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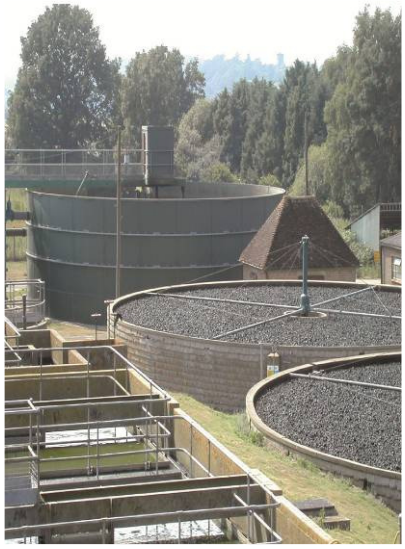
# Water Cycle Study Update

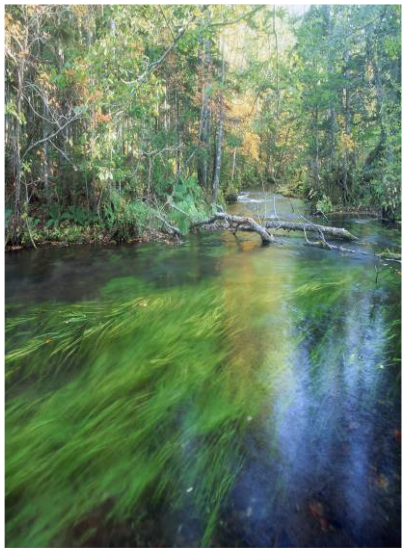
Final Report

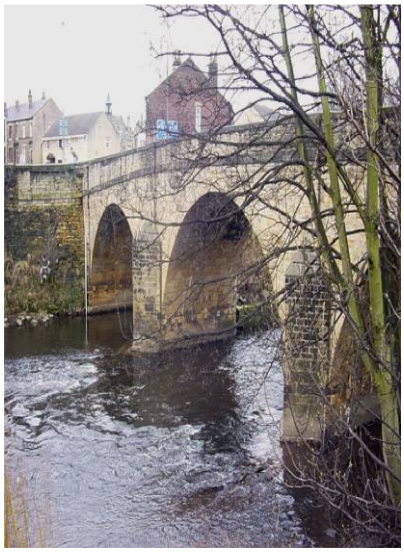
September 2012

Prepared for:
Stratford-on-Avon District Council

UNITED KINGDOM & IRELAND







| REVISION SCHEDULE | | | | | |
|---|---|---|---|---|---|
| **Rev** | **Date** | **Details** | **Prepared by** | **Reviewed by** | **Approved by** |
| 1 | June 2012 | Draft Report | Gemma Hoad<br>Water Scientist | Carl Pelling<br>Principal Consultant | Carl Pelling<br>Principal Consultant |
| | | | Amy Ruocco<br>Assistant Water Specialist | | |
| 2 | June 2012 | Final Report | Gemma Hoad<br>Water Scientist | Carl Pelling<br>Principal Consultant | Jon Robinson<br>Technical Director |
| 3 | September 2012 | Addition of 2 Local Service Villages | Gemma Hoad<br>Water Scientist | Carl Pelling<br>Principal Consultant | Carl Pelling<br>Principal Consultant |

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# TABLE OF CONTENTS

## NON-TECHNICAL SUMMARY

The Stratford-on-Avon District Council Water Cycle Study (WCS) has previously been reported in a Scoping and Outline Warwickshire Sub-Regional WCS which was completed in March 2010[1] and was based on previous drafts of the Stratford-on-Avon Core Strategy.

Stratford-on-Avon District Council has decided that it wishes to consider a more dispersed pattern of growth, which seeks to allocate more housing to the Local Service Villages and other villages than previously proposed in the current Local Plan Review 1996–2011, or previous drafts of the Core Strategy.

This WCS Update will help Stratford-on-Avon District Council determine the most appropriate locations for development within Local Service Villages (with respect to water infrastructure and the water environment) to be identified in the developing Local Plan.

Growth information has been used to determine any water cycle constraints, if and how the constraints can be resolved and how they may impact on phasing of development over the plan period. Furthermore, it provides a suggested approach to the management and use of water, which demonstrates ways to ensure that the sustainability of the water environment in the study area is not compromised by growth.

A Water Cycle Strategy is presented for the District as a whole and for each of the Local Service Villages.

### The Wastewater Strategy

*Wastewater Treatment*

The table below provides an indication of the Wastewater Treatment Works (WwTWs) which are currently unable to accept any additional growth within the Local Service Villages (amber), and which have able capacity (green).

| SUMMARY OF WWTW AVAILABLE CAPACITY | |
|---|---|
| **WwTW Catchment** | **Phasing of Development** |
| Alcester | Capacity for all additional growth |
| Bearley | Capacity for all additional growth |
| Bideford on Avon | WwTW at consent limit |
| Butlers Marston | WwTW at consent limit |
| Cherington | WwTW at consent limit |
| Claverdon | Capacity for all additional growth |
| Earlswood – Spring Brook | Capacity for all additional growth |
| Ettington Works | Capacity for all additional growth |

[1] Halcrow (2010) – Warwickshire Sub-Regional Water Cycle Study, Stratford-on-Avon Scoping and Outline Final Report

| SUMMARY OF WWTW AVAILABLE CAPACITY | |
|---|---|
| **WwTW Catchment** | **Phasing of Development** |
| Fenny Compton | Capacity for all additional growth |
| Gaydon | WwTW at consent limit |
| Ilmington | WwTW at consent limit |
| Itchen Bank | Capacity for all additional growth |
| Lighthorne Heath | Capacity for all additional growth |
| Long Compton | WwTW at consent limit |
| Long Marston | WwTW at consent limit |
| Moreton Morrell | Capacity for all additional growth |
| Napton | WwTW at consent limit |
| Northend | Capacity for all additional growth |
| Oxhill | Capacity for all additional growth |
| Preston on Stour | Capacity for all additional growth |
| Redditich – Spernal | Capacity for all additional growth |
| Shipston – Fell Mill | Capacity for all additional growth |
| Snitterfield | Capacity for all additional growth |
| Stratford – Milcote | Capacity for all additional growth |
| Tanworth-in-Arden | Capacity for all additional growth |
| Tysoe | Capacity for all additional growth |
| Wellesbourne | WwTW at consent limit |
| Wootton Wawen | Capacity for all additional growth |
| Priors Marston (TW) | WwTW at consent limit |

The WCS has shown that several WwTWs have capacity to accept wastewater flow from the proposed growth without the need for improvements to treatment infrastructure. This is the case for those works highlighted in green in the table above. Growth is not constrained by wastewater treatment in these locations.

The remaining WwTWs of Bideford on Avon, Butlers Marston, Cherington, Gaydon, Ilmington, Long Compton, Long Marston, Napton, Wellesbourne, and Priors Marston are shown to already be at their limit of consent with current housing levels. Therefore solutions are required in order to accommodate the growth to ensure that the increased wastewater flow discharged does not impact on the current quality of the receiving watercourses, their associated ecological sites and also to ensure that the watercourses can still meet with legislative requirements.

The detailed assessments have shown that improvements for all WwTW are possible within the limits of conventionally applied technology, but that development in these catchments may require annual completions to be limited until solutions are in place with the exception of Bideford on Avon. For Bideford on Avon, water quality modelling has shown that despite the increase in treated flow, the quality conditions of the existing consent would be sufficient to prevent the quality of the River Avon from deteriorating from its current Water Framework Directive (WFD) status for all discharge parameters. Hence no upgrades are required and there are no phasing implications on growth in this catchment.

The WCS has concluded that the study partners, including Stratford-on-Avon District Council, the Environment Agency, Severn Trent Water and Thames Water should work together to determine if any of the potential solutions proposed in the study are acceptable and hence conclude when and how much development can be accommodated across the District in the early phases of the Local Plan delivery period.

In all cases, the assessments have shown that the ability of watercourses to meet future water quality targets (Good Status) under the WFD will not be compromised by growth alone and hence growth should not be seen as a barrier to watercourses in the District meeting 'Good Status' in the future.

*Ecological Impacts*

There are four statutory designated sites that have been identified as potentially being connected to WwTW discharges in Stratford-on-Avon District Council: River Blythe SSSI, Sherbourne Meadows SSSI adjacent to Bell Brook, Welford Field SSSI on a tributary of the Middle Avon River and the River Arrow Local Nature Reserve at Alcester. All other designated sites identified within the district are remote from watercourses into which WwTW's discharge treated effluent.

The Water Cycle Study identifies that all four of these WwTW's have existing consented headroom, which is sufficient to accommodate all of the proposed growth sites. Hence no infrastructure upgrades are required to deliver the proposed growth levels in these locations. Growth in these catchments would not therefore deteriorate water quality, or increase flood risk and hence there is no barrier to delivering the proposed growth levels.

Ten WwTWs in Stratford-on-Avon District Council will require a change to their consents in order to comply with the WFD requirements for no deterioration downstream. For all ten sites, 'no deterioration' is achievable within the limits of conventional treatment. With such consent tightening in place there should be no deterioration in downstream water quality and therefore there will be no adverse effects on wildlife in the receiving watercourses.

All developments at Local Service Villages would have potential for the enhancement of ecological value through new SuDS opportunities linked to the new development. These could provide habitat for Warwickshire BAP species and habitats such as fen, marsh and swamp, great crested newt or water vole.

*Sewer Capacity*

In order to ensure wastewater from growth can be drained to the WwTWs, an assessment of sewer capacity constraints on potential growth sites was undertaken. This assessment has determined where developers will need to contribute to upgrades to existing sewerage infrastructure (sewer mains or pumping stations) or towards new infrastructure; but concludes no significant barrier to development with respect to sewer capacity.

**The Water Supply Strategy**

Based on the total planned growth assessed, the WCS has concluded that Stratford-on-Avon would have adequate water supply to cater for growth in the plan period.

However, the WCS has identified that there are long term limitations on further abstraction from the raw water resources supplying the district and that there is a drive to ensure the delivery of sustainable development for Stratford-on-Avon as a whole. Hence there are key drivers requiring that water demand is managed in the study area for all new development in order to achieve long term sustainability in terms of water resources.

In order to reduce reliance on raw water supplies from rivers and aquifers, the WCS has set out ways in which demand for water as a result of development can be minimised without incurring excessive costs or resulting in unacceptable increases in energy use. In addition, the assessment has considered how far development in the District can be moved towards achieving a theoretical 'water neutral' position i.e. that there is no net increase in water demand between the current use and after development across the Plan period has taken place. A pathway for achieving neutrality as far as practicable has been set out, including advice on:

- what measures need to be taken technologically to deliver more water efficient development;
- what local policies need to be developed to set the framework for reduced water use through development control;
- how measures to achieve reduced water use in existing and new development can be funded; and
- where parties with a shared interest in reducing water demand need to work together to provide education and awareness initiatives to local communities to ensure that people and business in the District understand the importance of using water wisely.

Four water neutrality scenarios have been proposed and assessed to demonstrate what is required to achieve different levels of neutrality in the District. This has been undertaken for two different water neutrality options, as described below.

- Option 1 – all properties remaining unmetered in 2035 (at the end of STW's WRMP period) would be metered in addition, through a specific initiative in conjunction with Stratford-on-Avon District Council for the WCS for the medium, high and very high scenarios.
- Option 2 – only 10% of households that remain unmetered in 2035 (at the end of STW's WRMP period) would be metered additionally (equates to 1,600 dwellings).

For Option 1 and 2, total neutrality could be achieved with relatively standard, but high spec water efficient fittings being retrofitted into existing households, with new properties built to CSH 3/4.

The assessment concluded that measures should be taken to deliver the first step on the neutrality pathway by implementing the medium scenario, which is generally considered to require a modest level of funding and joint partnership working. Depending on the success of the first step, higher scenarios could then be aspired to. The following initial measures are therefore suggested by the WCS:

- ensure all housing is water efficient, new housing development must go beyond Building Regulations and as a minimum reach Code for Sustainable Homes Level 3 or 4 for water. Where appropriate, specific developments should be identified for water re-use/greywater features to be included;

- carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 10% of the existing housing stock, additional to that in the WRMP, with easy fit water saving devices; and,
- Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

**Surface Water Drainage Management**

Conventional surface water drainage systems for new development were designed to convey rainwater and surface water run-off away as quickly as possible. This helps to prevent flooding of the drained area, but may cause flooding of downstream areas. In addition to the increased flood risk, conventional drainage systems can cause pollution of the receiving watercourses as impermeable surfaces accumulate pollutants such as hydrocarbons, tyre fragments and debris, detergents and grit and particulates.

Sustainable Drainage Systems (SuDS) can be used to both hold back and treat surface water run-off thereby reduce downstream flood risk and protect or improve water quality in the water environment.

The vision for sustainable surface water management in the proposed new growth in Stratford-on-Avon is based on the following key aims:

- linkage to water efficiency measures, including rainwater harvesting; and,
- linkage to the Warwickshire wide Surface Water Management Plan (SWMP).

The aim is that all SuDS should include environmental enhancement and should provide amenity, social and recreational value.

Although SuDS are an important tool in managing surface water drainage across the District, at a site specific level, the requirements of any discharge of surface water from a site are dictated by the specifics of the water level management system operated by the Environment Agency. Developers or development control officers should seek the advice of the Environment Agency.

**Water Cycle Strategy Recommendations and Policy**

In order to support the further development of the Stratford-on-Avon's Local Plan with respect to water services infrastructure and the water environment; the WCS reports a site specific assessment of the potential constraints on each of the growth sites where the majority of development within the District is likely to take place.

The following policies are also recommended to deliver the Water Cycle Strategy:

<u>WW1 – Development Phasing</u>

Development in Salford Priors, Pillerton Priors, Brailes (Upper and Lower), Tysoe (Upper and Middle) and Priors Marston will need to be restricted to a minimal annual completion rate to be agreed with STW and Environment Agency until a new solution is in place post 2015, as there is insufficient headroom to accommodate further growth.

<u>WW2 – Development and Sewerage Network</u>

Development at sites indicated in the WCS (Amber) to have potentially limited sewer network capacity should be subject to a pre-development enquiry with STW (or TW where necessary) to determine upgrades needed to prior to planning permission being granted.

WS1 – Water Efficiency in new homes

Ensure all housing is water efficient, new housing development must go beyond Building Regulations and as a minimum reach Code for Sustainable Homes Level 3 or 4 for water.

WS2 – Water Efficiency Retrofitting

Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 10% of the existing housing stock with easy fit water savings devices

WS3 – Water Efficiency Promotion

Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

SWM1 – Sewer Separation

Developers should ensure foul and surface water from new development and redevelopment are kept separate where possible. Where sites which are currently connected to combined sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken.

SWM2 – Above Ground Drainage

Developers should aspire to achieve 100% above ground drainage for all future developments, where feasible. Where this is not feasible due to for example housing densities, land take, ground conditions, topography, or other circumstances, the development proposals should maximise opportunities to use SuDS measures which require no additional land take, i.e. green roofs, permeable surfaces and water butts.

SWM3 – SuDS and Green Infrastructure

Developers should ensure linkage of SuDS to green infrastructure to provide environmental enhancement and amenity, social and recreational value. SuDS design should maximise opportunities to create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space.

SWM4 – SuDS and Water Efficiency

Developers should ensure linkage of SuDS to water efficiency measures, including rainwater harvesting.

SWM4 – Linkages to SWMP, SuDS Handbook, SFRA

Developers should ensure SuDS design supports the findings and recommendations of the Warwickshire Surface Water Management Plan (SWMP), the SuDS Manual (either the CIRIA SuDS Manual or the Warwickshire SuDS Manual when available) and Stratford-on-Avon District Council's SFRA.

SWM5 – Water Quality Improvements

Developers should ensure, where possible, that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the Water Framework Directive.

ECO1 – Biodiversity Enhancement

It is recommended that the Council include a policy in its Core Strategy which commits to seeking and securing (through planning permissions etc) enhancements to aquatic biodiversity in Stratford-on-Avon District through the use of SuDS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities) in line with the Warwickshire Green Infrastructure Strategy.

In addition, the following recommendations are also made by the study:

- key partners in the WCS maintain regular consultation with each other as development proposals progress;
- the WCS should remain a living document, and be reviewed on an annual basis as development progresses and appropriate changes are made to the various studies and plans that support it;

| GLOSSARY OF ACRONYMS AND ABBREVIATIONS | |
|---|---|
| **Abbreviation** | **Description** |
| AMP | Asset Management Plan |
| BAP | Biodiversity Action Plan |
| BGS | British Geological Society |
| BOD | Biochemical Oxygen Demand |
| BREEAM | Building Research Establishment Environmental Assessment Method |
| CAMS | Catchment Abstraction Management Strategy |
| CBA | Cost Benefit Analysis |
| CFMP | Catchment Flood Management Plan |
| CIL | Community Infrastructure Levy |
| CIRIA | Construction Industry Research and Information Association |
| CLG | Communities and Local Government |
| CRC | Carbon Reduction Commitment |
| CSH | Code for Sustainable Homes |
| CSO | Combined Sewer Overflow |
| CWS | County Wildlife Sites |
| DEFRA | Department for Environment, Food and Rural Affairs |
| DO | Dissolved Oxygen |
| DPD | Development Plan Document |
| DG2 | Register of pressure of water mains |
| DWF | Dry Weather Flow |
| DWI | Drinking Water Inspectorate |
| EA | Environment Agency |
| EIB | European Investment Bank |
| FEH | Flood Estimation Handbook |
| FFT | Flow to Full Treatment |
| FMfSW | Flood Maps for Surface Water |
| GHG | Greenhouse Gas |

| GLOSSARY OF ACRONYMS AND ABBREVIATIONS | |
|---|---|
| **Abbreviation** | **Description** |
| GI | Green Infrastructure |
| GWR | Greywater Recycling |
| HA | Highways Agency |
| HMWB | Heavily Modified Water Body (under the Water Framework Directive) |
| l/h/d | Litres/head/day (a water consumption measurement) |
| LCT | Limits of Conventional Treatment |
| LDDs | Local Development Documents |
| LDF | Local Development Framework |
| LFE | Low Flow Enterprise (low flow model) |
| LLFA | Lead Local Flood Authority |
| LPA | Local Planning Authority |
| MCA | Multi-Criteria Analysis |
| Ml | Mega Litre (a million litres) |
| NE | Natural England |
| NH4 | Ammonium |
| NPPF | National Planning Policy Framework |
| NRD | National Receptor Database (Environment Agency) |
| NWA | No Water Available (in relation to CAMS) |
| OFWAT | The Water Services Regulation Authority (formerly the Office of Water Services) |
| OR | Occupancy Rate |
| O-A | Over Abstracted (in relation to CAMS) |
| O-L | Over Licensed (in relation to CAMS) |
| P | Phosphorous |
| PE | Population Equivalent |
| PR | Periodic Review |
| PS | Pumping Station |
| p/d | Persons per dwelling |
| Q95 | The river flow exceeded 95% of the time |

| GLOSSARY OF ACRONYMS AND ABBREVIATIONS | |
|---|---|
| **Abbreviation** | **Description** |
| RAG | Red/Amber/Green Assessment |
| RBMP | River Basin Management Plan |
| RoC | Review of Consents (under the Habitats Directive) |
| RQO | River Quality Objective |
| RQP | River Quality Planning |
| RTPI | Royal Town Planning Institute |
| RWH | Rainwater Harvesting |
| SAB | SuDS Approval Body |
| SAC | Special Area for Conservation |
| SFRA | Strategic Flood Risk Assessment |
| SPA | Special Protection Area |
| SPD | Supplementary Planning Document |
| SPZ | Source Protection Zone |
| SS | Suspended Solids |
| SSSI | Site of Special Scientific Interest |
| SoA | Stratford-on-Avon District Council |
| STW | Severn Trent Water |
| SUDS | Sustainable Drainage Systems |
| SWMP | Surface Water Management Plan |
| SWMS | Sustainable Water Management Study |
| TW | Thames Water |
| UKCIP02 | United Kingdom Climate Impacts Programme 2002 |
| UKCP09 | United Kingdom Climate Projections 2009 |
| UKTAG | United Kingdom Technical Advisory Group (to the WFD) |
| UKWIR | United Kingdom Water Industry Research group |
| UPM | Urban Pollution Management |
| UWWTD | Urban Wastewater Treatment Directive |
| WCS | Water Cycle Study |

| GLOSSARY OF ACRONYMS AND ABBREVIATIONS | |
|---|---|
| **Abbreviation** | **Description** |
| WFD | Water Framework Directive |
| WN | Water Neutrality |
| WRMP | Water Resource Management Plan |
| WRMU | Water Resource Management Unit (in relation to CAMS) |
| WRZ | Water Resource Zone (in relation to a water company's WRMP) |
| WSI | Water Services Infrastructure |
| WTW | Water Treatment Works |
| WwTW | Waste Water Treatment Works |

# 1 INTRODUCTION

## 1.1 Study Need and Drivers

Stratford-on-Avon District Council is currently in the process of updating its evidence base to support the production of a third draft of the Core Strategy. This study will be an important part of the evidence base that will help to identify sites with potential for development over the period 2008 to 2028.

