E	Reserve	100	0
CC_23C	Preferred	100	0
CC_23B	Preferred	100	0
C_97	Preferred	100	0.3
C_82	Reserve	100	2.45
C_76	Reserve	100	5.55
C_39	Preferred	100	27.19
C_17	Preferred	100	0.16
C_101A	Preferred	100	0
DA_8	Preferred	100	0
DA_5C	Reserve	100	1.14
DA_5A	Preferred	100	0
DA_2	Preferred	100	0
F_44	Reserve	100	5.22
F_35B	Reserve	100	0
K_5	Reserve	100	5.5
K_2	Preferred	100	0.03
K_1B	Preferred	100	0
L_19	Preferred	80.55	0.11
L_18B	Preferred	99.44	0
MK_4	Reserve	100	7
M_19B	Reserve	94.68	12.65
M_19A	Reserve	100	5.75
M_60	Preferred	100	16.26
M_12A	Reserve	100	3.7
N_1A	Preferred	100	0.02
N_14B	Preferred	100	0.3
N_13B	Preferred	100	5.11
SC_13A	Reserve	99.59	0.32
S_8A	Preferred	100	0
S_46	Preferred	100	3.48
S_20	Reserve	100	0
T_51	Preferred	100	34.04
T_31B	Reserve	100	2.56
W_7A	Preferred	100	1.71
W_5	Reserve	100	0
W_1B	Preferred	100	0

Site	Site Type	Percentage of site in FZ1 (fluvial)	Percentage of site in FMfSW 1000yr (pluvial)
W_1A	Preferred	100	1.2
BOW_E1	Economic	99.72	13.77
CCN_E1	Economic	100	2.93
CIR_E12	Economic	100	0.3
CIR_E11	Economic	94.41	48.55
CIR_E10	Economic	100	0
CIR_E6	Economic Reserve	100	0
CIR_E14	Economic	14.62	13.5
CIR_E13	Economic	100	1.14
LEC_E1	Economic	100	0.63
MOR_E6	Economic	100	0
MOR_E11	Economic Reserve	100	0
TET_E2	Economic	100	0

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.

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.

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 STW outfall
- Catchment descriptors from FEH CD-ROM

6.2.3 Results

Table 6-2 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 STW with the highest flow increase is Cirencester with a predicted 1.4% increase on the Q30 flows.

Table 6-2: Summary of the predicted DWFs increase

WwTW	Receiving w/c	ReFH Q30 (m3/s)	ReFH Q100 (m3/s)	Current DWF (m3/d)	Max Predicted DWF (m3/d)	Flow change m3/s	Flow change % Q30	Flow change % Q100
Blockley	Blockley Brook	4.800	6.400	710	768	0.001	0.014%	0.011%
Chipping Campden	Cam Brook Trib R Stour	5.200	6.700	1573	1840	0.003	0.059%	0.046%
Honeybourne	Cow Honeybourne Brook	2.900	3.900	934	1069	0.002	0.054%	0.040%
Ampney St Peter	Ampney Brook	2.300	3.400	361	388	0.000	0.013%	0.009%
Andoversford	River Coln	0.600	1.100	144	153	0.000	0.018%	0.010%
Bourton On The Water	River Dikler	7.000	10.000	2355	2371	0.000	0.003%	0.002%
Broadwell	Caudwell Brook	2.000	2.600	595	685	0.001	0.052%	0.040%
Cirencester	River Chern	0.700	1.000	6966	7814	0.010	1.403%	0.982%
Fairford	River Coln	3.100	5.000	1233	1301	0.001	0.025%	0.016%
Lechlade	River Leach	1.000	1.800	700	720	0.000	0.022%	0.012%
Moreton-in-Marsh	River Evenlode	0.600	0.900	1113	1391	0.003	0.537%	0.358%
Northleach	River Leach	0.800	12.000	132	160	0.000	0.041%	0.003%
Tetbury	Tetbury Branch, River Avon	2.800	4.100	695	772	0.001	0.023%	0.016%

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

The above assessment is based on May 2014 growth figures with the exception of Tetbury where the higher November 2014 figures were used. At all other treatment works the predicted additional flow based on the November 2014 figures was either the same or slightly lower than with the May 2014 figures.

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.

7 Environmental constraints and opportunities

7.1 Methodology

A desk study exercise to identify environmental risks and opportunities associated with the 388 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 was 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 CDC area and the potential risks and opportunities associated with the development of the proposed sites.

7.2 Data collection

Information was collected on a range of environmental designations and features (see Table 7-1). This information was available from a range of online environmental database/mapping sources or was provided by the EA and the CDC. Some environmental designations originally searched for were not present in the CDC area or were not relevant. These are also identified in Table 7-1. Relevant features were grouped into six topic areas: Biodiversity, Historic Environment, Landscape, Water, Geology and Soils and Waste (see Table 7-2).

Table 7-1: Environmental designations and features

Environmental feature	Description	Relevant to CDC area
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.	Yes
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 with an equally wide range of water permeability and storage.	Yes
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.	Yes
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.	Yes

Environmental feature	Description	Relevant to CDC area
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.	Yes
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.	Yes
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).	Yes
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.	Yes
Local Nature Reserve	Local Nature Reserves (LNRs) are non-statutory areas of local importance for nature conservation that complement nationally and internationally designated geological and wildlife sites. LNRs 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.	No
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.	No
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.	No
National Trails	National Trails are long distance walking, cycling and horse riding routes through the best landscapes in England and Wales.	Yes
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).	No
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.	Yes
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.	Yes
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.	Yes
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.	Yes
Special Area of Conservation	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	Yes

Environmental feature	Description	Relevant to CDC area
	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.	No
Watercourse	A river, stream or other riparian feature i.e., ditch, as shown on OS mapping.	Yes
Water Framework Directive 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.	Yes
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.	No

Some environmental datasets were requested from CDC but were not available at the time of writing:

- Air Quality Management Area (AQMA) - An area that the local authority must declare where national air quality objectives are not likely to be achieved.
- 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.
- 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.
- Green Corridor - Green corridors are areas identified by the CDC 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.
- Waste Licence Site - an environmental licence granted for specific activities. The majority of waste management facilities are licensed under the Waste Management Licensing Regulations 1994.

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

Topic	Environmental feature	Search buffer (m)
	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 Cotswold District is predominantly rural in character with the River Thames forming its southern boundary and the River Coln flowing in a north west to south east direction through the centre. Another notable river is the River Churn, which flows through Cirencester. The area contains a range of sites designated for their nature conservation value. There are two Special Areas of Conservation (SACs) within the district: Cotswold Beechwoods (see Table 7-3) and North Meadow and Clattinger Farm (see

Table 7-4). 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. The Cotswold Beechwoods SAC also contains the Cotswold Commons and Beechwoods NNR, which is a nationally important site for its beech woodland and limestone grassland habitats. North Meadow and Clattinger Farm SAC is one of only two sites in southern England containing lowland hay meadows[38]. There are no SPAs or Ramsar sites in the district; the closest sites are located at the Severn Estuary, approximately 18km to the west of the district.

38 JNCC (2014) North Meadow and Clattinger Farm. Accessed online at http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0016372 on 14/08/2015.

Table 7-3: Cotswold Beechwoods SAC

Feature	Description
Area (ha) [39]	585.85
General site character[39]	Inland water bodies (2%) Dry grassland, Steppes (1.5%) Broad-leaved deciduous woodland (82%) Coniferous woodland (5%) Mixed woodland (10%) Other land (including towns, villages, roads, waste places, mines, industrial sites) (0.5%).
Notable species	Beech Forest *Asperulo-Fegetum* Red helleborine *Cephalantera ruba* Stinking hellebore *Helleborus foetidus* Narrow-lipped helleborine *Epipactis leptochila* Wood barley *Hordelymus europaeus*
Asperulo-Fagetum beech forests	This Annex I habitat is the primary reason for the site has been selected as an SAC. This type occurs on circumneutral to calcareous soils[40]. The SAC represents the most westerly extensive blocks of beech forests in the UK, and are floristically richer than the Chilterns[39].
Semi-natural dry grasslands and scrubland facies	This Annex I habitat is present as a qualifying feature for the SAC, but not the primary reason[39]. *Festuco-Brometalia* grasslands are found on thin, well-drained, lime-rich soils associated with chalk and limestone[41]. A large number of rare plants are associated with this habitat, as well as having noteworthy invertebrate fauna.

Table 7-4: North Meadow and Clattinger Farm SAC

Feature	Description
Area (ha)[38]	104.88
General site character[39]	Inland water bodies (2%) Dry grassland, Steppes (15%) Humid grassland, Mesophile grassland (71%) Improved grassland (12%)
Notable species[41]	Lowland hay measows *Sanguisorba officinalis - Alopecurus pratensis* Red fescue *Festuca rubra* Crested dog-stail *Cynosurus cristatus* Meadow foxtail *Alopecurus pratensis* Great burnet *Sanguisorba officinalis* Meadowsweet *Filipendula ulmaria* Meadow buttercup *Ranunculus acris* Fritillary *Fritillaria meleagris*
Lowland hay measows *Sanguisorba officinalis - Alopecurus pratensis*[41]	This Annex I grassland type is rare in the UK and occurs almost entirely in central and southern England, with a few outlying fragments along the Welsh borders and is the primary reason for the selection of this site. It is estimated to cover less than 1,500 ha in total. The sites selected as SACs are those that have the largest surviving areas of the habitat and show a high degree of conservation of structure and function associated with stable patterns of traditional low-intensity management. North Meadow and Clattinger Farm contains a very high proportion (>90%) of the surviving UK population of fritillary *Fritillaria meleagris*, a species highly characteristic of damp lowland meadows.

39 JNCC (undated) Cotswold Beechwoods. Accessed online at http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0013658 on 14/08/2015.

40 JNCC (undated) Habitat account - Forests. Accessed online at http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H9130 on 14/08/2015.

41 JNCC (undated) Habitat account - Natural and semi-natural grassland formations. Accessed online at http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H6210 on 14/08/2015.

There are also 33 SSSIs within the CDC area[42] (2006 data), of which almost all are in 'favourable' or 'unfavourable – recovering' condition; however, there are three sites which are 'unfavourable declining' - Cotswold Water Park, Lark Wood and Winson Meadows[43]. Many of these SSSIs are within the vicinity of or have waterbodies within them and are designated for meadows on floodplains. Barnsley Warren is an SSSI that includes a section of Winterbourne Stream, although is designated for its limestone grassland. Cotswold Water Park has a significant amount of water bodies, with more than 150 lakes[44]. Cleeve Common SSSI includes the source of the River Isbourne, to the River Avon. At the local level, there are 411 Local Wildlife Sites[42] (2006 data) (known in Gloucestershire as Key Wildlife Sites). Local sites are important for their scientific, educational and historical value as well as their visual qualities. Many Key Wildlife Sites are meadows and woodlands. Datasets on Key Wildlife Sites were not available.

There is increasing evidence that some Cotswold river valleys are becoming increasingly dry during the summer months, particularly towards their source[42]. Cotswold's rivers and streams are generally of a high water quality that support a diverse range of aquatic life[45]. In upland areas, the rivers support sparse vegetation such as mosses and liverworts. Insects include stoneflies, mayflies and caddisflies, which are hunted by salmon and brown trout and birds such as dippers[46]. In lowland areas, the watercourses tend to be nutrient rich, supporting coarse fish such as chub, dace and roach. Rare lamprey, white-clawed crayfish and depressed river mussel can also be found in these areas[46].

The Cotswolds AONB covers a large part of the CDC area. It runs for nearly 95km, forming part of an outcrop of Jurassic rocks that run north east from the Dorset coast to the Yorkshire Coast[47]. The Cotswolds AONB is the largest of the 41 AONBs in England and Wales, with an area of 2,038km^2 [48]. Approximately 10% of the Cotswolds AONB is woodland, with 86% being farmland, of which 44% is grassland[49]. There is one greenbelt area in the district, located between Gloucester and Cheltenham.

The CDC area contains two National Trails: the Cotswold Way which runs from the south west of the district in a north easterly direction, and the Thames Path, which runs along the southern border of the district. The Cotswold Way runs for 164km along the Cotswold escarpment from Bath to Chipping Campden[50]. The Thames Path runs from the source of the Thames in the Cotswolds to London, a distance of 294km[51].

There are 244 scheduled monuments in the CDC area[42] (referred to as 'Scheduled Ancient Monuments' in the Local Plan). Scheduled monuments are nationally important sites that are given legal protection through the Ancient Monuments and Archaeological Areas Act 1979. There are 145 designated Conservation Areas (as of May 2002) and 31 Parks and Gardens of Special Historic Interest[42], the largest of which is Cirencester Park.

The CDC area contains the largest number of listed buildings of any district in the UK[42] with over 5,000 in the district[52]. A large number of these are located in Cirencester and Moreton-in-Marsh. When considering planning applications, local authorities are required to pay particular regard to

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42 Cotswold District Council (2006) Local Plan - 2001-2011

43 Natural England (2014) Sites of Special Scientific Interest. Accessed online at http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm on 14/08/2014.

44 Cotswold Water Park Trust (2014) Cotswold Water Park. Accessed online at http://www.waterpark.org/ on 14/08/2015.

45 Gloucestershire Wildlife Trust (undated) Target Habitats and Species. Accessed online at http://www.gloucestershirewildlifetrust.co.uk/what-we-do/local-nature-conservation/living-landscapes/cotswold-rivers/habitats-and-species on 14/08/2015.

46 Gloucestershire Wildlife Trust (undated) Rivers and Streams. Accessed online at http://www.gloucestershirewildlifetrust.co.uk/wildlife/habitats/rivers-and-streams on 14/08/2015.

47 Cotswolds Conservation Board & Gloucestershire Geology Trust (2005). The Geological & Geomorphological Importance of the Cotswolds area of Outstanding Natural Beauty.

48 Cotswold District Council (2013). Cotswolds AONB. Accessed online at http://www.cotswold.gov.uk/residents/planning-building/landscape/cotswolds-aonb/ on 14/08/2015.

49 Cotswolds Area of Outstanding Natural Beauty (2013). Cotswolds AONB Management Plan 2013-2018.

50 National Trails (undated) Cotswold Way. Accessed online at http://www.nationaltrail.co.uk/cotswold-way on 14/08/2015.

51 National Trails (undated) Thames Path. Accessed online at http://www.nationaltrail.co.uk/thames-path on 14/08/2015.

52 English Heritage (undated). Search Results, Gloucestershire, Cotswold. Accessed online at http://list.english-heritage.org.uk/results.aspx on 14/08/2015.

the preservation of any listed building, its setting or any of special architectural or historic interest[42].

The agricultural quality of the land in the CDC is generally classified as ALC Grade 3 (good to moderate). There is a band of Grade 2 (very good) land, running east to west along the southern boundary of the CDC area. There are limited pockets of Grade 5 (very poor) land, with even fewer areas of Grade 1 (excellent) land.

Surface water quality is generally good. There are 51 river bodies and two lakes in the CDC area, of which 37% achieved good ecological status/potential. Poor is noted for the River Churn as it flows through Cirencester and section of the River Coln. Phosphate concentrations are a concern on the Rivers Evenlode, Glyme and Ampney Brook. In the northern portion of CDC area, rivers generally have a status of either 'Good' or 'Moderate'.

The majority of the District is identified as a Principal Aquifer, following the line of the Cotswold Hills. . Much of the CDC has a Groundwater Vulnerability Zone (GVZ) of 'Major - High' or 'Minor Aquifer - High'. Source Protection Zones (SPZs) vary within the CDC area from zone 1 to zone 3, with the most of area covered by zones 2 and 3, with most of the area covered by zones 2 and 3. Zone 1 has a 50 day travel time from any point below the water table to the source, whereas zone 3 is where all groundwater recharge is presumed to be discharged at the source. The majority of the district is a surface water and Nitrate Vulnerable Zone (NVZ).

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 Appendix C, which shows the number of environmental features that fall within a buffer zone of each draft allocation site. The presence of an environmental designation or feature may 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.

River corridors form natural wildlife corridors and are an important feature of the landscape in the district, requiring adequate buffer zones free of development[42]. All sites have an environmental feature that falls within the buffer zones. This is due to all sites containing Grade 2 or 3 ALC and many also falling within the Cotswolds AONB. Development in this area may be restricted and appropriate mitigation will need to be agreed with CDC to avoid any adverse impact on the landscape quality of the AONB. Where agricultural land is classified as ALC Grade 2 or 3, CDC will need to justify the loss of the 'best and most versatile land'[53] rather than develop poorer quality land.

High risk sites that have nine or more environmental feature categories (i.e. the type of environmental feature, not the number of individual features) within a buffer zone are shown in Table 7-5.

Table 7-5: High risk CDC sites

CDC Site (No. of categories affected)	Environmental feature categories affected	Description
C_75 (9) C_97 (9) CIR_E12 (9) CIR_E13 (9) CIR_E5 (9)	Scheduled Monument	The Corinium Roman town is within the site boundary. Long Barrow and Roman amphitheatre and cemetery and the Settlement south east of Chesterton Farm are also within the boundary.
	Listed Buildings	There are 318 Listed Buildings within the WPP1 site boundary or within 100m.
	Registered/Historic Park and Garden	Cirencester Park borders the site.
	AONB	Cotswolds AONB borders the site.
	WFD Classification and water course	Daglingworth Stream and the Churn have WFD classifications.
	Aquifer - Bedrock / Superficial Deposits	Secondary A (bedrock and superficial) and Principle (bedrock) aquifers
	ALC	Grade 2
	Landfill/Historic landfill	There are two landfill and two historic landfill sites within the buffer zone.
B_32 (9)	SSSI	Salmonsbury Meadows.
	Ancient or Semi-Natural Woodland	Bourton Wood is within 100m of the site.
	Scheduled Monument	Iron Age fortified enclosure known as Salmosbury Camp is within the site. Bourton Bridge Roman settlement borders the site. A settlement site and burrows is within 500m of the site.
	Listed Buildings	There are 113 Listed Buildings within the WPP15 site boundary or within 100m.
	AONB	Cotswolds AONB borders the site.
	WFD Classification and water course	Windrush runs through the site. The Eye is within 200m.
	Aquifer - Bedrock / Superficial Deposits	Secondary (superficial) and Unproductive (bedrock) aquifers.
	ALC	Grade 3.
	Landfill/Historic landfill	There is two landfill sites and no historic landfill sites within the buffer zone.

Most sites fall within the 1,000m buffer zone of an SSSI, 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. This indicates that development of a draft allocation site could present a risk to the features of the SSSI, particularly if there is a direct pathway between the site and the SSSI. These risks may include habitat loss, contamination or disturbance through the release of contaminants from the development site or increased public access (for amenity purposes) to the designated site. Operations likely to damage the special interest of a SSSI have been identified by Natural England; therefore an assessment of each individual development proposal would need to be made to determine whether a development is likely to have an effect. Mitigation measures such as introducing buffer zones and creating new habitats within the draft allocation sites may help reduce any potential adverse effects, while also providing new habitat for mobile interest features from the SSSI. No sites are within 2000m of North Meadow and Clattinger Farm SAC. However, other

53 Natural England (2012) Developing farmland: regulations on land use. Accessed online at https://www.gov.uk/developing-farmland-regulations-on-land-use on 14/08/2015.

development sites will also need to be assessed if a pathway to a SAC exists and adverse effects are likely.

Draft allocation sites within close proximity to a scheduled monument or listed building may have an impact on their setting. There are many draft allocation sites with a number of listed buildings either within the site or within the 100m buffer zone. In particular, sites within Cirencester have significant potential for an effect due to the large number of heritage sites located there. Mitigation measures such as buffer zones or screening planting around the draft allocation sites could help avoid impacts and may provide a positive effect to the setting of historic features, as well as provide important green space and help manage surface water run-off. There may be an opportunity to enhance the setting of listed buildings and scheduled monuments through removal of intrusive features or appropriate vegetation planting. Development of any site may also present an opportunity to investigate any archaeological remains that may be present.

Where draft allocation sites have the potential to affect the biological or chemical quality of a watercourse or other waterbody, its development could conflict with WFD objectives and appropriate mitigation measures would be required to avoid such impacts. Cotswolds District Council should aim to set back development a minimum of 6m from a river (wider buffers of 7-8m are set by the EA regions for Main Rivers), providing a buffer strip to 'make space for water' and allow additional capacity to accommodate climate change impacts. 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 a watercourse.

Many sites are within 200m of a watercourse, therefore 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.

The majority of draft allocation sites are located close to a known landfill site. A risk assessment would be required to determine the potential for the development site to be contaminated or for the presence of pathways between the development site and landfill that could be created through its development. Contamination of groundwater and surface waters could occur if pathways from the landfill site are created.

All sites are located within an area designated as an aquifer. Many sites lie on Principal Aquifer, which is geology that exhibits high irregular and/or fracture permeability, usually providing a high level of water storage. These aquifers may also support water supply and/or river base flow on a strategic scale[54]. Many sites are also on superficial deposits, mainly categorised as 'Secondary A', which are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers[54]. Therefore, many, if not all, sites may require measures to avoid the risk of groundwater contamination.

Groundwater contamination and other features may place restrictions on the use of SuDS at the site, although the risk of groundwater contamination from SuDS can be effectively managed. The use of SuDS also provides an opportunity to improve (or maintain) recharge of the aquifer. SuDS can have numerous benefits by creating wildlife habitats, recreation and amenity areas and improvements to the local landscape.

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. Sustainable Drainage Systems (SuDS) are the recommended approach as stated in 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;

54 Environment Agency (2014) Aquifers. Accessed online at http://apps.environment-agency.gov.uk/wiyby/117020.aspx on 14/08/2015.

- 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[55] 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.*

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

55 Natural England (2011), Protecting water from agricultural runoff: buffer strips, First edition, September 2011. Accessed online at http://adlib.everysite.co.uk/resources/000/266/464/TIN098.pdf on 14/08/2015.

Current evidence shows that 6m is the minimum effective width.' Scottish Environmental Protection Agency (SEPA) guidance[56] 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 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 7-6.

Table 7-6: 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.

56 SEPA (2009), Riparian Vegetation Management Good Practice Guide. Accessed online at http://www.sepa.org.uk/media/151010/wat_sg_44.pdf on 14/08/2015.

Environmental opportunity	Potential environmental benefits
	• 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.
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 and Appendix C). 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 CDC 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 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.

- 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.

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 site's 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.

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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 (4) - Intense summer rainfall and higher winter rainfall increases flood risk	No - not considered in company assessments	
Wastewater treatment	Medium (4) - 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	Yes - climate change modelling and mapping	

Sources:

(1) Thames River Basin Management Plan

(2) Thames Water's Water Resource Management Plan

(3) Bristol Water's Water Resource Management Plan

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

(5) CDC Strategic Flood Risk Assessment

8.3 Conclusions

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	BW, EA, STWL, TWUL, WW	As required
Take "no regrets" decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts	CDC, developers	

9 Summary and Recommendations

9.1 Summary of conclusions

The water cycle study has been carried out in co-operation with the Environment Agency, Bristol Water, Thames Water, Severn Trent Water and Wessex Water. Overall, there are no issues which indicate that the planned scale, location and timing of planned development within the District is unachievable from the perspective of supplying water and wastewater services and preventing deterioration of water quality in receiving waters.

The WCS has identified where infrastructure upgrades are expected to be required to accommodate planned growth. Timely planning and provision of infrastructure upgrades will depend upon regular engagement between CDC, water companies, the EA and developers.

At project inception the Environment Agency set out a number of questions to be answered by the WCS. These are tabulated in Appendix D.

9.1.1 Development scenarios and policy issues

- Sites already with planning consent will account for virtually all planned growth up to 2019/20, after which point the additions from sites with planning permission tail off and the contribution of future allocations start to take effect. The impact of these future allocations is the focus of the study, and included:
    - 1 strategic site (Land at Chesterton Farm, Cirencester),
    - 30 preferred sites,
    - 21 reserve sites and
    - 14 economic development areas (2 classified as Reserve).
- The projected growth rate for Cotswold District, at an average of 380 per annum, is not significantly different to the annual rate of housing provision from the now defunct 2006 South West Regional Spatial Strategy and the 2009 Gloucestershire and Districts Strategic Housing Market Assessment. Consequently there are no “surprises” for water companies in the quantum of growth to be planned for in the District.
- The strategic site at Land at Chesterton Farm, Cirencester accounts for approximately 80% of all proposed housing growth in the emerging Local Plan. The capacity at Cirencester WwTW has already been upgraded to accommodate this and other growth in the Cirencester catchment. The remaining allocations across the District (approximately 500) are relatively modest in scale, though in small towns and villages the infrastructure will normally be sized to serve the existing population and therefore may have little spare capacity for growth.
- Legal agreements under the Town and Country Planning Act Section 106 agreement, and Community Infrastructure Levy agreements are not intended to be used to obtain funding for water or wastewater infrastructure. It is not, therefore necessary for Cotswold District Council to identify requirements for developers to contribute towards the cost of upgrades in its Local Plan.
- The Water Industry Act sets out arrangements for connections to public sewers and water supply networks, and developers should ensure that they engage at an early stage with the relevant water supplier and sewerage undertaker to ensure that site-specific capacity checks can be undertaken and where necessary additional infrastructure constructed to accommodate the development. Where permitted the water company or sewerage undertaker may seek developer contributions towards infrastructure upgrades. Upgrades to water resources, water treatment works and wastewater treatment works are funded through the company business plans.

9.1.2 Water resources

- Within those settlements supplied by Thames Water (including all preferred allocation sites with the exception of those in Tetbury), the Water Resource Management Plan makes adequate provision for the forecast growth in housing within Cotswold District and therefore water resources should not be considered to be a barrier to the planned growth in the District.

- The wider issue of an increase in the forecast demand within the SWOX zone is being addressed jointly by Thames Water and the Environment Agency. Initially this will focus on implementing and monitoring the impacts of demand management measures which are the focus for water resource management during AMP6 (2015-2020). In parallel, Thames Water continues to investigate the timing for future development of strategic new resources, which could include reservoirs and/or large-scale water recycling. Progress on this work will be published by Thames Water in its WRMP Annual Statements and in a Statement of Common Ground to be jointly prepared by CDC, EA and TWUL.
- In Tetbury (supplied by Bristol Water), the Water Resource Management Plan and comments from BW evidence that there are no issues with water resources to serve the planned growth.
- There are no allocation sites within the small areas of the District supplied water by Severn Trent Water and Wessex Water.

9.1.3 Water supply

- Thames Water have confirmed that they are able to supply the planned growth in Down Ampney without infrastructure upgrade. In all other settlements supplied by Thames Water, further modelling will be required to determine the scale of the water supply infrastructure upgrades that may be needed. Whilst it is expected that infrastructure upgrades will be required to serve the planned growth within these settlements, there remains adequate time for this infrastructure to be delivered by Thames Water without restricting the timing, location or scale of planned development. Measures to address supply to the strategic development at Cirencester are further progressed by Thames Water. This development accounts for over 80% of new housing to be allocated.
- In Tetbury, Bristol Water state that there are no issues with water supply infrastructure to serve the planned growth.

9.1.4 Wastewater collection

- Existing sewerage infrastructure is reported to be adequate to accommodate the planned growth in Blockley, Cirencester (where the strategic development would be served by a completely new sewer connecting to the WwTW), Lechlade and Tetbury.
- In all other settlements it is anticipated that some infrastructure upgrades will be required within the sewerage systems.
- Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage and treat wastewater arising from new domestic development. The majority of future growth within the District already has planning permission, therefore the sewerage undertakers should already be aware of this forthcoming growth. However, except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption or requisition from a developer. Early developer engagement with water companies is therefore essential to ensure that sewerage capacity can be provided without delaying development.

9.1.5 Wastewater treatment and water quality

- WwTWs at Ampney St Peter, Blockley, Chipping Campden, Cirencester, Honeybourne and Tetbury are assessed as having capacity within their existing flow and quality consents to accommodate the proposed growth. Cirencester WwTW may, however, require further upgrade to prevent a Water Framework Directive (WFD) deterioration for Ammonia. The required standard of treatment would be achievable using current Best Available Technology (BAT) for wastewater treatment.
- WwTWs at Andoversford, Bourton-on-the-Water, Broadwell, Fairford, Lechlade, Moreton-in-Marsh and Northleach are all predicted to require some infrastructure upgrades to accommodate higher flows and/or to prevent a WFD deterioration. The required standard of treatment would be achievable using current Best Available Technology.

- The potential for accommodating additional growth beyond the preferred growth scenario was tested for Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury. Assuming standards of treatment are upgraded, additional growth above and beyond the preferred sites (up to 200 extra houses) could be accommodated at all five settlements with no deterioration effect on the receiving watercourse.
- It is not possible to reach Good Ecological Status (GES) for the watercourses receiving discharges from Broadwell, Cirencester, Moreton on Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury sewage treatment works (STWs) in relation to the chemical element Phosphate. Separate assessment by the Environment Agency has confirmed that wastewater treatment solutions to address this are currently technically unfeasible, and therefore they conclude that the planned growth has very little bearing on the ability of these water bodies to meet Good Ecological Status. At Tetbury and Blockley the assessment indicated that the planned growth would prevent the water bodies achieving Good Ecological Status. However, the Environment Agency has concluded that this is due to the conservative modelling approach taken.
- In summary, the Environment Agency has confirmed that "there are no limiting factors for growth based on the levels of growth indicated within the Local Plan, subject to the relevant mitigation measures and infrastructure upgrades stated within the Water Quality Assessment being delivered."
- Sewerage undertakers monitor flow and quality at their WwTWs and their internal planning processes monitor the growth trajectories at each WwTW to ensure that where required additional capacity can be put in place before existing permit limits are reached.
- 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. An odour screening assessment concluded that five sites (three in Moreton-in-Marsh and two in Northleach) may be at risk of experiencing odour due to their proximity to the existing WwTW. It is recommended that odour impact assessments be undertaken prior to allocation of these sites. None of the other preferred or reserve sites are likely to be impacted by odour from WwTWs.

9.1.6 Flood Risk

- The percentage of each site at risk from fluvial or surface water flooding was calculated. This information may be used to supplement the information presented at the settlement scale in the Strategic Flood Risk Assessment.
- 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. The impact of increased effluent flows are not predicted to have a significant impact upon flood risk in the receiving watercourses at any of the settlements with planned growth in the District.

9.1.7 Environmental constraints and opportunities

- A desk study exercise to identify environmental risks and opportunities associated with the 388 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 was 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 CDC area and the potential risks and opportunities associated with the development of the proposed sites.

9.1.8 Climate change

- A qualitative assessment has been undertaken to assess the potential impacts of Climate Change on the assessments made in this water cycle study. This used 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.
- The capacity of the sewerage system and the water quality of receiving water bodies stand out as two elements of the assessment where the consequences of climate change are expected to be high, but no account has been made of climate impacts in the assessment. This should be addressed at detailed assessment stage.

9.2 Recommendations

Primary responsibility for the provision of water and wastewater services to new developments lies with the Water Companies and Sewerage Undertakers. Cotswold District Council should facilitate their planning by providing clear information and updates on the location, scale and timing of allocations. As the primary environmental regulator the Environment Agency has a key role in determining the environmental capacity of water resources and receiving waters in the District. Finally, site developers and promoters should ensure that they engage at an early stage with the appropriate Water Companies and Sewerage Undertakers to enable them to ascertain the capacity of existing water supply and wastewater networks and where necessary upgrade their infrastructure.

It is intended that Thames Water, the Environment Agency and Cotswold District Council will prepare a Statement of Common Ground setting out an agreed approach to ensuring provision of infrastructure to serve the strategic development in Cirencester and measures to address the future supply-demand balance in the SWOX water resource zone. Furthermore it is CDC's intention to summarise the conclusions of the Water Cycle Study in the forthcoming update of the Infrastructure Delivery Plan. This will include schedules of infrastructure upgrades and timescales required to support delivery of the Local Plan.

Table 9-1 summarises the specific recommendations made throughout the Water Cycle Study:

Table 9-1: Summary of all recommendations

Aspect	Action	Responsibility	Timescale
General	Provide annual updates of projected housing growth to water companies via the Authority Monitoring Report	CDC (and other LPAs in the SWOX zone)	Annually
Water resources	Take account of the updated housing growth projections across SWOX in the next update of the WRMP	TWUL	2015 and annually
	Require new developments to be designed to Building Regulations water consumption standard for water scarce areas (110 litres per person per day) Apply demand management measures as per Water Resource Management Plans	CDC	TBC - dependent on Local Plan timetable and the 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 CDC.	TWUL	Early 2015 and beyond
	Seek early consultation with the water supplier in order to ensure adequate time is available to provide local distribution main upgrades to meet	Developers	Ongoing

Aspect	Action	Responsibility	Timescale
	additional demand.		
Foul sewerage infrastructure	Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to CDC where concerns over the timing of development arise.	STWL, TWUL, WW	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
WwTW flow and quality	Sewerage undertakers to assess growth demands as part of their wastewater asset planning activities and feedback to CDC where concerns arise.	STWL, TWUL, WW	Ongoing
WwTW odour	Consider odour risk in selection of site allocations	CDC	
	Carry out an odour assessment for those 5 sites identified as at potential risk. In reality this could be done as 2 odour assessments for Moreton-in-Marsh and Northleach WwTWs	Site proposer	
Water quality	Where possible, take into account the water quality constraints when allocating and phasing development sites.	CDC	Ongoing
	Take into account the findings of the water quality assessment when considering requirements for WwTW upgrades to ensure that additional treatment capacity and permit changes can be met without delaying development. Feedback to EA and CDC where concerns arise.	STW, TWUL, WW	Ongoing
	Where the water quality assessment indicates that permits may require a higher standard of treatment than currently achievable using Best Available Technologies, provide clear advice to sewerage undertakers and CDC on: - the approach to permitting, - requirements for any additional studies (for example additional water quality sampling, modelling, macro-invertebrate surveys etc.), - advise CDC where water quality constraints may limit the potential for growth.	EA	Ongoing
Protecting and enhancing the water environment	Consultation with CDC 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.	CDC	
	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.	CDC / Developers	
	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.	CDC / Developers	
	Existing water features i.e., ponds, ditches and	CDC /	

Aspect	Action	Responsibility	Timescale
	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.	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.	CDC / 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.	CDC / Developers	
Climate Change	When undertaking detailed assessments of environmental or asset capacity, consider how climate change can be considered	BW, EA, STWL, TWUL, WW	As required
	Take "no regrets" decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts	CDC, developers	

Appendices

A Appendix: Water Quality Assessment – Phase 2

A Appendix– Water quality assessment

A.1 Introduction

The increased discharge of effluent due to an increase in the population served by a Wastewater Treatment Works (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 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 Environmental Permit (EP) may be required for the WwTW 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 13 WwTW catchments which will receive the majority of additional flows in the Cotswold District.

This report assesses the potential water quality impacts due to growth in WwTW effluent flows and loads at those 13 WwTW discharge points.

A.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 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	0.12mg/l	0.08mg/l

The EA has provided WFD 2014 set catchment/reach-specific targets for all the pollutants. The EA has advised that for unlisted sites the 2nd cycle 2013 should be used.

On this basis the following targets (see Table 2) have been used at the WwTW discharge points assessed:

Table 2: Pollutants targets by WwTW.

WwTW	BOD 90%ile mg/l	Ammonia 90%ile mg/l	P mean mg/l	Waterbody / WQ point
AMPNEY ST PETER	5	0.6	0.077	GB106039030300 / PUTR0002
ANDOVERSFORD	5	0.6	0.08	Not Available
BOURTON ON THE WATER	4	0.3	0.06	GB106039030470 / PWRR0003
BROADWELL	4	0.3	0.065	GB106039037410 / PEVR0010
CIRENCESTER	5	0.6	0.077	GB106039023800 / PUTR0009
FAIRFORD	5	0.6	0.08	Not Available
LECHLADE	5	0.6	0.078	GB106039030040 / PUTR0061
MORETON-IN-MARSH	5	0.6	0.064	GB106039037410 / PEVR0016
NORTHLEACH	5	0.6	0.078	GB106039030040 / PUTR0061
BLOCKLEY	4	0.3	0.066	GB109054039830 / 09882040
CHIPPING CAMPDEN	4	0.3	0.067	GB109054039870 / 09835950
HONEYBOURNE	5	0.6	0.08	Not Available
TETBURY	5	0.6	0.072	GB109053027800 / Z6540110

A.3 Methodology

The contaminants assessed were Biochemical Oxygen Demand (BOD), Ammonia (NH_4) and Phosphate (P).

The selected approach was to use the EA River Quality Planning (RQP) tool in conjunction with their recommended guidance documents: "Water Quality Planning: no deterioration and the Water Framework Directive" and "Horizontal guidance"[1]. This uses a steady state Monte Carlo Mass Balance approach where flows and water quality are sampled from modelled distributions based on data where available.

The data required to run the RQP software were:

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

1 Environment Agency. H1 Environmental risk assessment for permits: overview and annexes. Accessed online at https://www.gov.uk/government/publications/h1-environmental-risk-assessment-for-permits-overview on 17/08/20158.

- Standard deviation for each contaminant

River quality target data:

- No deterioration target
- 'Good status' target

The above data inputs should be based on observations where available. In the absence of observed data EA guidance requires that:

- If the observed WwTW discharge flow and quality data are not available the following values may be used:
  - Flow mean: 1.25*DWF
  - Flow SD: 1/3*mean
  - Quality data: permit values
- If observed river flows were not available these were obtained from an existing model or a low-flows estimation software.
- If observed water quality data were not available these were obtained from an existing model or a neighbouring catchment with similar characteristics.
- Where a treatment works was predicted to lead to a WFD class deterioration, or a deterioration of greater than 10%, or a Good status failure it was necessary to determine a possible future permit value which would prevent a class deterioration or a >10% deterioration or the Good status targets failure. The value was determined using the RQP tool function that calculates the required discharge quality according to the specified river target.

A.4 Study objectives

RQP models were required to be set up and run using the present-day and 2019/20 and 2033/34 growth scenarios, initially based on preferred development sites only. Further analysis considering higher growth scenarios were subsequently undertaken (see section A.10).

The study was required to assess effluent flows from the preferred development sites to assess the impact of the increased contaminant loads on the receiving watercourses due to the extra wastewater flows. These results were required to confirm that there will not be deterioration on the watercourse which will cause a downgrading of the current class for each individual element. This forms the water quality assessment for the Water Cycle Study. Should deterioration result a new permit value was required to be calculated.

Further modelling was required to be undertaken for those WwTWs that are predicted to fail the ‘good status’ target due to the proposed growth in the population that they serve. This was to determine whether improvements are required both upstream as well as at each WwTW.

Addressing existing diffuse pollution is beyond the remit of the WCS, and therefore the analysis was undertaken following the assumption that the upstream diffuse sources of pollution had been addressed (i.e. ‘good status’ achieved upstream). This was achieved by setting the upstream quality at the level of ‘good status’ in the model.

Table 3 below lists all the WwTWs to be assessed together with the actual permits values.

Table 3: WwTWs to be assessed and permitted values

WwTW	Permitted Flow - DWF Max value (m3/d)	Permitted BOD 5 Day ATU 95%ile (mg/l)	Permitted BOD - Max Value (mg/l)	Permitted Ammoniacal Nitrogen as N 95%ile (mg/l)	Permitted Ammoniacal Nitrogen as N Max value (mg/l)	Permitted Phosphate Max value (mg/l)
AMPNEY ST PETER	458	20	Not available	5	Not available	NA
ANDOVERSFORD	295	30	Not available	15	Not available	NA
BOURTON ON THE WATER	3366	20	Not available	2	Not available	NA
BROADWELL	1010	26	Not	3	Not available	NA

			available			
CIRENCESTER	13333	8	Not available	4	Not available	2
FAIRFORD	1433	15	Not available	5	Not available	NA
LECHLADE	1009	15	Not available	3	Not available	NA
MORETON-IN-MARSH	1290	15	Not available	5	Not available	NA
NORTHLEACH	325	30	Not available	3	Not available	NA
TETBURY	1200	20	Not available	10	Not available	NA
BLOCKLEY	813	15	Not available	5	Not available	NA
CHIPPING CAMPDEN	1646	10	Not available	5	Not available	NA
HONEYBOURNE	1630	10	Not available	5	Not available	NA

A.5 Data collection

The datasets required to assess the discharge permits are the following:

- River flow data (received from the EA)
- River quality data (received from the EA)
- Current WwTWs permits (received from the EA and Thames Water)
- RQP tool (received from the EA)
- Existing water quality models (received from the EA)
- Current river classifications (received from the EA)
- 2009 base line and 2013 and 2014 WFD river target for BOD, P and NH_4 (received from the EA, see section A.2)
- EA guidance documents (received from the EA)
- WwTWs flow and quality data (received from Severn Trent Water, Thames Water, Wessex Water)
- WwTWs discharge information (e.g. location, receiving water, etc.) (received from Severn Trent Water, Thames Water, Wessex Water)
- GIS SIMCAT model (received from the EA)

A.6 Input data and results

The input data and RQP results are presented for each WwTW in a summary table. This contains also the source of each value. The WwTWs discharge flow statistics were calculated from the Dry Weather Flow (DWF) provided by all the water companies and as stated in the methodology the mean and standard deviation were estimates using the following relationships:

- Flow mean = 1.25*DWF
- Flow SD = 1/3*mean

Thames Water also provided all the effluent quality data for BOD and NH4. For P data were available only for Cirencester that is the only site with P permit limit. The statistical values were derived from the 2011-13 observed values. For the others sites the data were extracted from the Thames 2009 SIMCAT model. Whilst for BOD and NH4 Thames Water provided a future concentration value according to the future performances, for phosphate the same parameters were used for all the scenarios because this is removed by chemical dosing and therefore it was assumed that the same P reduction performance can be maintained by increasing the dosing.

Severn Trent Water provided 12 sampling measures for the 95%ile for BOD and NH4 for the period 2013-14 for all the three WwTWs they manage (Blockley, Chipping Campden and Honeybourne). Those were used to calculate the current average 95%ile. These averages and the suggested Coefficient of Variation (0.6 for BOD and for NH4) were used as input in the RQP tool function that calculate the mean and SD from a given %ile. For P a mean value obtained from a limited samples before 2009 were provided. The current values were also used for future scenarios on advice from Severn Trent Water.

Wessex Water provided a current mean and SD for BOD, NH4 and P for Tetbury WwTW. The SD for P was calculates as mean/3. The current values so obtained were use also for future scenarios on advice from Wessex Water.

All the upstream river flow data were extracted from the Thames basin SIMCAT model since no low flow estimates were available. For the WwTWs not covered by the model, the three managed by Severn Trent Water and the one managed by Wessex Water the upstream river flow data were calculated with the Low Flows 2 software.

The majority of the river water quality data were also extracted from the Thames basin SIMCAT model (calculated or observed) for two reasons:

- There are no water quality monitoring points upstream of the study WwTWs.
- The number of samples for the period 2009-14 were too low to make a sound statistical analysis.

For the four WwTWs not covered by the Thames basin SIMCAT model the river quality data were extracted from the closest water quality point on the receiving watercourse or alternatively the mid-point of the watercourse's WFD class.

Table 4 shows the number of houses with planning permission, SHLAA strategic, SHLAA preferred and SHLAA reserve for the period 2014/20 and 2021/34 that will be served by each WwTW. The table includes all WwTWs and sites which would be served by private treatment plants or septic tanks. The 13 WwTWs selected for water quality analysis are highlighted in red text. For the scenario 2019/20 (include houses for period 2014 to 2020) and 2033/34 (include houses for period 2014 to 2034) the SLHAA reserve sites were not included. These were included for the additional housing scenario (see section A.10).

Table 4: Number of houses served by each WwTW divided by categories and for the period 2014/20 and 2014/34.

Sewerage Undertaker	Receiving WwTW	Total Planning Permission 2014/20	Total Planning Permission 2014-34	Total SHLAA Preferred 2014/20	Total SHLAA Preferred 2014-34	Total SHLAA Reserve 2014/20	Total SHLAA Reserve 2014-34	Total 2014/20 (Excluding Reserve)	Total 2014/34 (Excluding Reserve)	Total 2014/20	Total 2014/34
Private											
	Septic tank	85	85	0	0	0	0	85	85	85	85
Private Total		**85**	**85**	**0**	**0**	**0**	**0**	85	85	**85**	**85**
Severn Trent Water	AVENING STW	12	12	0	0	0	0	12	12	12	12
	BLOCKLEY (STW)	**9**	**9**	**7**	**51**	**7**	**36**	**16**	**60**	**23**	**96**
	CHIPPING CAMPDEN (STW)	**50**	**50**	**23**	**127**	**1**	**80**	**73**	**177**	**74**	**257**
	HONEYBOURNE STW	**159**	**159**	**15**	**80**	**4**	**25**	**174**	**239**	**178**	**264**
	Nethercote STW	1	1	0	0	0	0	1	1	1	1
Severn Trent Water Total		**231**	**231**	**45**	**258**	**12**	**141**	**276**	**489**	**288**	**630**
Thames Water	**AMPNEY ST PETER STW**	**25**	**25**	**3**	**31**	**0**	**43**	28	56	**28**	**99**
	ANDOVERSFORD STW	**24**	**24**	**8**	**40**	**0**	**0**	32	64	**32**	**64**
	Bibury STW	16	16	0	0	0	0	16	16	16	16
	Bledington STW	6	6	0	0	0	0	6	6	6	6
	Bourton on the Water STW	**632**	**632**	**10**	**10**	**0**	**32**	**642**	**642**	**642**	**674**
	BROADWELL STW	**66**	**66**	**30**	**30**	**0**	**87**	**96**	**96**	**96**	**183**
	CIRENCESTER STW	**603**	**603**	**198**	**2393**	**4**	**119**	**801**	**2996**	**805**	**3115**
	COBERLEY STW	2	2	0	0	0	0	2	2	2	2
	Fairford STW	**362**	**412**	**0**	**0**	**0**	**77**	**362**	**412**	**362**	**489**
	GUITING POWER STW	2	2	0	0	0	0	2	2	2	2
	KEMPSFORD STW	30	30	0	0	0	0	30	30	30	30
	LECHLADE STW	**82**	**82**	**1**	**18**	**0**	**0**	**83**	**100**	**83**	**100**
	LONGBOROUGH STW	1	1	0	0	0	0	1	1	1	1
	Lower Swell STW	6	6	0	0	0	0	6	6	6	6
	MORETON-IN-MARSH STW	**378**	**533**	**0**	**21**	**15**	**150**	**378**	**554**	**393**	**704**
	NAUNTON STW	3	3	0	0	0	0	3	3	3	3
	NORTHLEACH STW	**10**	**10**	**9**	**53**	**0**	**0**	**19**	**63**	**19**	**63**
	TEMPLE GUITING STW	1	1	0	0	0	0	1	1	1	1
	Whittington STW	1	1	0	0	0	0	1	1	1	1
	Withington STW	-2	-2	0	0	0	0	-2	-2	-2	-2
	GREAT RISSINGTON STW	1	1	0	0	0	0	1	1	1	1
Thames Water Total		**2249**	**2454**	**64**	**246**	**19**	**508**	**2508**	**5050**	**2527**	**5558**
Wessex Water	**Tetbury STW**	**661**	**736**	**3**	**27**	**8**	**43**	**664**	**763**	**672**	**806**
Wessex Water Total		**661**	**736**	**3**	**27**	**8**	**43**	**664**	**763**	**672**	**806**

A.6.1 Red / Amber / Green Analysis - WwTWs

The sewerage undertakers 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 works close to its current capacity limit	Further modelling will be required to determine the scale of the WwTW upgrades that may be needed. Capacity can be provided given sufficient time to implement upgrades

A.6.2 WFD Compliance

Compliance against WFD targets for the 2019/20 and 2033/34 scenarios was calculated using the Actual situation as baseline. Compliance / or non-compliance is indicated on the results tables as follows:

Modelled water quality is within the WFD target for the determinand in question.	Modelled water quality does not meet the WFD target for the determinand in question.

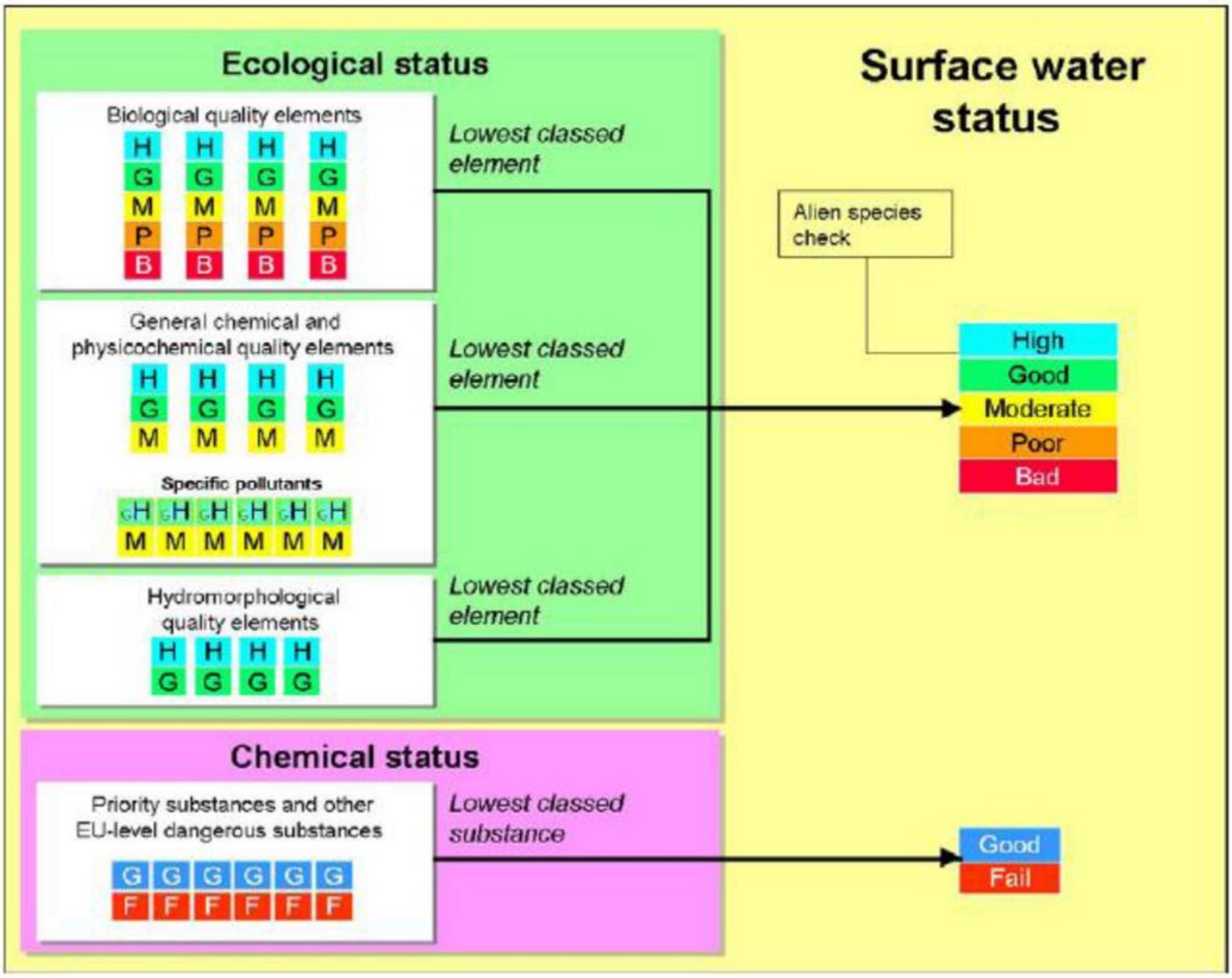
The status of the receiving watercourse is reporting using the same traffic-colour used by the EA "Method statement for the classification of surface water bodies v3" as shown in Figure 1. The 'Ecological status' is defined as the lowest class element between the 'Biological quality elements', the 'General chemical and physicochemical quality elements' and the 'Hydromorphological quality elements'. Each element is classified as bad, poor, moderate, good or high. The 'Chemical status' is defined as the lowest classed substance defined in the 'Priority substances and other EU-level dangerous substances'. Each substance is classified as fail or good.

For each WwTW a summary table (see Table 5) for the receiving watercourse reports the single status for 'NH4' and 'P', the 'Ecological status' that take in consideration also NH4 and P, the 'Chemical status' and the Overall status that takes into consideration both the 'Ecological' and 'Chemical status'. The table reports the baseline status (2009) that represents the first classification made for the watercourse, together with the 2013 or 2014 WFD classifications, and the overall objective for the watercourse.

Table 5: Summary table representing the baseline and 2013 or 14 status watercourse status and its objective.

<table>
<tr><th></th><th>Overall</th><th>Ecological</th><th>Chemical</th><th>Ammonia</th><th>Phosphate</th></tr>
<tr><td>Baseline (2009) status</td><td rowspan="2">Overall watercourse's status</td><td rowspan="2">Ecological watercourse's status</td><td rowspan="2">Chemical watercourse's status</td><td rowspan="2">Watercourse's status for NH4</td><td rowspan="2">Watercourse's status for P</td></tr>
<tr><td>2013 or 14 status</td></tr>
<tr><td>Objective</td><td>Overall watercourse's objective</td><td>Ecological watercourse's objective</td><td>Chemical watercourse's objective</td><td>Watercourse's objective for NH4</td><td>Watercourse's objective for P</td></tr>
</table>

Figure 1: Classification of Surface Water Status from "Method statement for the classification of surface water bodies



A.6.3 Ampney St Peter WwTW

Ampney St Peter WwTW discharges into the Ampney Brook as shown in Figure 2.

The status of the receiving watercourse is summarised in Table 6 below.

Table 6: Ampney Brook River status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Bad	Bad	Not available	High	High
2013 status	Good	Good	Not available	High	High
Objective	Good Status by 2015	Good Status by 2015	Not available	High	High

Figure 2: GIS SIMCAT map of Ampney St Peter discharge location.

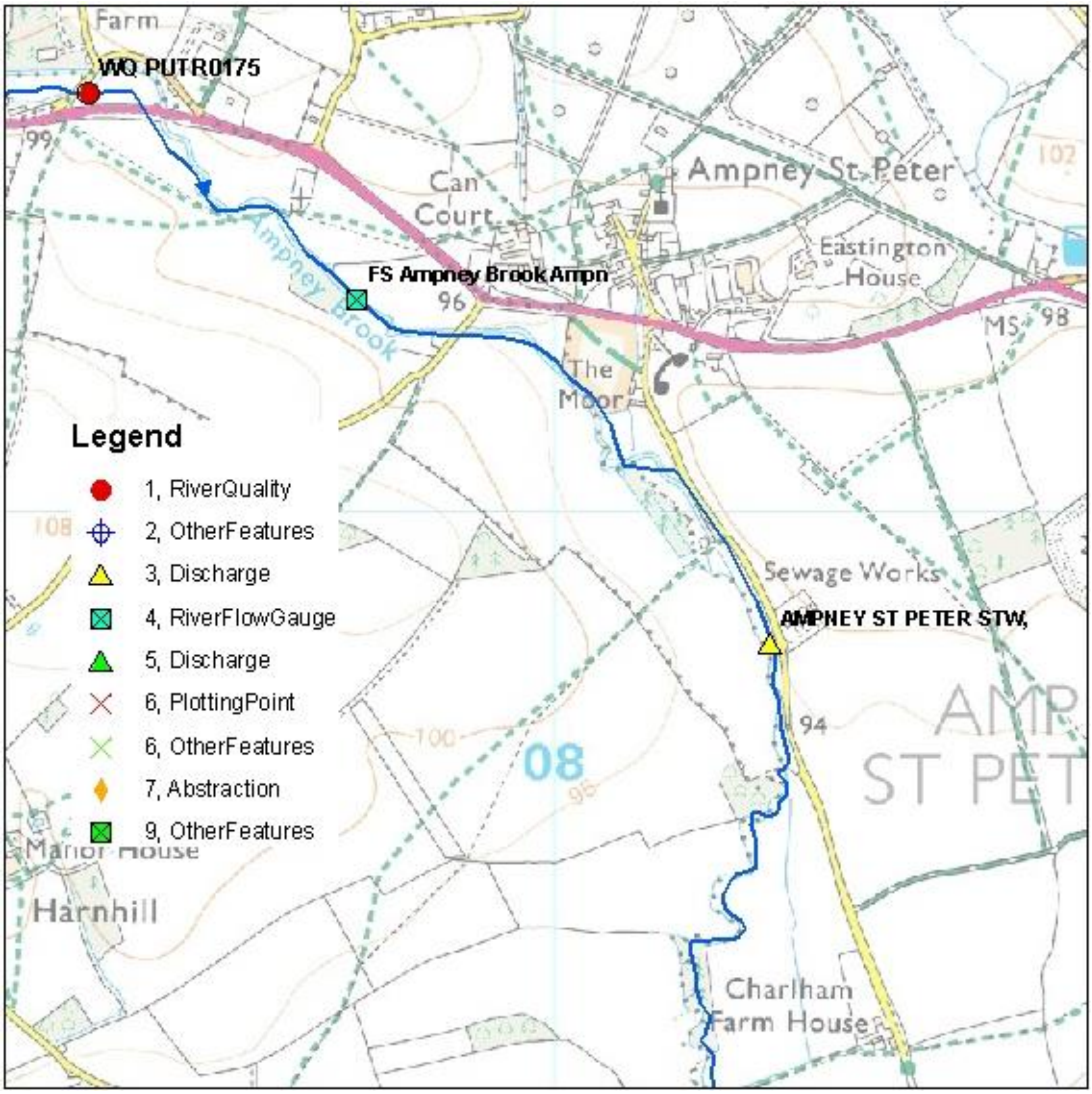


Table 7 shows the input data and RQP results for Ampney St Peter. The works has permitted values for DWF, BOD and ammonia and is currently operating within these permits. Future scenarios predict that the WwTW will be working below such values, and they will not be close to the current capacity.

Table 7: Input data and RQP results for Ampney St Peter WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	53.17	SIMCAT calculated value just upstream STW	0.45	Thames Water	NA	0.45	Thames Water	NA	0.42	Thames Water	NA
	SD			0.15			0.15			0.14		
	5%ile	2.52										
BOD (mg/l)	Mean	0.746	U/s WQ point PUTR0175 from SIMCAT	4.50	Thames Water	1.49	4.55	Thames Water	1.5	4.61	Thames Water	1.49
	SD	0.437										
	95%ile			9.00			9.11			9.22		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.015	U/s WQ point PUTR0175 from 09-13 data	0.60	Thames Water	0.07	0.64	Thames Water	0.07	0.67	Thames Water	0.07
	SD	0										
	95%ile			1.40			1.48			1.57		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.012	U/s WQ point PUTR0175 from SIMCAT	4.85	SIMCAT discharge value	0.18	4.85	SIMCAT discharge value	0.18	4.85	SIMCAT discharge value	0.17
	SD	0.005		1.89			1.89			1.89		
	Target Mean	0.077	2014 WFD									

The upstream water quality (WQ) point is 1.67km from the discharge point. Table 8 below shows the statistics used in SIMCAT and those derived from the observed data:

Table 8: Statistics used in SIMCAT and those derived from the observed data for WQ point PUTR0175

			SIMCAT model				Data 09-13		
WQ point	Distance	Pollutant	Mean	SD	Samples	Distribution	Mean	SD	Samples
PUTR0175	1.67	BOD	0.746	0.437	32	2 Log Normal			0
PUTR0176	1.67	Amm	0.015	0.000	34	1 Normal	0.021	0.016	61 (49<0.03)
PUTR0177	1.67	P	0.012	0.005	34	2 Log Normal	0.019	0.011	15 (8<0.02)

Due to the low number of samples for the period 09-13 the SIMCAT data were used. The EA guidance suggests considering the effect of the natural purification when the upstream point is some distance from the discharge point. However, because the predicted SIMCAT values upstream of the works are relatively close (see Table 9) to the observed values this seems to be negligible. Figure 3 and Figure 4 show the SIMCAT results with a good calibration for all determinands. Phosphate is the only pollutant that breaches the target at the discharge point.

Table 9: SIMCAT calculated values immediately upstream of the WwTW.

SIMCAT calculated values		
Pollutant	**Mean**	**SD**
BOD	0.824	0.504
Amm	0.014	0.010
P	0.009	0.004

The RQP results confirm that the upstream WFD target for phosphate is not achieved for the present day situation and the future scenarios. No deterioration is achieved for all of the pollutants except for the 2019/20 scenario for BOD with a deterioration of 1%.

The RQP function was used to calculate the required discharge quality in order to meet the river target using the present day situation as input data. The results in Table 10 show that the target can be achieved using BAT (for P this is a mean of 0.5mg/l):

Table 10: WwTW discharge quality required to meet WFD targets - Ampney St Peter WwTW.

Pollutant	Target	Mean	SD	95%ile
P	0.08	1.91	0.73	3.28

Figure 3: SIMCAT result for flow and phosphate.

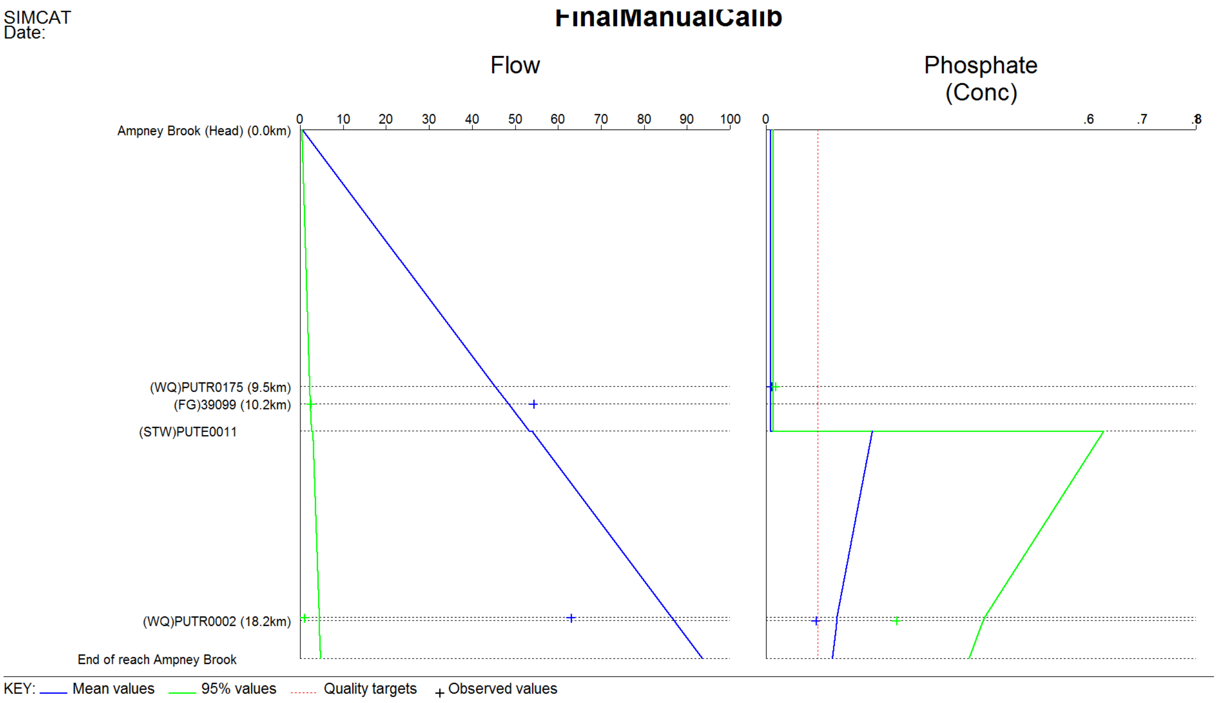
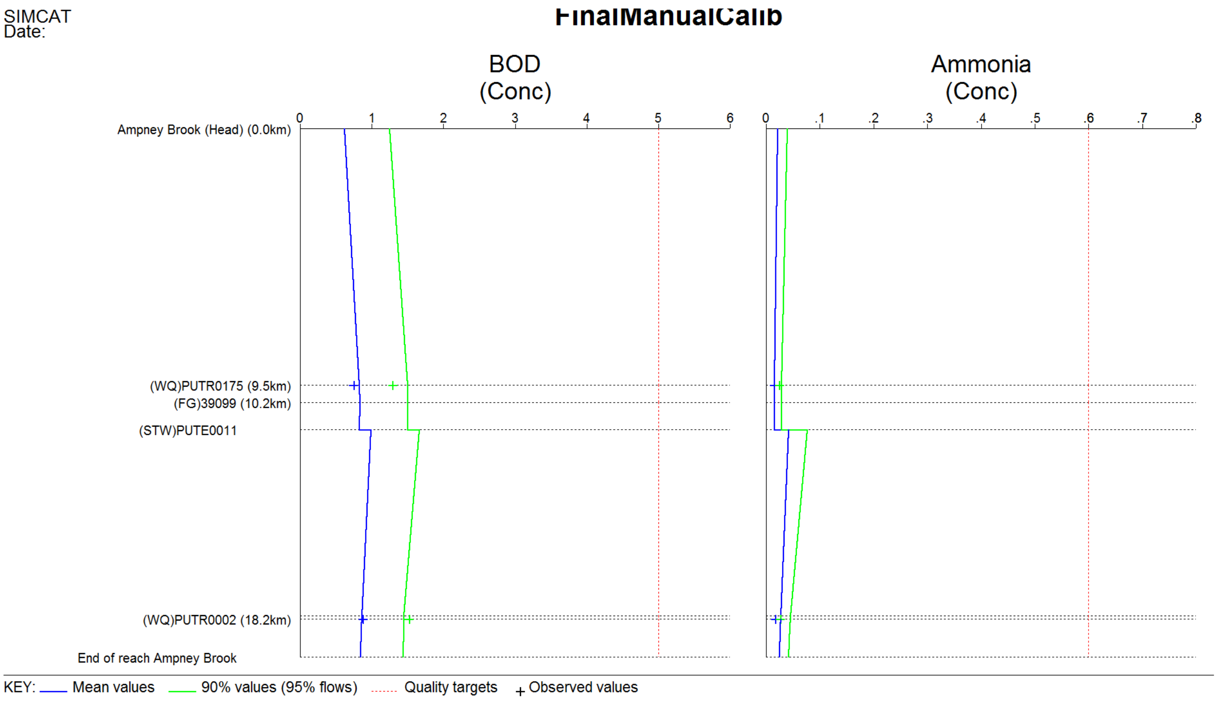


Figure 4: SIMCAT result for BOD and Ammonia.