The study will help Stratford-on-Avon District Council determine the most appropriate locations for development (with respect to water infrastructure and the water environment) to be identified in the Local Development Framework in a future Site Allocations Development Plan Document.

Stratford-on-Avon District Council has decided that it wishes to consider a more dispersed pattern of growth, which seeks to allocate more housing to the Local Service Villages and other villages than previously proposed in the current Local Plan Review 1996–2011, or previous drafts of the Core Strategy. Therefore an update to the existing Water Cycle Study (WCS) is required to assess the potential impacts of the spatial approach within and adjacent to Local Service Villages in the District.

The objective of the WCS update is to identify any constraints on housing growth planned in the Local Service Villages and other villages in the Stratford-on-Avon District up to 2028 that may be imposed by the water cycle and how these can be resolved i.e. by ensuring that appropriate Water Services Infrastructure (WSI) can be provided to support the proposed development. Furthermore, it should provide a strategic approach to the management and use of water which ensures that the sustainability of the water environment in the district is not compromised.

## 1.2 WCS History

The Stratford-on-Avon District Council Water Cycle Study (WCS) has previously been reported in a Scoping and Outline Warwickshire Sub-Regional WCS which was completed in March 2010[2].

The Scoping and Outline report, based on the West Midlands Regional Spatial Strategy (WMRSS) assessed the baseline conditions of various elements of the water cycle in Stratford-on-Avon, including the natural water environment and the capacity of the WSI that would be used to support growth. In addition, the Stage 1 study undertook a high level assessment of the likely growth in town locations and the proposed levels of growth within the district, and determined where growth would be achievable within the existing capacity of both the infrastructure and the water environment at a strategic level.

In addition to the changes in the preferred spatial strategy for growth, a number of key water related documents (including the Environment Agency's River Basin Management Plans, Severn Trent Water and Thames Water's Water Resource Management Plans, United Kingdom Climate Projections 2009 (UKCP09) etc.) have been published, and as such, the evidence upon which the Outline WCS conclusions and recommendations were founded has changed.

[2] Halcrow (2010) – Warwickshire Sub-Regional Water Cycle Study, Stratford-on-Avon Scoping and Outline Final Report

## 1.3 Study Governance

This WCS update has been carried out with the guidance of the Steering Group and comprised the following organisations:

- Stratford-on-Avon District Council;
- Severn Trent Water (STW) Ltd;
- Warwickshire County Council; and
- Environment Agency.

Thames Water was also consulted with respect to one element of specific wastewater treatment infrastructure falling within their area of operation.

The Steering Group met during the completion of the study to both guide and feedback on the assessments undertaken in support of the study.

## 1.4 WCS Update Scope

This WCS update provides information at a level suitable to ensure that there are solutions to deliver growth for the preferred development allocations, including the policy required to deliver it.

The outcome is the development of a water cycle strategy for the district which informs site specific and other DPDs of the water environment and WSI issues. This will need to be considered in bringing growth forward at various sites, including guidance for developers in conforming to the requirements of the strategy.

The following sets out the key objectives of the WCS update for Stratford-on-Avon District Council:

- determine if solutions to wastewater treatment for each growth Local Service Village are required and how this might impact phasing of development within (and around) each village;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine whether additional water resources are required to support growth;
- determine upgrades required to water supply infrastructure relative to potential options for growth;
- consider whether growth can be delivered and achieve a 'neutral water use' condition. Provide a pathway to achievement of water neutrality;
- provide detail on SuDS constraints for the villages
- determine impact of infrastructure and mitigation provision on housing delivery phasing; and
- provide policy recommendations.

## 1.5 Study Drivers

A full list of the key legislative drivers shaping the study is detailed in the Stage 1 Outline WCS2, and a summary table is included in Appendix 1 of this study for reference. However, it is important to note that the key driver for this study is Water Framework Directive compliance.

It is important to ensure that growth, through abstraction of water for supply and discharge of treated wastewater, does not prevent waterbodies in Stratford-on-Avon District Council (and

more widely) from achieving the standards required of them as set out in the Water Framework Directive (WFD) River Basin Management Plans.

Other relevant studies that have a bearing on the provision of water services infrastructure for development include, but are not limited to, the following key documents:

- Stratford-on-Avon District Council Level 1 Strategic Flood Risk Assessment;
- The Warwickshire, Coventry and Solihull Biodiversity Action Plan; and,
- The Stratford-on-Avon District Council Green Infrastructure Strategy.

### 1.5.1 *Changing Planning Legislation and Policy*

Significant changes are currently being made to national planning policy and legislation governing land use change and development in the UK. The Localism Act received Royal Assent in 2011, the aim of which is to essentially decentralise power away from central government to individuals, communities and councils.

One of the key implications of the Localism Act is that communities have more influence on land use and development decision making at a local level. District councils will need to support communities with this process, and hence with understanding the implications of this WCS report with respect to potential impacts and effects of development on WSI and the water environment going forward.

## 1.6 Water Use – Key Assumption

For all wastewater and water supply assessments, an assumption was made on the likely use per new household going forward in the plan period. It was agreed with STW that a starting assumption of 150l/h/d would be used to calculate wastewater generation and water use per person.

It is acknowledged that this figure exceeds the current Building Regulations requirement of 125l/h/d for all new homes. However, in their asset planning STW will continue to assume this higher water use for new homes as their analysis has shown that even when homes are built to a standard of 125l/h/d, the average household use increases over time due to various factors. STW and TW are required under their remit to the industry regulator Ofwat, to plan for the expected actual use. Therefore, it is important that conclusions made on infrastructure capacity within this study are consistent with STW's and TW's planning strategies.

This study has however considered the effect that achieving lower average per person consumption would have on infrastructure capacity and the water environment to assist in developing policy that supports and helps lead to a lower per capita consumption.

## 1.7 Report Structure

There are several water cycle elements that have been considered in this WCS. However, because some strategic level WSI can often serve a larger geographical area some water cycle elements are common to several of the growth sites in combination. These elements are assessed at a district level and hence are presented within a separate chapter in this report. These elements include:

- Wastewater treatment; and,
- Water availability (Water Resources).

The other water cycle elements of the study are specific to each site and hence these elements have been reported at the 'settlement area' level. These elements include:

- Wastewater network;
- Water supply network; and,
- Flood risk;

This report has therefore been set out in the following way to assist its presentation as a primarily planning based source of evidence:

- the planned growth in relation to the water cycle assessment (Chapter 2);
- the assessment of district wide water cycle elements (Chapters 3 and 4);
- a summary of how the site specific water cycle elements have been assessed and the WSI and water environment issues within the Local Service Villages (Chapter 5); and,
- Policy and other recommendations (Chapter 6).

# 2 PROPOSED GROWTH

## 2.1 Preferred Growth Strategy

The purpose of the Water Cycle Study update is to assess the potential impact of a revised wider dispersal of proposed development upon Stratford-on-Avon District's water environment and WSI, including flood risk, surface water drainage, water resources, wastewater infrastructure and water quality and ecological issues. Stratford-on-Avon District Council's revised spatial approach of future expected development will focus more development in the 39 Local Service Villages and smaller villages within the District up to 2028. These figures form the basis for the WCS.

The focus of this study is on wastewater treatment infrastructure and the impact of wastewater treatment on water quality and ecology within the District and more widely. This is because a more dispersed spatial pattern of growth affects more Wastewater Treatment Works (WwTW) and because many of the WwTWs serving the District discharge into smaller watercourses with less dilution capacity near the headstreams of the rivers.

## 2.2 Housing

The total assessed in the WCS update is 2,109 dwellings. This has been based on an average of 57 dwellings within each of the Local Service Villages identified.

Growth within the town of Stratford-on-Avon and other growth locations have already been adequately assessed within the Outline study undertaken at the Sub-Regional level and hence is not considered further within this WCS update.

Table 2-1 provides a summary of the housing figures to be assessed, and due to the focus on wastewater treatment, includes the WwTW catchments within which they are located.

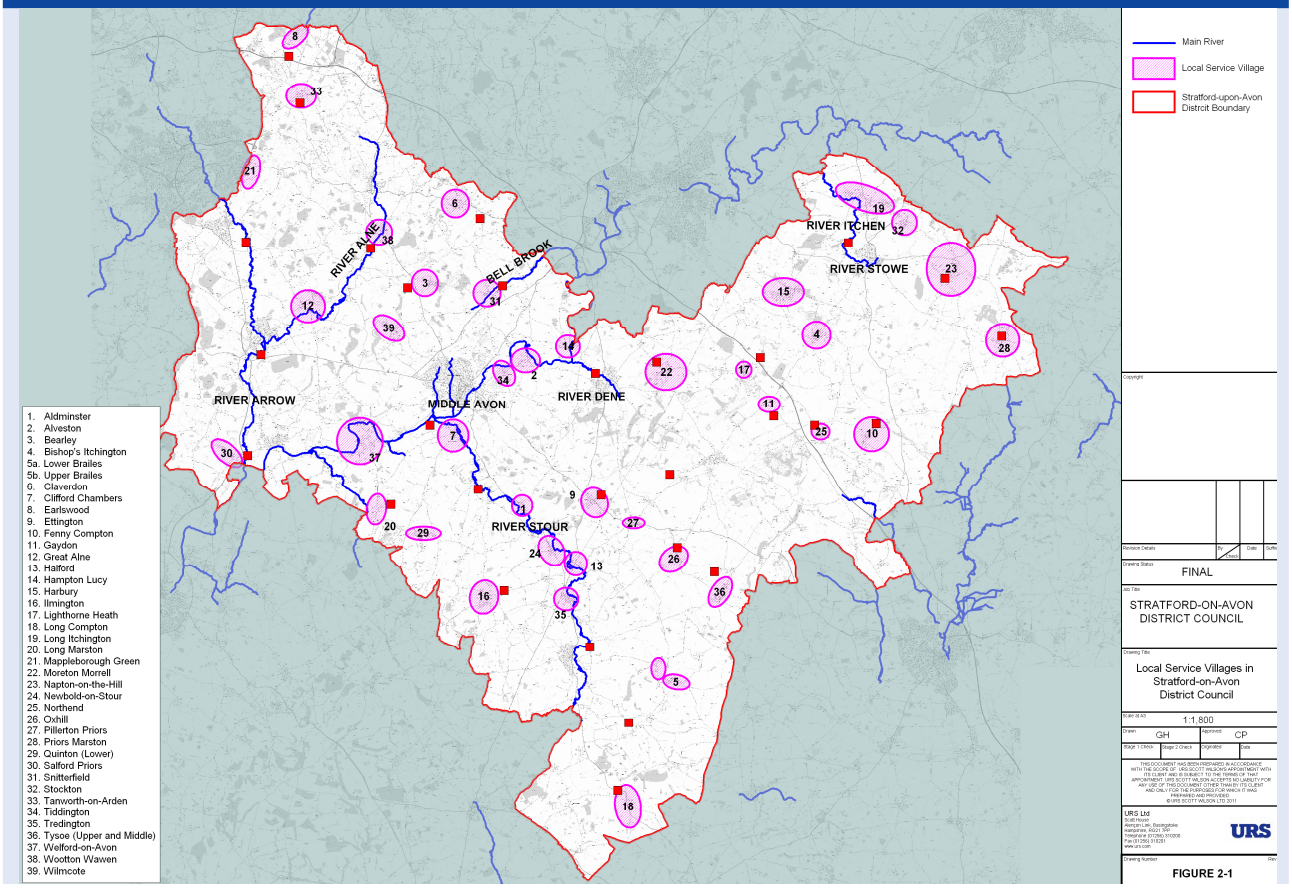
**TABLE 2-1: SUMMARY OF HOUSING FIGURES TO BE ASSESSED**

| WwTW Catchment | Local Service Village | Proposed Allocation | % of Housing Supply |
|---|---|---|---|
| Alcester | Great Alne | 57 | 2.56% |
| Bearley | Bearley | 57 | 2.56% |
| Bidford on Avon | Salford Priors | 57 | 2.56% |
| Butlers Marston | Pillerton Priors | 57 | 2.56% |
| Cherington | Brailes (Upper & Lower) | 57 | 2.56% |
| Claverdon | Claverdon | 57 | 2.56% |
| Earlswood - Spring Brook | Earlswood | 57 | 2.56% |
| Ettington Works | Ettington | 57 | 2.56% |
| Fenny Compton | Fenny Compton | 57 | 2.56% |
| Gaydon | Gaydon | 57 | 2.56% |
| Ilmington | Ilmington | 57 | 2.56% |

| | | | |
|---|---|---|---|
| Itchen Bank | Bishops Itchington | 228 | 10.26% |
| | Harbury | | |
| | Long Itchington | | |
| | Stockton | | |
| Lighthorne Heath | Lighthorne Heath | 57 | 2.56% |
| Long Compton | Long Compton | 57 | 2.56% |
| Long Marston | Long Marston | 114 | 5.13% |
| | Quinton (Lower) | | |
| Moreton Morrell | Moreton Morrell | 57 | 2.56% |
| Napton | Napton-on-the-Hill | 57 | 2.56% |
| Northend | Northend | 57 | 2.56% |
| Oxhill | Oxhill | 57 | 2.56% |
| Preston on Stour | Alderminster | 57 | 2.56% |
| Redditch - Spernal | Mappleborough Green | 57 | 2.56% |
| Shipston - Fell Mill | Halford | 171 | 7.69% |
| | Newbold-on-Stour | | |
| | Tredington | | |
| Snitterfield | Snitterfield | 57 | 2.56% |
| Stratford - Milcote | Alveston | 285 | 12.82% |
| | Tiddington | | |
| | Clifford Chambers | | |
| | Welford-on-Avon | | |
| | Wilmcote | | |
| Tanworth-in-Arden | Tanworth-in-Arden | 57 | 2.56% |
| Tysoe | Tysoe (Upper & Middle) | 57 | 2.56% |
| Wellesbourne | Hampton Lucy | 57 | 2.56% |
| Wootton Wawen | Wootton Wawen | 57 | 2.56% |
| Priors Marston (TW) | Priors Marston | 57 | 2. 56% |
| TOTAL | | 2,223 | 100% |

Locations of Local Service Villages for the proposed growth have been provided by Stratford-on-Avon District Council and these have been used to inform both strategic and village specific infrastructure capacity assessments and requirements (Figure 2-1).

**FIGURE 2-1: LOCAL SERVICE VILLAGES IN STRATFORD-ON-AVON DISTRICT COUNCIL**



# 3 WASTEWATER TREATMENT ASSESSMENT

## 3.1 Wastewater Treatment Assessment Approach

Increases in residential and employment growth results in an increase in wastewater flows generated within a district and hence it is essential to consider:

- Whether there is sufficient capacity within existing treatment facilities (WwTWs) to treat the additional wastewater;
- what new infrastructure is required to provide for the additional wastewater treatment; and
- whether waterbodies receiving the treated flow can cope with the additional flow without affecting water quality and.

There are therefore two elements to the assessment of existing capacity (and any solutions required) with respect to wastewater treatment:

- the capacity of the infrastructure itself to treat the wastewater (infrastructure capacity); and
- the capacity of the environment to sustain additional discharges of treated wastewater (environmental capacity).

### 3.1.1 *Wastewater Treatment in Stratford-on-Avon District Council*

Wastewater treatment in the district is provided via several WwTWs with the majority operated and maintained by STW, all of which discharge to surface watercourses. Each of these WwTWs is fed by a network of wastewater pipes (the sewerage system) which drains wastewater generated by property to the treatment works; this is defined as the WwTWs 'catchment'.

Due to the dispersed nature of development within the district (and the costs and energy required to pump wastewater over large distances), each settlement tends to have its own designated WwTW, hence numerous WwTWs are affected by growth in the district.

### 3.1.2 *Management of WwTW Discharges*

All WwTWs are issued with a consent to discharge by the Environment Agency which sets out conditions on the maximum volume of treated flow that it can discharge and also limits on the quality of the treated flow. These limits are set in order to protect the water quality and ecology of the receiving waterbody. They also dictate how much flow can be received by each WwTW, as well as the type of treatment processes to be used at the WwTWs.

The volume element of the discharge consent determines the maximum number of properties that can be connected to a WwTW catchment. When discharge consents are issued for the first time they are generally set with a volume 'freeboard', which acknowledges that allowance needs to be made for additional connections. This allowance is termed 'consented headroom'. The quality conditions applied to the discharge consent are derived to ensure that the water quality of the receiving waterbody is not adversely affected, even when the maximum amount of flow is discharged. For the purposes of this WCS, a simplified assumption is applied that the consented headroom is usable[3] and would not affect downstream water quality. This headroom therefore determines how many properties can be

[3] In some cases, there is a hydraulic restriction on flow within a WwTWs which would limit full use of the maximum consented headroom,

connected to the WwTW before a new discharge consent would need to be issued (and hence how many properties can connect without significant changes to the treatment infrastructure).

When a new discharge consent is required, an assessment needs to be undertaken to determine what new quality conditions would need to be applied to the discharge. If the quality conditions remained unchanged, the increase in flow would result in an increase in total load of some substances being discharged to the receiving waterbody. This may have the effect of deteriorating water quality and hence in most cases, an increase in consented discharge flow results in more stringent (or tighter) conditions on the quality of the discharge. The requirement to treat to a higher level may result in an increase in the intensity of treatment processes at the WwTWs which may also require improvements or upgrades to be made to the WwTW to allow the new conditions to be met.

In some cases, it may be possible that the quality conditions required to protect water quality and ecology are beyond that which can be achieved with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

The primary legislative driver which determines the quality conditions of any new consent to discharge are the Water Framework Directive (WFD) and the Habitats Directive (HD) as described in the following subsections.