A.6.4 Andoversford WwTW

Andoversford WwTW discharges into the River Coln as shown in Figure 5.

The status of the receiving watercourse is summarised in the Table 11 below:

Table 11: River Coln status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Poor	Poor	Good	High	High
2013 status	Moderate	Moderate	Good	High	High
Objective	Good Status by 2027	Good Status by 2027	High Status by 2015	High	High

Figure 5: GIS SIMCAT map of Andoversford discharge location.

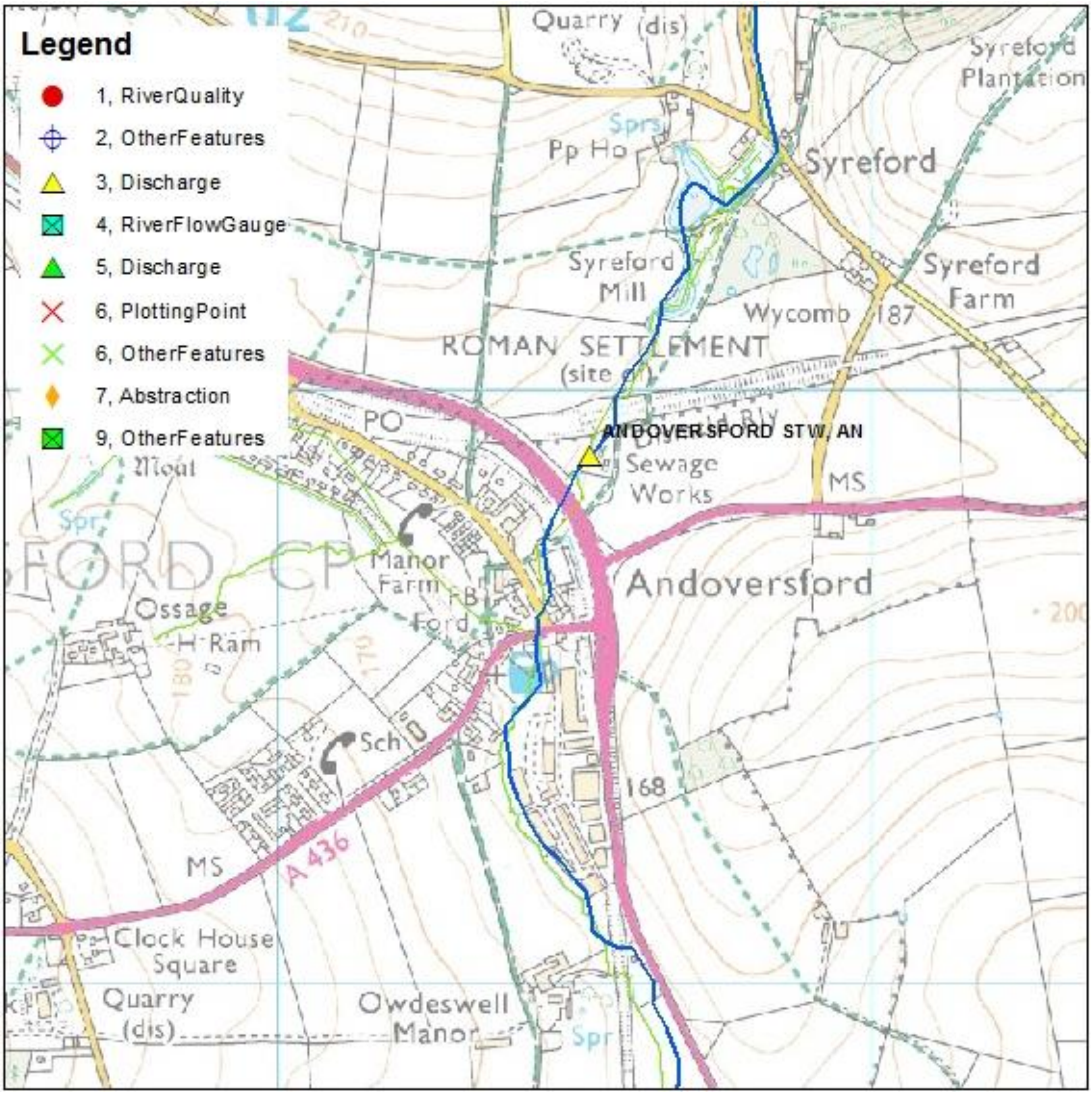


Table 12 shows the input data and RQP results for Andoversford. The works has permit values for DWF, BOD and ammonia and is currently operating within its permits. Future scenarios predict that the WwTW will continue to operate within its permit for DWF, BOD but for NH4 it will reach its capacity for 2019/20 scenario and will exceed it for the 2033/34 scenario.

Table 12: Input data and RQP results for Andoversford WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	17.35	SIMCAT calculated value just upstream STW	0.18	Thames Water	NA	0.2	Thames Water	NA	0.2	Thames Water	NA
	SD			0.06			0.06			0.06		
	5%ile	1.59										
BOD (mg/l)	Mean	1.029	SIMCAT calculated value just upstream STW	5.00	Thames Water	1.74	5.20	Thames Water	1.77	5.40	Thames Water	1.79
	SD	0.456										
	95%ile			10.00			10.40			10.81		
	Target 90%ile	5	2013 WFD									
Amm (mg/l)	Mean	0.029	SIMCAT calculated value just upstream STW	3.00	Thames Water	0.23	3.60	Thames Water	0.29	4.21	Thames Water	0.34
	SD	0.023										
	95%ile			8.00			9.60			11.22		
	Target 90%ile	0.6	2013 WFD									
P (mg/l)	Mean	0.04	SIMCAT calculated value just upstream STW	3.83	SIMCAT discharge value	0.14	3.83	SIMCAT discharge value	0.15	3.83	SIMCAT discharge value	0.15
	SD	0.011		1.43			1.43			1.43		
	Target Mean	0.08	2013 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model presents a good calibration downstream of the discharge point whilst indicating a failure for phosphate. The calibration results are shown in Figure 6 and Figure 7.

The RQP model predicts as well that phosphate fails it target for the present-day situation and both future scenarios. There is a 2% and 3% deterioration for BOD for 2019/20 and 2033/34 scenarios respectively; 26% and 48% for ammonia for 2019/20 and 2033/34 scenarios respectively; and 7% deterioration for phosphate for both 2020 and 2034.

The RQP function was used to calculate the required discharge quality for P in order to meet the river target using the present day situation as input data. The results in Table 13 show that the target can be achieved using BAT (for P this is a mean of 0.5mg/l):

Table 13: WwTW discharge quality required to meet WFD targets - Andoversford WwTW.

Pollutant	Target	Mean	SD	95%ile
P	0.08	1.55	0.57	2.61

New permit values were calculated for the determinands that present a deterioration of more than 10% or a class deterioration. These were calculated using as river target the present day concentration in the river plus a 10% deterioration or, if there was a class deterioration, the limit of the current class. Table 14 shows the result for NH4 where the present day concentration + 10% deterioration was used because there is no class deterioration. The permit values can be achieved with BAT for ammonia since this is a 95%ile of 1mg/l.

Table 14: WwTW discharge quality required to meet up to 10% or no class deterioration for Andoversford WwTW.

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	-	-	-	-	-
Ammonia	2033/34	0.25	3.09	2.64	8.14
Phosphate	-	-	-	-	-

Figure 6: SIMCAT result for flow and phosphate.

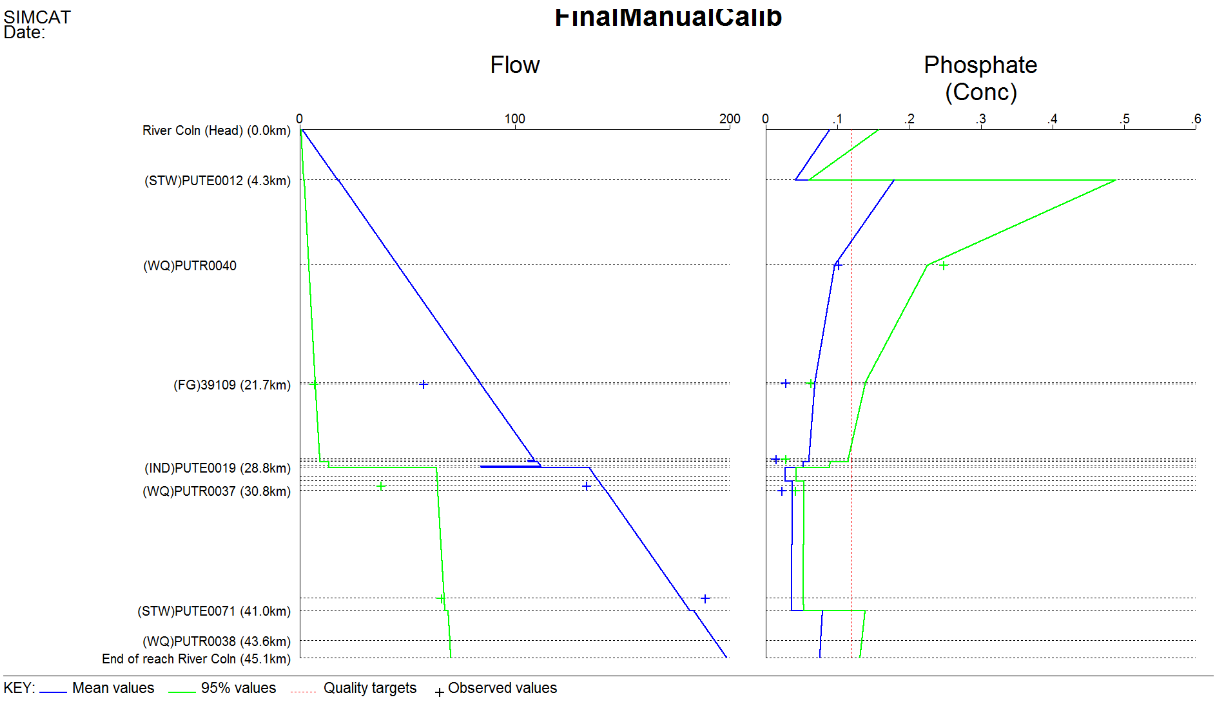
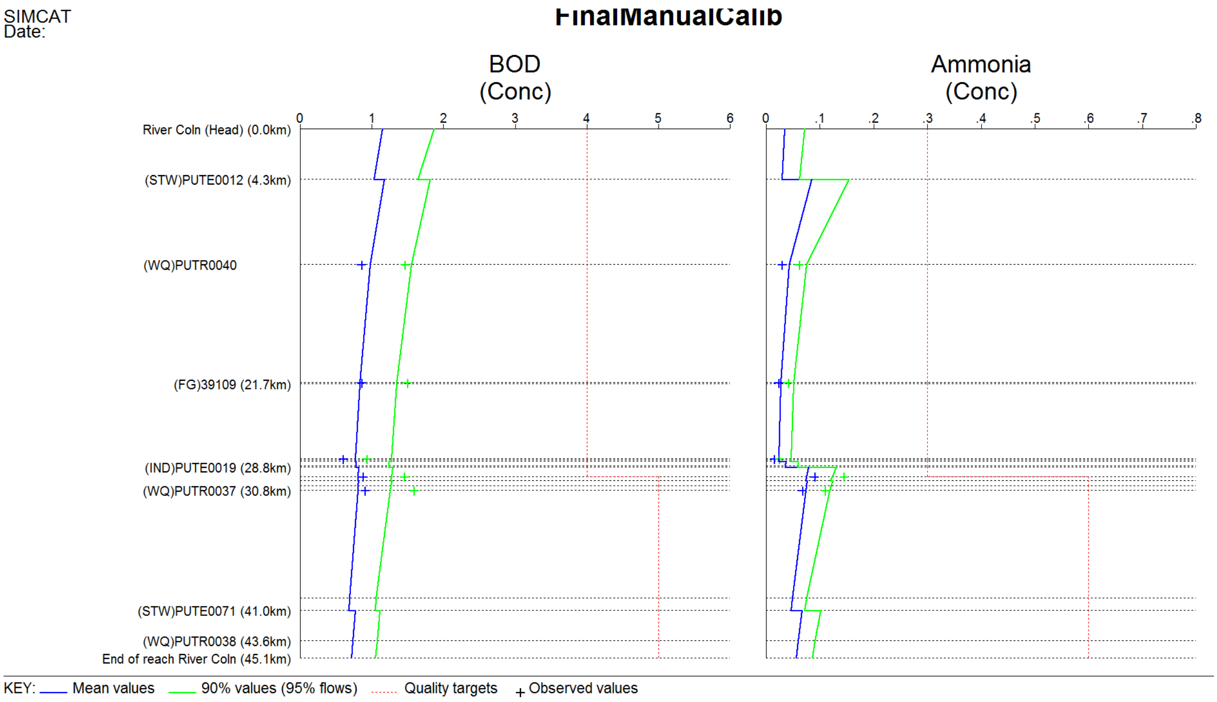


Figure 7: SIMCAT result for BOD and Ammonia.



A.6.5 Blockley WwTW

Blockley WwTW discharges into the River Dikler as shown in Figure 8.

The status of the receiving watercourse is summarised in the Table 15 below:

Table 15: River Dikler status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Not available	High	High
2013 status	Moderate	Moderate	Not available	High	Moderate
Objective	Good Status by 2027	Good Status by 2027	Not available	High	High

Figure 8: Map of Blockley discharge location. Not included in GIS SIMCAT.

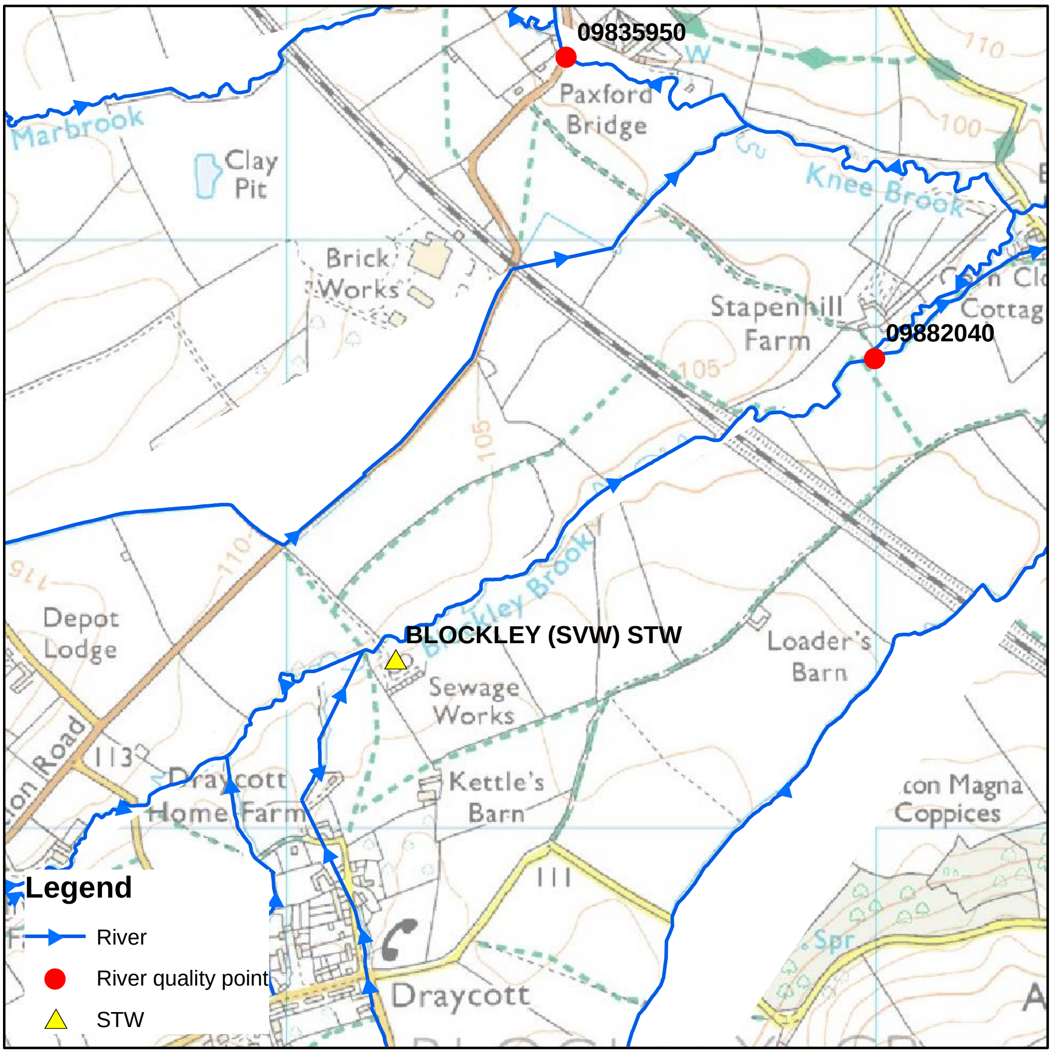


Table 16 shows the input data and RQP results for Blockley. The works has permitted values for DWF, BOD and ammonia and currently is operating within its permits for DWF, BOD. It will work at its DWF permit for both future scenarios. Severn Trent Water has not provided any predicted performance for future scenarios so the current values have been used for those.

Table 16: Input data and RQP results for Blockley WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	0.133	Low flow software	0.89	Severn Trent Water	NA	0.89	Severn Trent Water	NA	0.91	Severn Trent Water	NA
	SD			0.30			0.30			0.30		
	5%ile	0.023										
BOD (mg/l)	Mean	1.041	D/s WQ point 09882040 from 04-07	1.64	Severn Trent Water	2.69	1.64	Severn Trent Water	2.69	1.64	Severn Trent Water	2.7
	SD	0.517										
	95%ile			3.50			3.50			3.50		
	Target 90%ile	4	2014 WFD									
Amm (mg/l)	Mean	0.072	D/s WQ point 09882040 from 09-14	0.52	Severn Trent Water	0.98	0.52	Severn Trent Water	0.98	0.52	Severn Trent Water	0.98
	SD	0.067										
	95%ile			1.44			1.44			1.44		
	Target 90%ile	0.3	2014 WFD									
P (mg/l)	Mean	0.075	D/s WQ point 09882040 from 09-14	2.84	Severn Trent Water	2.56	2.84	Severn Trent Water	2.56	2.84	Severn Trent Water	2.57
	SD	0.07		0.95			0.95			0.95		
	Target Mean	0.066	2014 WFD									

The Thames basin SIMCAT model does not include this works or watercourse. The Severn basin SIMCAT model was not available to this study. River flow were calculated using the Low Flows 2 software. There is a WQ point approximately 1km downstream from the discharge point and this has been used to assign the river quality data. Table 17 below shows the statistics derived from the observed data provided.

Table 17: Statistics derived from the observed data for WQ Point 09882040.

			Data 04-14			
WQ point	Distance	Pollutant	Mean	SD	Samples	Data Period
9882040	circa 1km	BOD	1.041	0.517	51 (16<1, 3<1.39, 1<1.63)	2004-07
9882040	circa 1km	Amm	0.072	0.067	66 (12<0.03)	2009-14
9882040	circa 1km	P	0.075	0.07	33	2009-14

The RQP model predicts that the WwTW fails to meet the river targets for NH4 and P for the present day situation and the future scenarios. However the 'no deterioration' target is achieved. Looking at the observed data for the WQ point downstream of the works it appears that the results obtained are overestimating the real situation and this is likely to be due to:

- the use of the WQ point downstream of the works that already includes the impact of the WwTW potentially could imply that its effect is double counted if this watercourse has a low purification effect and/or,

- the Low Flows 2 software gives an underestimated value of the 5%ile river flow.

However the main aim of this analysis is to compare the effect on the river of the future growth against the present situation and this predicts virtually no deterioration due to the increased effluent discharges.

The RQP function to calculate the required discharge quality in order to meet the river target using the present day situation for ammonia and P as input data gives the following results:

Table 18: WwTW discharge quality required to meet WFD targets - Blockley WwTW

Pollutant	Target	Mean	SD	95%ile
Amm	0.3	0.16	0.15	0.44
P	0.07	0.06	0.02	0.1

Since the river target could not be reached for P and ammonia with Best Available Technology (BAT) (for P this is a mean of 0.5mg/l, for ammonia this is a 95%ile of 1mg/l) using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has GES for P. For ammonia the river quality upstream for the present-day situation already meets GES (a mean of 0.066 and a SD of 0.022 for phosphate). The worst case future scenario was modelled first to verify whether the river target could be achieved with BAT applied. The other scenarios were modelled if this was not achieved. The present day was not modelled since it is the same as for 2019/20 scenario. The targets for P were not reached in any of the scenarios as shown in Table 19 even when GES was assumed upstream of the discharge point.

Table 19: Good upstream quality results

Scenario	Pollutant	Target	Mean	SD	95%ile
2030/31	P	0.066	0.07	0.02	0.11
2019/20	P	0.066	0.07	0.02	0.11

A.6.6 Bourton on the Water WwTW

Bourton on the Water WwTW discharges into the River Dikler as shown in Figure 9.

The status of the receiving watercourse is summarised in the Table 20 below:

Table 20: River Dikler status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Good	Good	Not available	High	Good
2013 status	Moderate	Moderate	Not available	High	High
Objective	Good Status by 2015	Good Status by 2015	Not available	High	Good

Figure 9: GIS SIMCAT map of Bourton on the Water discharge location.

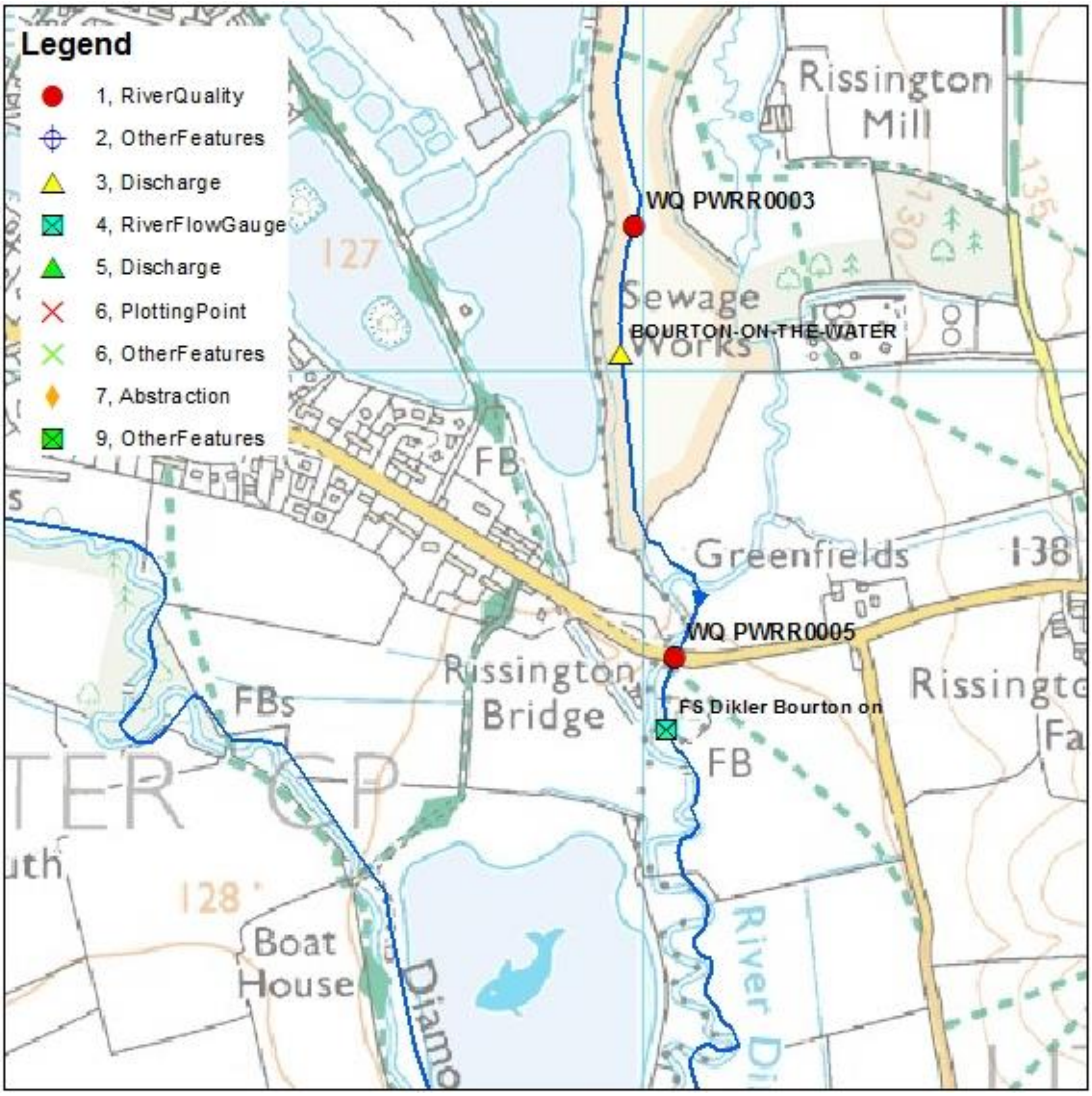


Table 21 shows the input data and RQP results for Bourton on the Water. The works has permitted values for DWF, BOD and ammonia and it is currently working within its permits.

Future scenarios predict that the WwTW will continue to operate within its permit for DWF and BOD but for NH4 it will exceed it for the 2019/20 scenario.

Table 21: Input data and RQP results for Bourton on the Water WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	85	SIMCAT calculated value just upstream STW	2.94	Thames Water	NA	3.15	Thames Water	NA	NA	NA	NA
	SD			0.98			1.05			NA		
	5%ile	18.6										
BOD (mg/l)	Mean	0.91	U/s WQ point PWRR0003 from 09-14	5.00	Thames Water	1.94	5.60	Thames Water	2.03	NA	NA	NA
	SD	0.7										
	95%ile			10.00			11.20			NA		
	Target 90%ile	4	2014 WFD									
Amm (mg/l)	Mean	0.018	U/s WQ point PWRR0003 from SIMCAT	0.40	Thames Water	0.07	0.72	Thames Water	0.11	NA	NA	NA
	SD	0.01										
	95%ile			1.20			2.16			NA		
	Target 90%ile	0.3	2014 WFD									
P (mg/l)	Mean	0.04	U/s WQ point PWRR0003 from SIMCAT	2.72	SIMCAT discharge value	0.18	2.72	SIMCAT discharge value	0.19	NA	NA	NA
	SD	0.078		1.15			1.15			NA		
	Target Mean	0.061	2014 WFD									

There is an upstream WQ point 0.14km from the discharge point and Table 22 below shows the statistics used in SIMCAT and those derived from the observed values provided:

Table 22: Statistics used in SIMCAT and those derived from the observed data for WQ point PWRR0003.

			SIMCAT model				Data 09-14		
WQ point	Distance	Pollutant	Mean	SD	Samples	Distribution	Mean	SD	Samples
PWRR0003	0.14km	BOD	0.960	0.603	32	2 Log Normal	0.911	0.69	58 (31<1)
PWRR0003	0.14km	Amm	0.018	0.010	31	2 Log Normal	not enough data	not enough data	61 (59<0.03)
PWRR0003	0.14km	P	0.040	0.078	32	2 Log Normal	not enough data	not enough data	61 (52<0.02)

Due to the low number of samples for the period 2009/14 the SIMCAT data was used. The EA guidance suggests considering the effect of the natural purification when the upstream point is some distance from the discharge point, however, considering the short distance, this can be considered negligible. Figure 10 and Figure 11 show the SIMCAT results with a good calibration for all determinands. For P it looks like it was no possible to match both upstream and downstream WQ observed data. P is the only pollutant that breaches the target at the discharge point. The RQP results confirm that P is still not reaching its target for the present-day situation and future scenarios and indicates that ammonia also fails to reach its targets for all scenarios. There is a 5% deterioration for BOD, a 57% deterioration for NH4 and a 6% deterioration for P for the 2019/20 scenario.

The RQP function has been used to calculate the required discharge quality in order to meet the river target using present day situations. The results are shown in Table 23:

Table 23: WwTW discharge quality required to meet WFD targets - Bourton on the Water WwTW

Pollutant	Target	Mean	SD	95%ile
P	0.06	0.44	0.18	0.79

The river target could be reached for P with BAT (for P this is a mean of 0.5mg/l) since the model result (mean of 0.44) is close to the 10% of the model tolerance / variability.

New permit values were calculated for the determinands that present a deterioration of more than 10% or a class deterioration. These were calculated using as river target the present day concentration in the river plus a 10% deterioration or, if there was a class deterioration, the limit of the current class. Table 24 shows the result for NH4 where the present day concentration + 10% deterioration was used because there is no class deterioration. No-deterioration can be achieved with BAT for ammonia since this is a 95%ile of 1mg/l.

Table 24: 'No Deterioration' Permit Values for Bourton on the Water

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	-	-	-	-	-
Ammonia	2019/20	0.08	0.49	0.52	1.47
Phosphate	-	-	-	-	-

Figure 10: SIMCAT result for flow and phosphate.