### 3.1.3 *WFD Compliance*

The WFD is the most significant piece of water legislation since the creation of the EU. The overall requirement of the directive is that all waterbodies in the UK must achieve "Good Status". The definition of a waterbody's 'status' is a complex assessment that combines standards for water quality with standards for water availability, hydromorphology (i.e. habitat and flow quality) with ecological requirements.

The two key aspects of the WFD relevant to the wastewater assessment in this WCS are the policy requirements that:

- development must not cause a deterioration in status of a waterbody[4]; and
- development must not prevent future attainment of 'good status', hence it is not acceptable to allow an impact to occur just because other impacts are causing the status of a water body to already be less than good.

Where consented headroom at a WwTW would be exceeded by proposed levels of growth, a water quality modelling assessment has been undertaken to determine the quality conditions that would need to be applied to the new consent to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in Appendix 2.

### 3.1.4 *Habitats Directive*

The Habitats Directive and the Habitats Regulations has designated some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been ongoing since the translation of the Habitats Directive into the UK Habitats Regulations called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the

[4] i.e. a reduction High Status to Good Status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained

abstraction licences and discharge consents it has previously issued on sites which became protected (and hence designated) under the Habitats Regulations.

If the RoC process identifies that an existing licence or consent cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the licence or consent. As a result of this process, restrictions on some discharge consents have been introduced to ensure that any identified impact on downstream sites is mitigated. Although the Habitats Directive does not directly stipulate conditions on discharge, the Habitats Regulations can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions) from water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

Where consented headroom at a WwTW would be exceeded by proposed levels of growth, a Habitats Regulations assessment exercise has been undertaken in this WCS to ensure that Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would not be adversely affected. The scope of this assessment also includes non Habitats Directive sites designated at a national (SSSI) and local level (LNRs). This assessment is reported in Section 3.3 of this chapter (Ecological Appraisal).

### 3.1.5 *Assessment Methodology Summary*

A stepped assessment approach has been developed for the WCS to determine the impact of the proposed growth on wastewater treatment capacity and the environmental capacity of the receiving watercourse. The assessment steps are outlined below:

- determine the amount of growth draining to each WwTW and calculate the additional flow generated;
- calculate available headroom at each WwTW;
- determine whether the growth can be accommodated within existing headroom;
- for those WwTWs where headroom is exceeded, calculate what quality conditions need to be put in place to meet the two key objectives of the WFD to ensure:
    - no deterioration in receiving watercourse from its current WFD status;
    - future Good Status is not compromised by growth.
- determine whether any quality conditions required to meet WFD objectives would be beyond the limits of conventional treatment
- where the conditions are achievable, determine any infrastructure upgrades required to meet the new consent conditions and phasing implications of these upgrades; and
- where the conditions are not achievable, determine alternative solutions for treatment in that catchment.
- Undertake an ecological site screening assessment to determine if any Habitats Directive (or other nationally or locally) designated sites are likely to be affected,

In order to complete the above steps, the following assessment techniques were developed. Details of the procedures can be found in Appendix 2:

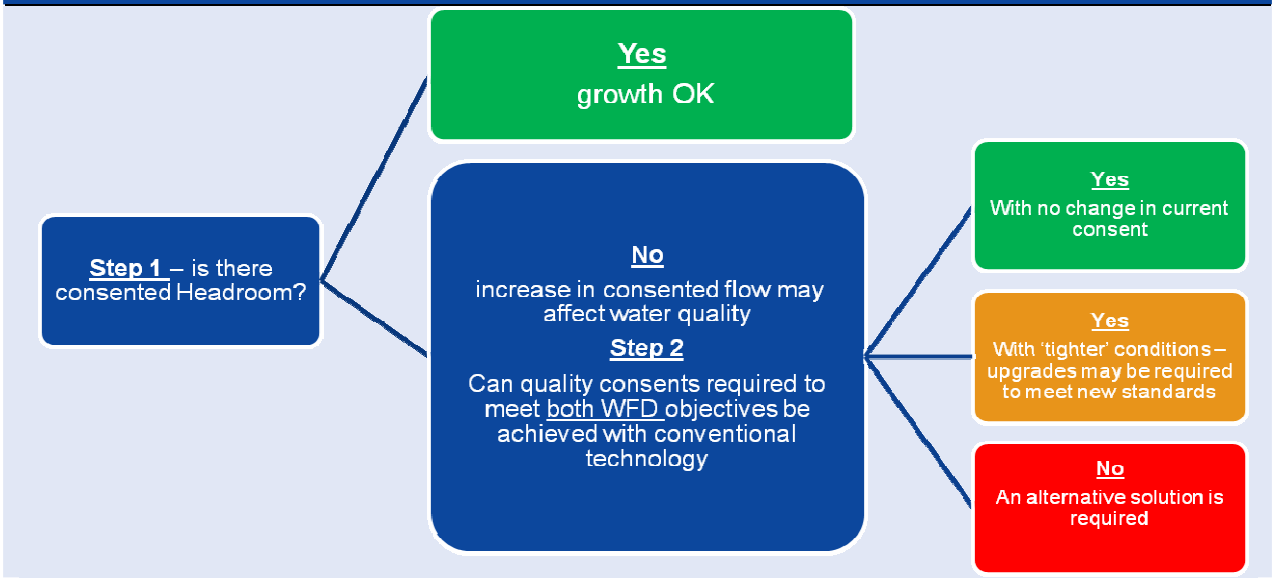
- a headroom calculation spreadsheet was developed; and,
- a water quality modelling procedure was agreed with the Environment Agency using Environment Agency software designed for determining discharge consent conditions.

### 3.1.6 *RAG Assessment Overview*

The results for each WwTW are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG code refers broadly to the following categories and the process is set out in Figure 3-1.

- Green – water quality will not be adversely affected. Growth can be accepted with no changes to the WwTW infrastructure or consent required.
- Amber – in order to protect water quality changes to the discharge consent are required, and upgrades may be required to WwTW infrastructure which may have phasing implications;
- Red - in order to protect water quality changes to the discharge consent are required which are beyond the limits of what can be achieved with conventional treatment. An alternative solution needs to be sought.

**FIGURE 3-1: RAG ASSESSMENT PROCESS DIAGRAM FOR WASTEWATER TREATMENT CAPACITY**



## 3.2 Wastewater Treatment Assessment – Results

The assessment results are presented in this section and have been reported as follows:

- catchments where growth can be accepted within the current consented headroom have been reported together in a single subsection;
- those requiring a new consent and hence a water quality assessment have been reported in individual subsections of this results section.

### 3.2.1 *WwTW with Consented Headroom*

The volume of wastewater generated from growth in each WwTW catchment was calculated for the proposed growth locations and compared to the treatment capacity at each WwTW.

Table 3-1 details the WwTW where existing consented headroom is sufficient to accommodate all of the proposed growth and hence no infrastructure upgrades are required to deliver the proposed growth levels in these locations.

Growth in these catchments would not deteriorate water quality, or increase flood risk and hence there is no barrier to delivering the proposed growth levels. These catchments are Green in the RAG assessment and have not been assessed any further.

**TABLE 3-1: WWTW WITH CONSENTED HEADROOM**

| Relevant WwTW | Local Service Village | Current Consented DWF ($m^3/d$) | Future 2028 DWF after Growth ($m^3/d$) | Headroom Assessment | |
|---|---|---|---|---|---|
| | | | | 2026 Headroom Capacity ($m^3/d$) | Approximate Residual Housing Capacity after Growth (2028) [5] |
| Alcester | Great Alne | 3,150 | 2,591 | 559 | 1,775 |
| Bearley | Bearley | 172 | 125 | 47 | 149 |
| Claverdon | Claverdon | 250 | 238 | 12 | 38 |
| Earlswood - Spring Brook | Earlswood | 440 | 431 | 9 | 29 |
| Ettington Works | Ettington | 460 | 198 | 262 | 832 |
| Fenny Compton | Fenny Compton | 251 | 125 | 126 | 400 |
| Itchen Bank | Bishops Itchington | 2,881 | 2,690 | 191 | 607 |
| | Harbury | | | | |
| | Long Itchington | | | | |
| | Stockton | | | | |
| Lighthorne Heath | Lighthorne Heath | 193 | 188 | 5 | 16 |

[5] Based on an Occupancy rate of 2.1 and consumption rate of 150 l/h/d

**TABLE 3-1: WWTW WITH CONSENTED HEADROOM**

| Relevant WwTW | Local Service Village | Current Consented DWF ($m^3$/d) | Future 2028 DWF after Growth ($m^3$/d) | Headroom Assessment | |
|---|---|---|---|---|---|
| | | | | 2026 Headroom Capacity ($m^3$/d) | Approximate Residual Housing Capacity after Growth (2028) [5] |
| Long Marston | Long Marston | 835 | 488 | 347 | 1,102 |
| | Quinton (Lower) | | | | |
| Moreton Morrell | Moreton Morrell | 148 | 127 | 21 | 67 |
| Northend | Northend | 120 | 104 | 16 | 51 |
| Oxhill | Oxhill | 130 | 115 | 15 | 48 |
| Preston on Stour | Alderminster | 140 | 118 | 22 | 70 |
| Redditch - Spernal | Mappleborough Green | 27,500 | 19,875 | 7,624 | 24,206 |
| Shipston - Fell Mill | Halford | 1,697 | 1,478 | 219 | 696 |
| | Newbold-on-Stour | | | | |
| | Tredington | | | | |
| Snitterfield | Snitterfield | 343 | 254 | 89 | 283 |
| Stratford - Milcote | Alveston | 13,110 | 9,608 | 3,502 | 11,118 |
| | Tiddington | | | | |
| | Clifford Chambers | | | | |
| | Welford-on-Avon | | | | |
| | Wilmcote | | | | |
| Tanworth-in-Arden | Tanworth-in-Arden | 99 | 75 | 24 | 76 |
| Wootton Wawen | Wootton Wawen | 2,536 | 1,932 | 604 | 1,918 |

Table 3-1 also includes information on how many additional homes could be connected before the headroom would be exceeded to inform potential variations to the spatial strategy.

### 3.2.2 *WwTW without Consented Headroom*

The calculations of headroom demonstrated that several WwTW would not have sufficient headroom once all the growth in the catchment is included as detailed in Table 3-2.

**TABLE 3-2: WWTW WITHOUT CONSENTED HEADROOM**

| Relevant WwTW | Local Service Village | Current Consented DWF ($m^3/d$) | Future 2028 DWF after Growth ($m^3/d$) | Headroom Assessment | |
|---|---|---|---|---|---|
| | | | | 2026 Headroom Capacity ($m^3/d$) | Approximate Residual Housing Capacity after Growth (2028) [6] |
| Bidford on Avon | Salford Priors | 1,870 | 1,888 | -18 | -57 |
| Butlers Marston | Pillerton Priors | 120 | 138 | -18 | -57 |
| Cherington | Brailes (Upper & Lower) | 365 | 418 | -53 | -168 |
| Gaydon | Gaydon | 110 | 120 | -10 | -32 |
| Ilmington | Ilmington | 210 | 213 | -3 | -9 |
| Long Compton | Long Compton | 165 | 171 | -6 | -19 |
| Napton | Napton-on-the-Hill | 197 | 201 | -4 | -13 |
| Priors Marston | Priors Marston | 152 | 152 | -18 | -57 |
| Tysoe | Tysoe (Upper & Middle) | 181 | 202 | -21 | -67 |
| Wellesbourne | Hampton Lucy | 1,559 | 1,567 | -8 | -25 |

All of these WwTW required water quality modelling to determine whether the quality consents needed in order to meet WFD objectives would be achievable within the limits of conventionally applied treatment. Detailed results from the modelling are provided in Appendix 2.

A summary of the results and proposed infrastructure upgrades required are included in the following subsections for each of the WwTWs.

**Bideford on Avon**

Bideford on Avon WwTW currently has no headroom in its existing discharge consent; hence the growth in the catchment would cause the WwTW to exceed its existing consent conditions by 18$m^3/d$.

[6] Based on an Occupancy rate of 2.1 and consumption rate of 150 l/h/d

WFD Compliance

Water quality modelling has shown that despite the increase in treated flow, the quality conditions of the existing consent would be sufficient to prevent the quality of the River Avon from deteriorating from its current WFD status for all discharge parameters.

The modelling has also shown that the growth would not prevent future Good Status being reached in the River Avon for Phosphate.

Upgrade Requirements

There is no requirement to change the quality conditions of the existing consent as the additional volumetric flow would not cause a deterioration in WFD status; hence no upgrades are required and there are no phasing implications on growth in the catchment.

RAG Assessment

Growth in the Bideford on Avon catchment is given a Green status. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Butlers Marston**

Butlers Marston WwTW currently has no headroom in its existing discharge consent; hence the growth in the catchment would cause the WwTW to exceed its existing consent conditions by 18$m^3$/d.

WFD Compliance

Water quality modelling has shown that despite the increase in treated flow, the quality conditions of the new consent would be sufficiently relaxed to not require significant upgrades at the WwTW and still prevent the quality of the River Dene from deteriorating from its current WFD status for all discharge parameters.

The modelling has also shown that the growth would not prevent future Good Status being reached in the River Dene for Phosphate as it would not be possible without the growth.

Upgrade Requirements

Despite the new consent requirements being fairly relaxed, STW have indicated that there is minimal process capacity based on existing headroom and current quality performance. Therefore process upgrades Butlers Marston WwTW may be required, to accommodate future growth. Although there is likely to be room for expansion[7], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted to a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[8].

RAG Assessment

The growth in the Butlers Marston catchment is given an Amber status. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

[7] Assuming adjacent land can be made available
[8] Assumes 2 years required to complete upgrades from funding being made available in 2015.

**Cherington**

Cherington WwTW currently has no headroom in its existing discharge consent; hence the growth in the catchment would cause the WwTW to exceed its existing consent conditions by 53m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the River Stour, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia and a new condition would be required for Phosphate[9]. Modelling has show that the Phosphate consent would need to be slightly under 1mg/l (annual average) and hence theoretically below the level of conventional treatment. However, it is considered that a 1mg/l consent is likely to be acceptable on the basis that such modelling has some degree of uncertainty.

The changes are therefore within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The Stour is already at Good Status or higher and hence the 'No Deterioration' assessment meets both objectives of the WFD.

Upgrade Requirements and Phasing

The requirement to limit Phosphate concentrations and the significant change of Ammonia conditions required for the new consent is likely to require process upgrades at Cherington WwTW. Although there is likely to be room for expansion[10], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence early phasing of development will need to be restricted to a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017.

RAG Assessment

The growth in the Cherington catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Gaydon**

Gaydon WwTW currently has some headroom allowance before it exceeds its existing discharge consent. However, with all the proposed growth in the catchment, it would cause the WwTW to exceed its existing consent conditions by 10m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the River Dene (the WwTW discharges into a tributary of the River Dene), the quality conditions on the new discharge consent would need to be tighter than the current conditions for BOD, Ammonia and a new condition would be required for Phosphate. However, these changes are within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

[9] BOD conditions would not need to change
[10] Assuming adjacent land can be made available

The modelling has shown that growth would not prevent future Good Status being reached in the River Dene for Phosphate as it would not be possible without the growth.

Upgrade Requirements and Phasing

The requirement to limit Phosphate concentrations and the significant change of Ammonia conditions required for the new consent is likely to require process upgrades at Gaydon WwTW. As there is some existing headroom allowance, 25 houses could be connected before an upgrade would be required. Although there is likely to be room for expansion[11], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[12].

RAG Assessment

The growth in the Gaydon catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Ilmington**

Ilmington WwTW currently has some headroom allowance before it exceeds its existing discharge consent. However, with all the proposed growth in the catchment, it would cause the WwTW to exceed its existing consent conditions by $3m^3/d$.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the Back Brook (the WwTW discharges into the Fosse Way Brook), new quality conditions on the discharge consent would be required for Ammonia and Phosphate[13]. However, these changes are within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The modelling has shown that growth would not prevent future Good Status being reached in the Back Brook for Phosphate as it would not be possible without the growth.

Upgrade Requirements and Phasing

The requirement to limit Ammonia and Phosphate concentrations required for the new consent is likely to require process upgrades at Ilmington WwTW. As there is some existing headroom allowance, 48 houses could be connected before an upgrade would be required. Although there is likely to be room for expansion[14], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence early phasing of development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[15].

[11] Assuming adjacent land can be made available
[12] Assumes 2 years required to complete upgrades from funding being made available in 2015.
[13] BOD conditions would not need to change
[14] Assuming adjacent land can be made available
[15] Assumes 2 years required to complete upgrades from funding being made available in 2015.

RAG Assessment

The growth in the Ilmington catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Long Compton**

Long Compton WwTW currently has some headroom allowance before it exceeds its existing discharge consent. However, with all the proposed growth in the catchment, it would cause the WwTW to exceed its existing consent conditions by 6m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the Nethercote Brook, new quality conditions on the discharge consent would be required for Ammonia and Phosphate[16]. However, these changes are within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The modelling has shown that growth would not prevent future Good Status being maintained in the Nethercote Brook for Phosphate as it would not be possible without growth.

Upgrade Requirements and Phasing

The requirement to limit Ammonia and Phosphate concentrations required for the new consent is likely to require process upgrades at Long Compton WwTW. As there is some existing headroom allowance, 38 houses could be connected before an upgrade would be required. Although there is likely to be room for expansion[17], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence early phasing of development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[18].

RAG Assessment

The growth in the Long Compton catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Napton**

Napton WwTW currently has some headroom allowance before it exceeds its existing discharge consent. However, with all the proposed growth in the catchment, it would cause the WwTW to exceed its existing consent conditions by 4m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the River Stowe, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia and a new condition would be required for

[16] BOD conditions would not need to change
[17] Assuming adjacent land can be made available
[18] Assumes 2 years required to complete upgrades from funding being made available in 2015.

Phosphate[19]. However, these changes are within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The modelling has shown that growth would not prevent future Good Status being maintained in the River Stowe for BOD or Phosphate as it would not be possible without the growth.

Upgrade Requirements and Phasing

The requirement to limit Phosphate concentrations and the significant change of Ammonia conditions required for the new consent is likely to require process upgrades at Napton WwTW. As there is some existing headroom allowance, 44 houses could be connected before an upgrade would be required. Although there is likely to be room for expansion[20], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[21].

RAG Assessment

The growth in the Napton catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

**Priors Marston**

Priors Marston WwTW currently has no headroom in its existing discharge consent; hence the growth in the catchment would cause the WwTW to exceed its existing consent conditions by 18m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the Highfurlong Brook, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia; these changes are within the limits of conventional treatment.

A new quality condition would be required for Phosphate[22]. Modelling for P has shown that both with and without any growth in the LSV, the P consent would need to be under 1mg/l (annual average) and hence theoretically below the level of conventional treatment. However, the watercourse is currently achieving Good Status for P which shows that the WwTW is likely to be outperforming on P quality and hence the small amount of additional growth should not alter this position. This would need to be confirmed as part of a detailed assessment when Thames Water apply for a new consent to discharge.

For this WCS a solution is considered feasible at this WwTW.

Upgrade Requirements and Phasing

The requirement to limit Phosphate concentrations and the significant change of Ammonia conditions required for the new consent is likely to require process upgrades at Priors Marston

[19] BOD conditions would not need to change
[20] Assuming adjacent land can be made available
[21] Assumes 2 years required to complete upgrades from funding being made available in 2015.
[22] BOD conditions would not need to change

WwTW. Although there is likely to be room for expansion[23], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[24].