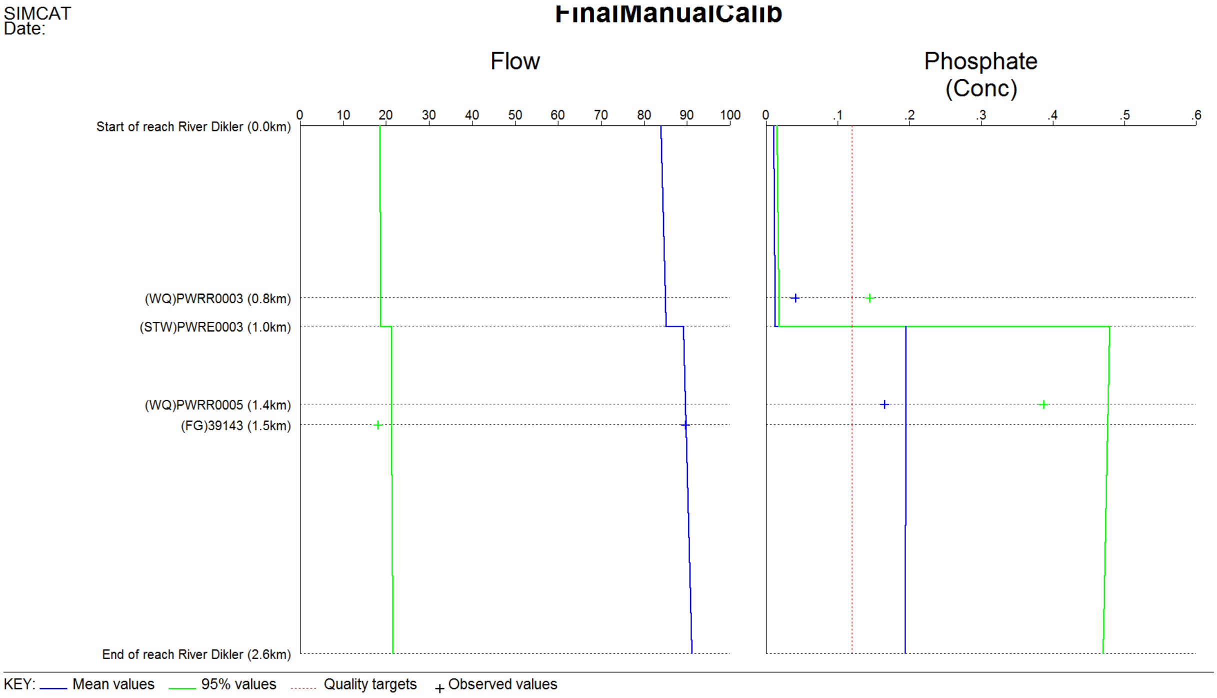
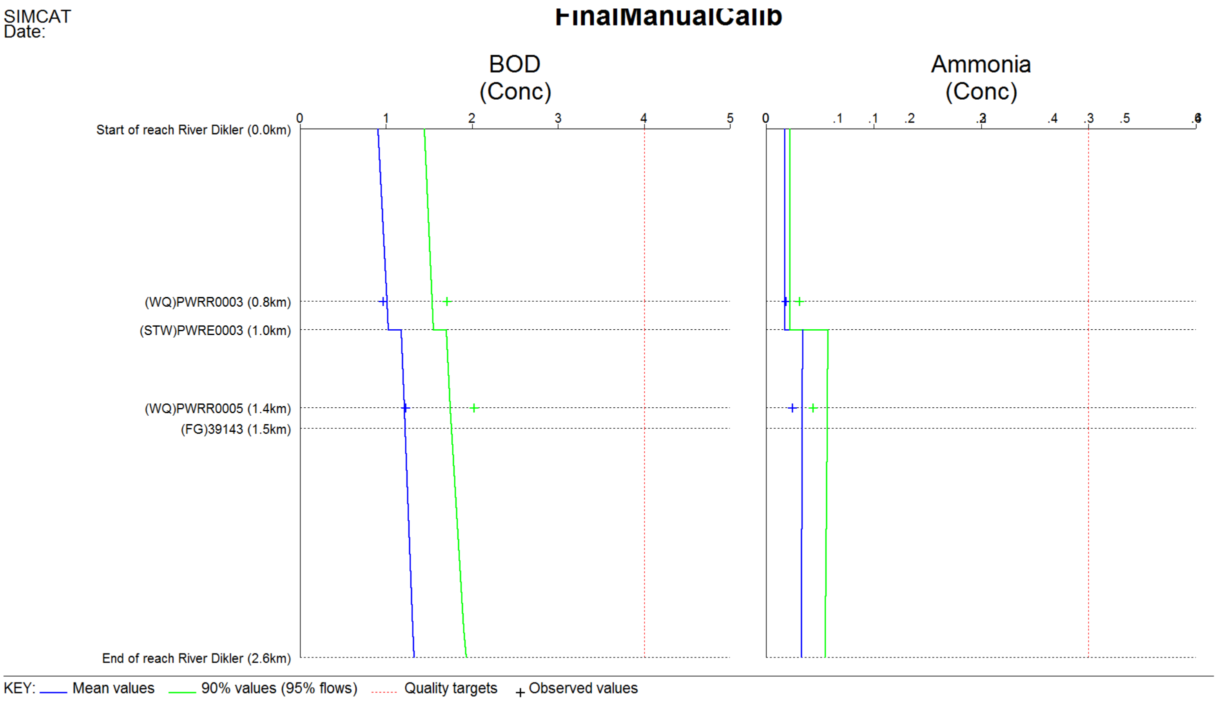


Figure 11: SIMCAT result for BOD and Ammonia.



A.6.7 Broadwell WwTW

Broadwell WwTW discharges into the River Evenlode as shown in Figure 12.

The status of the receiving watercourse is summarised in the Table 25 below:

Table 25: River Evenlode status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Good	Good	Poor
2013 status	Moderate	Moderate	Good	High	Poor
Objective	Good Status by 2027	Good Status by 2027	High Status by 2015	Good	Poor: Disproportionately expensive (P1b)

Figure 12: GIS SIMCAT map of Broadwell discharge location.

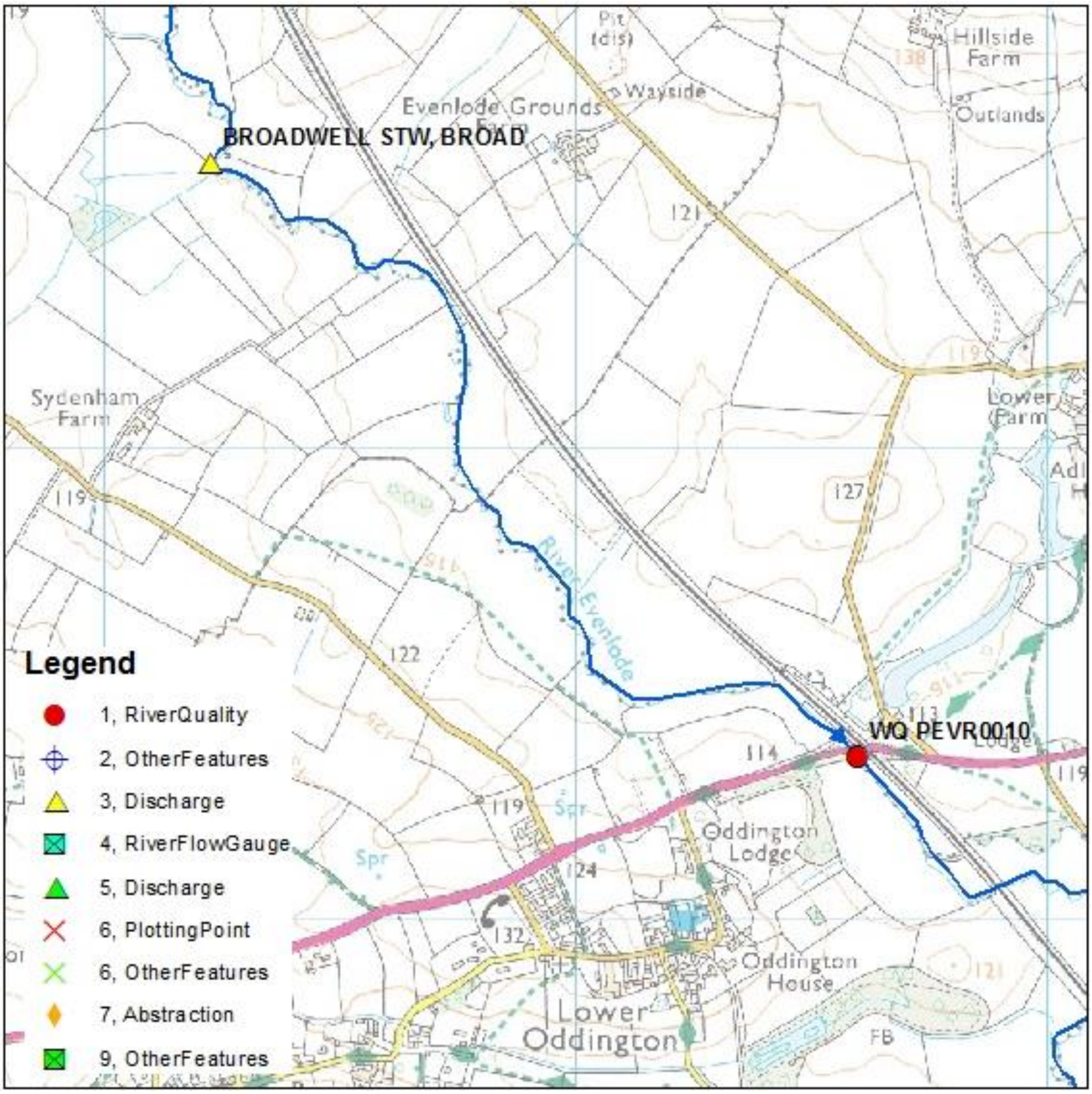


Table 26 shows the input data and RQP results for Broadwell. The works have permit values for BOD and ammonia and currently it is operating within its permits. Future predictions predict that the WwTW will continue to operate within its permits for BOD but it will be close to its current capacity for NH4.

Table 26: input data and RQP results for Broadwell WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	48.77	SIMCAT calculated value just upstream STW	0.74	Thames Water	NA	0.76	Thames Water	NA	NA	NA	NA
	SD			0.25			0.25			NA		
	5%ile	8.14										
BOD (mg/l)	Mean	1.275	SIMCAT calculated value just upstream STW	4.00	Thames Water	2.29	4.09	Thames Water	2.3	NA	NA	NA
	SD	0.802										
	95%ile			8.00			8.18			NA		
	Target 90%ile	4	2014 WFD									
Amm (mg/l)	Mean	0.118	SIMCAT calculated value just upstream STW	0.80	Thames Water	0.21	0.89	Thames Water	0.21	Na	NA	NA
	SD	0.049										
	95%ile			2.00			2.23			NA		
	Target 90%ile	0.3	2014 WFD									
P (mg/l)	Mean	0.404	SIMCAT calculated value just upstream STW	4.76	SIMCAT discharge value	0.52	4.76	SIMCAT discharge value	0.53	NA	NA	NA
	SD	0.285		1.14			1.14			NA		
	Target Mean	0.065	2014 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model present a good calibration with a slight overestimation for P and NH4 as shown in Figure 13 and Figure 14, and indicates a failure for phosphate upstream and downstream the WwTW.

The RQP results confirm that the watercourse fails its targets for P for the present day situation and for the future scenario. There is no deterioration for either BOD or ammonia, but there is a 2% deterioration for phosphate for the 2019/20 scenario.

The RQP function has been used to calculate the required discharge quality in order to meet the river target for P. The RQP reported that "the river target is not achievable without improving the upstream water quality".

Since the river target could not be reached for P using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has Good Ecological Status (GES). A mean of 0.065 and a SD of 0.0216 for phosphate were used. The worst case scenario was modelled first, to verify if the river target could be achieved with the Best Available Technology (BAT) (for P this is a mean of 0.5mg/l). The other scenarios were modelled if this was not achieved. Table 27 shows that the required target cannot be achieved for any of the scenarios with BAT even when assuming GES upstream of the discharge point.

Table 27: Permit values required to meet river targets assuming GES upstream

Scenario	Pollutant	Target	Mean	SD	95%ile
2019/20	P	0.065	0.06	0.01	0.08
Present	P	0.065	0.05	0.01	0.08

Figure 13: SIMCAT result for flow and phosphate.

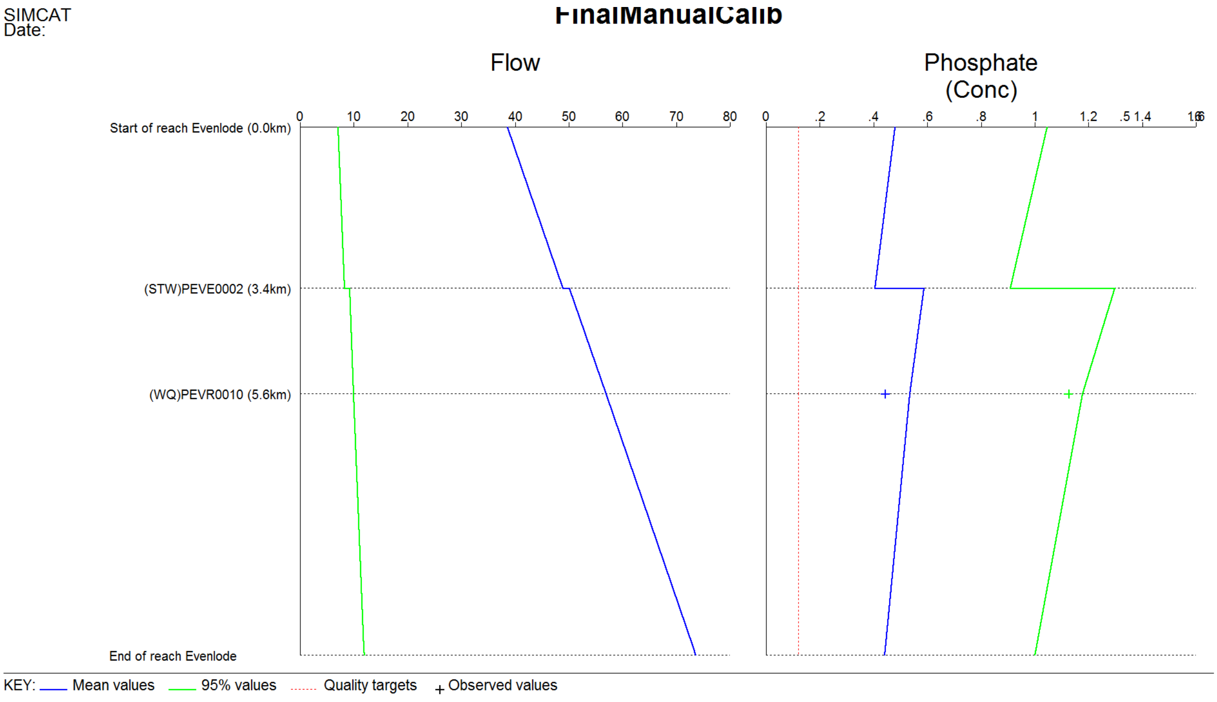
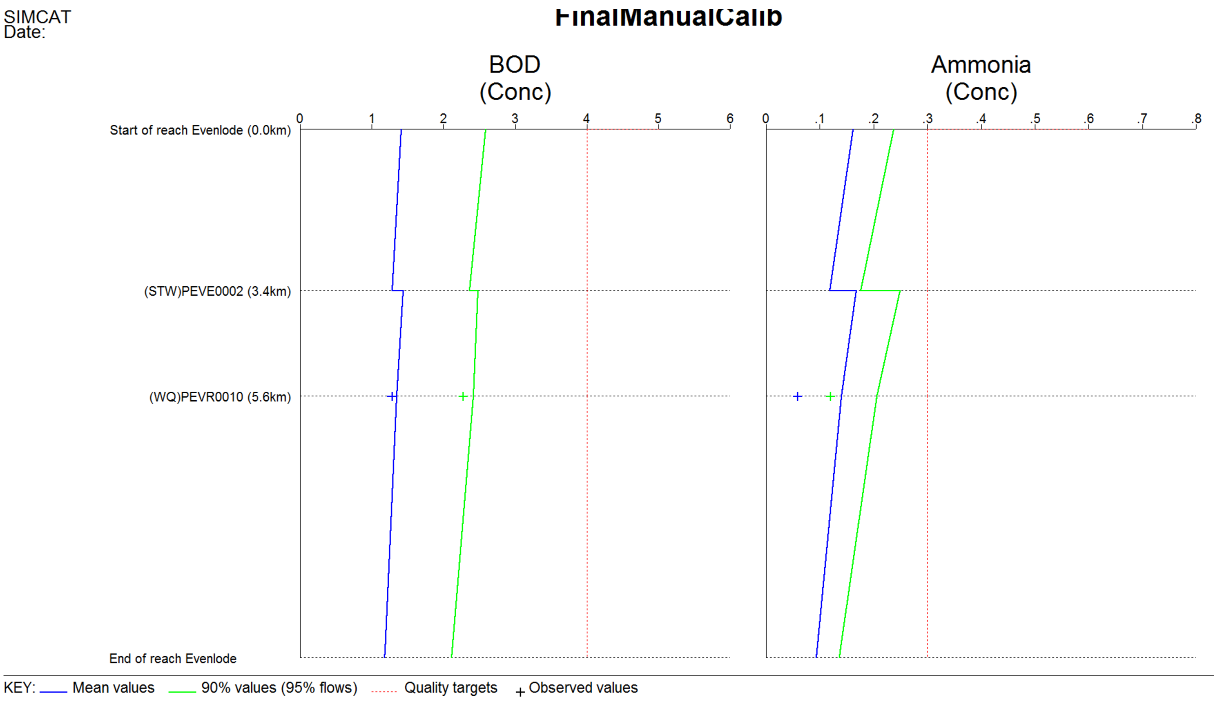


Figure 14: SIMCAT result for BOD and Ammonia.



A.6.8 Chipping Campden WwTW

Chipping Campden WwTW discharges into The Cam as shown in Figure 15.

The status of the receiving watercourse is summarised in the Table 28 below:

Table 28: The Cam River status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Not available	Good	Poor
2013 status	Moderate	Moderate	Not available	High	Poor
Objective	Good Status by 2027	Good Status by 2027	Not available	Good	Poor: disproportionately expensive (P1a)

Figure 15: Map of Chipping Campden discharge location. Not included in GIS SIMCAT

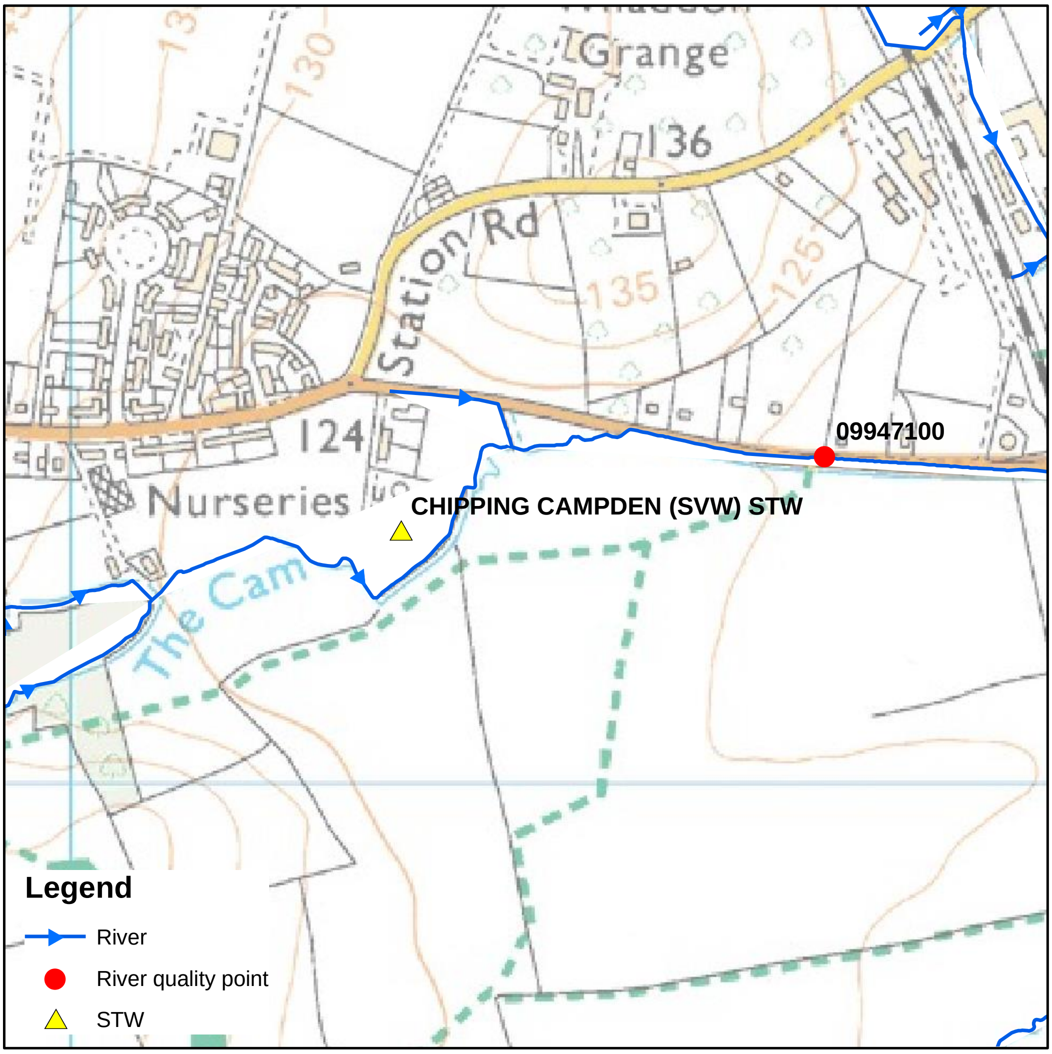


Table 29 shows the input data and RQP results for Chipping Campden. The works has permit values for DWF, BOD and NH4 and is currently operating within its permits. It will reach its DWF capacity for 2019/20 scenario and it will exceed it for 2033/34 scenario. However, Severn Trent advised that there is "reasonable spare capacity at this treatment works". Severn Trent Water has not provided any predicted performance for future scenarios so the current values have been used for those.

Table 29: input data and RQP results for Chipping Campden WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	0.093	Low flow software	1.17	Severn Trent Water	NA	1.24	Severn Trent Water	NA	1.27	Severn Trent Water	NA
	SD			0.39			0.41			0.42		
	5%ile	0.016										
BOD (mg/l)	Mean	1.466	D/s WQ point 09947100 from 05-08	0.97	Severn Trent Water	1.74	0.97	Severn Trent Water	1.74	0.97	Severn Trent Water	1.73
	SD	0.937										
	95%ile			2.08			2.08			2.08		
	Target 90%ile	4	2014 WFD									
Amm (mg/l)	Mean	0.149	D/s WQ point 09947100 from 05-08	0.10	Severn Trent Water	0.21	0.10	Severn Trent Water	0.21	0.10	Severn Trent Water	0.21
	SD	0.12										
	95%ile			0.28			0.28			0.28		
	Target 90%ile	0.3	2014 WFD									
P (mg/l)	Mean	0.608	D/s WQ point 09947100 from 05-08	2.28	Severn Trent Water	2.2	2.28	Severn Trent Water	2.21	2.28	Severn Trent Water	2.21
	SD	0.409		0.76			0.76			0.76		
	Target Mean	0.067	2014 WFD									

The Thames basin SIMCAT model does not include this works. The Severn basin SIMCAT model was not available to this study. River flows were calculated using the Low Flows 2 software. There is a WQ point approximately 0.4km downstream from the discharge point and this has been used to assign the river quality data. Table 30 below shows the statistics derived from the observed data provided:

Table 30: Statistics derived from the observed data for WQ point 09947100.

			Data 05-08. No data available after 2008		
WQ point	**Distance**	**Pollutant**	**Mean**	**SD**	**Samples**
9947100	circa 0.4km	BOD	1.466	0.937	51 (16<1, 3<1.39, 1<1.63)
9947100	circa 0.4km	Amm	0.149	0.12	66 (12<0.03)
9947100	circa 0.4km	P	0.608	0.409	33

The RQP model predicts that the WwTW fails to meet the river targets for P for the present day situation and the future scenarios. However the 'no deterioration' target is achieved. Looking at the observed data for the WQ point downstream of the works and the river classification for NH4 and P it seems that the assumption made might represent quite well the actual river condition. The determinands concentration might be overestimating the real situation and this may be due to:

- the use of the WQ point downstream of the works that include already the impact of the WwTW potentially could imply that its effect is potentially double counted if this watercourse has a low de-purification effect, and/or;
- the Low Flows 2 software underestimates the 5%ile river flow.

However the main aim of this analysis is to compare the effect on the river of the future growth against the present situation and this shows that virtually there is no deterioration due to it.

The RQP function was used to calculate the required discharge quality in order to meet the river target using the present day situation. Table 31 shows the results.

Table 31: WwTW discharge quality required to meet WFD targets - Chipping Campden

Pollutant	Target	Mean	SD	95%ile
P	0.07	0.03	0.01	0.05

Since the river target could not be reached for P with BAT (for P this is a mean of 0.5mg/l) using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has GES (A mean of 0.067 and a SD of 0.02 for P). The worst case scenario was modelled first, to see if this would reach the target with BAT. The other scenarios were modelled if this was not achieved. Table 32 shows that the required target cannot be achieved for any of the scenarios with BAT even when assuming GES upstream of the discharge point.

Table 32: Permit values required to meet river targets assuming GES upstream

Scenario	Pollutant	Target	Mean	SD	95%ile
2033/34	P	0.067	0.07	0.02	0.11
2019/20	P	0.067	0.07	0.02	0.11
Present	P	0.067	0.07	0.02	0.11

A.6.9 Cirencester WwTW

Cirencester WwTW discharges into the Cerney Wick Brook as shown in Figure 16.

The status of the receiving watercourse is summarised on the Table 33 below:

Table 33: River Cerney Wick Brook status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Poor	Poor	Good	High	Bad
2013 status	Poor	Poor	Good	High	Bad
Objective	Good Status by 2027	Good Status by 2027	High Status by 2015	High	Bad: Disproportionately expensive (P1b)

Figure 16: GIS SIMCAT map of Cirencester discharge location.

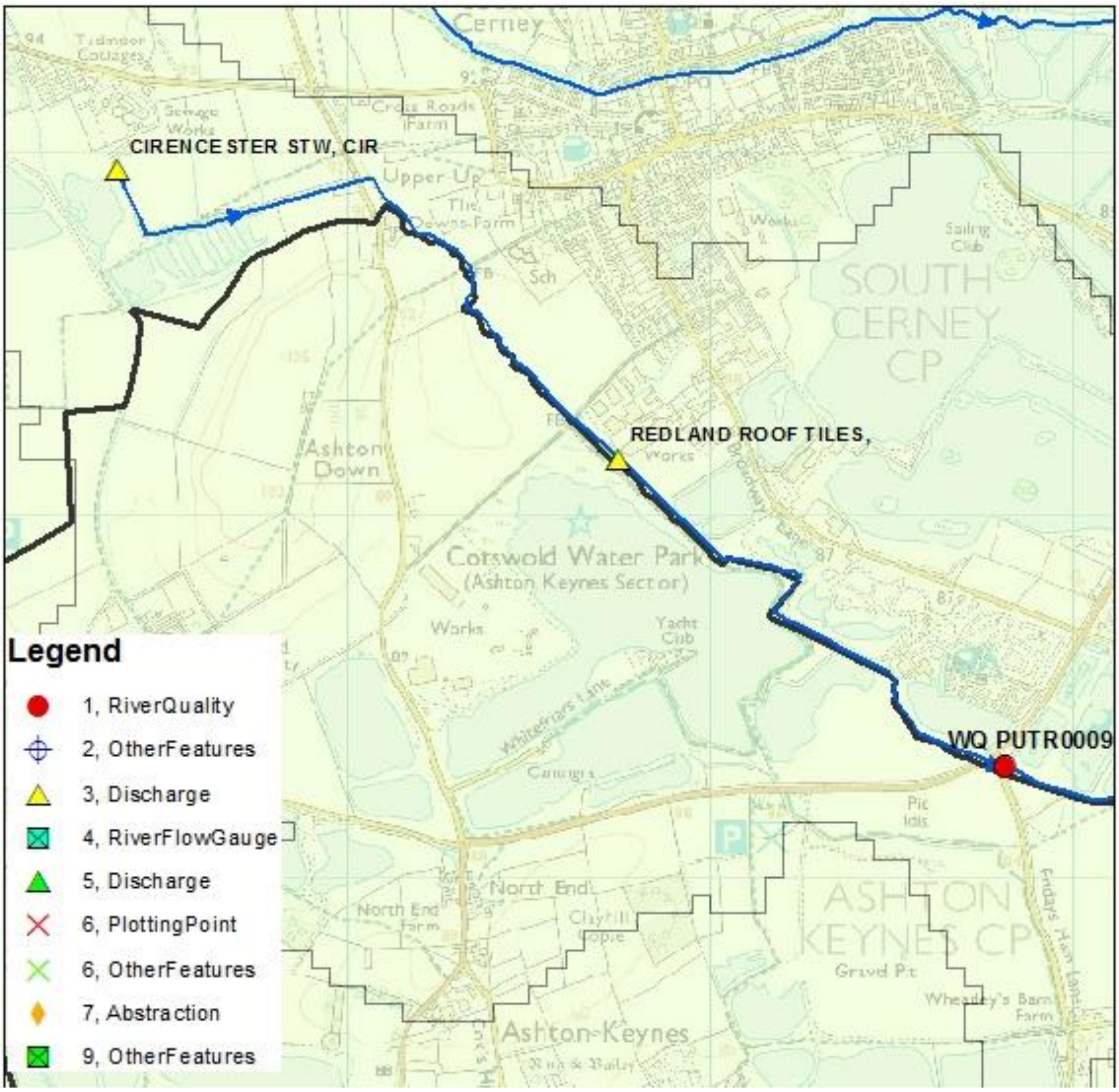


Table 34 shows the input data and RQP results for Cirencester. The works has permitted values for DWF, BOD, NH4 and P and is currently operating within its permits. Future scenarios predict that the WwTW will continue to operate within its permit for DWF and all determinands.

Table 34: Input Data and RQP Results for Cirencester WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	7.25	SIMCAT calculated value just upstream STW	8.71	Thames Water	NA	8.84	Thames Water	NA	8.95	Thames Water	NA
	SD			2.90			2.95			2.98		
	5%ile	2.2										
BOD (mg/l)	Mean	0.841	SIMCAT calculated value just upstream STW	2.50	Thames Water	3.03	2.58	Thames Water	3.1	2.79	Thames Water	3.33
	SD	0.95										
	95%ile			5.00			5.15			5.57		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.014	SIMCAT calculated value just upstream STW	0.40	Thames Water	0.48	0.52	Thames Water	0.62	0.86	Thames Water	1.03
	SD	0.02										
	95%ile			1.00			1.31			2.15		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.35	SIMCAT calculated value just upstream STW	0.92	Thames Water	0.69	0.92	Thames Water	0.69	0.92	Thames Water	0.69
	SD	0.152		0.4			0.4			0.4		
	Target Mean	0.077	2014 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model as shown in Figure 17 and Figure 18 presents a good calibration for all of the pollutants but NH4 where it looks like it was no possible to match the downstream WQ observed data. The model shows a failure in P and NH4. For the latter the failure seems to be due to the problem with the calibration.

The RQP model predicts as well that P fails its target for the present-day situation and both future scenarios and NH4 for both future scenarios. There is a 2% and a 10% deterioration for BOD for 2019/20 and 2033/34 respectively; 29% and 115% for NH4 for 2019/20 and 2033/34 respectively; and no deterioration for phosphate in either of the future scenarios.

The RQP function has been used to calculate the required discharge quality in order to meet the river target using the present day situation for P and 2019/20 for NH4. The result reported that for P "the river target is not achievable without improving the upstream water quality". Table 35 below shows the results for NH4:

Table 35: WwTW discharge quality required to meet WFD targets - Cirencester WwTW.

Pollutant	Target	Mean	SD	95%ile
Amm	0.6	0.51	0.4	1.28

Since the river target could not be reached for P with BAT (for P this is a mean of 0.5mg/l) using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has GES (a mean of 0.077 and a SD of 0.025 for P). The worst case scenario was modelled first to verify if the river target could be achieved with application of BAT. The other scenarios were modelled if this was not achieved. Table 36 shows that the required target cannot be achieved for any of the scenarios with BAT even when assuming GES upstream of the discharge point.

Table 36: Good river quality results

Scenario	Pollutant	Target	Mean	SD	95%ile
2033/34	P	0.077	0.08	0.03	0.14
2019/20	P	0.077	0.07	0.03	0.13
Present	P	0.077	0.07	0.03	0.13

New permit values were calculated for the determinands that present a deterioration of more than 10% or a class deterioration. These were calculated using as river target the present day concentration in the river plus a 10% deterioration or, if there was a class deterioration, the limit of the current class. Table 37 shows the result for NH4 where the present day concentration + 10% deterioration was used because there is no class deterioration. Permit values can be achieved with BAT for ammonia since this is a 95%ile of 1mg/l.

Table 37: WwTW discharge quality required to meet up to 10% or no class deterioration for Cirencester.

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	-	-	-	-	-
Ammonia	2033/34	0.53	0.45	0.34	1.12
Phosphate	-	-	-	-	-

Figure 17: SIMCAT result for flow and phosphate.