RAG Assessment

The growth in the Priors Marston catchment is given a Amber status on the basis that that upgrades are required, but are likely to be within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk and maintaining Good Status for P.

**Tysoe**

Tysoe WwTW currently has no headroom in its existing discharge consent; hence the growth in the catchment would cause the WwTW to exceed its existing consent conditions by 21m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the Wagtail Brook (the WwTW discharges into a tributary of the Wagtail Brook), the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia and a new condition would be required for Phosphate[25]. Modelling has show that the Phosphate consent would need to be slightly under 1mg/l (annual average) and hence theoretically below the level of conventional treatment. However, it is considered that a 1mg/l consent is likely to be acceptable on the basis that such modelling has some degree of uncertainty.

The changes are therefore within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The modelling has shown that growth would not prevent future Good Status being maintained in the Wagtail Brook for Phosphate as it would not be possible without the growth.

Upgrade Requirements and Phasing

The requirement to limit Phosphate concentrations and the significant change of Ammonia conditions required for the new consent is likely to require process upgrades at Tysoe WwTW. Although there is likely to be room for expansion[26], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[27].

RAG Assessment

The growth in the Tysoe catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

[23] Assuming adjacent land can be made available
[24] Assumes 2 years required to complete upgrades from funding being made available in 2015.
[25] BOD conditions would not need to change
[26] Assuming adjacent land can be made available
[27] Assumes 2 years required to complete upgrades from funding being made available in 2015.

**Wellesbourne**

Wellesbourne WwTW currently has some headroom allowance before it exceeds its existing discharge consent. However, with all the proposed growth in the catchment, it would cause the WwTW to exceed its existing consent conditions by 8m$^3$/d.

WFD Compliance

Water quality modelling has shown that in order to maintain current WFD status downstream in the River Dene, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia[28]. However, this change is within the limits of conventional treatment and hence a solution is considered feasible at this WwTW.

The modelling has shown that growth would not prevent future Good Status being maintained in the River Dene for Phosphate.

Upgrade Requirements and Phasing

The significant change of Ammonia condition required for the new consent is likely to require process upgrades at Wellesbourne WwTW. As there is some existing headroom allowance, 32 houses could be connected before an upgrade would be required. Although there is likely to be room for expansion[29], funding for these upgrades is not likely to be available until 2015 (start of AMP6) and hence development will need to be restricted at a rate to be agreed with STW until sufficient process capacity is made available between 2015 and 2017[30].

RAG Assessment

The growth in the Wellesbourne catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment. Upon application of the revised discharge consent, STW should determine potential impact of the additional discharge on flood risk.

## 3.3 Ecological Appraisal

There are four statutory designated sites that have been identified as potentially being connected to WwTW discharges in Stratford-on-Avon District Council: River Blythe SSSI, Sherbourne Meadows SSSI adjacent to Bell Brook, Welford Field SSSI on a tributary of the Middle Avon River and the River Arrow Local Nature Reserve at Alcester. All other designated sites identified within the district are remote from watercourses into which WwTW's discharge treated effluent. The River Arrow, River Alne and River Middle Avon all drain into the River Avon which itself drains into the Severn Estuary SAC/SPA/Ramsar site. However, the Severn Estuary is over 50km downstream of Stratford-on-Avon District Council and as such there is no realistic link given the large dilution factors that would be involved.

The ecological background to the statutory designated sites included the details of the interest features and relevant condition assessments are provided in Appendix 4. Sherbourne Meadows SSSI and Welford Field SSSI are essentially designated for their flood meadow. Local Nature Reserves do not have citations as such but the River Arrow LNR is designated

[28] BOD and Phosphate conditions would not need to change
[29] Assuming adjacent land can be made available
[30] Assumes 2 years required to complete upgrades from funding being made available in 2015.

for its river, pond and wet grassland and the locally rare small teasel. The River Blythe SSSI is designated for its riverine habitats.

### 3.3.1 *Impact on designated sites*

Sherbourne Meadows SSSI is immediately downstream of Snitterfield WwTW, Welford Field SSSI is downstream of Stratford – Milcote WwTW, River Blythe SSSI is downstream of Earlswood – Spring Brook WwTW and River Arrow LNR is approximately 5km downstream of Redditch WwTW. Therefore, any need to increase the consented discharge volumes from these WwTWs could have impacts on the downstream designated sites. However, the Water Cycle Study identifies that all four of these WwTW's have existing consented headroom, which is sufficient to accommodate all of the proposed growth sites. Hence no infrastructure upgrades are required to deliver the proposed growth levels in these locations. Growth in these catchments would not therefore deteriorate water quality, or increase flood risk and hence there is no barrier to delivering the proposed growth levels. No further consideration is therefore required.

### 3.3.2 *Impacts on ecology outside designated sites*

In addition to impacts on designated sites, a range of other UK or Warwickshire Coventry & Solihull BAP species or otherwise protected/notable species that are found in Warwickshire can be affected by wastewater discharge. These include:

- Water vole (protected through Wildlife & Countryside Act 1981 and a UK BAP species)
- Grass snake (partially protected through Wildlife & Countryside Act 1981)
- Common toad (UK BAP species)
- Great crested newt (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a UK BAP species)
- Birds such as bittern, kingfisher (protected through Wildlife & Countryside Act 1981 and a UK BAP species), lapwing and snipe; and
- Otter (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a UK BAP species).

Similarly important habitats (all listed in the Warwickshire BAP) include:

- Rivers & streams;
- Canals;
- Reedbeds;
- Fen, marsh and swamp;
- Ponds, lakes and reservoirs.

All of these habitats and species are present (or possibly present) in Stratford-on-Avon District Council.

It is not possible within the scope of this commission to undertake a detailed investigation and evaluation of the impacts of the changes in water quality/flow and infrastructure to be delivered under the water cycle study on wildlife generally. This is because since it would be necessary to undertake detailed species surveys of each watercourse and utilise detailed flow and quality data/modelling which has not been available for this commission for most watercourses.

Ten WwTWs in Stratford-on-Avon District Council will require a change to their consents in order to comply with the Water Framework Directive requirements for no deterioration downstream:

- Bidford on Avon WwTW;
- Butlers Marston WwTW;
- Cherington WwTW;
- Gaydon WwTW;
- Ilmington WwTW;
- Long Compton WwTW;
- Long Marston WwTW;
- Napton WwTW;
- Wellesbourne WwTW; and
- Priors Marston WwTW.

For all ten sites, 'no deterioration' is achievable within the limits of conventional treatment. With such consent tightening in place there should be no deterioration in downstream water quality and therefore there will be no adverse effects on wildlife in the receiving watercourses.

### 3.3.3 *Ecological opportunities associated with Local Service Villages*

All developments at Local Service Villages would have potential for the enhancement of ecological value through new SuDS opportunities linked to the new development. These could provide habitat for Warwickshire BAP species and habitats such as fen, marsh and swamp, great crested newt or water vole. In addition, the following Local Service Villages are close to existing watercourses and may therefore present opportunities for more specific riverine habitat improvements associated with development, such as the creation of an improved river profile and improved backwaters/meanders:

- Earlswood;
- Great Alne;
- Welford-on-Avon;
- Clifford Chambers;
- Newbold-on-Stour;
- Halford;
- Tredington;
- Alveston;
- Gaydon;
- Wootton Wawen;
- Wilmcote;
- Snitterfield; and,
- Long Itchington.

It should be noted that the Local Service Village of Welford-on-Avon lies very close to Welford Field SSSI. Development here would therefore provide a potential specific opportunity to enhance this SSSI.

## 3.4 Climate Change Sensitivity – Water Quality

Though not directly influencing water quality and water environments, climate change has the potential to impact and alter the water environment through increasing river temperatures, reducing flows and increasing diffuse run-off from heavier rainfall and storm events, all of which can alter the quality of the receiving water bodies.

The Environment Agency's 'Potential Impacts of Climate Change on River Water Quality' study[31] reported that relatively little research has been undertaken in assessing the impacts of climate change on water quality. However, the following high-level findings were reported from the literature review undertaken as part of the study:

- water quality will be affected by changes in flow regime;
- lower minimum flows imply less volume for dilution and hence higher concentrations downstream of point discharges;
- enhanced growth of algal blooms in rivers and reservoirs could affect levels of dissolved oxygen and the costs of treating water for potable supply;
- increased storm events, especially in summer, could cause more frequent incidence of combined sewer overflows, discharging highly polluted waters into receiving water bodies. The potential impacts on urban water quality will be largely driven by these changes in short duration rainfall intensity overwhelming drainage systems, as well as rising sea levels affecting combined sewerage outfalls;
- the most immediate reaction to climate change is expected to be an increase in river and lake water temperatures with subsequent effects on Dissolved Oxygen levels;
- more intense rainfall and flooding could result in increased suspended solids, sediment yields and associated contaminant metal fluxes;
- nutrient loads are expected to increase;
- in shallow lakes, oxygen levels may decline and cyanobacteria blooms may become more extensive; and
- in the UK, there has been relatively little research on toxins in streams, lakes and sediments, as the problems are thought to be limited. However, climate change may alter this perception.

Climate change studies, especially in relation to water quality and ecology, are at fairly early stages and the outcomes are subject to considerable uncertainty. However, understanding the processes and mechanisms controlling water quality and ecology, and how these combine and interact, is essential for sustaining potable water supplies and conserving river systems[31]. As such, the findings of this study and planned adaptation and mitigation options should be updated when further research and guidance becomes available.

### Climate Change, Water Quality and Adaptation

Table 3-3 provides a summary of the potential climate change adaptation and mitigation measures that could be considered in Stratford-on-Avon District Council with regards to water

[31] Potential Impacts of Climate Change on River Water Quality. Science Report SC070043/SR1, Environment Agency 2008

quality and wastewater services infrastructure. The organisations likely to be responsible for leading these measures have been identified alongside the suggested timescale for these actions to start being taken forward (Immediate, Medium (1 - 10 years) and Long (10+ years)).

**TABLE 3-3: WATER QUALITY AND WASTEWATER POTENTIAL CLIMATE CHANGE ADAPTION AND MITIGATION**

| Potential Climate Change | Potential Impact | Adaption and Mitigation Measures | Lead Organisation (s) | | | | Timescale for Action |
|---|---|---|---|---|---|---|---|
| | | | SoA | EA | STW | NE | |
| Temperature Rise | • Decrease in Dissolved Oxygen in rivers – impact on river ecology and wildlife<br>• Faster wastewater asset deterioration<br>• Changes in wastewater process efficiency | Ensure climate change mitigation strategies are in place for species and habitats at risk, e.g. BAPS | | ✓ | | ✓ | Medium |
| | | Monitor long-term Dissolved Oxygen levels in rivers and impacts | | ✓ | | | Medium |
| | | Improve resilience of wastewater assets to temperature rise, where new assets are required or upgraded | | | ✓ | | Medium |
| Winter rainfall increase | • Increased diffuse pollution<br>• Insufficient infrastructure capacity – storm tanks, CSOs etc.<br>• Increased risk to rivers from combined sewer outflows | Where possible, control diffuse pollution runoff through SuDS | ✓ | ✓ | ✓ | ✓ | Immediate |
| | | Promoting the creation and preservation of space (e.g. verges, agricultural land, and green urban areas, including roofs) in support of water quality, biodiversity and flood risk goals | ✓ | ✓ | | ✓ | Immediate |
| Summer rainfall decrease | • Degraded wetlands<br>• More frequent low river flows<br>• Less dilution in rivers for wastewater discharge<br>• Reduced risk to rivers from combined sewer outflows<br>• Tightening of discharge consent<br>• Reduced flexibility – effluent required to maintain river flows | Ensure climate change mitigation strategies are in place for species and habitats at risk, e.g. Biodiversity Action plans | | ✓ | | ✓ | Medium |
| | | Consideration of future climate change impacts on wastewater discharges when renewing consents | | ✓ | ✓ | | Medium |
| Increase in weather extremes (heatwaves, intense rainfall, storms) | • Increased flooding and risk of service loss<br>• Increased clean-up costs<br>• Inability of infrastructure to cope<br>• Increased subsidence – pipe failure | Promoting the creation and preservation of space (e.g. verges, agricultural land, and green urban areas, including roofs) in support of water quality, biodiversity and flood risk goals | ✓ | ✓ | | ✓ | Immediate |
| | | Improve resilience of key wastewater assets such as CSOs, WwTW and outfalls, including new industry design standards for wastewater assets | | | ✓ | | Medium |

### 3.5 Wastewater Summary

Table 3-4 provides a summary of the RAG assessment of the WwTWs within the Stratford-on-Avon WCS study area.

**TABLE 3-4: WASTEWATER TREATMENT SUMMARY**

| WwTW | Watercourse | Is Headroom Available? | Is a quality consent update possible – within LCT? | Solution Available? |
|---|---|---|---|---|
| Alcester | River Arrow | Yes | N/A | |
| Bearley | Tributary of Edstone Brook | Yes | N/A | |
| Bidford on Avon | River Avon | No | Yes | No upgrade required |
| Butlers Marston | River Dene | No | Yes | Upgrade required with some phasing implications |
| Cherington | River Stour | No | Yes | Upgrade required with some phasing implications |
| Claverdon | Tributary of Claverdon Brook | Yes | N/A | |
| Earlswood - Spring Brook | Spring Brook | Yes | N/A | |
| Ettington Works | Tributary of River Dene | Yes | N/A | |
| Fenny Compton | Tributary of River Itchen | Yes | N/A | |
| Gaydon | Tributary of River Dene | No | Yes | Upgrade required with some phasing implications |
| Ilmington | Fosse Way Brook | No | Yes | Upgrade required with some phasing implications |
| Itchen Bank | River Itchen | Yes | N/A | |
| Lighthorne Heath | Tach Brook | Yes | N/A | |
| Long Compton | Nethercote Brook | No | Yes | Upgrade required with some phasing implications |
| Long Marston | Gran Brook | No | Yes | Upgrade required with some phasing implications |
| Moreton Morrell | Tributary of Charlecote Brook | Yes | N/A | |

**TABLE 3-4: WASTEWATER TREATMENT SUMMARY**

| WwTW | Watercourse | Is Headroom Available? | Is a quality consent update possible – within LCT? | Solution Available? |
|---|---|---|---|---|
| Napton | River Stowe | No | Yes | Upgrade required with some phasing implications |
| Northend | Tributary of River Dene | Yes | N/A | |
| Oxhill | Tributary of Wyngates Brook | Yes | N/A | |
| Preston on Stour | River Stour | Yes | N/A | |
| Redditch - Spernal | River Arrow | Yes | N/A | |
| Shipston - Fell Mill | River Stour | Yes | N/A | |
| Snitterfield | Tributary of Sherbourne Brook | Yes | N/A | |
| Stratford - Milcote | River Avon | Yes | N/A | |
| Tanworth-in-Arden | River Alne | Yes | N/A | |
| Tysoe | Tributary of Wyngates Brook | Yes | N/A | |
| Wellesbourne | River Dene | No | Yes | Upgrade required with some phasing implications |
| Wootton Wawen | River Alne | Yes | N/A | |
| Priors Marston (TW) | Highfurlong Brook | No | Yes | Upgrade required with some phasing implications |

# 4 WATER SUPPLY STRATEGY

## 4.1 Introduction

Water supply in for the majority of Stratford-on-Avon District Council area is provided by STW, with a small area in the south-east provided by TW. Given that TW supply such a small proportion of Stratford-on-Avon District Council, the water supply assessment of this WCS will only focus on STW.

The Scoping and Outline Warwickshire Sub-Regional WCS[32] has already completed an assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems. The outline assessment has been based on the Environment Agency's Catchment Management Strategies (CAMS). Stratford-on-Avon District Council falls within two CAMS[33];

- The Warwickshire Avon CAMS; and,
- The Tame, Anker and Mease CAMS.

The process of describing catchment resources is not repeated in this WCS update. Instead this WCS has used the final version of STW's Water Resource Management Plans (WRMP) to determine available water supply against predicted demand and has considered how water efficiency can be further promoted and delivered for new homes beyond that which is planned for delivery in STWs WRMP.

### 4.1.1 *Water Resource Planning*

Water companies have historically undertaken medium to long term planning of water resources in order to demonstrate that a there is a long-term plan for delivering sustainable water supply within its operational area to meet existing and future demand.

As of 2007, it became a statutory requirement for water companies to prepare and maintain WRMPs which demonstrate how water companies are managing the balance between available supply and future demand over a 25 year plan. These plans are subject to consultation and approval by secretary of state every five years, but must be updated on a yearly basis.

WRMPs are a key document for a WCS as they set out how demand for water from growth within a water company's supply area can be met, taking into account the need to for the environment to be protected. As part of the statutory approval process, the plans must be approved by both the Environment Agency and Natural England (as well as other regulators) and hence the outcomes of the plans can be used directly to inform whether growth levels being assessed within a WCS can be supplied with a sustainable source of water supply.

Water companies manage available water resources within key zones, called Water Resource Zones (WRZ). These zones share the same raw resources for supply and are interconnected by supply pipes, treatment works and pumping stations. As such the customers within these zones share the same available 'surplus of supply' of water when it is freely available; but also share the same risk of supply when water is not as freely available during dry periods (i.e. deficit of supply). Water companies undertake resource modelling to calculate if there is likely to be a surplus of available water or a deficit in each WRZ by 2035, once additional demand from growth and other factors such as climate change are taken into account.

[32] Warwickshire Sub-Regional Water Cycle Strategy, Stratford-on-Avon Council, Scoping and Outline Final Report, Halcrow, 2010
[33] http://www.environment-agency.gov.uk/business/topics/water/119931.aspx

## 4.2 Water Resource Planning in Stratford-on-Avon

In formulating the statutory 2009/2010 WRMPs, STW used targets as set out in the West Midlands Regional Spatial Strategy (RSS) (as well as other sources) to calculate probable increases in demand for water over their 25 year plan period. Since the announcement of the government's intention of revocation of all RSSs and hence likely removal of a regional driver setting local targets for growth, several local planning authorities have reassessed growth targets within their LDF and have proposed differing levels of growth to that which water companies may have assumed.

Therefore, prior to use of the findings of the STW WRMP, it was essential to ensure that the growth being assessed for the district within this WCS was comparable to the growth assumptions used in formulating their current WRMP.

In reviewing the latest update to the STW WRMP, and through liaison with STW it has been established that the growth figures assessed for this WCS study are catered for in the 2035 prediction of supply and demand deficits in the relevant WRZs under average conditions. Therefore, conclusions on available water supply from STW's WRMP can be used directly in this study to inform and support Stratford-on-Avon District Council's LDF.

## 4.3 Demand for Water

Likely increases in demand in the study area have been calculated using six different water demand projections based on different rates of water use for new homes that could be implemented through potential future policy.