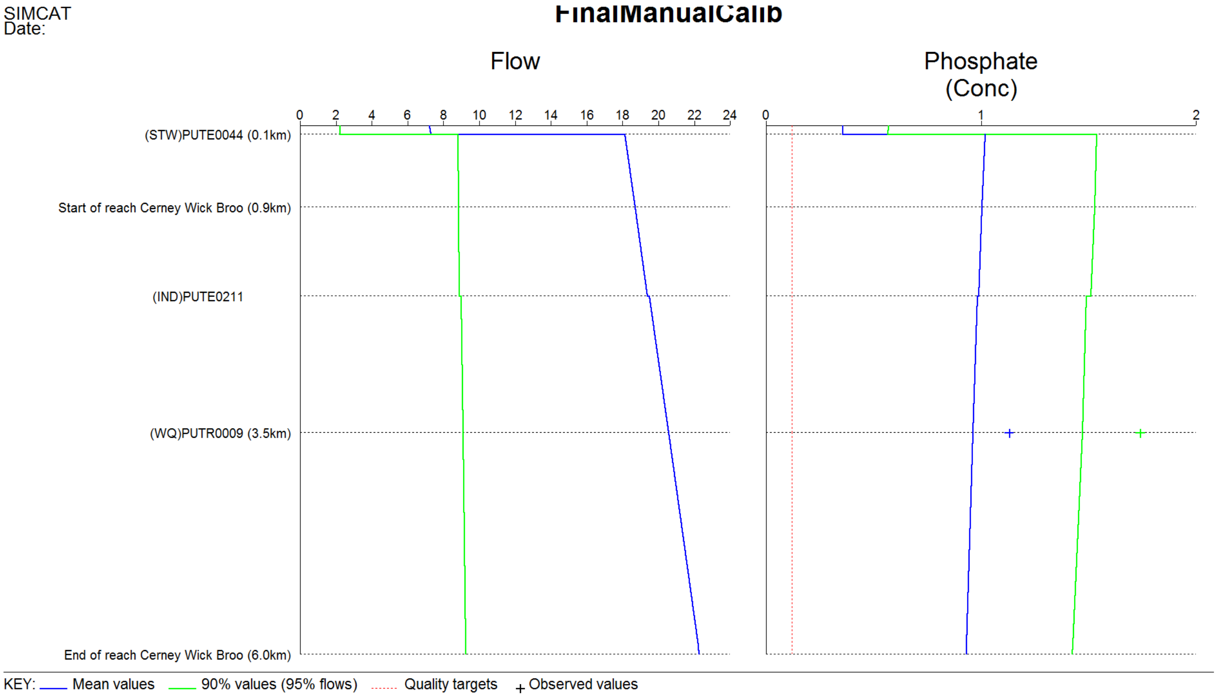
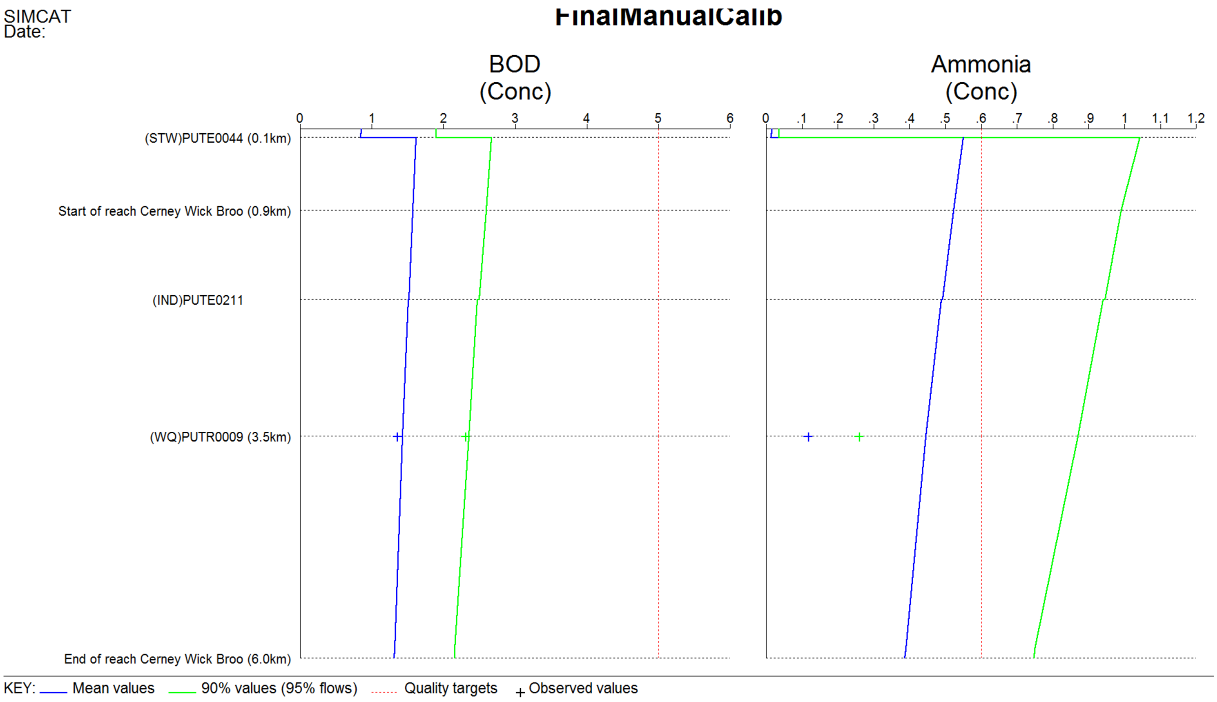


Figure 18: SIMCAT result for BOD and Ammonia.



A.6.10 Fairford WwTW

Fairford WwTW discharges into the River Coln as shown in Figure 19.

The status of the receiving watercourse is summarised in the Table 38 below:

Table 38: River Coln status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Poor	Poor	Good	High	High
2013 status	Moderate	Moderate	Good	High	High
Objective	Good Status by 2027	Good Status by 2027	High Status by 2015	High	High

Figure 19: GIS SIMCAT map of Fairford discharge location.

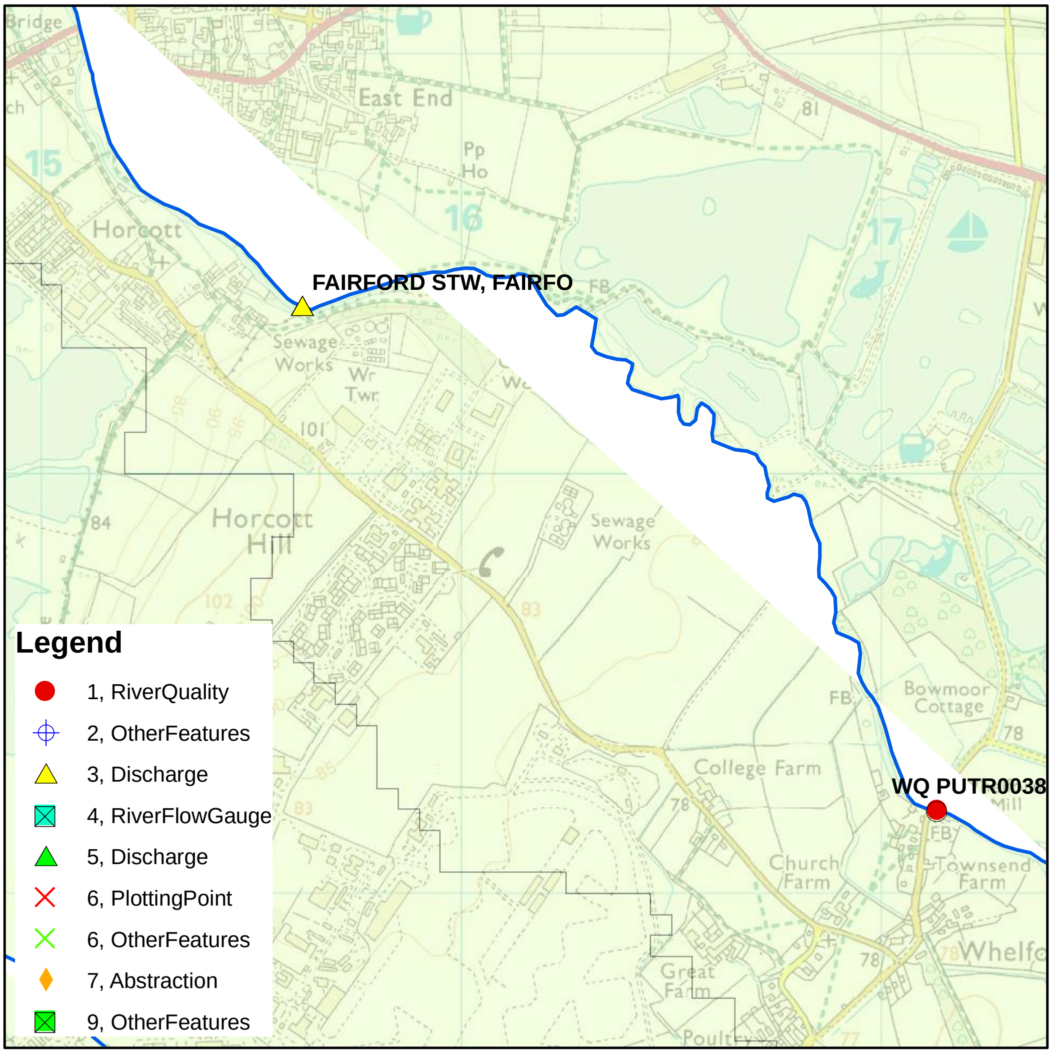


Table 39 shows the input data and RQP result for Fairford. The works has permit values for DWF, BOD and ammonia and currently it is operating within its permits. Future scenarios predict that the WwTW will continue to operate within its permits for DWF and all determinands.

Table 39: Input data and RQP results for Fairford WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	181	SIMCAT calculated value just upstream STW	1.54	Thames Water	NA	1.66	Thames Water	NA	1.57	Thames Water	NA
	SD			0.51			0.55			0.52		
	5%ile	67.1										
BOD (mg/l)	Mean	0.676	SIMCAT calculated value just upstream STW	6.00	Thames Water	1.07	6.46	Thames Water	1.09	6.52	Thames Water	1.08
	SD	0.272										
	95%ile			12.00			12.91			13.04		
	Target 90%ile	5	2013 WFD									
Amm (mg/l)	Mean	0.046	SIMCAT calculated value just upstream STW	1.50	Thames Water	0.09	2.07	Thames Water	0.11	2.15	Thames Water	0.11
	SD	0.021										
	95%ile			4.00			5.52			5.73		
	Target 90%ile	0.6	2013 WFD									
P (mg/l)	Mean	0.035	SIMCAT calculated value just upstream STW	2.56	SIMCAT discharge value	0.06	2.56	SIMCAT discharge value	0.06	2.56	SIMCAT discharge value	0.06
	SD	0.008		1.03			1.03			1.03		
	Target Mean	0.08	2013 WFD									

There is a WQ point and flow gauges (FG) respectively 10.2km and 1.0km upstream the discharge point. The SIMCAT model as shown in Figure 20 and Figure 21 present a good calibration for the flow and determinands. In order to consider the purification effect, the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. Also the flow was taken from the SIMCAT calculated value just upstream of the discharge point. The model indicate that none of the determinands fail their targets.

The RQP model predicts that the water course meets its targets for all the determinands for the present day and the future scenarios. There is a 2% BOD deterioration for 2019/20 and a 1% deterioration for the 2033/34 scenario; a 22% deterioration for NH4 for both scenarios; phosphate does not have any deterioration for either of the two scenarios.

New permit values were calculated for the determinands that present a deterioration of more than 10% or a class deterioration. These were calculated using as river target the present day concentration in the river plus a 10% deterioration or, if there was a class deterioration, the limit of the current class. Table 40 shows the results for NH4 where the present day concentration + 10% deterioration was used because there is no class deterioration. The permit value required can be achieved with BAT for ammonia this is a 95%ile of 1mg/l.

Table 40: 'No Deterioration' Permit Values for Fairford.

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	-	-	-	-	-
Ammonia	2033/34	0.1	1.88	1.6	4.95
Phosphate	-	-	-	-	-

Figure 20: SIMCAT result for flow and phosphate.

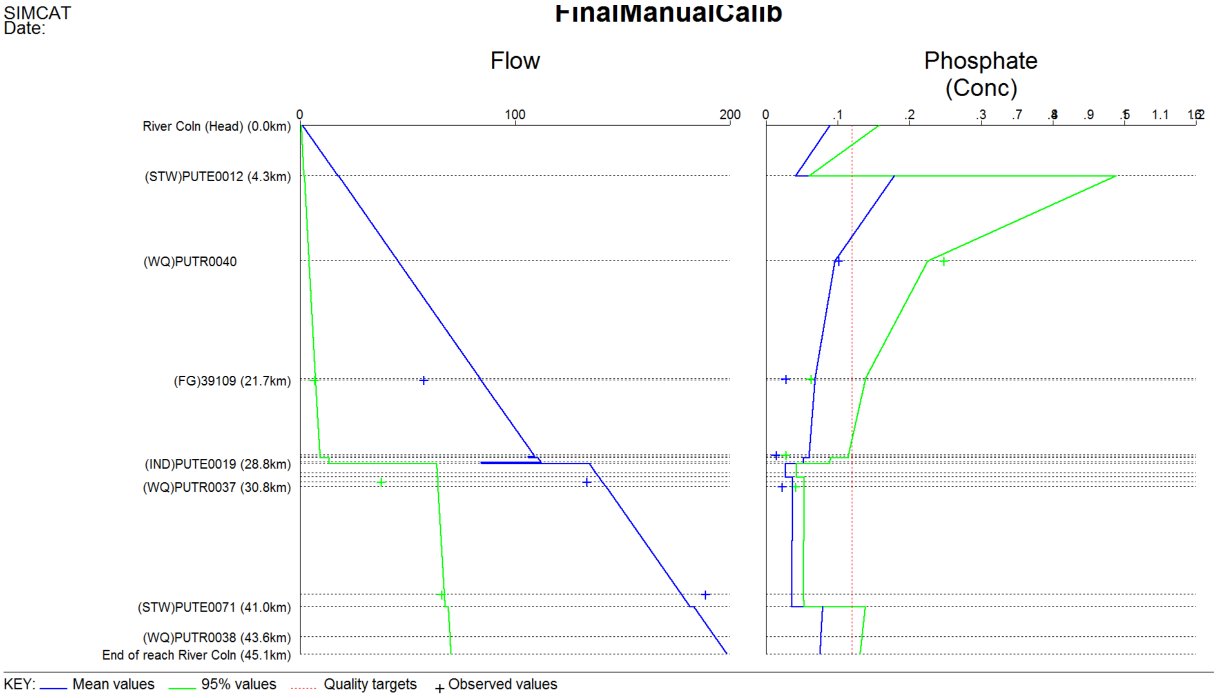
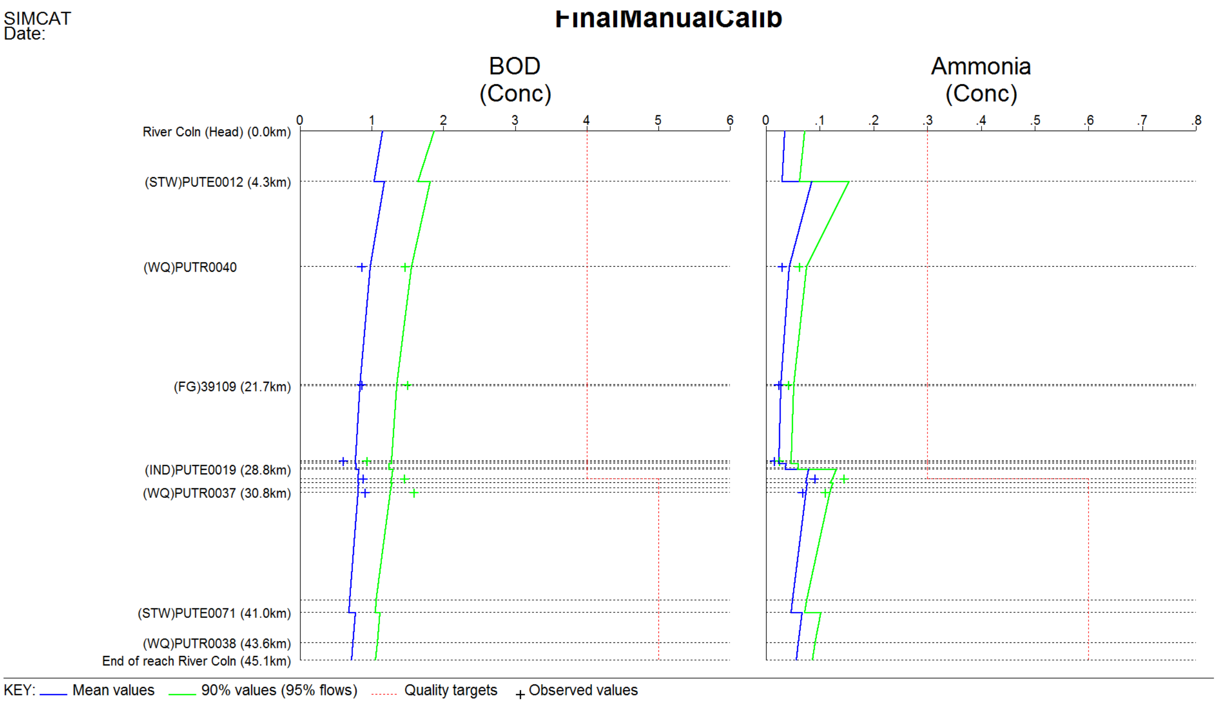


Figure 21: SIMCAT result for BOD and Ammonia.



A.6.11 Honeybourne WwTW

The Honeybourne WwTW discharges into The Cam as shown in Figure 22.

The status of the receiving watercourse is summarised in Table 41 below:

Table 41: The Cam River Status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Bad	Bad	Not available	High	Poor
2013 status	Poor	Poor	Not available	High	Poor
Objective	Good Status by 2027	Good Status by 2027	Not available	High	Poor: disproportionately expensive (P1a)

Figure 22: Map of Honeybourne discharge location. Not included in GIS SIMCAT.

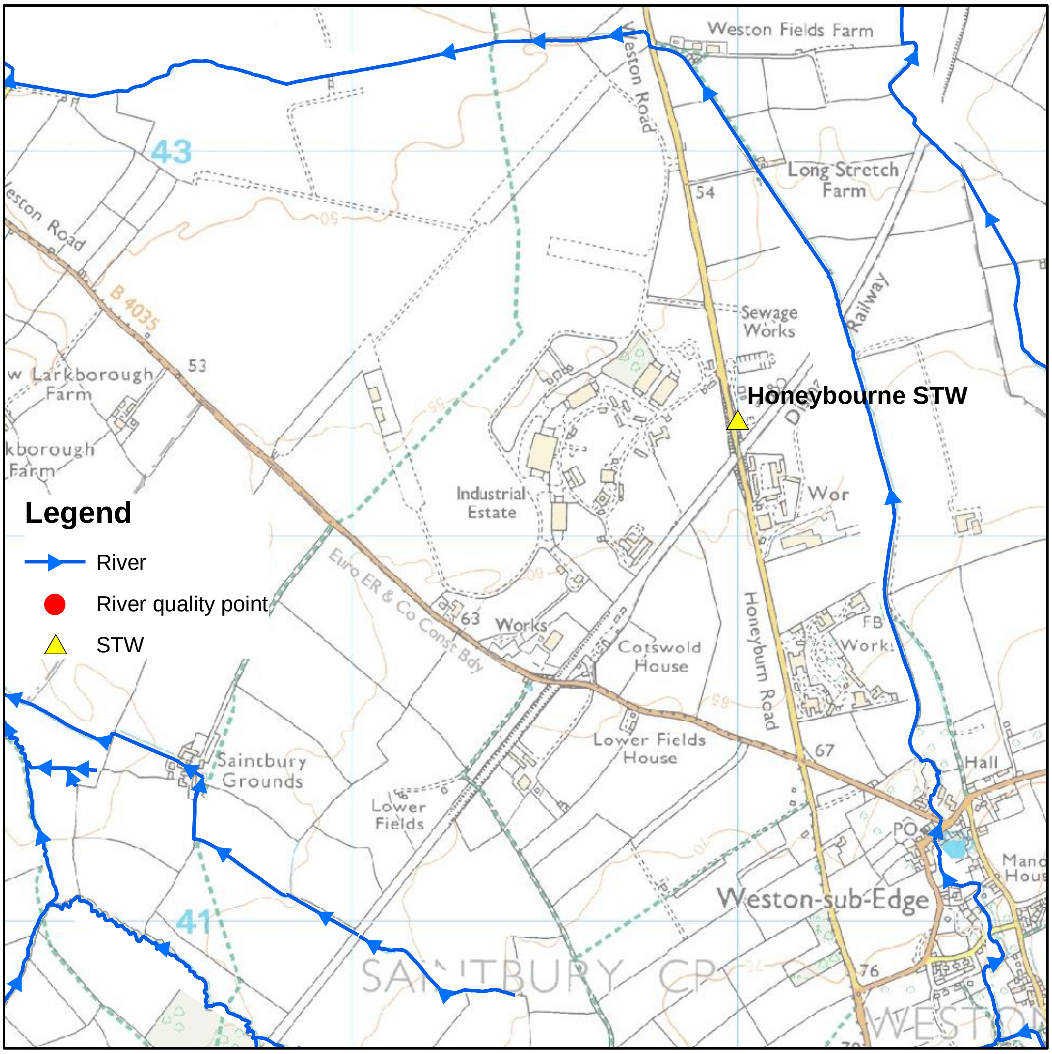


Table 42 shows the input data and RQP results for Honeybourne. The works has permit values for DWF, BOD and NH4 and is currently operating within its permits. It will work at its DWF permit for both future scenarios. Severn Trent Water has not provided any predicted performance for future scenarios so the current values have been used for those.

Table 42: input data and RQP results for Honeybourne WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	0.02	Low flow software	1.97	Severn Trent Water	NA	2	Severn Trent Water	NA	2.04	Severn Trent Water	NA
	SD			0.66			0.67			0.68		
	5%ile	0.002										
BOD (mg/l)	Mean	N/A	not available	0.67	Severn Trent Water	N/A	0.67	Severn Trent Water	N/A	0.67	Severn Trent Water	N/A
	SD	N/A										
	95%ile			1.42			1.42			1.42		
	Target 90%ile	5	2013 WFD									
Amm (mg/l)	Mean	0.07	middle of its class (high)	0.10	Severn Trent Water	0.21	0.10	Severn Trent Water	0.21	0.10	Severn Trent Water	0.21
	SD	0.07										
	95%ile			0.27			0.27			0.27		
	Target 90%ile	0.6	2013 WFD									
P (mg/l)	Mean	0.653	middle of its class (poor)	3.92	Severn Trent Water	3.95	3.92	Severn Trent Water	3.95	3.92	Severn Trent Water	3.95
	SD	0.218		1.31			1.31			1.31		
	Target Mean	0.08	2013 WFD									

The Thames basin SIMCAT model does not include this works. The Severn basin SIMCAT model was not available to this study. River flows were calculated using the Low Flows 2 software. The river quality data has been assigned using the middle value of its class for NH4 and P. No classification is available for BOD. For NH4 the 90%ile so obtained and the suggested Coefficient of Variation of 1 were used as input in RQP to calculate the mean and SD. The SD for P were calculated as 1/3 of the mean so obtained.

The RQP results highlight that phosphate is the only pollutant that breaches the target for the present-day scenario and the future scenarios. However all of the pollutants meet the 'no deterioration target'.

As phosphate fails the target, the RQP function has been used to calculate the required discharge quality in order to meet the river target using the present-day situation. Table 43 shows the results.

Table 43: WwTW discharge quality required to meet WFD targets - Honeybourne WwTW.

Pollutant	Target	Mean	SD	95%ile
P	0.08	0.07	0.02	0.12

Since the river target could not be reached for P with BAT (for P this is a mean of 0.5mg/l) using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has GES (a mean of 0.08 and a SD of 0.026 for P). The worst case scenario was modelled first to verify if the required discharge quality, in order to meet the river target, could be achieved with BAT applied. Table 44 shows that the required target cannot be achieved for any of the scenarios with BAT even when assuming GES upstream of the discharge point.

Table 44: Permit values required to meet river targets assuming GES upstream.

Scenario	Pollutant	Target	Mean	SD	95%ile
2033/34	P	0.08	0.08	0.03	0.13
2019/20	P	0.08	0.08	0.03	0.13
Present	P	0.08	0.08	0.03	0.13

A.6.12 Lechlade WwTW

Lechlade WwTW discharges into the River Leach as shown in Figure 23.

The status of the receiving watercourse is summarised in the Table 45 below:

Table 45: River Leach status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Not available	High	High
2013 status	Poor	Poor	Not available	High	Good
Objective	Good Status by 2027	Good Status by 2027	Not available	High	High

Figure 23: GIS SIMCAT map of Lechlade discharge location.

Table 46 shows the input data and the RQP results for Lechlade. The works has permit values for DWF, BOD and NH4 and currently it is operating with its permits. Future predictions suggest the WwTW will continue to operate within the permit criteria's but NH4 will reach its capacity for 2033/34 scenario.

Table 46: input data and RQP results for Lechlade WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	79.5	SIMCAT calculated value just upstream STW	0.88	Thames Water	NA	0.89	Thames Water	NA	0.84	Thames Water	NA
	SD			0.29			0.30			0.28		
	5%ile	17.4										
BOD (mg/l)	Mean	0.867	SIMCAT calculated value just upstream STW	3.50	Thames Water	1.27	3.74	Thames Water	1.28	3.78	Thames Water	1.27
	SD	0.278										
	95%ile			7.00			7.47			7.57		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.057	SIMCAT calculated value just upstream STW	0.60	Thames Water	0.1	0.80	Thames Water	0.11	0.84	Thames Water	0.11
	SD	0.028										
	95%ile			1.50			2.00			2.11		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.043	SIMCAT calculated value just upstream STW	2.32	SIMCAT discharge value	0.08	2.32	SIMCAT discharge value	0.08	2.32	SIMCAT discharge value	0.08
	SD	0.02		0.78			0.78			0.78		
	Target Mean	0.078	2014 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model presents a good calibration for all determinands with a slight underestimation for BOD and overestimation for NH4 as shown in Figure 24 and Figure 25. None of the determinands fail their targets.

The RQP results indicate that the watercourse fails its target for P for the present day situation and the future scenarios. There is a 1% deterioration for 2019/20 with no deterioration for 2033/34 for BOD, whereas there is a 10% deterioration for NH4 for both the 2019/20 and 2033/34 scenarios. P presents no deterioration for either scenario.

The RQP function to calculate the required discharge quality has been used in order to meet the river target using the present day situation. The results in Table 47 show that the target can be achieved using BAT since for P this is a mean of 0.5mg/l:

Table 47: WwTW discharge quality required to meet WFD targets - Lechlade WwTW

Pollutant	Target	Mean	SD	95%ile
P	0.08	2.13	0.7	3.43

Figure 24: SIMCAT result for flow and phosphate.

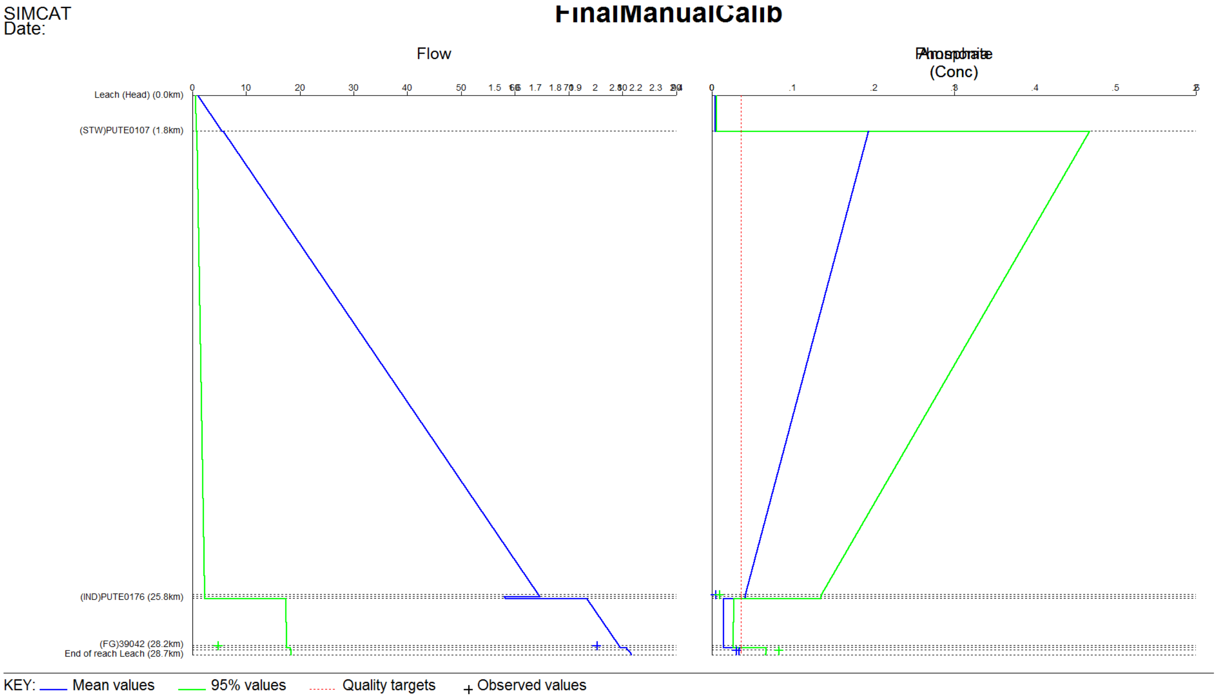
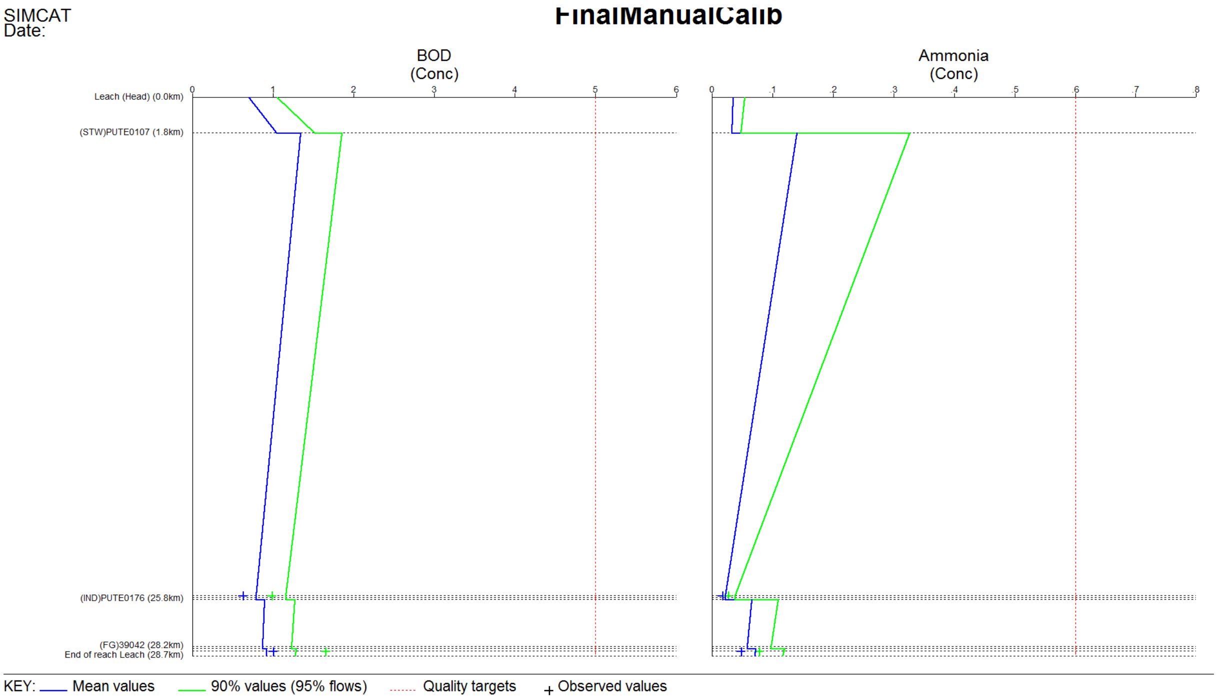


Figure 25: SIMCAT result for BOD and Ammonia.



A.6.13 Moreton-in-Marsh WwTW

Moreton-in-Marsh WwTW discharges into the Evenlode as shown in Figure 26.

The status of the receiving watercourse is summarised in Table 48 below:

Table 48: River Evenlode Status

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Good	Good	Poor
2013 status	Moderate	Moderate	Not available	Good	Poor
Objective	Good Status by 2027	Good Status by 2027	High Chemical Status by 2015	Good	Poor: disproportionately expensive (P1a)

Figure 26: GIS SIMCAT map of Moreton-in-Marsh discharge location.