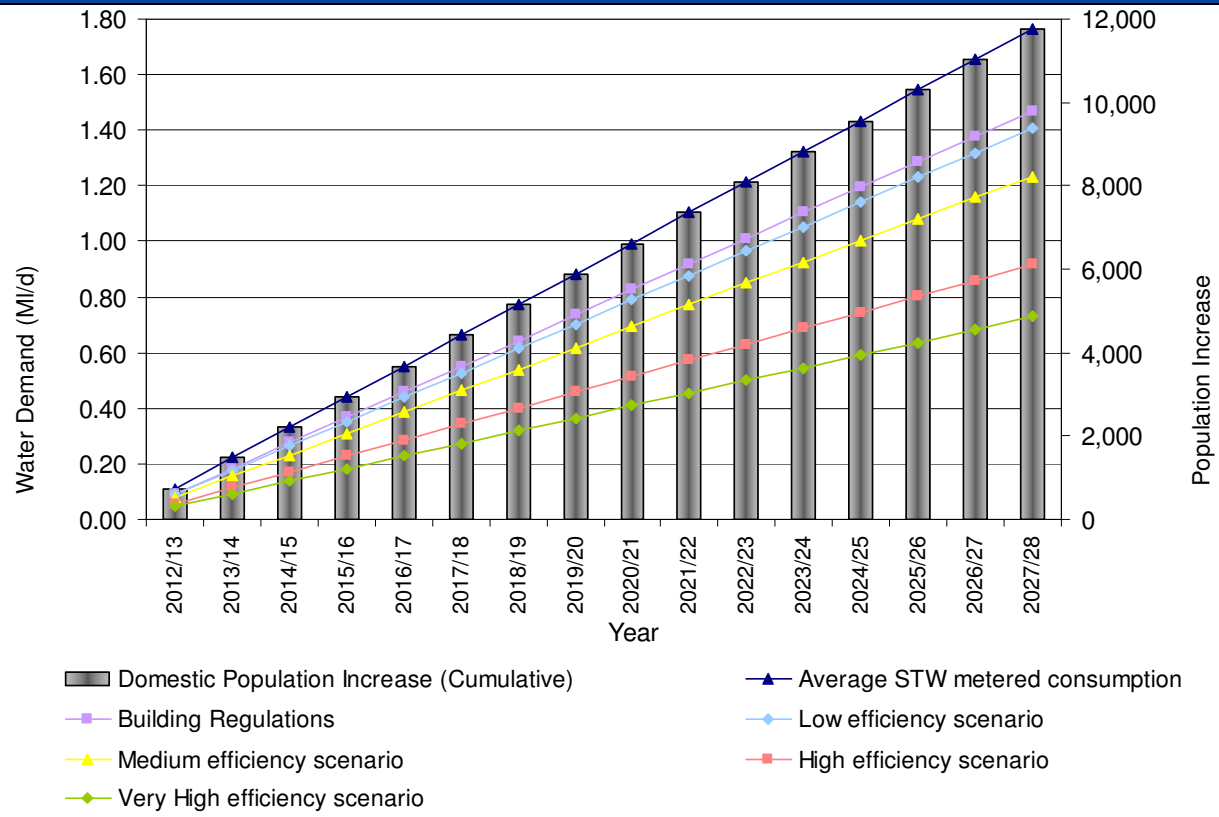
The projections were derived as follows:

- **Projection 1 – Baseline Assumption –** New homes would use 150 l/h/d[34], this reflects the planning consumption used by STW and TW to maintain security of supply;
- **Projection 2 – Building Regulations –** New homes would conform to (and not use more than Part G of the Building Regulations requirement (in force as of the 6th April 2010) of 125 l/h/d (equivalent to the Code for Sustainable Homes (CfSH) Level 1/2 rating of 120 l/h/d plus 5 l/h/d for outdoor use);
- **Projection 3 – Code for Sustainable Homes Levels 1 & 2 –** New homes would achieve CfSH Level 1/2 rating of 120 l/h/d;
- **Projection 4 – Code for Sustainable Homes Levels 3 & 4 –** New homes would achieve CfSH Level 3/4 rating of 105 l/h/d;
- **Projection 5 – Code for Sustainable Homes Levels 5 & 6 –** New homes would achieve CfSH Level 5/6 rating of 80 l/h/d; and,
- **Projection 6 – Very High Efficiency –** New homes would include both greywater recycling and rainwater harvesting reducing water use to a minimum of 62 l/h/d.

Using these projections, the increase in demand for water could range between 0.73 and 1.76Ml/d by 2028. The projections are shown in Figure 4-1.

[34] Taking into account 5l/h/d for jobs

**FIGURE 4-1: RANGE OF WATER DEMANDS ACROSS PLAN PERIOD IN STRATFORD-ON-AVON DEPENDING ON EFFICIENCY LEVELS OF NEW HOMES**




### 4.3.1 *Planned Water Availability Summary*

The WRMP for STW has been used to summarise water availability to meet the projected demand for Stratford-on-Avon District Council covering the planning period to 2028.

**Water Supply Zones**

Severn Trent WRZ 3 – Severn

This zone serves the majority of the population of Stratford-on-Avon District Council. This WRZ is covered by two main abstraction catchments, the Warwickshire Avon CAMS (which covers the majority of the study area) and the Tame, Anker and Mease CAMS (which covers the north east of the study area). There are water resource issues affecting both groundwater and surface water. Aquifers are under pressure in a number of areas. The River Severn is a major source of water with five key water supply abstractions with potential to impact on a number of SPA, cSAC and Ramsar sites. Within WRZ3 there are 171 water dependent SSSIs and 13 Natura 2000 sites.

There is a continued supply-demand risk within WRZ3, which worsens over the planning period. There is a deficit in 2010-11 which remains negative and is estimated to be approximately 145 Ml/d in 2034-35.

Severn Trent Water WRZ4 – Birmingham

This zone covers a small proportion of the study area in the north-west. This WRZ is covered by the Tame, Anker and Mease CAMS. Within WRZ4 there are 10 water dependent SSSIs sites.

There is a continued supply-demand risk within WRZ4, which worsens towards the end of the planning period. There is a deficit in 2017-18 which remains negative as is estimated to be approximately 23 Ml/d in 2034-35.

**Supply-Demand Strategy**

STW have identified a number of schemes that will benefit both WRZs and help to reduce the supply-demand deficit. As a result of the supply-demand enhancements planned, in future WRMPs WRZ3 and WRZ4 will be combined to form a single, large, integrated zone. The strategy is to:

- maximise the sustainable use of existing resources, by increasing strategic distribution links;
- use aquifer storage and recovery to utilise spare resource and treatment capacity during periods of low demand;
- provide some new groundwater source development;
- continue to reduce leakage; and,
- carry out measures to help customers become more water efficient and reduce their demand.

This strategy ensures that STW maintain a headroom surplus throughout the planning period.

## 4.4 Water Efficiency Plan

Through a series of demand management measures and improvement of existing resources (which have been approved at a strategic level by the Environment Agency and Natural England), STW is predicting a supply surplus of available water in 2035 within the WRZs located within Stratford-on-Avon District Council which would provide sufficient water supply to supply the levels of growth within the district through the plan period.

Since development within the District is not proposed to exceed that for STW are planning, there is no need to evaluate the impacts of water supply in the district independently of the Water Resource Management Plan and its assessments.

However, there are several key drivers for ensuring that water use in the development plan period is minimised as far as possible. This WCS therefore includes an assessment of the feasibility of achieving a 'water neutral' position after growth across the district.

As is the case for all sustainable use of resources, the three 'R's of reduce, reuse and recycle are key to maximising the sustainability and reduce is the first and arguably most important element of sustainable water use to consider.

## 4.5 Drivers and Justification for Water Efficiency

The study area, and West Midlands generally, is an area of moderate water stress[35]. Any growth and increase in population will further exacerbate this issue. In addition, the key sources of raw water (rivers and aquifers) supplying Stratford-on-Avon District Council are considered to be close to their limit of water they can continue to yield for abstraction, before ecosystems and other users reliant on these sources would be adversely affected.

In order to ensure surplus raw water supply for growth in the study area, STWs water resource plan over the next 25 years is reliant on more efficient use of existing resources and demand reduction from customers. The proposals and opportunities for new resources are limited, in the main due to the limitation on available new resources locally, which means that looking beyond the next 25 years, further new resources would likely need to be transferred into the area to cater for further increases in population and hence water demand. This creates a very strong driver for new homes in the next 25 years to be made as efficient as economically possible to safeguard the future resources to be made available by STW in the study area,

Stratford-on-Avon District Council are aspiring to promote sustainable development within the District, as such higher levels of efficiency should be considered as part of this WCS and its recommendations for the LDF more widely.

STW have to consider new measures to address supply and demand deficits within the WRZ serving Stratford-on-Avon. Therefore, measures should be taken to reduce demand from new property as far as possible.

### Climate Change and Availability of Water

It is predicted that climate change will further reduce the available water resources in Stratford-on-Avon District Council as rainfall patterns change to less frequent, but more extreme, rainfall events. Climate change is thought to be the most significant risk to water supplies from 2020 and beyond in the WRZs within Stratford-on-Avon District Council. This could lead to sustainability reductions of abstraction licences.

Managing Climate Change

STW recognise in their Strategic Direction Statement[36] that the effects of climate change will be a key challenge over the 25 year plan period with the need to increase resilience of assets to cope with greater weather extremes. Similarly within their 2010-2035 Water Resource Management Plan STW highlight that climate change is the most significant risk to long term supply/demand balance.

Customers expect STW to provide a continuous supply of water, but the resilience of the supply systems have the potential to be affected by the impact of climate change with severe weather-related events, such as flooding or an 'outage' incident at a source works supplying one of the major centres of population in the region. In STW's PR09 submission, they addressed the impacts of climate change with a focus on making more sustainable use of existing supplies, through investment in leakage reduction and meter installation.

In planning for future water resources availability, STW have accounted for the impacts of climate change within their calculations of available raw water for use and forecast demand. STW has used assumptions on climate change impacts based on the UKCIP02 scenarios, the information on sustainability changes provided at the time by the Environment Agency and the

[35] As classified by the Environment Agency
[36] Severn Trent Water (2007) Focus on Water, Strategic Direction Statement 2010 - 2035

Environment Agency' Water Resources Plan guideline. STW have been reviewing the more recent UKCP09 climate change projections and working with UKCIP and the Environment Agency to carry out analysis of the implied impacts. These will be incorporated into future reviews and planning, including the annual review of the WRMP and PR14.

Impact on Supplies

STW have assessed the impacts of climate change on zonal deployable output using rainfall runoff modelling, by generating four new river flows databases;

- the baseline 'no-impact flows;
- the dry climate change scenario
- the mid-range climate change scenario
- the wet climate change scenario

The mid-range scenario was incorporated into the central estimate forecast of DO and the wet and dry scenarios have been used in the headroom assessment.

Work to assess the impacts of climate change on groundwater sources suggested impacts would not be significant under the modelled mid range scenario, but under the dry scenario, there would be some potentially large reductions in recharge and Dissolved Oxygen (DO). Even under the mid range scenario however, summaries in the WRMP indicate the Severn WRZ to have the greatest reduction.

The main findings are that even under a wet scenario, 2035 climate change impact represents a large decrease in DO in the Severn WRZ. The overall impact of climate change on water resources over the plan period is estimated as around 144 Ml/d.

Impact on Demand

The main impact of climate change on demand is related to periods of extremely hot and dry weather that will increase the peak demand for water. STW have accounted for the impact on the peak demand and the longer duration effect of a dry year through applying factors to the household and non-household water consumption rate in their supply-demand modelling.

Although they have planned for the anticipated impacts of climate change, the view of STW and other water companies is that, in order to manage the effects of climate change effectively, the single most cost effective step in water resources climate change resilience is to manage demand downwards. The reduction in demand will also help to reduce carbon emissions which aids in reducing impacts of climate change.

## 4.6 Water Neutrality

### 4.6.1 *What is Water Neutrality?*

Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less) than it was before development took place[37]. If this can be achieved, the overall balance for water demand is 'neutral', and there is considered to be no net increase in demand as a result of development. In order to achieve this, new development needs to be subject to planning policy which aims to ensure that where possible, houses and businesses are built to high standards of water efficiency through the

[37] Water Neutrality is defined more fully in the Environment Agency report 'Towards water neutrality in the Thames Gateway' (2007)

use of water efficient fixtures and fittings, and in some cases rainwater harvesting and greywater recycling.

It is theoretically possible that neutrality can be achieved within a new development area, through the complete management of the water cycle within that development area. In addition to water demand being limited to a minimum, it requires:

- all wastewater to be treated and re-used for potable consumption rather than discharged to the environment;
- maximisation of rainwater harvesting (in some cases complete capture of rainfall falling within the development) for use in the home; and
- abstraction of local groundwater or river flow storage for treatment and potable supply.

Achieving 'total' water neutrality within a development remains an aspirational concept and is usually only considered for an eco-town or eco-village type development, due to the requirement for specific catchment conditions to supply raw water for treatment and significant capital expenditure. It also requires specialist operational input to maintain the systems such as wastewater re-use on a community scale. Total neutrality for a single development site is yet to be achieved in the UK, although there are exemplar ecotowns and eco-settlements such as Rackheath in Norfolk where it is an aspiration that is being worked towards.

For the majority of new development, in order for the water neutrality concept to work, the additional demand created by new development needs to be offset in part by reducing the demand from existing population and employment. Therefore, a 'planning area' needs to be considered where measures are taken to reduce existing or current water demand from the current housing and employment stock. The planning area in this case is considered to be Stratford-on-Avon District Council as a whole.

**Twin-Track Approach**

Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible, whilst at the same time taking measures, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[38]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted. Appendix 5 provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

**Achieving Total Neutrality – is it feasible?**

When considering neutrality within an existing planning area, it is recognised by the Environment Agency[39] that achievement of total water neutrality (100%) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

[38] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[39] Environment Agency (2009) *Water Neutrality, an improved and expanded water management definition*

This WCS therefore considers four water neutrality targets and sets out a 'pathway' for how the most likely target (or level of neutrality) can be achieved. The pathway concept is discussed in more detail in Appendix 5, and highlights the importance of developing local policy in Stratford-on-Avon District for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

### 4.6.2 *Water Neutrality Scenarios*

Four water neutrality targets have been proposed and assessed. Each target moves beyond the Business as Usual scenario which is considered to be:

- 105l/h/d for new affordable homes[40] and 125 l/h/d for all other new homes[41];
- no mandatory efficiency target for non-domestic property; and,
- continued meter installation in existing homes as planned in STW's WRMP up to 2035.

At 28 per cent, the existing level of metering within the STW region is lower than the national average[42]. STW's future target for meter penetration[43] on domestic water meters is 69 per cent by 2035.

The WRMP assumes this rate will continue to the target of 69% of customers metered by 2035. Therefore, the Water Neutrality scenarios could assume a further 31% meter penetration within the existing housing stock by the end of the plan period in line with STW's WRMP.

The water neutrality scenarios have been developed based on the following generic assumptions. For clarity, Stratford-on-Avon District Council has been considered as a whole when assessing the scenarios:

**Very High Scenario**

The key assumptions for this scenario are:

- it assumes water neutrality is achieved, however it is considered as aspirational only as it is unlikely to be feasible based on:
    - existing research into financial viability of such high levels of water efficiency measures in new homes; and,
    - uptake of retrofitting water efficiency measures considered to be at the maximum achievable (35%) in the county.
- It would require:
    - a significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;
    - strong local policy within the LDF on restriction of water use in new homes on a district scale which is currently unprecedented in the UK; and,
    - all new development to include water recycling facilities across the district which is currently limited to small scale development in the UK.

[40] Levels 3 and 4 – Code for Sustainable Homes
[41] Building regulations Part G Requirement
[42] Severn Trent Water - Water Resources Management Plan, Final Version (2010)
[43] proportion of properties within the STW supply area which have a water meter installed

The scenario has been developed as a context to demonstrate what is required to achieve the full aspiration of water neutrality.

**High Scenario**

The key assumptions for this scenario are:

- A high water neutrality percentage[44] is achieved but requires significant funding and partnership working, and adoption of new local policy which is currently unprecedented in the UK.
- It would require:
    - Uptake of retrofitting water efficiency measures to be very high (25%) in relation to studies undertaken across the UK;
    - a significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required; and,
    - strong local policy within the LDF on restriction of water use in new homes on a district scale which is currently unprecedented in the UK;

It is considered that, despite being at the upper scale of percentage uptake of retrofitting measures, it is technically and politically feasible to obtain this level of neutrality if a fully funded joint partnership approach could be developed.

**Medium Scenario**

The key assumptions for this scenario are:

- The water neutrality percentage[45] achieved is approximately 50% of the total neutrality target and would require funding and partnership working, and adoption of new local policy which has only been adopted in a minimal number of LDFs in the UK.
- It would require:
    - Uptake of retrofitting water efficiency measures to be reasonably high (20%) in the county;
    - a significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required; and,
    - local policy within the LDF on restriction of water use in new homes on a district scale which goes beyond that seen generally in the UK.

It is considered that it is technically and politically feasible to obtain this level with a relatively modest funded joint partnership approach and with new developers contributing relatively standard, but high spec water efficient homes.

[44] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue
[45] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue

**Low Scenario**

The key assumptions for this scenario are:

- The water neutrality percentage[46] achieved is low but would require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement; and,
- It would require:
    - Uptake of retrofitting water efficiency measures to be fairly low (10%);
    - a relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders; and,
    - local policy within the LDF on restriction of water use would be easy to justify and implement.

It is considered that it is technically and politically straightforward to obtain this level with a small funded joint partnership approach and with new developers contributing standard, but water efficient homes with a relative low capital expenditure.

### 4.6.3 *Neutrality Scenario Assessment Results*

To achieve total water neutrality, the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, existing demand in Stratford-on-Avon District was calculated to be 17 Ml/d.

For each neutrality option and scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise, UKWIR[47], the Environment Agency and Ofwat to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (Appendix 5).

For each neutrality scenario, total demand was then calculated at three separate stages for housing as follows:

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting for the differing levels of water efficiency in new homes;
- Stage 2 – total demand post growth with effect of metering applied for the differing levels of water efficiency in new homes; and,
- Stage 3 – total demand post growth with metering and water efficient retrofitting applied to existing homes for the differing levels of water efficiency in new homes. Two Water neutrality options have been undertaken. The first option assumes that all of the properties that would remain unmetered by 2035 (the end of STW's WRMP period) would be metered in addition by STW as a specific initiative for the WCS for the Medium, High and Very High water neutrality scenarios. The second looks at STW undertaking a more realistic 'additional' 10% metering initiative (on top of the WRMP commitment), which equates to approximately 1,600 homes.

[46] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue
[47] UKWIR – The United Kingdom Water Industry Research group, attended and part funded by all major UK water companies

**Option 1**

Table 4-1 details the results for achieving total Water Neutrality. This assumes that all properties remaining unmetered in 2035 (at the end of STW's WRMP period) would be metered in addition, through a specific initiative in conjunction with Stratford-on-Avon District Council for the WCS for the medium, high and very high scenarios. If neutrality is achieved, the result is displayed as green. If it is not, but within 20%, it is displayed as amber, and red if not achieved. The percentage of total neutrality achieved per scenario is also provided.

**TABLE 4-1: WATER NEUTRALITY SCENARIO ASSESSMENT – OPTION 1**

| New Homes & Employment Demand Projections | Demand from Growth (Ml/d) | Total demand post growth* (Ml/d) | Total demand after metering effect (Ml/d) | Total demand after metering & WE F&F (Ml/d) | % Neutrality Achieved |
|---|---|---|---|---|---|
| Baseline Assumption | 1.76 | 18.84 | 18.09 | 18.09 | Not Achieved |
| Building Regulations | 1.47 | 18.54 | 17.80 | 17.80 | 51% |
| Low WN Scenario | 1.41 | 18.48 | 17.73 | 17.62 | 63% |
| Medium WN Scenario | 1.23 | 18.31 | 17.00 | 16.33 | 100% |
| High WN Scenario | 0.92 | 17.99 | 16.68 | 15.31 | 100% |
| Very High WN Scenario | 0.73 | 17.80 | 16.49 | 14.57 | 100% |

- * prior to demand management for existing stock

The results show that total neutrality is achieved by applying the medium scenario, whilst the low neutrality scenario gives 63% neutral water use. This is mainly on the basis that 100% metering (i.e. a further 31% of all current properties metered beyond what STW are currently planning) would offset a large proportion of the additional demand from new development.