Table 49 shows the input data and RQP results for Moreton-in-Marsh. The works has permit values for DWF, BOD and NH4 and is currently operating within its permits. Future scenarios predict that the WwTW will continue to operate within its permit but it will be close to its permitted capacity for DWF.

Table 49: input data and RQP results for WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	2.465	SIMCAT calculated value just upstream STW	1.39	Thames Water	NA	1.5	Thames Water	NA	1.44	Thames Water	NA
	SD			0.46			0.50			0.48		
	5%ile	0.341										
BOD (mg/l)	Mean	1.61	SIMCAT calculated value just upstream STW	3.00	Thames Water	3.61	3.47	Thames Water	4.05	3.69	Thames Water	4.21
	SD	1.082										
	95%ile			6.00			6.94			7.38		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.395	SIMCAT calculated value just upstream STW	0.60	Thames Water	0.83	1.07	Thames Water	1.31	1.29	Thames Water	1.52
	SD	0.22										
	95%ile			1.50			2.68			3.23		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	1.242	SIMCAT calculated value just upstream STW	2.73	SIMCAT discharge value	1.96	2.73	SIMCAT discharge value	1.98	2.73	SIMCAT discharge value	1.97
	SD	2.22		1.15			1.15			1.15		
	Target Mean	0.064	2014 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model presents a good calibration for P and a slight underestimation for BOD. It underestimate NH4 and as a consequence it does not show a failure of target as indicated by the WQ point downstream. It indicates a failure of the target for P. This can be seen in Figure 27 and Figure 28.

The RQP model predicts that the watercourse fails its targets for both ammonia and phosphate for the present-day situation and the future scenarios. There is a 12% and 17% deterioration for BOD for 2019/20 and 2033/34 respectively, 58% and 83% for ammonia and a 1 % deterioration for phosphate for both scenarios.

The RQP function has been used to calculate the required discharge quality in order to meet the river target using the present-day situation. For P it reported that "the river target is not achievable without improving the upstream water quality".

Table 50 below shows the result for NH4:

Table 50: WwTW discharge quality required to meet WFD targets - Moreton-in-Marsh WwTW.

Pollutant	Target	Mean	SD	95%ile
Amm	0.6	0.26	0.49	1.01

Since the river target could not be reached for P with BAT (for P this is a mean of 0.5mg/l) using the actual condition for the upstream river quality values, the RQP function to calculate the required discharge quality in order to meet the river target was run assuming that the river upstream has GES (a mean of 0.064 and a SD of 0.021 for P). The worst case scenario was modelled first, to verify if the required discharge quality, in order to meet the river target, could be achieved with BAT applied. The other scenarios were modelled if this was not achieved. Table 52 shows that the required target cannot be achieved for any of the scenarios with BAT even when assuming GES upstream of the discharge point.

Table 51: Permit values required to meet river targets assuming GES upstream

Scenario	Pollutant	Target	Mean	SD	95%ile
2019/20	P	0.064	0.06	0.03	0.11
2033/34	P	0.064	0.07	0.03	0.12
Present	P	0.064	0.07	0.03	0.12

New permit values were calculated for the determinands that present a deterioration of more than 10% or a class deterioration. These were calculated using as river target the present day concentration in the river plus a 10% deterioration or, if there was a class deterioration, the limit of the current class. Table 52 shows the result for BOD and NH4 where the present day concentration + 10% deterioration was used because there is no class deterioration. Both permit values can be achieved with BAT since for ammonia this is a 95%ile of 1mg/l and for BOD is a 95%ile of 5mg/l.

Table 52: WwTW discharge quality required to meet up to 10% or no class deterioration for Moreton-in-Marsh.

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	2033/34	3.97	3.79	2.9	9.39
Ammonia	2033/34	0.91	0.7	0.54	1.73
Phosphate	-	-	-	-	-

Figure 27: SIMCAT result for flow and phosphate.

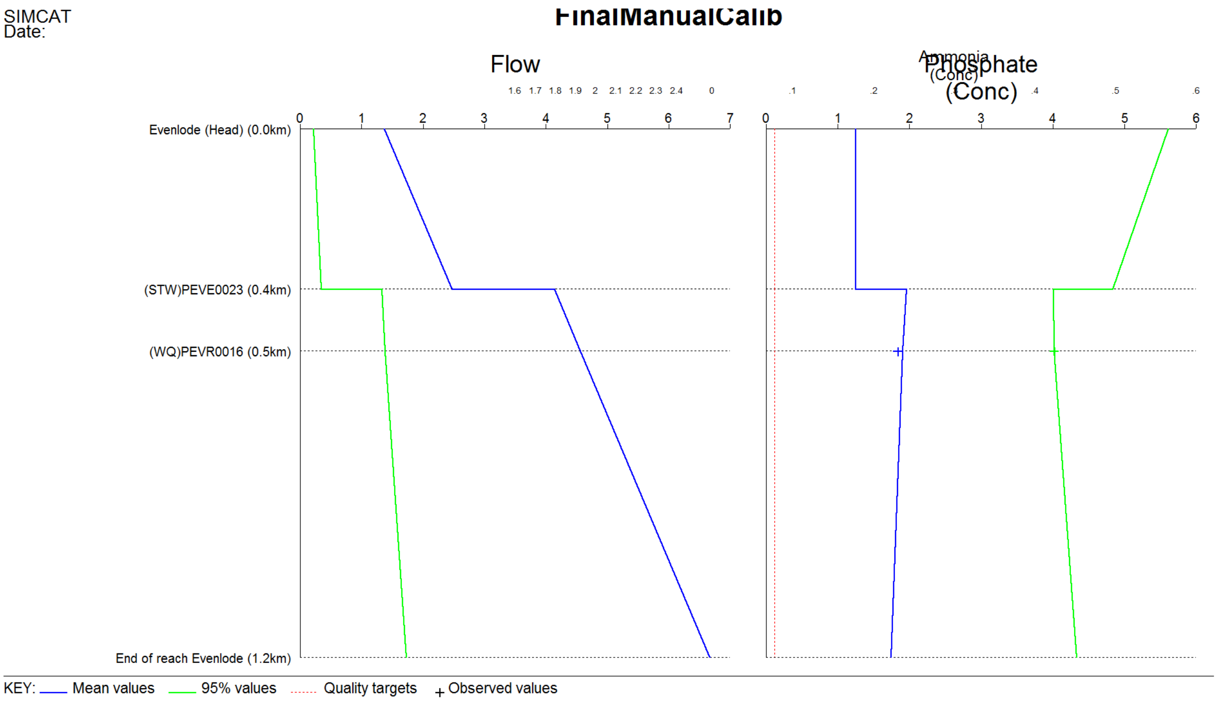
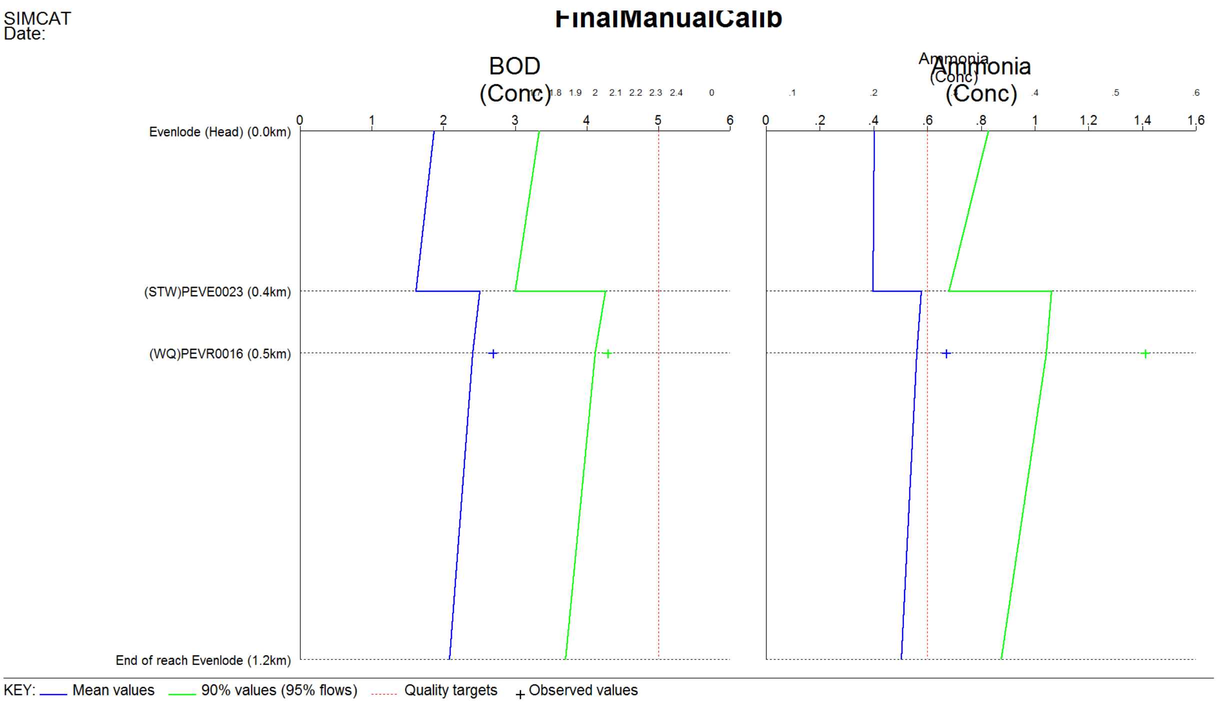


Figure 28: SIMCAT result for BOD and Ammonia.



A.6.14 Northleach WwTW

Northleach discharges into the River Leach as shown in Figure 29.

The status of the receiving watercourse is summarised in Table 53 below:

Table 53: River Leach status.

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Moderate	Moderate	Not available	High	High
2013 status	Poor	Poor	Not available	High	Good
Objective	Good Status by 2027	Good Status by 2027	Not available	High	High

Figure 29: GIS SIMCAT map of Northleach discharge location.

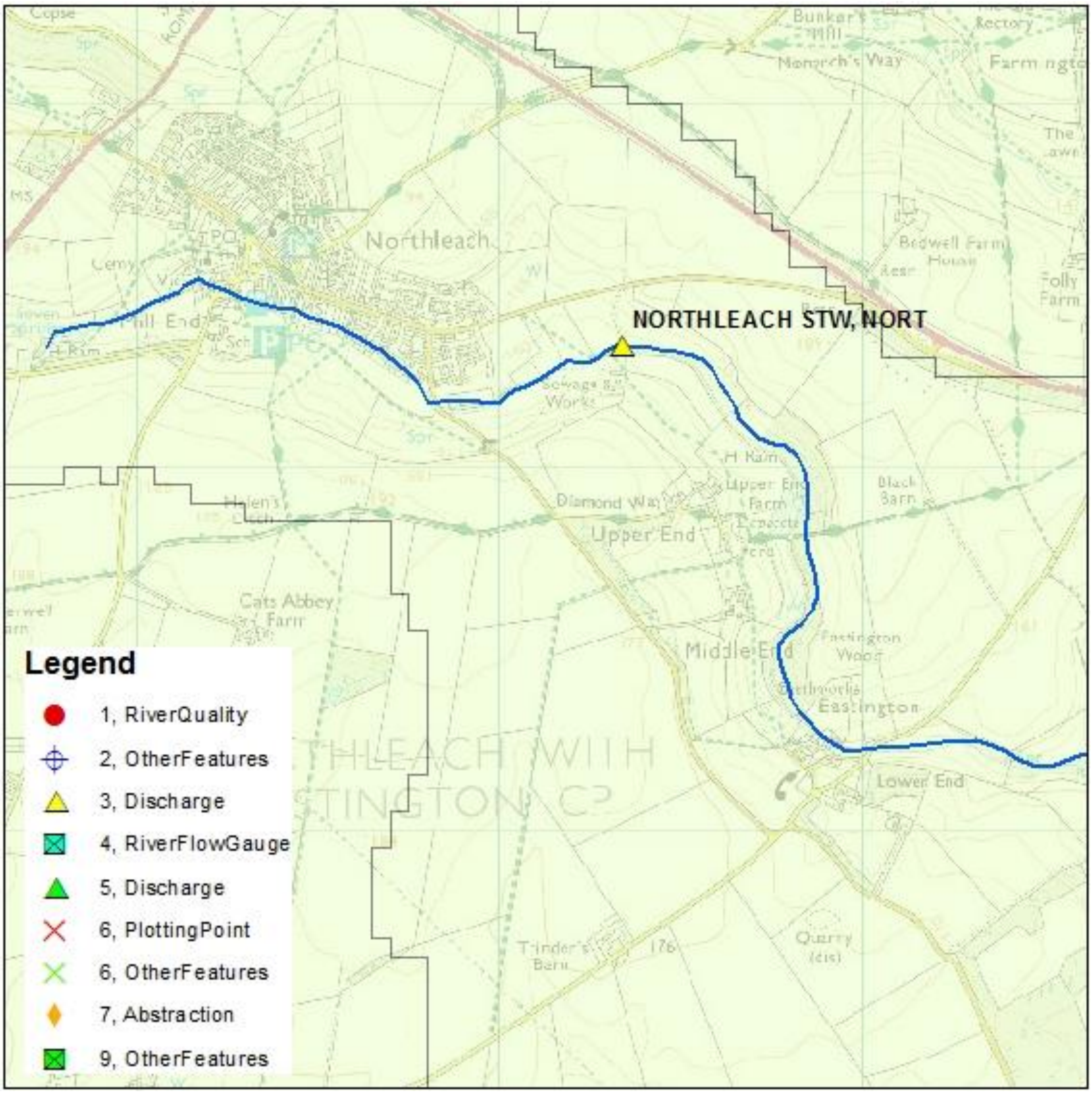


Table 54 shows the input data and RQP results for Northleach. The works has permit values for DWF, BOD and currently it is operating with these permits. Future scenarios predict that the

WwTW will continue to operate within its permits but NH4 that will become close to its permit by 2033/34.

Table 54: input data and RQP results for Northleach WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	5.459	SIMCAT calculated value just upstream STW	0.16	Thames Water	NA	0.16	Thames Water	NA	0.15	Thames Water	NA
	SD			0.05			0.05			0.05		
	5%ile	0.609										
BOD (mg/l)	Mean	1.042	SIMCAT calculated value just upstream STW	6.00	Thames Water	2.02	6.07	Thames Water	2.02	6.22	Thames Water	2.05
	SD	0.377										
	95%ile			12.00			12.13			12.44		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.032	SIMCAT calculated value just upstream STW	0.40	Thames Water	0.09	0.42	Thames Water	0.09	0.47	Thames Water	0.1
	SD	0.011										
	95%ile			1.00			1.06			1.18		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.009	SIMCAT calculated value just upstream STW	7.33	SIMCAT discharge value	0.46	7.33	SIMCAT discharge value	0.46	7.33	SIMCAT discharg e value	0.43
	SD	0.003		1.17			1.17			1.17		
	Target Mean	0.078	2014 WFD									

There is no WQ point upstream of the WwTW and the river quality data were taken from the SIMCAT calculated values just upstream of the discharge point. The model presents a good calibration for all determinands with a slight underestimation for BOD and overestimation for NH4 as shown in Figure 30 and Figure 31. It also indicates the failure of its targets for P.

The RQP model predicts that the watercourse fails its targets for phosphate for the present-day and future scenarios. There is only a 1% deterioration for BOD in 2033/34; 11% for ammonia in 2033/34, whilst there is no deterioration for phosphate in either of the scenarios.

The RQP function has been used to calculate the required discharge quality in order to meet the river target using the present-day scenarios. The results in Table 55 show that the target can be achieved using BAT (for P this is a mean of 0.5mg/l):

Table 55: WwTW discharge quality required to meet WFD targets -Northleach WwTW

Pollutant	Target	Mean	SD	95%ile
P	0.08	1.13	0.18	1.44

In order to prevent a water quality deterioration at Northleach for future scenarios, sewage treatment would have to be improved to meet standards for Ammonia. In order to meet the 'no deterioration' permit, the revised permit values in Table 56 must be met. This can be achieved using BAT since for ammonia this is a 95%ile of 1mg/l.

Table 56: WwTW discharge quality required to meet up to 10% or no class deterioration for Northleach

Parameter	Scenario with the strictest permit requirement	Present day + 10% deterioration or class boundary target	Permit values required to meet target		
			Mean	SD	95%ile
BOD	-	-	-	-	-
Ammonia	2033/34	0.1	0.5	0.39	1.25
Phosphate	-	-	-	-	-

Figure 30: SIMCAT result for flow and phosphate.

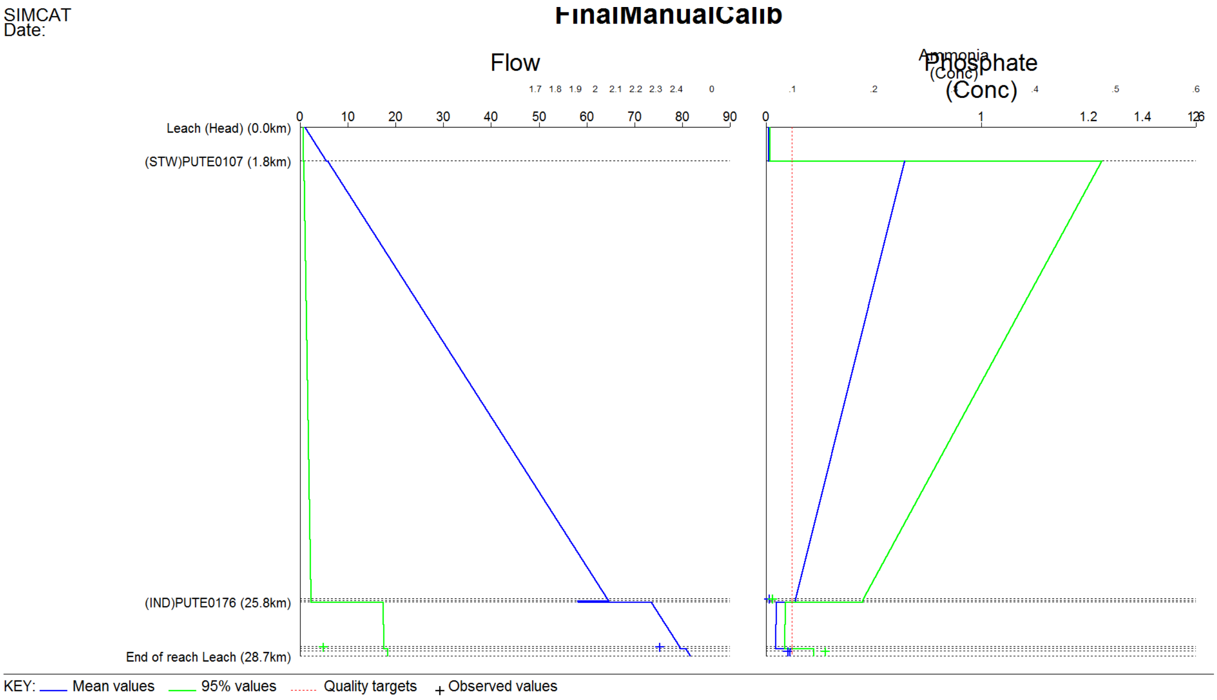
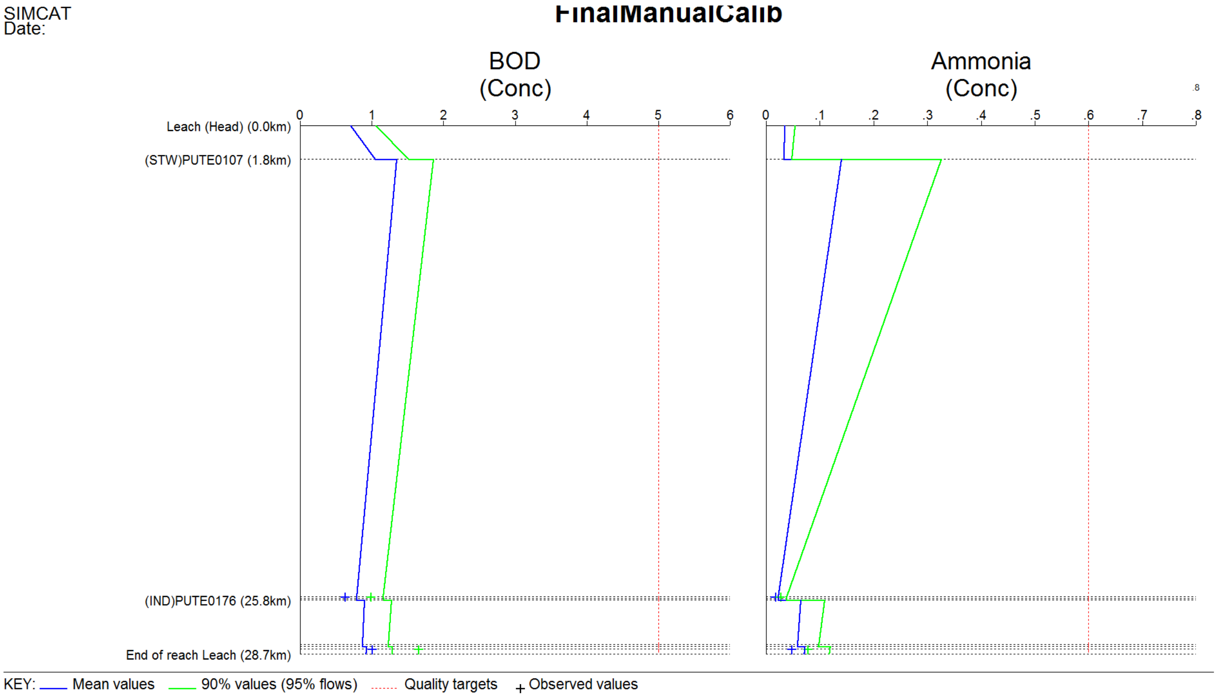


Figure 31: SIMCAT result for BOD and Ammonia.



A.6.15 Tetbury WwTW

Tetbury WwTW discharges into the River Avon as shown in Figure 32.

The status of the receiving watercourse is summarised in Table 57 below:

Table 57: River Avon Status

	Overall	Ecological	Chemical	Ammonia	Phosphate
Baseline status	Good	Good	Not available	High	Good
2013 status	Good	Good	Not available	Good	Good
Objective	Good Status by 2015	Good Status by 2015	Not available	High	Good

Figure 32: Map of Tetbury discharge location. Not located in GIS SIMCAT

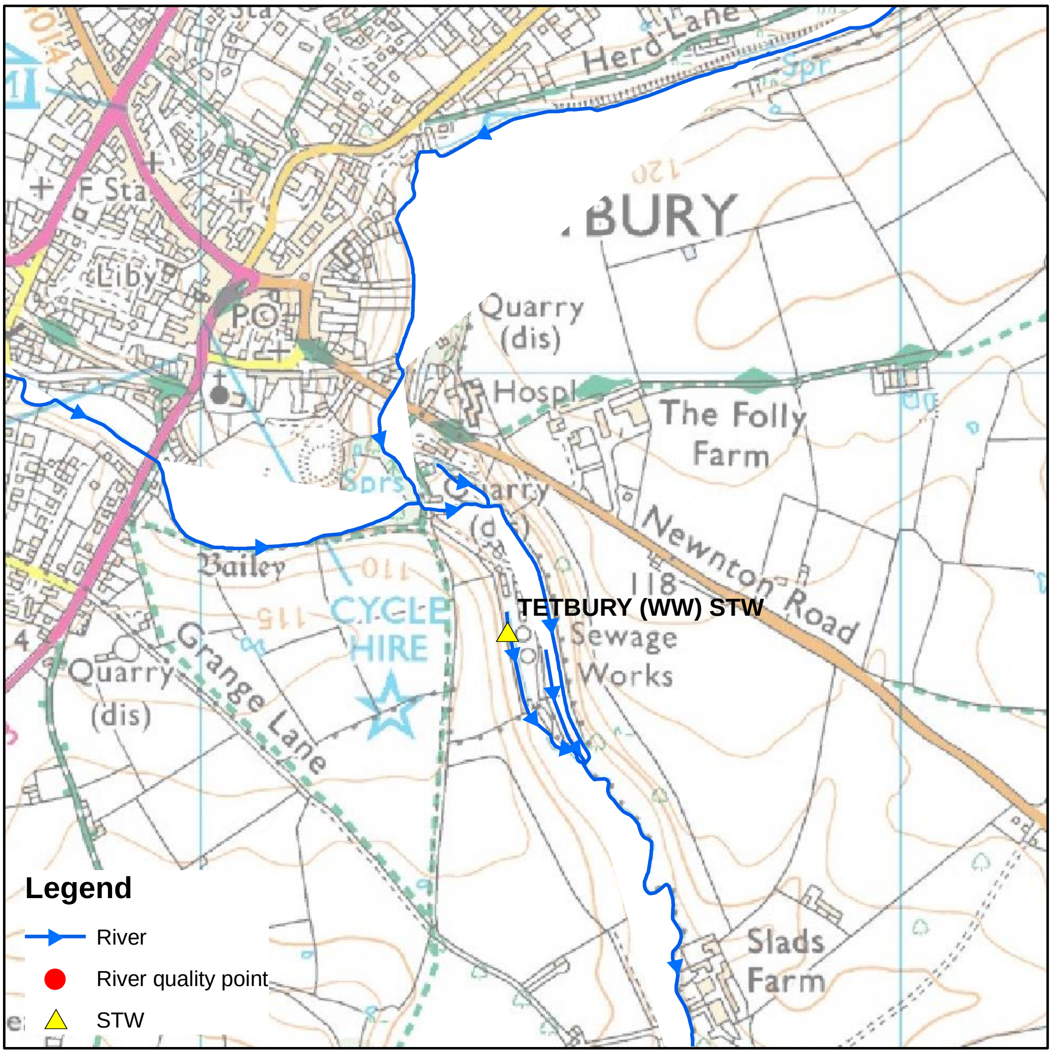


Table 58 shows the input data and RQP results for Tetbury. The works has permit values for DWF, BOD and NH4 and currently is operating within its permits. It will work at its DWF permit for both future scenarios. Wessex Water has not provided any predicted performance for future scenarios so the current values have been used for those.

Table 58: Input data and RQP results for Tetbury WwTW.

Parameter	Statistic	River	Source	Present day (2013)			2019/20			2033/34		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	0.354	Low flow software	0.87	Wessex Water	NA	1.11	Wessex Water	NA	1.15	Wessex Water	NA
	SD			0.29			0.37			0.38		
	5%ile	0.086										
BOD (mg/l)	Mean	N/A	no data available	7.00	Wessex Water	N/A	7.00	Wessex Water	N/A	7.00	Wessex Water	N/A
	SD	N/A										
	95%ile			10.00			10.00			10.00		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.22	middle of its class (good)	2.00	Wessex Water	2.6	2.00	Wessex Water	2.72	2.00	Wessex Water	2.74
	SD	0.22										
	95%ile			4.00			4.00			4.00		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.056	middle of its class (good)	1.73	Wessex Water	1.31	1.73	Wessex Water	1.38	1.73	Wessex Water	1.39
	SD	0.019		0.58			0.58			0.58		
	Target Mean	0.072	2014 WFD									

The Thames basin SIMCAT model does not include this works. The Avon basin SIMCAT model was not available to this study. River flow were calculated using the Low Flows 2 software. The river quality data has been assigned using the middle value of its class for NH4 and P. No classification is available for BOD so no run was possible for it. For NH4 the 90%ile so obtained and the suggested Coefficient of Variation of 1 were used as input in RQP to calculate the mean and SD. The SD for P were calculated as 1/3 of the mean so obtained.

The RQP model predicts that both NH4 and P fail the targets. There is a deterioration for NH4 of 5% for both the 1029/20 and 2033/34 scenarios, whereas P has a deterioration of 5% and 6% for 2019/20 and 2033/34 respectively.

The RQP function has been used to calculate the required discharge quality in order to meet the river targets for NH4 and P. The results in Table 59 shows that the river target could not be reached for both determinands with BAT (for P this is a mean of 0.5mg/l, for ammonia a 95%ile of 1mg/l).

Table 59: WwTW discharge quality required to meet WFD targets - Tetbury WwTW

Pollutant	Target	Mean	SD	95%ile
Amm	0.6	0.42	0.22	0.84
P	0.07	0.08	0.03	0.12

A.7 Climate change

The National Planning Policy Framework practice guidance[2] states that "addressing climate change is one of the core land use planning principles which the National Planning Policy Framework expects to underpin both plan-making and decision-taking. To be found sound, Local Plans will need to reflect this principle and enable the delivery of sustainable development in accordance with the policies in the National Planning Policy Framework."

Likewise the Environment Agency's Water Cycle Study Guidance states that the development of water infrastructure should contribute "to the shift to a low carbon economy."

The Thames RBMP Annex H includes an assessment of the evidence on climate change to 2050 and the potential impacts this will have on achieving WFD good ecological status. Key issues relevant to this water quality assessment are:

- higher summer temperatures leading to lower background levels of dissolved oxygen,
- reduced summer rainfall leading to lower mean summer flows, meaning that there will be reduced dilution of treated effluent, and
- requirements for higher standards of treatment (in particular for P removal) can lead to increased carbon emissions.

The EA's "Water Quality Planning: no deterioration and the Water Framework Directive" and "Horizontal guidance" make no mention of how to account for climate change in water quality planning. Various studies by UK Water Industry Research (UKWIR)[3,4] and the Environment Agency[5] do however provide some background to how to approach this issue. CEH's Future Flows and Groundwater Levels work provides an assessment at a number of gauges (including the Ock at Abingdon) as well as a methodology for how to apply climate change assessments to river flows at other sites[6].

This assessment has not specifically modelled the impacts of climate change on the status and deterioration of the watercourses and it would be advisable to address this issue at a local level when considering permit changes to WwTWs. It is likely that this would require as a minimum consideration of changes to river water temperature and flows.

The RBMP encourages us to look for win-win" actions, and integrated and catchment-based approaches are encouraged. One example here could be catchment based land management and river restoration projects could be used to both reduce diffuse P inputs and to help maintain summer base flows in watercourses. The RBMP cautions that taking actions for specific pressures may be counter-productive. So for example the carbon costs of increased treatment standards need to be assessed against the environmental benefits they will achieve.

A.8 Phosphate

The Thames RBMP indicates that phosphates (along with diatoms, macrophytes, fish and invertebrates) is one of the main individual elements which the EA assesses as leading to a failure to achieve good ecological status, with only around 35% of water bodies achieving their good status target for phosphate. Phosphate has been assessed as a major cause of biological failures (e.g. diatoms and macrophytes). Recent research on the Thames basin[7] has indicated that WFD targets can only be achieved by a combination of measures to reduce P both through agricultural management practices and removal at WwTWs. This paper found that a combined

2 Department of Communities and Local Government (2014) National Planning Policy Framework Practice Guidance: Climate Change.

3 UKWIR (2007) Climate Change, the Aquatic Environment and the Water Framework Directive. Ref: 07/CL/06/5

4 UKWIR (2005) Effects of Climate Change on River Water Quality. Ref: 05/CL/06/4

5 Environment Agency (2007) Preparing for climate change impacts on freshwater ecosystems (PRINCE). Ref SC030300/SR. Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291081/scho0507bmoj-e-e.pdf on 01/09/2014.

6 Accessed online at http://www.ceh.ac.uk/sci_programmes/water/future%20flows/ffgwlsites.html#Background on 01/09/2014.

7 Whitehead PG et al (2013) A cost-effectiveness analysis of water security and water quality: impacts of climate and land-use change on the River Thames system. Phil Trans R Soc A 371: 20120413. Accessed online at http://dx.doi.org/10.1098/rsta.2012.0413 on 17/08/2015.

approach requiring 20% reduction in agricultural inputs and P removal at WwTWs to meet a discharge concentration of P of 0.3mgl^{-1} total P would be the most cost-effective approach for the Thames basin. Notably however this study did not take into account the high carbon costs of treating wastewaters to this standard.

The RBMP aims to tack this via the following measures:

- Agriculture and rural land management. A range of approaches are in use including promotion of best-practice, partnership working pilots and Water Protection Zones (WPZs). One large-scale project underway in South Oxfordshire is the River of Life project on the River Thames[8]. Here the Earth Trust are restoring wetland features and habitat along 2km of river bank and floodplain. This type of restoration and the use of buffer zones have the potential to reduce P inputs to the watercourse; the Whitehead et al (2013) paper found these to be the most cost-effective measure but not on their own sufficient to tackle the P issue in the Thames basin.
- Legislative and regulatory measures.
- Water industry measures, in particular P removal at WwTWs where the economic and carbon costs can be justified. The water industry is also increasingly seeking to play a role in catchment-based approaches with the aim of achieving WFD P targets at a lower economic and carbon cost. Thames Water are undertaking a catchment sensitive farming trial to address P[9].

A.9 Summary and conclusions

A.9.1 Method

The increased discharge of effluent due to an increase in the population served by a Wastewater Treatment Works (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 Environment Agency 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 permit may be required for the WwTW 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".

During the preparation of the phase I Water Cycle Study (WCS) the Environment Agency advised that it would be necessary to undertake an assessment of the water quality impact of development in the 13 WwTW catchments which will receive the majority of additional flows in the Cotswold District.

The assessment was undertaken using the EA's River Quality Planning (RQP) tool which enables a Monte-Carlo analysis to be undertaken at a single point of discharge to a watercourse. This was supplemented by results from their SIMCAT model of the Thames River Basin District (RBD).

RQP models were initially set up and run using the present-day and 2019/20 and 2033/34 growth scenarios using only the preferred development sites. Effluent flows were calculated to assess the impact of the increased contaminant loads on the receiving watercourses due to the extra wastewater flows.

Addressing existing diffuse pollution is beyond the remit of the WCS, and therefore the analysis was undertaken following the assumption that that the upstream diffuse sources of pollution had been addressed (i.e. ‘good status’ achieved upstream). This was achieved by setting the upstream quality at the level of ‘good status’ in the model. This assumption was used when good status could not be achieved downstream of the works with current upstream water quality even when BAT standards are applied to the works. .

8 Accessed online at http://www.earthtrust.org.uk/Our-work/waterandwetlands/RiverofLife.aspx on 17/08/2015.

9 Thames Water (2014) Business Plan 2015-2020 Part A - Summary.

A.9.2 Results

Table 60 summaries the modelling results for passing and failing of the following targets:

- 'Good status';
- 'No 10% deterioration';
- 'No class deterioration'.

Table 60: RQP results summaries for failing targets of: 'Good Status', > 10% Deterioration' and 'Class Deterioration'.

Watercourse (WwTW discharging into it)	Scenario	Failing 'Good status' target?			Failing 'No > 10% deterioration' target?			Failing 'Class deterioration' target?		
		BOD	Amm	P	BOD	Amm	P	BOD	Amm	P
Key	(green)	Achieves good status			No deterioration			No class deterioration		
	(amber)	NA			Up to 10% deterioration			NA		
	(red)	Fails good status			More than 10% deterioration			Class deterioration		
River Avon - Tetbury Branch (Ampney St Peter)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	1%	0%	0%	No	No	No
	33/34	No	No	Yes	0%	0%	-6%	No	No	No
River Coln (Andoversford)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	2%	26%	7%	No	Yes	No
	33/34	No	No	Yes	3%	48%	7%	No	No	No
River Dickler (Bourton the Water)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	5%	57%	6%	No	No	No
	33/34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Evenlode (Broadwell)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	0%	0%	2%	No	No	No
	33/34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cerney Wick Brook (Cirencester)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	Yes	Yes	2%	29%	0%	No	No	No
	33/34	No	Yes	Yes	10%	115%	0%	No	Yes	No
River Coln (Fairford)	Actual	No	No	No	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	No	2%	22%	0%	No	No	No
	33/34	No	No	No	1%	22%	0%	No	No	No
River Leach (Lechlade)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	1%	10%	0%	No	No	No
	33/34	No	No	Yes	0%	10%	0%	No	No	No
River Evenlode (Moreton-in-Marsh)	Actual	No	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	Yes	Yes	12%	58%	1%	Yes	No	No
	33/34	No	Yes	Yes	17%	83%	1%	No	No	No
River Leach (Northleach)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	No	Yes	0%	0%	0%	No	No	No
	33/34	No	No	Yes	1%	11%	-7%	No	No	No
River Dickler (Blockley)	Actual	No	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	No	Yes	Yes	0%	0%	0%	No	No	No
	33/34	No	Yes	Yes	0%	0%	0%	No	No	No
The Cam	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A

(Chipping Campden)	19/20	No	No	Yes	0%	0%	0%	No	No	No
	33/34	No	No	Yes	-1%	0%	0%	No	No	No
The Cam (Honeybourne)	Actual	N/A	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	N/A	No	Yes	NA	0%	0%	N/A	No	No
	33/34	N/A	No	Yes	NA	0%	0%	N/A	No	No
River Avon (Tetbury)	Actual	N/A	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	19/20	N/A	Yes	Yes	N/A	5%	5%	N/A	No	No
	33/34	N/A	Yes	Yes	N/A	5%	6%	N/A	No	No

A.9.3 Best Available Technology (BAT) assessment

The EA requested to compare the modelling results against BAT. Table 61 summarises for each WwTW the following questions:

- Will the WwTW remain within its existing permit?
- Do any of the determinands experience a 10% deterioration and if so can this be prevented by application of BAT?
- Do any of the determinands experience a class deterioration and if so can this be prevented by application of BAT?
- Do any of the determinands experience a failure in reaching good status and if so can this be prevented by application of BAT?

The EA advised that the following permit values are achievable using best available technology, and that these values should be used for modelling all WwTWs potential capacity irrespective of the existing treatment technology and size of the works:

- BOD (95%ile) = 5mg/l
- Ammonia (95%ile) = 1mg/l
- Phosphate (mean) = 0.5mg/l

This does not take in consideration if it is feasible to upgrade each existing WwTW to such technology due to constraints of cost, timing, space, carbon cost etc.

Table 61 shows a summary of the conclusions using BAT whilst Table 62 reports information on the runs and the model results used to compare against BAT.

Table 61: Summary of results assuming BAT is applied (excluding reserve sites)

Watercourse (WwTW discharging into it)	**DWF Permit Compliant**	**Could the development cause a greater than 10% deterioration in WQ?**	**Could the development cause a deterioration in WFD class of any element?**	**Could the development prevent the water body from reaching GES?**
Key	(green)	Passes		
	(amber)	Fails: target is achievable using BAT or permit capacity is reached		
	(red)	Fails: target is not achievable using BAT or permit capacity is exceeded.		

Watercourse (WwTW discharging into it)	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
River Avon - Tetbury Branch (Ampney St Peter)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
River Coln (Andoversford)	No DWF permit exceedance is predicted	10 % deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
River Dickler (Bourton the Water)	No DWF permit exceedance is predicted	10 % deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with the best technology available	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT. The mean requested is within the 10% model tolerance/variability
Evenlode (Broadwell)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.

Watercourse (WwTW discharging into it)	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Cerney Wick Brook (Cirencester)	No DWF permit exceedance is predicted	10 % deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for Amm and P. Upgrade to the WwTW is needed but it is not achievable with BAT for P also assuming GES upstream. For Amm it is possible to reach GES with BAT also in the current upstream condition.
River Coln (Fairford)	No DWF permit exceedance is predicted	10 % deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with the best technology available	No class deterioration is predicted. No WwTW upgrade is required	Good status achieved. No upgrade is required
River Leach (Lechlade)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
River Evenlode (Moreton-in-Marsh)	No DWF permit exceedance is predicted	10 % deterioration is predicted for Amm and BOD. Upgrade to the WwTW is needed and it is achievable with BAT	Class deterioration is predicted for BOD. Upgrade to the WwTW is needed and it is achievable with BAT	Good status is not reached for Amm and P. Upgrade to the WwTW is needed but it is not achievable with BAT for P also assuming GES upstream. For Amm it is possible to reach GES with BAT also in the current upstream condition.

Watercourse (WwTW discharging into it)	DWF Permit Compliant	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
River Leach (Northleach)	DWF permit capacity is predicted to be achived for 2019/20 scenario	10 % deterioration is predicted for Amm. Upgrade to the WwTW is needed and it is achievable with BAT	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed and it is achievable with BAT
River Dickler (Blockley)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for Amm and P. Upgrade to the WwTW is needed but it is not achievable with BAT for Amm and P also assuming GES upstream for P (Amm has GES in the actual situation).
The Cam (Chipping Campden)	DWF permit exceedance is predicted for 20033/34 scenario	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.
The Cam (Honeybourne)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for P. Upgrade to the WwTW is needed but it is not achievable with BAT also assuming GES upstream.
River Avon (Tetbury)	No DWF permit exceedance is predicted	Predicted deterioration is less than 10%. No WwTW upgrade is required	No class deterioration is predicted. No WwTW upgrade is required	Good status is not reached for Amm or P. Upgrade to the WwTW is needed but it is not achievable with BTA for both determinands

The results in Table 62 were highlighted in green if the result is => than the BAT value, amber if it is in the 10% of the BAT value and red if it is < than the BAT value. Further explanation of column headers are:

- Scenario considered: specifies the discharge flow and quality scenario data used as input in the RQP run;
- Run to assess: specifies if the RQP run is to assess the no + 10% deterioration / class deterioration or the GES target;
- Upstream river condition used: specifies if the upstream river condition used for the run is the actual situation or if GES was assumed. The latter is indicated by the GES target for the river;
- Present day +10% deterioration or class boundary target: specifies the target used for the no deterioration run;
- Discharge values required to meet the target: these are the RQP tool output representing the discharge value required to meet the specific target. For BOD and ammonia the value to compare with BAT is the 95%ile whilst for P is the mean.

Table 62: Summary of the model results used to compare against BAT (excluding reserve sites)

WwTW	Parameter	Scenario considered	Run to assess:	Upstream river condition used	Present day + 10% deterioration or class boundary target	Discharge values required to meet target		
						Mean	SD	95%ile
Ampney	P	Present	GES	Actual situation		1.91	0.73	3.28
Andoversford	NH4	2033/34	no deterioration		0.25	3.09	2.64	8.14
	P	Present	GES	Actual situation		1.55	0.57	2.61
Blockley	NH4	Present	GES	Actual situation		0.16	0.15	0.44
	P	2019/20	GES	GES = 0.066		0.07	0.02	0.11
Bourton on the Water	NH4	Present	no deterioration		0.08	0.49	0.52	1.47
	P	2019/20	GES	Actual situation		0.44	0.18	0.79
Broadwell	P	Present	GES	GES = 0.065		0.05	0.01	0.08
Chipping Campden	P	Present	GES	GES = 0.067		0.07	0.02	0.11
Cirencester	NH4	2033/34	no deterioration		0.53	0.45	0.34	1.12
	NH4	Present	GES	Actual situation		0.51	0.4	1.28

WwTW	Parameter	Scenario considered	Run to assess:	Upstream river condition used	Present day + 10% deterioration or class boundary target	Discharge values required to meet target		
						Mean	SD	95%ile
	P	Present	GES	GES = 0.077		0.07	0.03	1.13
Fairford	NH4	2033/34	no deterioration		0.1	1.88	1.6	4.95
Honeybourne	P	Present	GES	GES = 0.08		0.08	0.03	0.13
Lechlade	P	Present	GES	Actual situation		2.13	0.7	3.43
Moreton in Marsh	BOD	2033/34	no deterioration		3.97	3.79	2.9	9.39
	NH4	2033/34	no deterioration		0.91	0.7	0.54	1.73
	P	Present	GES	GES = 0.064		0.07	0.03	0.12
Northleach	NH4	2033/34	no deterioration		0.10	0.5	0.39	1.25
	P	Present	GES	Actual situation		1.13	0.18	1.44
Tetbuty	NH4	Present	GES	Actual situation		0.42	0.22	0.84
	P	Present	GES	Actual situation		0.08	0.03	0.12

A.10 Additional Housing Scenarios

As described in section A.4, the initial analysis was based on scenarios for growth to 2020/21 and 2033/34 using only the preferred site options provided by CDC. Additional growth above and beyond the preferred sites was also required to be tested to identify the thresholds for water quality.

A.10.4 Method

The approach was as follows:

- If a settlement's WwTW does not cause a water quality failure in the preferred only scenario, test how many additional houses could be permitted before a WwTW upgrade is likely to be triggered. In other words how much additional headroom is available at the WwTW and in the receiving watercourse?
- Where the settlement's WwTW is likely to require an upgrade to accommodate the preferred-only scenario, test how many additional houses could be permitted before permitted levels of treatment would be required that are beyond the "Best Available Technology" (BAT) for wastewater treatment.

The WwTWs were divided into three groups:

- Group 1: those that do not present a deterioration or target failure with the preferred-only growth scenario. There are no WwTWs that meet this criteria (see Table 61);
- Group 2: those that present a deterioration or target failure with the preferred-only growth scenario but which could achieve good status if upgraded to use BAT: Ampney St Peter, Andoversford, Fairford, Lechlade and Northleach. These works were then tested to see how many additional houses above and beyond the preferred development sites could be accommodated if the WwTW were achieving BAT. To provide a realistic limit to the number of houses tested, the current reserve number was tested, was then rounded to the nearest 100 and tested, then this was doubled and tested;
- Group 3: those that cannot achieve good status even with BAT for the preferred-only development scenario: Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury. Development beyond the preferred option scenario is not recommended in these settlements and therefore no further modelling was undertaken for these.

A.10.5 Results

Ampney St Peter

Table 63 shows the input data and RQP results for Ampney St Peter using the existing performance with the current DWF volume and the BAT with future scenarios. Two scenarios were run: the '100 extra houses with BAT' to consider the 43 reserve houses that CDC has allocated for this work and the ''200 extra houses with BAT' to consider further growth at the works.

The RQP model predicts that the receiving watercourse would reach good status for all determinands and further growth, above 200 houses, could be accommodated without deteriorating the river status. The comparison with the present-day performance highlight the improvements that the use of BAT has on the receiving watercourse.

Table 63: Input data and RQP results for Ampney WwTW using BAT.

Parameter	Statistic	River	Source	Present day (2013)			100 extra houses with BAT			200 extra houses with BAT		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	53.17	SIMCAT calculated value just upstream STW	0.45	Thames Water	NA	0.43	Thames Water	NA	0.46	Thames Water	NA
	SD			0.15			0.14			0.15		
	5%ile	2.52										
BOD (mg/l)	Mean	0.746	U/s WQ point PUTR0175 from SIMCAT	4.50	Thames Water	1.49	2.35	BAT	0.21	2.35	BAT	0.23
	SD	0.437										
	95%ile			9.00			5.00			5.00		
	Target 90%ile	5	2014 WFD									
Amm (mg/l)	Mean	0.015	U/s WQ point PUTR0175 from 09-13 data	0.60	Thames Water	0.07	0.36	BAT	0.05	0.36	BAT	0.05
	SD	0										
	95%ile			1.40			1.00			1.00		
	Target 90%ile	0.6	2014 WFD									
P (mg/l)	Mean	0.012	U/s WQ point PUTR0175 from SIMCAT	4.85	SIMCAT discharge value	0.18	0.5	BAT	0.03	0.5	BAT	0.03
	SD	0.005		1.89			0.17			0.17		
	Target Mean	0.077	2014 WFD									

Andoversford

Table 64 shows the input data and RQP results for Andoversford using BAT. One scenario was run: the '100 extra houses with BAT' to consider further growth at the works because CDC has not currently identified any reserve sites in this settlement.

The RQP model predicts that the receiving watercourse would reach good status for all determinands and further growth, above 100 houses, could be accommodated without deteriorating the river status. The comparison with the present-day performance highlights the improvements that the use of BAT has on the receiving watercourse.

Table 64: Input data and RQP results for Andoversford WwTW using BAT.

Parameter	Statistic	River	Source	Present day (2013)			100 extra houses with BAT		
				STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	17.35	SIMCAT calculated value just upstream STW	0.18	Thames Water	NA	0.22	Thames Water	NA
	SD			0.06					
	5%ile	1.59					0.07		
BOD (mg/l)	Mean	1.029	U/s WQ point PUTR0175 from SIMCAT	5.00	Thames Water	1.74	2.35	BAT	1.65
	SD	0.456							
	95%ile			10.00			5.00		
	Target 90%ile	5	2014 WFD						
Amm (mg/l)	Mean	0.029	U/s WQ point PUTR0175 from 09-13 data	3.00	Thames Water	0.23	0.36	BAT	0.07
	SD	0.023							
	95%ile			8.00			1.00		
	Target 90%ile	0.6	2014 WFD						
P (mg/l)	Mean	0.04	U/s WQ point PUTR0175 from SIMCAT	3.83	SIMCAT discharge value	0.14	0.5	BAT	0.06
	SD	0.011		1.43			0.17		
	Target Mean	0.08	2014 WFD						

Fairford

Table 65 shows the input data and RQP results for Fairford using the existing performance with the current DWF volume and the BAT with future scenarios. Two scenarios were run: the '100 extra houses with BAT' to consider the 77 reserve houses that CDC has allocated for this works and the "200 extra houses with BAT' to consider further growth at the works.

The RQP model predicts that the receiving watercourse would reach good status for all determinands and further growth, above 100 houses, could be accommodated without deteriorating the river status. The comparison with the present-day performance highlights the improvements that the use of BAT has on the receiving watercourse.

Table 65: Input data and RQP results for Fairford WwTW using BAT.

Parameter	Statistic	River	Source	Present day (2013)			100 extra houses with BAT			200 extra houses with BAT		
				STW	Source	RQP Result	STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	181	SIMCAT calculated value just upstream STW	1.54	Thames Water	NA	1.6	Thames Water	NA	1.64	Thames Water	NA
	SD			0.51			0.53			0.55		
	5%ile	67.1										
BOD (mg/l)	Mean	0.676	SIMCAT calculated value just upstream STW	6.00	Thames Water	1.07	2.35	BAT	0.11	2.35	BAT	0.11
	SD	0.272										
	95%ile			12.00			5.00			5.00		
	Target 90%ile	5	2013 WFD									
Amm (mg/l)	Mean	0.046	SIMCAT calculated value just upstream STW	1.50	Thames Water	0.09	0.36	BAT	0.08	0.36	BAT	0.08
	SD	0.021										
	95%ile			4.00			1.00			1.00		
	Target 90%ile	0.6	2013 WFD									
P (mg/l)	Mean	0.035	SIMCAT calculated value just upstream STW	2.56	SIMCAT discharge value	0.06	0.5	BAT	0.04	0.5	BAT	0.05
	SD	0.008		1.03			0.17			0.17		
	Target Mean	0.08	2013 WFD									

Lechlade

Table 66 shows the input data and RQP results for Lechlade using BAT. One scenario was run: the '100 extra houses with BAT' to consider further growth at the works because CDC has not currently identified any reserve sites in this settlement.

The RQP model predicts that the receiving watercourse would reach good status for all determinands and further growth, above 100 houses, could be accommodated without deteriorating the river status. The comparison with the present-day performance highlights the improvements that the use of BAT has on the receiving watercourse.

Table 66: Input data and RQP results for Lechlade WwTW using BAT.

Parameter	Statistic	River	Source	Present day (2013)			100 extra houses with BAT		
				STW	Source	RQP Result	STW	Source	RQP Result
Flow (Ml/d)	Mean	79.5	SIMCAT calculated value just upstream STW	0.88	Thames Water	NA	0.87	Thames Water	NA
	SD			0.29			0.29		
	5%ile	17.4							
BOD (mg/l)	Mean	0.867	SIMCAT calculated value just upstream STW	3.50	Thames Water	1.27	2.35	BAT	1.25
	SD	0.278							
	95%ile			7.00			5.00		
	Target 90%ile	5	2014 WFD						
Amm (mg/l)	Mean	0.057	SIMCAT calculated value just upstream STW	0.60	Thames Water	0.1	0.36	BAT	0.1
	SD	0.028							
	95%ile			1.50			1.00		
	Target 90%ile	0.6	2014 WFD						
P (mg/l)	Mean	0.043	SIMCAT calculated value just upstream STW	2.32	SIMCAT discharge value	0.08	0.5	BAT	0.05
	SD	0.02		0.78			0.17		
	Target Mean	0.078	2014 WFD						

Northleach

Table 67 shows the input data and RQP results for Northleach using BAT. One scenario was run: the '100 extra houses with BAT' to consider further growth at the works because CDC has not currently identified any reserve sites in this settlement.

The RQP model predicts that the receiving watercourse would reach good status for all determinands and further growth, above 100 houses, could be accommodated without deteriorating the river status. The comparison with the present-day performance highlights the improvements that the use of BAT has on the receiving watercourse.

Table 67: Input data and RQP results for Northleach WwTW using BAT.

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Statistic</th><th rowspan="2">River</th><th rowspan="2">Source</th><th colspan="3">Present day (2013)</th><th colspan="3">100 extra houses with BAT</th></tr>
<tr><th>STW</th><th>Source</th><th>RQP Result</th><th>STW</th><th>Source</th><th>RQP Result</th></tr>
<tr><td rowspan="3">Flow (Ml/d)</td><td>Mean</td><td>5.459</td><td rowspan="3">SIMCAT calculated value just upstream STW</td><td>0.16</td><td rowspan="3">Thames Water</td><td rowspan="3">NA</td><td>0.18</td><td rowspan="2">Thames Water</td><td rowspan="3">NA</td></tr>
<tr><td>SD</td><td></td><td>0.05</td><td>0.06</td></tr>
<tr><td>5%ile</td><td>0.609</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">BOD (mg/l)</td><td>Mean</td><td>1.042</td><td rowspan="3">SIMCAT calculated value just upstream STW</td><td>6.00</td><td rowspan="3">Thames Water</td><td rowspan="4">2.02</td><td>2.35</td><td rowspan="3">BAT</td><td rowspan="4">1.64</td></tr>
<tr><td>SD</td><td>0.377</td><td></td><td></td></tr>
<tr><td>95%ile</td><td></td><td>12.00</td><td>5.00</td></tr>
<tr><td>Target 90%ile</td><td>5</td><td>2014 WFD</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Amm (mg/l)</td><td>Mean</td><td>0.032</td><td rowspan="3">SIMCAT calculated value just upstream STW</td><td>0.40</td><td rowspan="3">Thames Water</td><td rowspan="4">0.09</td><td>0.36</td><td rowspan="3">BAT</td><td rowspan="4">0.09</td></tr>
<tr><td>SD</td><td>0.011</td><td></td><td></td></tr>
<tr><td>95%ile</td><td></td><td>1.00</td><td>1.00</td></tr>
<tr><td>Target 90%ile</td><td>0.6</td><td>2014 WFD</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">P (mg/l)</td><td>Mean</td><td>0.009</td><td rowspan="2">SIMCAT calculated value just upstream STW</td><td>7.33</td><td rowspan="2">SIMCAT discharge value</td><td rowspan="3">0.46</td><td>0.5</td><td rowspan="2">BAT</td><td rowspan="3">0.04</td></tr>
<tr><td>SD</td><td>0.003</td><td>1.17</td><td>0.17</td></tr>
<tr><td>Target Mean</td><td>0.078</td><td>2014 WFD</td><td></td><td></td><td></td><td></td></tr>
</table>

Table 68 summarises the RQP modelling results by reporting for each WwTW whether the watercourse will reach or fail its 'Good status' target, 'No deterioration' target and no 'Class deterioration' target for each determinand and scenario.

The results predict that the use of BAT would enable additional growth above and beyond the preferred sites at all five settlements with no deterioration effect on the receiving watercourse, and actually predicts an improvement on the water quality.

Table 68: Summary of results for additional housing scenarios

Watercourse (WwTW discharging into it)	Scenario	Failing 'Good status' target?			Failing 'No > 10% deterioration' target?			Failing 'Class deterioration' target?		
		BOD	Amm	P	BOD	Amm	P	BOD	Amm	P
Key	(green)	Achives good status			No deterioration			No class deterioration		
	(amber)	NA			Up to 10% deterioration			NA		
	(red)	Fails good status			More than 10% deterioration			Class deterioration		
River Avon - Tetbury Branch (Ampney St Peter)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	100 extra	No	No	No	-86%	-29%	-83%	No	No	No
	200 extra	No	No	No	-85%	-29%	-94%	No	No	No
River Coln (Andoversford)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	100 extra	No	No	No	-5%	-70%	-57%	No	No	No
	200 extra	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
River Coln (Fairford)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	100 extra	No	No	No	-90%	-11%	-33%	No	No	No
	200 extra	No	No	No	-90%	-11%	-17%	No	No	No
River Leach (Lechlade)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	100 extra	No	No	No	-2%	0%	-38%	No	No	No
	200 extra	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
River Leach (Northleach)	Actual	No	No	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	100 extra	No	No	No	-19%	0%	-91%	No	No	No
	200 extra	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

A.11 Conclusions

There are numerous failures of WFD standards throughout the study reaches, with some very high concentrations of phosphate. In summary:

- All the WwTW but Fairford fail their P targets for the present-day situation, and at Bourton on the Water, Broadwell, Cirencester, Blockley, Cirencester and Moreton-in-Marsh the P load from the upstream catchment is such that the P target for the watercourse could not be achieved by increased treatment at the works on its own. For Broadwell, Cirencester, Moreton-in-Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury the river target cannot be achieved with BAT even assuming GES upstream of the works. This is indicative of a wider issue with P in the Thames basin and as such this should be addressed at a catchment level. The high concentrations at Blockley and Tetbury could be due to the modelling assumptions made and further investigation are required.
- Moreton-in-Marsh, Blockley and Tetbury fail their Ammonia targets for the present-day situation and Cirencester from 2019/20 scenario. At Blockley and Tetbury the Ammonia the river target cannot be achieved with BAT even assuming GES upstream of the work (Blockley has GES in the actual situation).. The high concentration at Blockley and Tetbury could be due to the assumption made and further investigation are required.

- None of the WwTW fail their targets for BOD for the present-day situation and future scenarios. BOD was not assessed at Honeybourne and Tetbury because no data were available.
- The analysis reported here cannot comment conclusively on the apportionment of pollutant loads between point and diffuse sources, but in 6 out of 13 cases the introduction of additional loads frequently results in significant deterioration (>10%) for Ammonia and in one case also for BOD.
- The use of BAT has the potential to benefit the receiving watercourses and accommodate future growth with no deterioration or improvement results compared to the present-day situation.

The implications for achieving the proposed growth within the Cotswold District area are that:

- If all of the water quality criteria are to be met, none of the WwTWs could accommodate the level of growth associated with the Preferred sites without an upgrade to the WwTW.
- Ampney St Peter, Andoversford, Fairford, Lechlade and Northleach would require upgrades to accommodate the Preferred sites, but this would be achievable using Best Available Technology (BAT) for wastewater treatment. In all 5 cases, the application of BAT would also enable the "Reserve" developments to be accommodated. In the case of Ampney St Peter and Fairford at least an additional 200 homes could then be accommodated. In Andoversford, Fairford and Northleach up to 100 additional homes were tested and could be accommodated.
- Blockley, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury are predicted to be unable to meet good status for the Preferred sites scenario even if they were upgraded to BAT. This points to underlying water quality issues further upstream, either from other point sources or from diffuse rural pollutants.
- Phosphate is an issue that will need to be addressed across the Thames River basin. This is likely to require a combination of further P removal at WwTWs along with agricultural practices (e.g. reductions in P application) and catchment-sensitive farming including riparian buffer zones.
- A predicted WFD class failure or deterioration by 2019/20 means that the works would require upgrade during AMP6. Therefore if no upgrade is scheduled during AMP6 there could be timing issues which would require either additional funding or phasing of development after 2019/20. Results indicated this may be an issue at Andoversford, Bourton on the Water, Cirencester, Fairford, Moreton in Marsh and Northleach.
- A predicted WFD class failure or deterioration between 2021 and 2033/34 could be addressed in AMP7 or 8 and so would not require phasing of development.

B Appendix: Environmental Agency conclusion to the Water Quality Assessment results

creating a better place

Environment Agency

Mr Giovanni Sindoni
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UK

Our ref: WA/2006/000244/OR-09/PO1
Date: 12 May 2015

Updated Water Quality Assessment

Cotswold District Council

Dear Giovanni,

Further to your e-mail dated 7 April 2015 containing the revised Water Quality Assessment (WQA) used to underpin the Water Cycle Study. We have reviewed the Water Quality Assessment (ref 2014s0815 – Cotswold WCS water quality assessment - Appendix v1 3 (3)) and we are now in a position to provide our formal position.

We are pleased to see the changes advised in our letter dated 24 February (ref WA/2006/000281/OR-21/IS1) have been made and incorporated into the Water Quality Assessment.

The WQA highlights the potential risks posed to water from the planned allocated development within the Local Plan. Based on the information within the WQA it is determined that, when taking into account Best Available Technology (BAT), infrastructure upgrades can ensure there is no Water Framework Directive (WFD) class boundary deterioration, in accordance with the WFD objectives.

In addition the WQA concludes that it is not possible to reach Good Ecological Status (GES) for the waterbodies receiving discharges from Broadwell, Cirencester, Moreton on Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury sewage treatment works (STWs) in relation to the chemical element Phosphate.

As part of the River Basin Management Plan (RBMP) we have recently undertaken assessments of what solutions would be required, in the present time, at STWs in order to get to GES in relation to Phosphate. Unfortunately we were unable to provide this information to meet the timescales of the WQA.

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Our assessment for Phosphate has indicated that for Broadwell, Cirencester, Moreton on Marsh, Blockley, Chipping Campden, Honeybourne and Tetbury STWs the solutions are currently deemed to be technically infeasible. Fundamentally this concludes that the planned allocated growth within the Local Plan has no, or very little, bearing on the ability of the waterbodies reaching to GES in relation to Phosphate.

It is pertinent to note that trials of what is technically feasible in relation to Phosphate are being undertaken, the results of which will be available in March 2017. The results will be reviewed in line with water company investigations and the overarching objectives of the WFD.

The WQA indicates that the growth proposed within the Local Plan which would increase loading to Brockley and Tetbury STWs would prevent the receiving waterbodies from reaching GES in relation to Ammonia, contrary to the aims of the WFD and national planning policy.

However we when assessing the growth from Tetbury STW a detailed water quality catchment model (SIMCAT) was not available to assess the entire waterbody. As such the assessment was based on a single monitoring point, the point of mixing (point of discharge from STW into the watercourse) downstream of the works using the River Quality Planning Toolkit (RQP Tool).

At this location Tetbury STW is making up 71% of the flow within the receiving watercourse, so there is very limited dilution of STW flow within the river. When a SIMCAT model is used numerous points throughout the catchment are used. Therefore, the discharge from the STW is assessed against the water quality in the wider catchment. We would consider results of the RQP Tool (which are the best available data at this time) to be very conservative. The results indicate to achieve a river target of Ammonia - 0.6 mg/l (90%ile), to ensure the development does not prevent GES, the corresponding Environmental Permit would have to be very stringent and go beyond what is considered technically feasible.

Whilst the WQA results indicate the growth would prevent the waterbody reaching GES it is pertinent to note that the proposed growth would only increase Ammonia concentration downstream by 6% respectively. Therefore, we are of the opinion that if a SIMCAT model was used, the growth proposed within the Local Plan would not prevent the waterbody (which receives discharges from Tetbury STW) from reaching GES.

Similarly, when assessing Blockley STW a SIMCAT model was not available to assess the entire waterbody. Therefore the assessment was based on a single monitoring point, the point of mixing (point of discharge from STW into the watercourse) downstream of the works using the RQP Tool. At this location Blockley STW is contributing approximately 87% of the flow within the receiving water, so there is very limited dilution of STW flow within the river. The results indicate to achieve a river target quality for Ammonia 0.5 mg/l (95%ile), to ensure the development does not prevent GES, the corresponding Environmental Permit would go beyond what is considered technically feasible.

Whilst the WQA results indicate the growth would prevent the waterbody reaching GES it is important to note that the proposed growth would only increase Ammonia concentration downstream by 2% respectively by 2033. Therefore, we are of the opinion that if a SIMCAT model was used, the growth proposed within the Local Plan would not prevent the waterbody (which receives discharge Blockley STW) from reaching GES.

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Conclusions

We consider that the revised WQA is now considered appropriate and accurate for use within the WCS. Its conclusions highlight the potential risks posed to water quality deterioration from significant levels of growth. Notwithstanding this there are no limiting factors for growth based on the levels of growth indicated within the Local Plan, subject to the relevant mitigation measures and infrastructure upgrades stated within the WQA being delivered.

The conclusions of the WQA will also inform the evidence required to support developing schemes for the National Environment Programme.

We look forward to reviewing the final collated WCS, if you have any further questions please don't hesitate to contact me.