**Option 2**

Table 4-2 details the results for undertaking a more realistic additional metering initiative with Stratford-on-Avon District Council and assuming that only 10% of households that remain unmetered in 2035 (at the end of STW's WRMP period) would be metered additionally (equates to 1,600 dwellings). If neutrality is achieved, the result is displayed as green. If it is not, but within 20%, it is displayed as amber, and red if not achieved. The percentage of total neutrality achieved per scenario is also provided.

**TABLE 4-2: WATER NEUTRALITY SCENARIO ASSESSMENT – OPTION 2**

| New Homes & Employment Demand Projections | Demand from Growth (Ml/d) | Total demand post growth* (Ml/d) | Total demand after metering effect (Ml/d) | Total demand after metering & WE F&F (Ml/d) | % Neutrality Achieved |
|---|---|---|---|---|---|
| Baseline Assumption | 1.76 | 18.84 | 18.09 | 18.09 | Not Achieved |
| Building Regulations | 1.47 | 18.54 | 17.80 | 17.80 | 51% |
| Low WN Scenario | 1.41 | 18.48 | 17.73 | 17.62 | 63% |
| Medium WN Scenario | 1.23 | 18.31 | 17.51 | 16.84 | 100% |
| High WN Scenario | 0.92 | 17.99 | 17.19 | 15.82 | 100% |
| Very High WN Scenario | 0.73 | 17.80 | 17.00 | 15.08 | 100% |

- * prior to demand management for existing stock

The results show that total neutrality is achieved by applying the medium scenario, whilst the low neutrality scenario gives 63% neutral water use.

### 4.6.4 *Delivery Requirements – Technological*

The details of what is required technologically from each scenario in terms of new build are included in Table 4-3.

**TABLE 4-3: DETAILS OF NEW BUILD SPECIFICATION REQUIRED TO MEET EACH WATER USE TARGET**

| Component | 150 l/h/d Standard Home | Business as usual | Low (120 l/h/d CSH Level 1/2) | Medium (105 l/h/d CSH Level 3/4) | High (80 l/h/d CSH Level 5/6) | Very High |
|---|---|---|---|---|---|---|
| Toilet flushing | 28.8 | 19.2 b | 19.2 b | 16.8 d | 16.8 d | 16.8 d |
| Taps | 42.3 a | 31.8 a | 31.8 a | 24.9 a | 18 a | 18 a |
| Shower | 30 | 30 | 24 | 18 | 18 | 18 |
| Bath | 28.8 c | 25.6 c | 25.6 c | 25.6 c | 22.4 f | 22.4 f |
| Washing Machine | 16.7 | 15.3 | 15.3 | 15.3 | 15.3 | 15.3 |
| Dishwasher | 3.9 | 3.9 | 3.6 | 3.6 | 3.6 | 3.6 |
| Recycled water | | | | | -16.1 e | -32.2 g |
| Total per head | 150.5 | 125.8 | 119.5 | 104.2 | 78 | 61.9 |
| Total per household | 325.08 | 271.728 | 258.12 | 225.072 | 168.48 | 133.704 |

- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e Rainwater harvesting
- f 120 litre bath
- g Rainwater/greywater harvesting for toilet and washing machine

More detail on the specific measures required under each scenario can be found in Appendix 5.

### 4.6.5 *Financial Cost Considerations*

There are detailed financial and sustainability issues to consider in deciding on a policy for water neutrality. Whilst being water efficient is a key consideration of this study, due to the wider vision for sustainable growth in the district, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development

It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings. These elements are broken down in more detail in Appendix 5.

The financial cost of delivering the technological requirements of each neutrality scenario have been calculated from available research and published documents. Summary tables below should be reviewed with Appendix 5 for supporting information.

**Neutrality scenario costs**

Using the information compiled, the financial costs per scenario has been calculated and are included in Table 4-4 (based on undertaking Water Neutrality Option 1) and Table 4-5 (based on undertaking Water Neutrality Option 2). It should be noted that these are only estimate costs.

**TABLE 4-4: ESTIMATED COST OF NEUTRALITY SCENARIOS – OPTION 1**

| Neutrality Scenario | CSH – Code Level | Outstanding Homes | | Existing Properties | | | | | Costs Summary | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Numbers | CSH cost | No. to be metered (10% existing) | Metering cost | Retrofit % | No. to retrofit | Retrofit cost | Developer | Non developer | Total |
| Low | 1 or 2 | 5,600 | - | 16,802 | £8,401,000 | 10% | 5420 | £271,000 | - | £8,672,000 | £8,672,000 |
| Medium | 3 or 4 | 5,600 | £700,000 | 16,802 | £8,401,000 | 20% | 10,840 | £1,788,600 | £700,000 | £10,189,600 | £10,889,600 |
| High | 5 or 6 (RWH) | 5,600 | £14,812,000 | 16,802 | £8,401,000 | 25% | 13,550 | £2,981,000 | £14,812,000 | £11,382,000 | £26,194,000 |
| Very High | 5 or 6 (RWH & GWR) | 5,600 | £22,428,000 | 16,802 | £8,401,000 | 35% | 18,970 | £4,173,400 | £22,428,000 | £12,574,400 | £35,002,400 |

**TABLE 4-5: ESTIMATED COST OF NEUTRALITY SCENARIOS – OPTION 2**

| Neutrality Scenario | CSH – Code Level | Outstanding Homes | | Existing Properties | | | | | Costs Summary | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Numbers | CSH cost | No. to be metered (10% existing) | Metering cost | Retrofit % | No. to retrofit | Retrofit cost | Developer | Non developer | Total |
| Low | 1 or 2 | 5,600 | - | 1,680 | £840,100 | 10% | 5420 | £271,000 | - | £1,111,100 | £1,111,100 |
| Medium | 3 or 4 | 5,600 | £700,000 | 1,680 | £840,100 | 20% | 10,840 | £1,788,600 | £700,000 | £2,628,700 | £3,328,700 |
| High | 5 or 6 (RWH) | 5,600 | £14,812,000 | 1,680 | £840,100 | 25% | 13,550 | £2,981,000 | £14,812,000 | £3,821,100 | £18,633,100 |
| Very High | 5 or 6 (RWH & GWR) | 5,600 | £22,428,000 | 1,680 | £840,100 | 35% | 18,970 | £4,173,400 | £22,428,000 | £5,013,500 | £27,441,500 |

### 4.6.6 *Carbon Cost Considerations*

As described in this section, there are sustainability issues to consider when considering a policy for promotion of water efficiency and water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable. More detail is provided in Appendix 5 on the methodology used to calculate carbon equivalents of energy used.

The WRMP Direction 2007[48] and WRP Guideline[49] require details of the greenhouse gas emissions that are likely to arise through the delivery of a water company's proposed WRMP. STW estimated[50] these from calculation of greenhouse gases as tonnes of carbon dioxide equivalent (tCO2e) for the base year 2007-08 of 251,683 tCO2e for drinking water treatment and distribution. For subsequent years the value of 0.36 tCO2e/Ml has been used with the forecast demand to give the mass of CO2e likely to be emitted on the basis of current technologies. In order to calculate the carbon costs of achieving water efficiency for the proposed growth in Stratford-on-Avon District Council, the value of 0.36 tCO2e/Ml has been used.

**Results**

The information was used along with estimates of energy used in recycling technology[51] to provide a carbon cost for each of the WN scenarios for Stratford-on-Avon District. The results are presented in Table 4-6.

The following assumptions have been applied:

- under the 'High' and 'Very high' scenarios, consideration must be taken of carbon use in rainwater harvesting as well as water use;
- A basic assumption that each new home is a 90m$^2$ 2-storey house with a small biological system; and,
- insufficient information was available to differentiate between energy used in a building regulations standard home at 125l/h/d and a CSH Code Level 1 or 2 home. Therefore, energy used per home is the same for 'business as usual (i.e. building regulations) and the low WN scenario.

[48] WRMP Regulations Statutory Instrument 2007 No. 727, WRMP Direction 2007, WRMP (No.2) Direction 2007, WRMP (No.2) (Amendment) Direction 2007, WRMP Direction 2008
[49] Water resources planning guideline, Environment Agency, November 2008, http://www.environment-agency.gov.uk/business/sectors/39687.aspx
[50] Severn Trent Water, Greenhouse Gas Emission Data, 2002-2009 & 2010/2011
[51] Environment Agency (2010) Energy and carbon implications of rainwater harvesting and greywater recycling

**TABLE 4-6: CARBON COSTS OF WATER NEUTRALITY SCENARIOS**

| WN Scenario | Relevant CSH Target | Water Use Reductions from retrofit pre WN Scenario (Ml/d) | Carbon reduction per WN scenario ($tCO^2e/d$) | Carbon use per New Home (kg/y) | Carbon use per New Home (kg/d) | Total Carbon use for New Homes ($tCO^2e/d$) | Total ($tCO^2e/d$) |
|---|---|---|---|---|---|---|---|
| Business as Usual | Building Regs Only | 0.00 | 0.00 | 681 | 1.87 | 17.21 | 17.21 |
| Low | Level 1/2 | 0.11 | -0.04 | 681 | 1.87 | 17.21 | 17.17 |
| Medium | Level 3/4 | 0.67 | -0.24 | 582 | 1.59 | 14.70 | 14.46 |
| High | Level 5/6 | 1.37 | -0.49 | 578 | 1.58 | 14.60 | 14.11 |
| Very High | Level 5/6 | 1.92 | -0.69 | 614 | 1.68 | 15.54 | 14.84 |

The results show that there are significant $CO^2$ savings to be made by homes being built to a higher water efficiency level and from the effect of existing homes using less energy to heat water through retrofitting of water efficient devices.

The additional energy used per house for RWH in the High scenario is offset by the savings made in using less water in line with Code Level 5/6 on the CSH; however the additional energy required for greywater recycling in the very high scenario makes this scenario higher in $CO^2$ emissions than both the medium and high WN scenarios. This suggests that in order to meet total neutrality there will be an increase in $CO^2$ emissions over less intensive WN scenarios and hence there are concerns over the long term sustainability of pursuing such a strategy.

### 4.6.7 *Preferred Strategy – Delivery Pathway*

The assessment of water neutrality in this WCS has been undertaken to demonstrate whether moving towards neutrality is feasible and what the cost, and technological implications might be to get as close to neutrality as possible.

To achieve any level of neutrality, a series of policies, partnership approaches and funding sources would need to be developed. This WCS has assumed a 'low' scenario would be favoured and sets out what would be required to support this strategy. This 'low' WN scenario would allow a WN target of 63% to be reached and is generally considered to require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement.

It is considered that, it is technically and politically straightforward to obtain this level with a small funded joint partnership approach and with new developers contributing standard, but water efficient homes with a relative low capital expenditure.

Depending on the success of the first step to neutrality, higher WN scenarios could be aspired to by further developing policies and partnership working to deliver greater efficiencies.

**Delivery Requirements – Policy**

In order to meet the low WN scenario, the following measures are suggested to support its delivery.

In order to meet the water neutrality target scenario given above, the following planning policy is recommended:

**POLICY RECOMMENDATION 1**

Ensure all housing is water efficient, new housing development must go beyond Building Regulations and as a minimum reach Code for Sustainable Homes Level 3 or 4 for water. Where appropriate, specific developments should be identified for water re-use/greywater features to be included.

Developers should prove that the appropriate Code Level for water have been met. When considering planning applications for new development (regardless of size), the planning authority and all consultees should consider whether the proposed design of the development has incorporated water efficiency measures, including (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances.

In addition, it is recommended that the following policies be introduced, to assist with the implementation of the above planning policy:

**POLICY RECOMMENDATION 2**

Carry out a programme of retrofitting and water audits of existing dwellings and non domestic buildings. Aim to move towards delivery of 10% of the existing housing stock, additional to that in the WRMP, with easy fit water saving devices.

Policy Recommendation 2 must work in parallel with the promotion and education programme outlined in Policy Recommendation 3. Further recommendations on how to achieve it are included in Section 4.6.8 below, including recommended funding mechanisms.

**POLICY RECOMMENDATION 3**

Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

4.6.8 ***Delivery Requirements – Partnership Approaches***

**To Support Policy Recommendation 2**

RWH/GWR schemes could be implemented into larger council owned and maintained buildings, such as schools or community centres. RWH could be introduced to public toilets, as has been carried out in Cambridge.

The retrofitting scheme should then be extended to non-Council owned properties, via the promotion and education programme outlined by Policy Recommendation 3.

A programme of water audits should be carried out in existing domestic and non-domestic buildings, again showcased by Council owned properties, to establish water usage and to

make recommendations for improving water efficiency measures. The water audits should be followed up by retrofitting water efficient measures in these buildings, as discussed above. In private non-domestic buildings water audits and retrofitting should be funded by the asset owner, the cost of this could be offset by the financial savings resulting from the implementation of water efficient measures. Funding options for domestic properties are discussed above.

STW (and TW) should consider a policy of moving towards 100% meter installation in the WRZs within the next statutory update to the WRMP (2015).

**To Support Policy Recommendation 3**

In order to ensure the uptake of retrofitting water efficient devices for non-council properties, Stratford-on-Avon District Council should implement an awareness and education campaign, which could include the following:

- working with STW (and TW) to help with its water efficiency initiative, which has seen leaflets distributed directly to customers and at events across the region each year[52];
- a media campaign, with adverts/articles in local papers and features on a local news programme;
- a media campaign could be supplemented by promotional material, ranging from those that directly affect water use e.g. free cistern displacement devices, to products which will raise awareness e.g. fridge magnets with a water saving message;
- encouraging developers to provide new residents with 'welcome packs', explaining the importance of water efficiency and the steps that they can take to reduce water use;
- working with retailers to promote water efficient products, possibly with financial incentives as were undertaken as part of the Preston Water Initiative[53];
- carrying out educational visits to schools and colleges, to raise awareness of water efficiency amongst children and young adults;
- working with neighbourhood trusts, community groups and local interest groups to raise awareness of water efficiency; and,
- carrying out home visits to householders to explain the benefits of saving water, this may not be possible for the general population of Stratford-on-Avon District Council, but rather should be used to support a targeted scheme aimed at a specific residential group, as was carried out for the Preston Water Initiative.

**Responsibility**

The three policy recommendations above are targeted at Stratford-on-Avon District Council and STW, as these are the major stakeholders, although the Environment Agency and other statutory consultees can also influence future development to ensure the water neutrality target is achieved.

It is therefore suggested that responsibility for implementing water efficiency policies be shared as follows:

[52] Anglian Water Services, Water Resource Management Plan, 2010, http://www.anglianwater.co.uk/environment/water-resources/resource-management/
[53] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

- responsibility for ensuring planning applications are compliant with the recommended policies lies with Stratford-on-Avon District Council and Environment Agency (and other statutory consultees as appropriate);
- responsibility for fitting water efficient devices in accordance with the policy lies with the developer, but this should be guided and if necessary enforced by Stratford-on-Avon District Council through the planning application process (as above);
- responsibility to ensure continuing increases in the level of water meter penetration lies with STW and TW;
- responsibility for retrofitting devices lies solely with Stratford-on-Avon District Council for Council owned housing stock and with Stratford-on-Avon District Council and developers (via section 106 agreements and CIL) for privately owned housing stock;
- responsibility for promoting water audits lies with Stratford-on-Avon District Council. It is suggested that the Council sets targets for the numbers of businesses that have water audits carried out and that a specific individual or team within the Council is responsible for promoting and water audits and ensuring the targets are met. The same team or individual could also be act as a community liaison for households (council and privately owned) and businesses where water efficient devices are to be retrofitted, to ensure the occupants of the affected properties understand the need and mechanisms for water efficiency; and
- responsibility for education and awareness of water efficiency should be shared between Stratford-on-Avon District Council, STW, TW and energy companies, as a partnership managed by the Council.

However it should be noted that a major aim of the education and awareness programme, as outlined by Policy Recommendation 2, is to change peoples' attitude to water use and water saving and to make the general population understand that it is everybody's responsibility to reduce water use. Studies have shown that the water efficiencies in existing housing stock achieved by behavioural changes, such as turning off the tap while brushing teeth or reducing shower time, can be as important as the installation of water efficient devices.

**Retrofitting funding options**

In addition to possible resistance from existing householders, the biggest obstacle to retrofitting is the funding mechanism.

Water companies are embarking on retrofit as part of their response to meeting Ofwat's mandatory water efficiency targets. These programmes are funded out of operational expenditure. If a company has, or is forecasting, a supply-demand deficit over the planning period, water efficiency programmes can form part of a preferred option(s) set to overcome the deficit. However, these options are identified as part of the companies water resource management plans and will have to undergo a cost-benefit analysis.

Stratford-on-Avon District Council could consider developer contributions to the Community Infrastructure Levy (CIL) or through S106 agreements.

Part 11 of the Planning Act 2008[54] (c. 29) ("the Act") provides for the imposition of a charge to be known as Community Infrastructure Levy (CIL). This is a new local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe

[54] http://www.legislation.gov.uk/ukpga/2008/29/contents

(as is the case with water resources in Stratford-on-Avon District) then the use of CIL is appropriate.

Section 106 (S106) of the Town and Country Planning Act 1990[55] allows a local planning authority (LPA) to enter into a legally-binding agreement or planning obligation with a landowner in association with the granting of planning permission, known as a Section 106 Agreement. These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required in Stratford-on-Avon District Council could be funded through these mechanisms; they therefore need to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company)[56]. Stratford-on-Avon District Council should consider a similar scheme, although this would require the agreement of STW and TW.

There are two possible European funding mechanisms available for the promotion of water efficiencies:

- European Investment Bank; and,
- European Regional Development Funds.

The European Investment Bank's lending policy[57] sets out how they will support water efficiency measures by water service providers and grant loans to promote water efficiency in buildings. This could be a possible funding route for a widespread retrofitting programme.

European Regional Development Funds are more limited, as funds are often preferentially directed towards energy efficiency projects, with the aim of reducing carbon emissions to achieve European targets. Allocated funding for the current programming period (2007 to 2013 are mainly allocated to such projects[58], although the possibility for funding water efficiency project post-2013 should be investigated.

**Retrofitting monitoring**

During delivery stage, it will be important to ensure sufficient monitoring is in place to track the effects of retrofitting on reducing demand form existing housing stock. The latest research shows that retrofitting can have a significant beneficial effect and can be a cost effective way of managing the water supply-demand balance[59]. However, it is acknowledged that savings from retrofitting measures do diminish with time. This means that a long-term communication strategy is also needed to accompany any retrofit programme taken forward. This needs to be supported by monitoring, so that messages can be targeted and water savings maintained in the longer-term. The communication and monitoring message also applies to new builds to maintain continued use of water efficient fixtures and fittings.

[55] http://www.legislation.gov.uk/ukpga/1990/8/contents
[56] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[57] http://www.eib.org/attachments/strategies/water_sector_lending_policy_2008_en.pdf
[58] Ensuring Water for All, Scoping Study Final Report, Environment Agency, 2010
[59] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

## 4.7 Water Supply and Climate Change Adaption

Table 4-7 provides a summary of the potential climate change adaptation and mitigation measures that could be considered in Stratford-on-Avon District Council with regards to water resources and water supply infrastructure. The organisations likely to be responsible for leading these measures have been identified alongside the suggested timescale for these actions to start being taken forward (Immediate, Medium (1 - 10 years) and Long (10+ years).