Yours sincerely

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Planning Advisor

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End

C Appendix: Environmental Designation Screening Results

			No buffer zone applicable				100m buffer							200m buffer	500m buffer					1000m buffer				2000m buffer		
CDC_Ref	Number of individual features within buffer	Number of feature categories within buffer	Aquifer Maps - Bedrock Deposit Designation	Aquifer Maps - Superficial Deposits Designation	Groundwater Source Protection Zone	WFD Classification	LNR	Greenbelt	Historic landfill	Landfill site	ALC	Ancient or Semi-Natural Woodland	Listed Buildings	Water courses	Scheduled Monument	Parks and Gardens	World Heritage Sites	Registered Battlefield	National Trails	AONB	NNR	National Park	SSSI	Ramsar	SAC	SPA
3132	6	6	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
6236	9	7	1	2	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0
A_2	7	6	2	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
A_3A	6	6	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
A_3B	13	8	1	2	0	0	0	0	0	2	1	0	4	1	1	0	0	0	0	1	0	0	0	0	0	0
A_4	9	7	1	1	0	0	0	0	1	2	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
A_5	5	5	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
A_7	8	7	1	0	0	0	0	0	0	1	1	0	2	1	1	0	0	0	0	1	0	0	0	0	0	0
AND_E2	15	9	2	2	1	0	0	0	0	2	1	0	4	1	1	0	0	0	0	1	0	0	0	0	0	0
B_10	8	7	1	1	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
B_15A	24	9	1	1	0	0	0	0	0	2	1	0	15	1	1	0	0	0	0	1	0	0	1	0	0	0
B_15B	22	9	1	2	0	0	0	0	0	2	2	0	11	1	1	0	0	0	0	1	0	0	1	0	0	0
B_16	10	6	1	2	0	0	0	0	0	2	2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
B_20	14	8	1	1	0	0	0	0	0	2	1	0	6	0	1	0	0	0	0	1	0	0	1	0	0	0
B_22	12	8	1	1	0	0	0	0	0	2	1	0	4	0	1	0	0	0	0	1	0	0	1	0	0	0
B_25	9	7	1	1	0	0	0	0	0	2	2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
B_26	5	5	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0
B_3	29	8	1	1	0	0	0	0	0	1	1	0	21	1	2	0	0	0	0	1	0	0	0	0	0	0
B_30	10	6	2	3	0	0	0	0	0	0	1	0	0	2	1	0	0	0	0	1	0	0	0	0	0	0
B_32	10	9	1	1	0	0	0	0	0	2	1	0	1	1	1	0	0	0	0	1	0	0	1	0	0	0
B_52	11	6	2	1	0	0	0	0	0	0	1	0	4	0	2	0	0	0	0	1	0	0	0	0	0	0
B_53	6	6	1	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
B_54	11	7	1	2	0	0	0	0	0	0	1	0	4	1	1	0	0	0	0	1	0	0	0	0	0	0
B_6	17	8	1	1	0	0	0	0	0	2	1	0	9	0	1	0	0	0	0	1	0	0	1	0	0	0
BK_1	6	5	1	0	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0
BK_11	5	4	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_12	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
BK_14A	7	6	1	2	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_14B	6	6	1	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_3	8	5	4	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_4	7	6	1	1	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_5	5	5	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_6	7	6	1	2	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_7	9	4	6	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BK_8	4	4	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BLK_E2	6	6	1	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
BOW_E1	10	7	1	2	0	0	0	0	0	2	2	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0
BOW_E2	8	7	1	1	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0
BOW_E3	9	8	1	1	0	0	0	0	0	2	1	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0
BOW_E4	12	8	1	1	0	0	0	0	0	2	1	0	4	0	1	0	0	0	0	1	0	0	1	0	0	0
C_101A	26	8	1	1	0	0	0	0	0	0	1	0	16	1	4	1	0	0	0	1	0	0	0	0	0	0
C_105	39	7	7	0	0	0	0	0	0	1	22	0	3	1	4	0	0	0	0	1	0	0	0	0	0	0
C_106	23	9	2	1	0	0	0	0	0	2	1	0	10	1	4	1	0	0	0	1	0	0	0	0	0	0
C_111	7	6	1	0	1	0	0	0	0	1	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
C_124	9	6	1	0	0	0	0	0	0	2	2	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0
C_132	6	4	2	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
C_136	11	7	2	1	0	0	0	0	0	1	1	0	3	0	2	0	0	0	0	1	0	0	0	0	0	0
C_143	9	7	1	1	0	0	0	0	0	2	1	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0
C_145	15	8	2	1	0	0	0	0	0	2	1	0	5	0	2	1	0	0	0	1	0	0	0	0	0	0
C_146	8	6	1	0	0	0	0	0	0	2	1	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0
C_148	7	5	2	0	0	0	0	0	0	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
C_150	41	8	1	1	0	0	0	0	0	0	1	0	31	2	3	1	0	0	0	1	0	0	0	0	0	0
C_158	6	6	1	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
C_16	10	6	4	0	0	0	0	0	0	1	1	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0
C_161	3	3	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_164	11	6	5	1	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C_165	21	7	8	0	0	0	0	0	0	2	2	0	2	2	4	0	0	0	0	1	0	0	0	0	0	0
C_17	15	8	2	1	0	0	0	0	0	2	1	0	4	0	3	1	0	0	0	1	0	0	0	0	0	0
C_173	7	4	3	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
C_174	4	4	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
C_22	18	7	2	1	0	0	0	0	0	0	1	0	10	1	2	0	0	0	0	1	0	0	0	0	0	0
C_39	7	6	1	0	0	0	0	0	0	1	1	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0
C_42	11	7	2	0	0	0	0	0	0	2	3	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0
C_44	15	7	1	1	0	0	0	0	0	0	1	0	7	0	3	1	0	0	0	1	0	0	0	0	0	0
C_52	29	8	3	1	0	0	0	0	0	0	1	0	19	1	2	1	0	0	0	1	0	0	0	0	0	0
C_57	29	8	1	1	0	0	0	0	0	0	1	0	20	1	3	1	0	0	0	1	0	0	0	0	0	0
C_58	5	4	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
C_64	5	4	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C_70	63	9	2	1	0	0	0	0	0	2	1	0	50	1	4	1	0	0	0	1	0	0	0	0	0	0
C_70B	14	9	1	1	0	0	0	0	0	1	1	0	3	1	4	1	0	0	0	1	0	0	0	0	0	0
C_75	30	9	16	0	1	0	0	0	1	2	3	0	4	0	1	1	0	0	0	1	0	0	0	0	0	0
C_76	9	6	1	0	0	0	0	0	0	2	2	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0
C_77	10	6	3	0	1	0	0	0	0	2	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
C_79	6	5	1	0	0	0	0	0	0	2	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
C_80	9	6	3	1	0	0	0	0	0	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
C_81	8	5	3	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C_82	18	7	2	1	0	0	0	0	0	2	1	0	9	0	2	0	0	0	0	1	0	0	0	0	0	0
C_84A	11	5	4	0	0	0	0	0	1	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
C_84B	9	4	3	0	0	0	0	0	0	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
C_84C	6	4	1	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_84D	6	4	1	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			No buffer zone applicable				100m buffer							200m buffer	500m buffer					1000m buffer				2000m buffer		
CDC_Ref	Number of individual features within buffer	Number of feature categories within buffer	Aquifer Maps - Bedrock Deposit Designation	Aquifer Maps - Superficial Deposits Designation	Groundwater Source Protection Zone	WFD Classification	LNR	Greenbelt	Historic landfill	Landfill site	ALC	Ancient or Semi-Natural Woodland	Listed Buildings	Water courses	Scheduled Monument	Parks and Gardens	World Heritage Sites	Registered Battlefield	National Trails	AONB	NNR	National Park	SSSI	Ramsar	SAC	SPA
C_89	10	7	2	2	0	0	0	0	0	0	1	0	1	2	1	0	0	0	0	1	0	0	0	0	0	0
C_93	21	8	1	1	0	0	0	0	0	1	1	0	12	0	3	1	0	0	0	1	0	0	0	0	0	0
C_97	24	9	2	1	0	0	0	0	0	2	1	0	11	1	4	1	0	0	0	1	0	0	0	0	0	0
CC_23A	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CC_23B	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CC_23C	5	4	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
CC_23D	7	5	2	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
CC_23E	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CC_29	8	5	2	1	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
CC_38A	8	6	2	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0	1	1	0	0	0	0	0	0
CC_38B	7	6	1	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0	1	1	0	0	0	0	0	0
CC_40	8	5	2	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0
CC_41	5	5	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
CC_43	4	4	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
CC_44	8	6	1	0	0	0	0	0	0	0	2	0	2	1	0	0	0	0	1	1	0	0	0	0	0	0
CC_48	21	6	2	0	0	0	0	0	0	0	1	0	15	0	1	0	0	0	1	1	0	0	0	0	0	0
CC_49A	7	5	2	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
CC_50	7	3	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CCN_E1	8	5	2	1	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
CCN_E2	4	3	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CCN_E3A	6	5	1	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
CCN_E3B	9	6	2	2	0	1	0	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
CIR_E1	8	5	3	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CIR_E10	29	8	1	1	0	0	0	0	0	0	1	0	20	1	3	1	0	0	0	1	0	0	0	0	0	0
CIR_E11	9	7	1	1	0	1	0	0	0	1	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
CIR_E12	24	9	2	1	0	0	0	0	0	2	1	0	11	1	4	1	0	0	0	1	0	0	0	0	0	0
CIR_E13	23	9	2	1	0	0	0	0	0	2	1	0	10	1	4	1	0	0	0	1	0	0	0	0	0	0
CIR_E14	22	8	2	1	0	1	0	0	0	0	1	0	11	2	3	0	0	0	0	1	0	0	0	0	0	0
CIR_E15A	12	9	1	1	0	1	0	0	0	1	1	0	3	2	1	0	0	0	0	1	0	0	0	0	0	0
CIR_E15B	11	9	1	2	0	1	0	0	0	1	1	0	1	2	1	0	0	0	0	1	0	0	0	0	0	0
CIR_E16	40	9	2	1	0	0	0	0	0	2	1	0	27	1	4	1	0	0	0	1	0	0	0	0	0	0
CIR_E17	10	7	3	2	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
CIR_E2	7	5	2	0	0	0	0	0	0	0	1	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0
CIR_E20	10	6	3	0	0	0	0	0	1	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
CIR_E4A	6	4	1	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CIR_E4B	6	4	1	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CIR_E5	30	9	16	0	1	0	0	0	1	2	3	0	4	0	1	1	0	0	0	1	0	0	0	0	0	0
CIR_E6	10	6	3	0	1	0	0	0	0	2	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
CIR_E8	11	7	3	0	1	0	0	0	0	2	2	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0
CIR_E9	5	4	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DA_1A	12	6	1	1	3	0	0	0	0	2	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_1B	12	6	1	1	3	0	0	0	0	1	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_2	8	6	1	1	3	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
DA_4	11	8	1	1	2	0	0	0	0	2	1	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0
DA_5A	12	6	1	1	3	0	0	0	0	2	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_5B	8	5	1	1	3	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_5C	12	6	1	1	3	0	0	0	0	2	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_7	10	7	1	1	2	0	0	0	0	1	2	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
DA_8	7	5	1	1	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA_9	8	5	1	2	2	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
F_14	12	6	3	2	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
F_15	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F_20A	9	6	2	1	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0
F_24	6	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
F_26	2	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F_32	6	4	1	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
F_34	10	5	2	2	3	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
F_35B	7	5	1	1	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
F_36B	14	7	2	3	3	0	0	0	0	0	3	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
F_38	9	6	1	1	1	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0
F_41	6	5	1	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
F_44	6	4	1	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F_45	7	6	1	1	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
F_46	7	5	1	1	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
FFD_E2	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
FFD_E3	9	6	2	1	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0
K_1A	11	7	1	0	0	0	0	0	0	2	1	0	2	2	0	0	0	0	1	0	0	0	2	0	0	0
K_1B	7	5	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0
K_1C	8	6	1	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	1	0	0	0	2	0	0	0
K_2	7	6	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	2	0	0	0
K_3	7	5	3	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
K_4	10	7	2	1	0	0	0	0	0	2	1	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0
K_5	4	4	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
K_6A	10	7	1	0	0	0	0	0	0	2	1	0	2	2	0	0	0	0	1	0	0	0	1	0	0	0
K_6B	5	5	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
L_1	16	7	1	1	0	0	0	0	0	0	1	0	9	0	2	1	0	0	1	0	0	0	0	0	0	0
L_12	5	5	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
L_13A	11	7	1	1	0	0	0	0	0	0	2	0	4	0	1	1	0	0	1	0	0	0	0	0	0	0
L_13B	7	6	1	1	0	0	0	0	0	0	2	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0
L_14	6	6	1	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
L_16	6	5	1	1	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

			No buffer zone applicable				100m buffer							200m buffer	500m buffer					1000m buffer				2000m buffer		
CDC_Ref	Number of individual features within buffer	Number of feature categories within buffer	Aquifer Maps - Bedrock Deposit Designation	Aquifer Maps - Superficial Deposits Designation	Groundwater Source Protection Zone	WFD Classification	LNR	Greenbelt	Historic landfill	Landfill site	ALC	Ancient or Semi-Natural Woodland	Listed Buildings	Water courses	Scheduled Monument	Parks and Gardens	World Heritage Sites	Registered Battlefield	National Trails	AONB	NNR	National Park	SSSI	Ramsar	SAC	SPA
L_17	4	4	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
L_18B	13	7	1	2	0	0	0	0	0	0	1	0	6	0	1	0	0	0	1	0	0	0	1	0	0	0
L_19	8	6	1	1	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0
L_22	4	4	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
L_26	6	4	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L_29	13	8	2	3	0	0	0	0	1	2	2	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
L_30	11	8	1	1	0	0	0	0	0	0	2	0	2	1	2	1	0	0	1	0	0	0	0	0	0	0
L_8	5	5	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
L_9	7	6	1	1	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0
LEC_E1	9	6	1	2	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0
LEC_E2A	6	5	1	1	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
LEC_E2B	6	5	1	1	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
LEC_E3	14	8	2	3	0	0	0	0	1	2	2	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0
LEC_E4	10	8	1	1	0	0	0	0	0	0	2	0	2	1	1	1	0	0	1	0	0	0	0	0	0	0
M_11	8	6	1	2	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
M_12A	7	5	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_12B	6	5	1	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_12C	5	5	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_13	8	6	1	3	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
M_14A	7	5	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_14B	8	6	1	2	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
M_14C	7	5	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_16	9	6	1	1	0	0	0	0	0	2	3	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
M_19A	10	5	1	3	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_19B	8	6	1	2	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_19C	10	6	1	3	0	0	0	0	0	1	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_21	8	5	1	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_24	18	6	1	1	0	0	0	0	0	0	1	0	12	0	2	0	0	0	0	1	0	0	0	0	0	0
M_25	8	5	1	1	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_27	9	7	1	2	0	1	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_29	15	7	1	2	0	0	0	0	0	0	1	0	7	1	2	0	0	0	0	1	0	0	0	0	0	0
M_31	9	6	1	2	0	0	0	0	0	1	2	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
M_51	19	7	1	1	0	0	0	0	0	0	1	0	12	1	2	0	0	0	0	1	0	0	0	0	0	0
M_56	19	7	1	2	0	0	0	0	0	0	1	0	11	1	2	0	0	0	0	1	0	0	0	0	0	0
M_57	7	6	1	1	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
M_58	10	7	1	1	0	0	0	0	0	1	2	0	3	0	1	0	0	0	0	1	0	0	0	0	0	0
M_59	5	5	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
M_60	15	6	1	2	0	0	0	0	0	0	1	0	8	0	2	0	0	0	0	1	0	0	0	0	0	0
M_7	8	5	1	2	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
M_9	9	6	1	3	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_9A	7	6	1	1	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_9B	7	6	1	1	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_9C	8	6	1	3	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
M_9D	6	6	1	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
MIC_E1A	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MIC_E1B	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_1	11	6	1	1	0	0	0	0	0	0	1	0	6	0	0	1	0	0	0	1	0	0	0	0	0	0
MK_2A	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_2B	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_3	4	4	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_4	4	3	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_7	6	4	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_8A	8	5	1	1	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
MK_8B	5	4	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E1	8	6	1	2	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
MOR_E10	7	5	1	2	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E11	6	5	1	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E12	8	5	1	1	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E3	8	6	1	2	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
MOR_E4	9	6	1	2	0	0	0	0	0	2	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
MOR_E5	11	6	1	3	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
MOR_E6	8	5	1	1	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E7	9	5	1	2	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
MOR_E8	10	5	1	3	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E9A	6	5	1	1	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MOR_E9B	6	5	1	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
N_12A	26	5	2	0	0	0	0	0	0	0	2	0	20	1	0	0	0	0	0	1	0	0	0	0	0	0
N_12B	22	8	7	1	0	1	0	0	0	1	2	0	8	1	0	0	0	0	0	1	0	0	0	0	0	0
N_12C	9	5	2	1	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0
N_13A	8	5	3	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0
N_13B	8	4	1	0	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0
N_13C	9	6	1	2	0	0	0	0	0	0	1	1	3	0	0	0	0	0	0	1	0	0	0	0	0	0
N_14A	8	5	2	0	0	0	0	0	0	1	1	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
N_14B	6	5	2	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
N_15	4	4	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
N_1A	6	5	1	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
N_1B	8	7	1	1	0	1	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
N_2	18	7	5	1	0	0	0	0	0	1	2	0	7	1	0	0	0	0	0	1	0	0	0	0	0	0
N_5A	20	5	1	1	0	0	0	0	0	0	1	0	16	0	0	0	0	0	0	1	0	0	0	0	0	0
N_5B	22	5	1	1	0	0	0	0	0	0	1	0	18	0	0	0	0	0	0	1	0	0	0	0	0	0
N_8	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

			No buffer zone applicable				100m buffer							200m buffer	500m buffer					1000m buffer				2000m buffer		
CDC_Ref	Number of individual features within buffer	Number of feature categories within buffer	Aquifer Maps - Bedrock Deposit Designation	Aquifer Maps - Superficial Deposits Designation	Groundwater Source Protection Zone	WFD Classification	LNR	Greenbelt	Historic landfill	Landfill site	ALC	Ancient or Semi-Natural Woodland	Listed Buildings	Water courses	Scheduled Monument	Parks and Gardens	World Heritage Sites	Registered Battlefield	National Trails	AONB	NNR	National Park	SSSI	Ramsar	SAC	SPA
NOR_E1	9	6	1	2	0	0	0	0	0	0	1	1	3	0	0	0	0	0	0	1	0	0	0	0	0	0
NOR_E2	23	5	2	0	0	0	0	0	0	0	2	0	17	1	0	0	0	0	0	1	0	0	0	0	0	0
NOR_E3A	6	5	1	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
NOR_E3B	8	7	1	1	0	1	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
RUR_E10	4	4	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
RUR_E12	8	6	1	1	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
RUR_E13	15	7	1	2	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
RUR_E14	21	11	3	2	3	0	0	0	1	2	3	0	1	1	1	0	0	0	0	0	0	0	3	0	1	0
RUR_E15	16	7	2	2	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
RUR_E16	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
RUR_E17	4	4	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
RUR_E18	15	7	7	1	2	0	0	0	0	2	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
RUR_E19	8	5	3	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
RUR_E7	16	8	1	1	3	0	0	0	0	0	2	0	3	1	1	0	0	0	0	0	0	0	3	0	1	0
S_1	12	8	1	0	1	0	0	0	0	2	1	0	2	0	3	1	0	0	0	1	0	0	0	0	0	0
S_14	7	4	4	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
S_2	18	7	1	0	0	0	0	0	0	2	1	0	10	0	2	1	0	0	0	1	0	0	0	0	0	0
S_20	7	5	2	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
S_22A	6	5	2	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
S_22B	5	3	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
S_34A	9	7	2	0	1	0	0	0	0	2	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
S_34B	9	7	2	0	1	0	0	0	0	2	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
S_39	8	7	1	0	0	0	0	0	0	1	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
S_43	24	7	1	0	0	0	0	0	0	2	1	0	16	0	2	1	0	0	0	1	0	0	0	0	0	0
S_46	18	7	1	0	0	0	0	0	0	2	1	0	10	0	2	1	0	0	0	1	0	0	0	0	0	0
S_47	9	7	1	0	0	0	0	0	0	2	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
S_48	11	8	3	0	1	0	0	0	0	1	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
S_49	6	5	2	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
S_50	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
S_51	8	7	2	0	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
S_52	11	8	3	0	1	0	0	0	0	1	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
S_53	7	7	1	0	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
S_54	14	6	8	0	0	0	0	0	0	2	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
S_55	14	6	3	0	0	0	0	0	0	1	1	0	6	0	2	0	0	0	0	1	0	0	0	0	0	0
S_57	8	5	3	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
S_8A	11	7	1	0	0	0	0	0	0	2	1	0	3	0	2	1	0	0	0	1	0	0	0	0	0	0
SC_11	18	8	1	1	2	0	0	0	0	0	3	0	8	1	1	0	0	0	0	0	0	0	1	0	0	0
SC_12	13	9	1	1	2	1	0	0	2	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
SC_13A	12	8	1	1	2	0	0	0	1	2	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
SC_19	29	7	1	1	2	0	0	0	0	0	2	0	20	1	2	0	0	0	0	0	0	0	0	0	0	0
SC_20	9	7	3	1	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
SC_21	5	3	3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SC_22	11	7	1	2	2	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0
SC_23	10	8	1	1	2	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	2	0	0	0
SC_27	16	7	2	2	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
SC_28	15	7	2	1	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
SC_29	15	7	1	2	3	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
SC_9	27	7	1	2	2	0	0	0	0	0	2	0	17	1	2	0	0	0	0	0	0	0	0	0	0	0
SC_E1	13	7	3	2	2	0	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	0	2	0	0	0
SC_E2	15	10	1	1	2	1	0	0	3	2	2	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0
SD_1	10	6	3	0	0	0	0	0	2	1	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_10	8	5	3	0	0	0	0	0	0	1	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_11	9	6	3	1	0	0	0	0	0	1	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_12	10	6	3	0	1	0	0	0	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_13	6	4	2	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_14	9	6	2	0	0	0	0	0	1	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_2	6	6	1	1	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_3	5	4	2	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_4	10	5	1	1	0	0	0	0	0	0	1	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_5	6	4	3	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_6	7	4	3	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_8	5	4	1	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_9A	9	5	3	0	0	0	0	0	1	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_9B	11	6	3	0	0	0	0	0	1	1	2	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0
SD_9C	14	6	3	0	1	0	0	0	2	2	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
SD_9D	9	5	3	0	1	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SID_E1	6	4	3	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
SID_E2	8	5	2	0	0	0	0	0	1	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SID_E3	10	5	1	1	0	0	0	0	0	0	1	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0
STW_E1	6	5	2	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
STW_E2	11	8	3	0	1	0	0	0	0	1	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
STW_E3	6	5	2	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
STW_E4	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
STW_E5	11	8	3	0	1	0	0	0	0	1	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0
STW_E6	7	7	1	0	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
STW_E7	7	5	2	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
STW_E9	9	7	2	0	1	0	0	0	0	2	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
T_1	7	6	1	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_17	34	7	1	0	2	0	0	0	0	2	1	0	26	0	1	0	0	0	0	1	0	0	0	0	0	0
T_22	41	7	1	0	2	0	0	0	0	2	1	0	33	0	1	0	0	0	0	1	0	0	0	0	0	0
T_26	8	6	1	0	2	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0

			No buffer zone applicable				100m buffer							200m buffer	500m buffer					1000m buffer				2000m buffer		
CDC_Ref	Number of individual features within buffer	Number of feature categories within buffer	Aquifer Maps - Bedrock Deposit Designation	Aquifer Maps - Superficial Deposits Designation	Groundwater Source Protection Zone	WFD Classification	LNR	Greenbelt	Historic landfill	Landfill site	ALC	Ancient or Semi-Natural Woodland	Listed Buildings	Water courses	Scheduled Monument	Parks and Gardens	World Heritage Sites	Registered Battlefield	National Trails	AONB	NNR	National Park	SSSI	Ramsar	SAC	SPA
T_28	10	7	2	0	2	0	0	0	0	2	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
T_31A	9	6	1	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_31B	8	7	1	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_31C	11	7	2	1	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_34	12	8	3	1	2	0	0	0	0	2	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
T_34C	9	6	3	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_34D	10	6	3	0	2	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
T_35	9	6	2	0	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_38	11	7	1	0	2	0	0	0	1	2	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
T_39	7	6	1	0	2	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
T_40	11	7	2	0	2	0	0	0	0	2	2	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
T_45	12	7	4	1	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
T_50	31	8	2	0	2	0	0	0	0	1	1	0	22	1	1	0	0	0	0	1	0	0	0	0	0	0
T_51	8	5	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_52	13	8	3	0	2	0	0	0	1	2	2	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
T_55	7	5	1	0	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_57	12	7	1	0	2	0	0	0	0	2	1	0	4	0	1	0	0	0	0	1	0	0	0	0	0	0
T_61	7	5	1	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_62	13	8	2	0	2	0	0	0	0	2	1	0	3	1	1	0	0	0	0	1	0	0	0	0	0	0
T_63A	8	5	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_63B	8	5	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_63C	9	5	2	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
T_64	27	8	1	0	2	0	0	0	0	1	1	0	19	1	1	0	0	0	0	1	0	0	0	0	0	0
T_67	7	6	1	0	2	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
T_70	9	6	2	0	2	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
T_71	11	7	2	0	2	0	0	0	0	2	2	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
TET_E1	8	5	2	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TET_E2	9	6	1	0	2	0	0	0	0	2	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
TET_E4	6	5	1	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
UR_2	7	4	2	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
UR_3	7	4	2	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
UR_E1	14	6	7	0	0	1	0	0	0	2	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
W_1A	12	4	1	0	0	0	0	0	0	0	1	0	9	0	0	0	0	0	0	1	0	0	0	0	0	0
W_1B	11	4	1	0	0	0	0	0	0	0	1	0	8	0	0	0	0	0	0	1	0	0	0	0	0	0
W_4	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_5	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_6	9	4	1	0	0	0	0	0	0	0	1	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0
W_7A	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_7B	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_8A	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_8B	4	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_8C	5	3	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
W_9	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
WIL_E1A	9	4	1	0	0	0	0	0	0	0	1	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0
WIL_E1B	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
WIL_E1C	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
WPP1	386	11	34	7	0	8	0	0	2	2	4	0	318	2	7	1	0	0	0	1	0	0	0	0	0	0
WPP10	12	6	5	0	0	1	0	0	0	2	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
WPP11	40	6	1	1	0	0	0	0	0	0	2	0	34	0	0	1	0	0	0	1	0	0	0	0	0	0
WPP12	126	10	13	2	4	1	0	0	0	1	1	1	101	1	0	0	0	0	0	1	0	0	0	0	0	0
WPP13	24	11	5	3	1	1	0	0	2	2	1	0	5	1	2	0	0	0	0	1	0	0	0	0	0	0
WPP14	24	9	1	3	3	0	0	0	0	2	2	0	10	1	1	0	0	0	0	0	0	0	0	0	1	0
WPP15	136	10	2	8	0	1	0	0	0	2	3	0	113	2	3	0	0	0	0	1	0	0	1	0	0	0
WPP16	126	9	2	7	3	1	0	0	0	0	3	0	107	1	1	0	0	0	0	0	0	0	1	0	0	0
WPP17	31	8	6	0	2	0	0	0	0	2	1	0	16	1	0	0	0	0	1	0	0	0	2	0	0	0
WPP18	15	8	4	1	1	0	0	0	2	1	1	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0
WPP2	78	11	3	3	2	2	0	0	3	2	3	0	54	2	2	0	0	0	0	0	0	0	2	0	0	0
WPP3	96	9	2	2	0	1	0	0	0	2	2	1	84	1	0	0	0	0	0	1	0	0	0	0	0	0
WPP4	248	11	10	2	2	0	0	0	2	2	3	0	222	1	2	0	0	0	0	1	0	0	1	0	0	0
WPP5	227	9	11	3	0	1	0	0	0	0	3	0	205	1	1	0	0	0	1	1	0	0	0	0	0	0
WPP6	115	9	1	7	0	1	0	0	0	2	3	0	96	1	3	0	0	0	0	1	0	0	0	0	0	0
WPP7	121	11	2	4	0	1	0	0	0	2	3	0	103	1	2	1	0	0	1	0	0	0	1	0	0	0
WPP8	135	8	9	0	1	0	0	0	0	2	1	0	117	0	3	1	0	0	0	1	0	0	0	0	0	0
WPP9	28	4	2	0	0	0	0	0	0	0	1	0	24	0	0	0	0	0	0	1	0	0	0	0	0	0

D Appendix: Conclusions to questions raised by Environment Agency

Table D-1 summarises the conclusions to the questions raised by the Environment Agency in the original project scope.

Table D-1: Summary of conclusions to questions raised by the Environment Agency

Question	Conclusion	Mitigation measures	Responsib-ility to address
Environment Agency Issue 1: Water Resources and Water Supply			
Is there capacity in existing licences for development?	Water is available in small areas of the District (Leach, Alscot Park and to a limited extent in the upper Windrush and Oolites), but there is no additional water available for licensing in the majority of the District.	Require new developments to be designed to Building Regulations water consumption standard for water scarce areas (110 litres per person per day) Apply demand management measures as per Water Resource Management Plans	Cotswold District Council Bristol Water Severn Trent Water Thames Water
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, the Cotswold District Local Plan Consultation Paper and both Bristol Waters' and Thames Waters' Water Resource Management Plans. 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 by Local Planning Authorities across the Swindon and Oxfordshire (SWOX) water supply zone compared to when Thames Water's Water Resource Management Plan was prepared. Thames Water will undertake further work in 2015 to assess how the supply-demand balance will be maintained in SWOX for the plan period.	Keep the timing of new major water resource infrastructure projects under review Safeguard land for water resource projects where required	Thames Water Cotswold DC and neighbouring Local Planning Authorities
Environment Agency Issue 2: Wastewater Collection and Treatment			
Is there volumetric capacity in existing effluent discharge permit for growth?	This has been assessed at each of the WwTWs planned to receive additional flows. Broadwell, Fairford and Moreton-in-Marsh	Require new developments to be designed to Building Regulations water	Cotswold District Council

Question	Conclusion	Mitigation measures	Responsib-ility to address
	WwTWs are particular constrained as upgrades would be required by 2021 to enable them to accommodate expected growth without failing their permits.	consumption standard for water scarce areas (110 litres per person per day) Plan WwTW upgrades in line with site allocations	 Severn Trent Water Thames Water Wessex Water
Will discharge permit be valid to meet future standard (e.g. WFD)?	If all of the water quality criteria are to be met, none of the WwTWs could accommodate the level of growth associated with the Preferred sites without an upgrade to the WwTW. Ampney St Peter, Andoversford, Fairford, Lechlade and Northleach would require upgrades to accommodate the Preferred sites, but this would be achievable using Best Available Technology (BAT) for wastewater treatment. In all 5 cases, the application of BAT would also enable the "Reserve" developments to be accommodated. In the case of Ampney St Peter and Fairford at least an additional 200 homes could then be accommodated. In Andoversford, Fairford and Northleach up to 100 additional homes were tested and could be accommodated. Blockley, Bourton-on-the-Water, Broadwell, Chipping Campden, Cirencester, Honeybourne, Moreton-in-Marsh and Tetbury are predicted to be unable to meet good status for the Preferred sites scenario even if they were upgraded to BAT. This points to underlying water quality issues further upstream, either from other point sources or from diffuse rural pollutants.	Ensure wastewater treatment works have capacity for already committed growth Divert development to settlements where the WwTW can accommodate more houses; Consider sewer transfer schemes to divert flow to watercourses that can receive flow discharge without affecting their WFD status; Apply strategy at catchment level to reduce the inputs of pollutants	Severn Trent Water Thames Water Wessex Water Cotswold District Council Severn Trent Water Thames Water Wessex Water Environment Agency and partners
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.		
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.	Ensure wastewater treatment works have capacity for already committed growth Built CDC's preferred allocations into asset management plans	Severn Trent Water Thames Water Wessex Water
Environment Agency Issue 3: Environmental Opportunities			

<table>
<tr><th>Question</th><th>Conclusion</th><th>Mitigation measures</th><th>Responsib -ility to address</th></tr>
<tr><td>Are we making the most of our new development?</td><td rowspan="2">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 incentives 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.</td><td rowspan="2">Provide clarity over SuDS design standards, ownership and maintenance

Promote the use of SuDS delivering multiple benefits through planning policies</td><td rowspan="2">Defra / national government

Cotswold District Council</td></tr>
<tr><td>Are there multi-use options that will provide water resources, flood risk management and water quality benefits?</td></tr>
</table>

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