**TABLE 4-7: WATER RESOURCES POTENTIAL CLIMATE CHANGE ADAPTION AND MITIGATION MEASURES**

| Potential Climate Change | Potential Impact | Adaption and Mitigation Measures | Lead Organisation (s) | | | | Timescale for Action |
|---|---|---|---|---|---|---|---|
| | | | SoA | EA | STW | NE | |
| Temperature Rise | • Increase in demand for water in summer<br>• Increased evapotranspiration<br>• Increased peak demand<br>• Faster water supply asset deterioration<br>• Changes in process efficiency | Ensure regional drought plans take into account the impacts of climate change | | ✓ | ✓ | | Medium |
| | | Manage seasonal changes in climate by reducing summer peaks in demand for water | ✓ | | ✓ | | Medium |
| | | Contribute to managing water demand through increased water efficiency in homes, businesses, industry and agriculture and promotion of water efficiency measures | ✓ | ✓ | ✓ | | Immediate |
| Winter rainfall increase | • Opportunity for more water storage<br>• Inadequate pump capacity for raw water<br>• Increased diffuse pollution | Manage seasonal changes in climate by increasing winter storage | | | ✓ | | Medium |
| | | Endure adequate pump capacity for increased winter storage requirements | | | ✓ | | Medium |
| | | Where possible, control diffuse pollution runoff through SuDS, particularly for new / redevelopment close to river and water bodies | ✓ | ✓ | ✓ | ✓ | Immediate |
| Summer rainfall decrease | • More frequent low river flows<br>• Increased competition for water<br>• Increased peak demand<br>• Changing customer expectations | Manage seasonal changes in climate by reducing summer peaks in demand for water | ✓ | | ✓ | | Medium |
| | | Contribute to managing water demand through increased water efficiency in homes, businesses, industry and agriculture and promotion of water efficiency measures | ✓ | ✓ | ✓ | | Immediate |
| | | Ensure that water abstraction is sustainable through monitoring | | ✓ | ✓ | | Medium |
| Increase in weather extremes (heatwaves, intense rainfall, storms) | • Increased run-off reduces recharge of aquifers<br>• Decrease in raw water quality – increased treatment cost<br>• Increased flooding and risk of service loss<br>• Increased flooding and risk of service loss<br>• Increased subsidence – pipe failure<br>• Increased contamination / Peak demand delivery during heat waves | Improve resilience of key water supply assets such as pumps, including new industry design standards for water assets | | | ✓ | | Medium |
| | | Where possible, control diffuse pollution runoff through SuDS, particularly for new / redevelopment close to river and water bodies | ✓ | ✓ | ✓ | ✓ | Immediate |
| | | Improve RBMP Programme of Measures to ensure WFD objectives are met and include climate change allowance | | ✓ | | | Medium |

# 5 LOCAL SERVICE VILLAGES ASSESSMENT

## 5.1 Introduction

Following the assessment of wastewater treatment capacity and water resources at the district level, this section of the WCS addresses infrastructure capacity issues related to the village specific locations.

## 5.2 Local Service Village Assessment Methodologies

### 5.2.1 *Wastewater Network*

The wastewater strategy to cater for growth requires an assessment of the capacity of the wastewater network (sewer system) to accept and transmit wastewater flows from the new development to the WwTW for treatment.

An assumption has been applied that it is preferential from a cost and phasing perspective to use capacity within the existing sewer network first, before new sewers are built and commissioned.

The capacity of the existing sewer network is an important consideration for growth, as in some cases the existing system is already at, or over its design capacity. Further additions of wastewater from growth can result in sewer flooding in the system (affecting property or infrastructure) or can increase the frequency with which overflows to river systems occur, resulting in ecological impact and deterioration in water quality.

STW and TW have undertaken an internal assessment of the capacity of the network system using local operational knowledge.

The results are presented for each of the LSVs in Section 5.3. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 5-1.

**TABLE 5-1: KEY FOR WASTEWATER NETWORK RAG ASSESSMENT**

| | | |
|---|---|---|
| **Development is likely to be possible without upgrades** | **Pumping station or pipe size may restrict growth; a pre-development enquiry is recommended before planning permission is granted** | **There is limited capacity in the network, hence solution required to prevent further CSO discharges or sewer flooding** |

### 5.2.2 *Flood Risk*

**Fluvial**

The flood risk to each of the LSVs has been considered using the Environment Agency Flood Maps. A green coding has been applied if the majority of the LSV is within Flood Zone (FZ) 1, whilst an amber coding has been applied if there are significant areas of the LSV in FZ 2 or 3.

**Surface Water Flood Risk**

A County wide Surface Water Management Plan (SWMP) is currently being undertaken by Warwickshire County Council, as Lead Local Flood Authority (LLFA).

Surface water flooding has only been reviewed on a LSV basis to provide an overview using the Flood Map for Surface Water (FMfSW) produced by the Environment Agency.

### 5.2.3 *Surface Water Management*

Surface water drainage methods that take account of run-off rates, water quality, pollution control, biodiversity and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS). Sustainable surface water management takes account of long term environmental and social factors in designing a surface water drainage system that avoids the problems of flooding, pollution or damage to the environment that may occur with conventional surface water management systems.

The National Planning Policy Framework (NPPF) sets out that proposed development should ensure runoff rates from the development are no greater than pre-development rates.

In addition, local planning policy requires that proposed development does not result in an increase in surface water runoff. In order to ensure this, attenuation of runoff is required to manage surface water runoff generated during the 1% annual probability storm event, inclusive of climate change.

**Adoption and Maintenance of SuDS**

Under the Flood and Water Management Act, responsibility for the adoption and maintenance of SuDS systems has been clarified. Before the implementation of the Act, maintenance and responsibility for SuDS systems in developments was inconsistent, with some SuDS systems becoming ineffective some time before their design life was exceeded, due to inadequate maintenance.

The Act will confirm the exact arrangement for adoption and maintenance of SuDS systems during 2012, but for the purposes of this WCS Update it should be assumed that:

- Warwickshire County Council will become responsible for the adoption and maintenance of new build SuDS;
- Warwickshire County Council will become the SuDS approving body (SAB) for all new build SuDS;
- the requirements for approving new build SuDS will be outlined in forthcoming national standards on the construction and operation of surface water drainage; and
- the current right to connect new developments to the existing public surface water sewerage network will be revoked and new surface water drainage systems will need to be approved in line with forthcoming National Sustainable Drainage Standards (to be published in 2012[60]) before any connection to the public sewerage network is allowed.

In light of the change in SuDS approval and maintenance, this WCS has undertaken a high level review of issues affecting potential SuDS options at specific sites, including:

- infiltration limitations (affecting some infiltration techniques);
- Environment Agency Flood Zone (potentially affecting space for surface attenuation features; and,
- Groundwater protection issues (see Section 5.2.4).

[60] http://ww2.defra.gov.uk/news/2010/07/29/benyon-flood-speech/

### 5.2.4 *SuDS and Groundwater Protection*

When considering infiltration SuDS, developers should consider the following with respect to protection of groundwater quality in the study area. The water environment is potentially vulnerable and there is an increased potential for pollution from inappropriately located and/or designed infiltration SuDS.

There are no Environment Agency designated Source Protection Zones (SPZ) within the Stratford-on-Avon District Council area. However, the following considerations should be taken into account with respect to infiltration SuDs:

- Soakaways and other infiltration SuDS must not be constructed in contaminated ground. The use of infiltration drainage would only be acceptable if a phased site investigation (in line with CLR11, 'Model Procedures for the Management of Land Contamination') showed the presence of no significant contamination. The use of non infiltration SUDS may be acceptable subject to agreement with the Environment Agency. More information on SuDS is available in the SuDS Manual produced by Warwickshire County Council.
- The Environment Agency considers that deep boreholes and other deep soakaways systems are not appropriate in areas where groundwater constitutes a significant resource. Deep soakways increase the risk of groundwater pollution.

## 5.3 Local Service Village Assessment

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 1 | Alderminster | STW | Preston on Stour | A series of PS in the foul combined system in Alderminster eventually discharge to Bell Inn PS which discharges pumped flow to Wimpstone. There are no known operational or capacity issues within the catchment. | Some areas of surface water flooding identified in the centre of the LSV. | The majority of the LSV is within FZ 1. The area to the south-west of A3400 is within FZ 2 and 3 of the River Stour. | River Stour | Alluvium and Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stour |
| 2 | Alveston | STW | Stratford – Milcote | Flows from Alveston are pumped to the Tiddington drainage area. Flows from Tiddington drain to Tiddington PS where they are conveyed into the Bridgetown catchment. The cumulative effect of development within the three settlements should be considered. Dependent upon the scale and location of proposed development, the impacts should be quantified using hydraulic modelling. | Some areas of surface water flooding identified in the south of the LSV. | The majority of the LSV is within Flood Zone 1; however the area to the north of Alveston Lane, The Rockery and the Woodlands is within FZ 2 and 3 of the Middle Avon, which has a history of flooding. | Middle Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Middle Avon. |
| 3 | Bearley | STW | Bearley | Bearley is a very small catchment and there are no known operational or capacity issues within the catchment. | Some areas of surface water flooding identified, away from existing areas of development. Appears to be associated with ordinary watercourses. | FZ 1 | Claverdon Brook | Mudstone | |
| 4 | Bishops Itchington | STW | Itchen Bank | There is an isolated minor flooding incident in the sub-catchment. However, it is not considered that development would affect the risk of flooding at this location. | Some areas of surface water flooding identified in the east of the LSV. | The majority of the LSV is within FZ1 - although a small area to the east of Bishops Itchington is in FZ 2 and 3 of the River Itchen. | River Itchen | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Itchen. |
| 5 | Brailes (Upper) | STW | Cherington | There are known capacity issues in the downstream reaches of the Cherington catchment. Dependent on the scale of proposed development, capacity improvements may be required. | Some areas of surface water flooding identified. Appears to be associated with ordinary watercourses. | Upper Brailes is located within FZ1. The majority of Lower Brailes is located within FZ1, although a small area through the centre of the LSV is within FZ 2 and 3 of the Sutton Brook. | | Mudstone | |
| | Brailes (Lower) | | | There are known capacity issues in the downstream reaches of the Cherington catchment. Dependent on the scale of proposed development, capacity improvements may be required. | | | Sutton Brook | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Sutton Brook. |

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 6 | Claverdon | STW | Claverdon | The majority of the network drains east by gravity. The Western part of the catchment is served by Henley Road PS which pumps flows to the central part of Claverdon. There are some records of minor flooding in the west of the catchment. Dependent on the location and scale of development, hydraulic modelling may be required to quantify the impact of development. | Some areas of surface water flooding identified in the centre of the LSV from the south-west to north-east. Appears to be associated with ordinary watercourse. | FZ 1 | Claverdon Brook | Mudstone | |
| 7 | Clifford Chambers | STW | Stratford – Milcote | Flows from Clifford Chambers are pumped directly to the Milcote STW. There are known capacity issues upstream of the Clifford Chambers PS. Development in the settlement may adversely impact upon the existing capacity issues and hydraulic modelling should be undertaken to quantify the impacts. | Area of surface water flooding identified in the centre of the LSV. | The majority of the LSV is within FZ1. An area is within FZ 2 and 3 of the River Stour which flows from the south-east to the north-west of the LSV. There is a history of flooding. | Middle Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stour. |
| 8 | Earlswood | STW | Earlswood - Spring | The northern part of the village is predominantly served by a gravity system with two small pumping stations: Cloweswood Lane PS and Valley Road PS. Foul / combined flow discharges south to the Malthouse Lane PS which subsequently pumps flow directly to the works. The southern part of the area is drained towards the north by gravity to Wood End PS which also discharges directly to the works. There are 6 PS' within the catchment, which are deemed to operate satisfactorily. There are no known capacity issues in the catchment. | Isolated areas of surface water flooding identified. | The area to the west of the LSV is within FZ 1 (towards Terry's Green), although the area around the River Blyth and Earlswood Lakes is within FZ 2 and 3. | River Blyth | Mudstone | Space for surface attenuation SuDS may be limited within the area identified in FZ 2 and 3. |
| 9 | Ettington | STW | Ettington Works | There is one PS in the catchment: Ettington - Spring Close. There is one unsewered area in the south of the catchment at Ettington Park. There are no known capacity or operational issues within the catchment. | Some areas of surface water flooding identified in the north-east of the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | | Mudstone | |
| 10 | Fenny Compton | STW | Fenny Compton | There are known capacity issues within the foul sewer located on Bridge Street. Development in the west and north may affect flood risk in this area. Dependent upon the location and scale of development, hydraulic modelling will be required to quantify the impact of development. | Some areas of surface water flooding identified in centre of the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | | Mudstone | |

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 11 | Gaydon | STW | Gaydon | Flows from Gaydon drain by gravity to the works and there are no PS', CSOs or storage tanks. There are no reported capacity issues within the catchment. However, there are isolated areas that are prone to siltation. | Surface water flooding identified in centre of the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | | Mudstone | |
| 12 | Great Alne | STW | Alcester | There are two PS in Great Alne. Flows are pumped to a gravity sewer in Upton, which subsequently flows to a PS in Haselor. There are no significant capacity issues in the catchment. | Some areas of surface water flooding identified in the centre of the LSV from the north to the south. Appears to be associated with ordinary watercourse. | The majority of the LSV is within FZ 1. The area to the south of the B4089 is within FZ 2 and 3 of the River Alne. There is a history of flooding. | River Alne | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Alne. |
| 13 | Halford | STW | Shipston – Fell Mill | Halford is served by the Tredington Fosse PS. There are no known capacity issues within the sub-catchment. | Area of surface water flooding identified in north-east of the LSV. Appears to be associated with ordinary watercourse. | The majority of the LSV is within FZ1. The south and south-west is located within FZ2 and 3 of the River Stour. There is a history of flooding | River Stour | Limestone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stour. |
| 14 | Hampton Lucy | STW | Wellesbourne | Hampton Lucy drains to the Charlescote PS before pumping directly to Wellesbourne STW. There are no known capacity or operational issues in the catchment. | Isolated areas of surface water flooding identified in the centre of the LSV. | The east of the LSV (including Charlecote Road) is located within FZ 2 and 3 of the River Avon and has a history of flooding. The area to the north-west is within FZ1. | River Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Avon. |
| 15 | Harbury | STW | Itchen Bank | There are 5 PS in Harbury. There are no significant capacity issues within the Harbury sub-catchment. | Some areas of surface water flooding throughout the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | River Itchen | Mudstone and Limestone | |
| 16 | Ilmington | STW | Ilmington | The majority of Ilmington drains directly to the works by gravity with the exception of Washbrook, which is pumped to the system via Washbrook Lane PS. This PS has known capacity issues. There are also known operational issues between the combined system at Back Street and storm water in the adjacent ditch. Dependant upon the scale of development, the impacts should be tested using hydraulic modelling. | Area of surface water flooding identified in the centre of the LSV from the south-west to the north-east. | The majority of the LSV is within FZ1 - although a small area through the centre of the village is within FZ2 of an un-named stream, which has a history of flooding. | | Mudstones | Space for surface attenuation SuDS may be limited within FZ 2. |
| 17 | Lighthorne Heath | STW | Lighthorne Heath | There are occasional capacity issues upstream of Lighthorne Heath PS. Any development should consider the impact on the PS, quantified through hydraulic modelling. | Isolated areas of surface water flooding identified. | FZ 1 | | Mudstone and Limestone | |

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| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 18 | Long Compton | STW | Long Compton | The entire Long Compton area drains by gravity to the works. There are known capacity issues in the downstream reaches of the catchment and there are records of flooding in the north of the catchment. Dependent upon the scale and location of proposed development, the impact should therefore be tested using hydraulic modelling. | Area of surface water flooding along A3400 from south to north of LSV. | The majority of the LSV is within FZ1. An area to the north of the LSV is within FZ 2 and 3 of the Nethercote Brook which flows from east to west. | Nethercote Brook | Mudstones | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Nethercote Brook. |
| 19 | Long Itchington | STW | Itchen Bank | There are four PS within Long Itchington. There are known operational issues reported downstream of the Whitehall Farm PS and there are known capacity issues at the PS. Dependent upon the scale and location of proposed development, the impact should therefore be tested using hydraulic modelling. | Area of surface water flooding identified in the north of the LSV. | The majority of the LSV is within FZ1. The area to the west and south is within FZ 2 and 3 of the River Itchen. There is a history of flooding. A small area is defended (close to the junction of Church Road and Bascote Road). | River Itchen | Mudstone and Limestone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Itchen. |
| 20 | Long Marston | STW | Long Marston | There is one PS in Long Marston. There are no known capacity issues within the settlement. | Area of surface water flooding identified in the centre of the LSV. | FZ 1 | Marchfont Brook | Mudstone | |
| 21 | Mappleborough Green | STW | Redditch – Spernal | There are a number of known capacity issues in the downstream sewerage network. The impact of any proposed development at Mappleborough Green should be quantified using hydraulic modelling as capacity improvements are likely to be required. | Some areas of surface water flooding identified in the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | River Arrow | Mudstone | |
| 22 | Moreton Morrell | STW | Moreton Morrell | The sewerage system at Moreton Morrell drains by gravity to the sewerage system. There are known issues with siltation in parts of the catchment and two minor flood events recorded. Depending on the scale and location of development, the impact on the sewerage network should be quantified using hydraulic modelling. | Some areas of surface water flooding identified in the LSV. Appears to be associated with ordinary watercourse. | The majority of the LSV is within FZ1 - although a small area in the north-west is within FZ 2 and 3 of an un-named brook. | | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3. |
| 23 | Napton-on-the-Hill | STW | Napton | There are 2 PS in Napton. There is a minor isolated flooding record on the outskirts of the settlement. Depending on the location and scale of development within the network, hydraulic modelling may be required to determine the impact on the sewerage network. | Area of surface water flooding identified in the LSV. | The majority of the LSV is within FZ1. The area to the south-west is located within FZ 2 and 3 of the River Stowe. | River Stowe | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stowe. |

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 24 | Newbold-on-Stour | STW | Shipston – Fell Mill | Newbold-on-Stour is served by Tredington Fosse PS. There are a number of PS' in the settlement: Stratford Road, Rimmell Close and Mill Lane. There are no known significant issues within the sub-catchment. | Areas of isolated surface water flooding identified in the LSV. | The majority of the LSV is within FZ1. However, the eastern part of the LSV is within FZ 2 and 3 of the River Stour. There is a history of flooding. | River Stour | Limestone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stour. |
| 25 | Northend | STW | Northend | There are no PS', CSOs or storage tanks within the Northend catchment. There are no capacity or operational issues. | Areas of isolated surface water flooding identified in the LSV. | FZ 1 | River Dene | Mudstone | |
| 26 | Oxhill | STW | Oxhill | The Oxhill area drains to Oxhill STW. Whatcote is pumped to Oxhill where the system drains by gravity to Oxhill PS where it is pumped to the works. There are known capacity issues in the 150mm dia combined sewer that passes to the east of Oxhill adjacent to the watercourse. There are also known capacity issues in the Oxhill SPS. Depending on the scale of proposed development, the impact of new development would need to be quantified using hydraulic modelling. | Area of surface water flooding identified in the south of the LSV. Appears to be associated with ordinary watercourse. | The majority of the LSV is within FZ1. The Wagtail Brook flows from the south-east to the north-west of the LSV with areas within FZ 2 and 3. | Tributary of Wagtail Brook | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Wagtail Brook. |
| 27 | Pillerton Priors | STW | Butlers Marston | There are some known capacity issues in the catchment. Dependent upon the location and scale of development, hydraulic modelling may be required to quantify the impact of development. | Area of surface water flooding identified in the north of the LSV. Appears to be associated with ordinary watercourse. | FZ 1 | Wagtail Brook | Mudstone | |
| 28 | Priors Marston | TW | Priors Marston | 57 properties may be a concern depending on where in the network they were to connect however the current system does not have operational issues but each application would need to be considered for the potential hydraulic impact. It would require further assessment as it is a small catchment. | Area of surface water flooding identified in the centre of the LSV. | FZ 1 | Highfurlong Brook | Mudstone | |
| 29 | Quinton (Lower) | STW | Long Marston | Lower Quinton - Station Road PS pumps flows from Upper and Lower Quinton to the works. This pumping station has known capacity issues and the impact of development in Lower Quinton on the PS should be quantified using hydraulic modelling. | Area of surface water flooding identified in the centre of the LSV. | FZ 1 | Marchfont Brook | Mudstone | |

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 30 | Salford Priors | STW | Bidford on Avon | Salford Priors is one sub-catchment within Bidford on Avon WwTW catchment. The settlement is pumped directly to the works via two parallel rising mains from Salford Priors PS. There are no reported capacity issues within the sub-catchment. | Area of surface water flooding identified in the south of the LSV. | The majority of the LSV is within FZ1. To the south of School Road there is an area of FZ 2 and 3 of the River Arrow and River Avon, which has a history of flooding. | River Arrow, Ban Brook, River Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Arrow and Avon. |
| 31 | Snitterfield | STW | Snitterfield | There is one PS and one CSO within the catchment. There is a minor flooding incident in the catchment. Depending on the location and scale of development, hydraulic modelling may be required to quantify the impact of development. | Areas of isolated surface water flooding identified in the LSV. | The majority of the LSV is within FZ1. An area around The Green and School Road is located within FZ 2 and 3 of the Bell Brook. There is a history of flooding. | Sherbourne Brook (Bell Brook) | Dolomitic Siltstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Bell Brook. |
| 32 | Stockton | STW | Itchen Bank | There are two PS in Stockton. There are known issues with blockages in the Stockton sub-catchment and there are recorded flooding incidents within the catchment. Dependent upon the location and scale of development. | Areas of isolated surface water flooding identified in the LSV. | FZ 1 | River Stowe | Mudstone and Limestone | |
| 33 | Tanworth-in-Arden | STW | Tanworth-in-Arden | There are two sub-catchments that drain south to the works: the northern part of the catchment drains to a PS before being pumped to the works. The oldest part of the village gravitates directly to the works. There are no known capacity or operational issues in Tanworth-in-Arden. | Area of surface water flooding identified in the north and south of the LSV. | FZ 1 | River Alne | Mudstone | |
| 34 | Tiddington | STW | Stratford – Milcote | Flows from Alveston are pumped to the Tiddington drainage area. Flows from Tidington drain to Tiddington PS where they are conveyed into the Bridgetown catchment. The cumulative effect of development within the three settlements should be considered. Dependent upon the scale and location of proposed development, the impacts should be quantified using hydraulic modelling. | Areas of isolated surface water flooding identified in the LSV. | The majority of the LSV is within FZ1. The north of the LSV is within FZ 2 and 3 of the Middle Avon which flows from west to east and has a history of flooding. | Middle Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Middle Avon. |
| 35 | Tredington | STW | Shipston – Fell Mill | There are two minor flooding incidents within the Tredington area. Development to the north of the settlement may require capacity improvements to be constructed. This should be confirmed using hydraulic modelling. | No surface water flood risk | The majority of LSV within FZ1. The south-west is located within FZ1, whilst the area to the north east and east of the LSV is within FZ2 and 3 of the River Stour. There is a history of flooding | River Stour, Back Brook, Wagtail Brook | Mudstone and Limestone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Stour. |

**TABLE 5-2: LOCAL SERVICE VILLAGE ASSESSMENT**

| Site Information | | Wastewater Treatment | | Wastewater Network Analysis | Surface Water Management and Flood Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Local Service Village** | **Water Company** | **WwTW** | **Foul Sewerage Network Capacity** | **Surface Water Flood Risk** | **Fluvial Flood Risk** | **Potential receiving watercourse for surface water** | **Geology** | **SuDS Constraints** |
| 36 | Tysoe (Upper and Middle) | STW | Tysoe | The Tysoe catchment is split between Upper, Middle and Lower Tysoe which all drain to Lower Tysoe WwTW. The Upper Tysoe sub-catchment is pumped to Middle Tysoe from Smarts Lane SPS, which then drains by gravity to the works. There is a record of minor flooding (E05) in the middle of the village and it is known that there are capacity issues at the Smarts Lane SPS. Dependent on the scale of proposed development, the impact of any development in the south of the village upstream of the recorded incident and in Upper Tysoe should be tested using hydraulic modelling. | Area of surface water flooding identified in the north (Middle Tysoe) of the LSV. Appears to be associated with ordinary watercourse. | The majority of the LSV is within FZ1 - although a small area in the south is within FZ 2 and 3 of an un-named brook. | Tributary of Wagtail Brook | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3. |
| 37 | Welford-on-Avon | STW | Stratford - Milcote | Flows from Welford-on-Avon drain to Weston on Avon SPS where they are pumped directly to the Milton STW. There are known capacity issues in parts of the catchment due to incapacity of a PS during storm conditions. Dependent on the scale and location of growth, proposals may adversely affect flood risk in these areas and the impact should be confirmed using hydraulic modelling. | Area of surface water flooding identified in the LSV. | The Middle Avon flows through the LSV, which has a history of flooding. The area to the south and south west are FZ1, whilst areas to the north of Welford-on-Avon are within FZ 2 and 3. | Middle Avon | Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the Middle Avon. |
| 38 | Wilmcote | STW | Stratford - Milcote | The majority of the village drains to separate foul and surface water systems. A small part of the village (to the south east) is combined. There are some minor capacity issues in the combined system to the south east (downstream end of the village). If the development occurs upstream of the capacity issues, the impact on this location will need to be considered. The combined system drains towards Stratford upon Avon. | Area of surface water flooding identified in the south-east of the LSV, associated with the un-named brook. | The majority of the LSV is within FZ 1. An un-named brook flows | | Mudstone | |
| 39 | Wootton Wawen | STW | Wootton Wawen | There is a 450mm diameter combined sewer that passes north to south through the village. The remainder of the sewers in the village are foul only. There are no separate public surface water sewers in the village. There is a minor known capacity issue in the foul only system in the east of the village but aside from this there are no known capacity issues in the village. | Area of surface water flooding identified in the west of the LSV. | The majority of the LSV is within FZ1. The River Alne flows from the north to the south of the LSV with areas within FZ 2 and 3. | River Alne | Sandstone and Mudstone | Space for surface attenuation SuDS may be limited within FZ 2 and 3 of the River Alne. |

# 6 WATER CYCLE STRATEGY RECOMMENDATIONS AND POLICY

The following policy recommendations are made and should be considered by Stratford-on-Avon District Council to ensure that the Stratford-on-Avon LDF considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, and phasing of growth. The policy is also recommended as a starting point to the replacement of the regional water based policies within the revoked West Midlands Plan.

## 6.1 Policy Recommendations Overview

### 6.1.1 *Wastewater*

**WW1 – Development Phasing**

Development in Salford Priors, Pillerton Priors, Brailes (Upper and Lower), Tysoe (Upper and Middle) and Priors Marston will need to be restricted to a minimal annual completion rate to be agreed with STW and Environment Agency until a new solution is in place post 2015, as there is insufficient headroom to accommodate further growth.

**WW2 – Development and Sewerage Network**

Development at sites indicated in the WCS (Amber) to have potentially limited sewer network capacity should be subject to a pre-development enquiry with STW (or TW where necessary) to determine upgrades needed to prior to planning permission being granted.

### 6.1.2 *Water Supply*

**WS1 – Water Efficiency in new homes**

Ensure all housing is water efficient, new housing development must go beyond Building Regulations and as a minimum reach Code for Sustainable Homes Level 3 or 4 for water.

**WS2 – Water Efficiency Retrofitting**

Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 10% of the existing housing stock with easy fit water savings devices

**WS3 – Water Efficiency Promotion**

Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

### 6.1.3 *Surface Water Management and Flood Risk*

**SWM1 – Sewer Separation**

Developers should ensure foul and surface water from new development and redevelopment are kept separate where possible. Where sites which are currently connected to combined sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken.

**SWM2 – Above Ground Drainage**

Developers should aspire to achieve 100% above ground drainage for all future developments, where feasible. Where this is not feasible due to for example housing

densities, land take, ground conditions, topography, or other circumstances, the development proposals should maximise opportunities to use SuDS measures which require no additional land take, i.e. green roofs, permeable surfaces and water butts.

**SWM3 – SuDS and Green Infrastructure**

Developers should ensure linkage of SuDS to green infrastructure to provide environmental enhancement and amenity, social and recreational value. SuDS design should maximise opportunities to create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space.

**SWM4 – SuDS and Water Efficiency**

Developers should ensure linkage of SuDS to water efficiency measures, including rainwater harvesting.

**SWM5 – Linkages to SWMP, SuDS Handbook, SFRA**

Developers should ensure SuDS design supports the findings and recommendations of the Warwickshire Surface Water Management Plan (SWMP), the SuDS Manual (either the CIRIA SuDS Manual or the Warwickshire SuDS Manual when available) and Stratford-on-Avon District Council's SFRA.

**SWM6 – Water Quality Improvements**

Developers should ensure, where possible, that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the Water Framework Directive.

### 6.1.4 *Ecology*

There is no indication that additional discharges beyond the current volumetric consent will result in adverse effects on the Sherbourne Meadows SSSI, Welford SSSI, River Blythe SSSI and River Arrow LNR, provided that 'no deterioration' of the water quality is achieved.

**ECO1 – Biodiversity enhancement**

It is recommended that the Council include a policy in its Core Strategy which commits to seeking and securing (through planning permissions etc) enhancements to aquatic biodiversity in Stratford-on-Avon District through the use of SuDS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities) in line with the Warwickshire Green Infrastructure Strategy.

## 6.2 Developer Guidance

A checklist has been developed to assist developers in ensuring their development proposals meet with the requirements of the overall strategy developed for Stratford-on-Avon District. This checklist is included in Appendix 3.

## 6.3 Further Recommendations

### 6.3.1 *Stakeholder Liaison*

It is recommended that key partners in the WCS maintain regular consultation with each other as development proposals progress.

### 6.3.2 *WCS Periodic Review*

The WCS should remain a living document, and be reviewed on an annual basis as development progresses and changes are made to the various studies and plans that support it; these include:

- five yearly reviews of STW's WRMP (next full review in 2015, although interim reviews are undertaken annually);
- second round of RBMP updates;
- Periodic review 2014 (PR14) (STW's business plan for AMP6 – 2015 to 2020); and,
- Climate change impact assessment milestones (see Table 6-1)

**TABLE 6-1: WATER RELATED PLANNING DOCUMENTS AND CLIMATE CHANGE**

| Document | Produced By | Date for Review |
|---|---|---|
| STW Water Resource Management Plan | STW | 2015 (though plan is reviewed annually) |
| TW Water Resource Management Plan | TW | 2015 (though plan is reviewed annually) |
| River Basin Management Plan – Severn, Thames, | Environment Agency | December 2015 |
| STW Strategic Direction Statement | STW | |
| TW Strategic Direction Statement | TW | |
| Catchment Abstraction Management Strategies | Environment Agency | Yearly updates provided. Date of next full review unknown |
| UKCP09 Projections and Impacts | UKCIP | On-going – check website for further research and case studies for mitigation / adaption (http://www.ukcip.org.uk/) |

## APPENDIX 1: LEGISLATIVE DRIVERS SHAPING THE WCS UPDATE

| Directive/Legislation/Guidance | Description |
|---|---|
| Birds Directive 2009/147/EC | Provides for the designation of Special Protection Areas. |
| Code for Sustainable Homes | The Code for Sustainable Homes has been introduced to drive a step-change in sustainable home building practice, providing a standard for key elements of design and construction which affect the sustainability of a new home. It will become the single national standard for sustainable homes, used by home designers and builders as a guide to development and by home-buyers to assist their choice of home.<br>It will form the basis for future developments of the Building Regulations in relation to carbon emissions from, and energy use in homes, therefore offering greater regulatory certainty to developers. The Code sets out a minimum water demand per person as a requirement for different code levels. CLG is currently in consultation on proposals to make certain code levels mandatory for all new homes. At present, only affordable homes must reach a certain code. |
| Eel Regulations 2009 | Provides protection to the European eel during certain periods to prevent fishing and other detrimental impacts. |
| Environment Act 1995 | Sets out the role and responsibility of the Environment Agency. |
| Environmental Protection Act 1990 | Integrated Pollution Control (IPC) system for emissions to air, land and water. |
| Flood & Water Management Act 2010 | The Flood and Water Management Act 2010 is the outcome of a thorough review of the responsibilities of regulators, local authorities, water companies and other stakeholders in the management of flood risk and the water industry in the UK. The Pitt Review of the 2007 flood was a major driver in the forming of the legislation. Its key features relevant to this WCS are:<br>• To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods.<br>• To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments.<br>• To widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list.<br>• To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges.<br>• To make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the SoS following a full public consultation. |
| Future Water, February 2008 | Sets the Government's vision for water in England to 2030. The strategy sets out an integrated approach to the sustainable management of all aspects of the water cycle, from rainfall and drainage, through to treatment and discharge, focusing on practical ways to achieve the vision to ensure sustainable use of water. The aim is to ensure sustainable delivery of water supplies, and help improve the water environment for future generations. |
| Groundwater Directive 80/68/EEC | To protect groundwater against pollution by 'List 1 and 2' Dangerous Substances. |

| Directive/Legislation/Guidance | Description |
|---|---|
| Habitats Directive 92/44/EEC and Conservation of Habitats & Species Regulations 2010 | To conserve the natural habitats and to conserve wild fauna and flora with the main aim to promote the maintenance of biodiversity taking account of social, economic, cultural and regional requirements. In relation to abstractions and discharges, can require changes to these through the Review of Consents (RoC) process if they are impacting on designated European Sites. Also the legislation that provides for the designation of Special Areas of Conservation provides special protection to certain non-avian species and sets out the requirement for Appropriate Assessment of projects and plans likely to have a significant effect on an internationally designated wildlife site. |
| Land Drainage Act 1991 | Sets out the statutory roles and responsibilities of key organisations such as Internal Drainage Boards, local authorities, the Environment Agency and Riparian owners with jurisdiction over watercourses and land drainage infrastructure. |
| Making Space for Water, 2004 | Outlines the Government's strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England. The policy aims to reduce the threat of flooding to people and property, and to deliver the greatest environmental, social and economic benefit. |
| National Planning Policy Framework | Planning policy in the UK is set by the National Planning Policy Framework (NPPF). The NPPF revokes most of the previous Planning Policy Statements and Planning Policy Guidance. However, NPPF does not revoke the PPS25 Practice Guide. NPPF advises local authorities and others on planning policy and operation of the planning system.<br><br>A WCS helps to balance the requirements of various planning policy documents, and ensure that land-use planning and water cycle infrastructure provision is sustainable. |
| Pollution Prevention and Control Act (PPCA) 1999 | Implements the IPPC Directive. Replaces IPC with a Pollution Prevention and Control (PPC) system, which is similar but applies to a wider range of installations. |
| Ramsar Convention | Provides for the designation of wetlands of international importance |
| Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC | This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its aim is to protect the environment from any adverse effects caused by the discharge of such waters. |
| Water Act 2003 | Implements changes to the water abstraction management system and to regulatory arrangements to make water use more sustainable. |

| Directive/Legislation/Guidance | Description |
|---|---|
| Water Framework Directive (WFD) 2000/60/EC | The WFD was passed into UK law in 2003. The overall requirement of the directive is that all river basins must achieve 'good ecological status' by 2015 or by 2027 if there are grounds for derogation. The WFD, for the first time, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. It effectively supersedes all water related legislation which drives the existing licensing and consenting framework in the UK.<br><br>The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG61, an advisory body which has proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that water bodies in the UK (including groundwater) meet the required status62. These have recently been finalised and issued within the River Basin Management Plans (RBMP). |
| Natural Environment & Rural Communities Act 2006 | Covering Duties of public bodies – recognises that biodiversity is core to sustainable communities and that Public bodies have a statutory duty that states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity |
| Water Resources Act 1991 | Protection of the quantity and quality of water resources and aquatic habitats. Parts have been amended by the Water Act 2003. |
| Wildlife & Countryside Act 1981 (as amended) | Legislation that provides for the protection and designation of SSSIs and specific protection for certain species of animal and plant among other provisions. |

[61] The UKTAG (UK Technical Advisory Group) is a working group of experts drawn from environment and conservation agencies. It was formed to provide technical advice to the UK's government administrations and its own member agencies. The UKTAG also includes representatives from the Republic of Ireland.
[62] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

## APPENDIX 2: WWTW CAPACITY ASSESSMENT RESULTS

### Modelling assumptions and input data

Several key assumptions have been used in the water quality and consent modelling as follows:

- the wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.1 people per house and an average consumption of 150 l/h/d (as set out in Section 1.6). The 150l/h/d figure makes an allowance for commercial use and use in schools and hospitals etc considered to represent increases in non-domestic use across the study area;
- WwTW current flows were taken as the current consented dry weather flow (DWF). Future 2028 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.1, a consumption value of 150l/h/d and allowance for an increase in infiltration) to the current consented DWF value;
- WwTW current discharge quality was taken as the current consented limits for each water quality element. Where an element did not have a consented limit, Ammonia was modelled as 10 mg/l and Phosphate as 4mg/l based on common consented limits in other locations. Figures for the mean and standard deviation of each element were calculated based on these consent levels using RQP 2.5 (discussed further below).
- River flow data for the RQP modelling has been provided by the Environment Agency based on outputs from the Low Flow Enterprise (LFE) model – data was provided as mean flow and Q95[63]. The receiving watercourse that had the WFD status was used to determine the location to extract the river flow data as there was a lack of monitoring data.
- The WFD 'no deterioration' targets for each WwTW are the downstream status, for each water quality element. The published status from the RBMP was used for this as consistent river monitoring data was not available for all the sites in the study area. Details are provided below along with the full results and outputs from the water quality modelling in Tables A2.1 and A2.2.
- For the purposes of this study, the limits of conventionally applied treatment processes are considered to be:
    - 5mg/l for BOD;
    - 1mg/l for Ammoniacal-N; and
    - 1mg/l for Phosphate.

### Assessment techniques

Modelling of the quality consents required to meet the two WFD requirements has been undertaken, using RQP 2.5 (River Quality Planning), the Environment Agency's software for calculating permit conditions. The software is a monte-carlo based statistical tool that determines what statistical quality is required from discharges in order to meet defined downstream targets, or to determine the impact of a discharge on downstream water quality compliance statistics.

The first stage of the modelling exercise was to establish the discharge consent standards that would be required to meet 'No Deterioration'. This would be the discharge consent limit

[63] Defined as the flow value exceeded 95% of the time i.e. a representation of low flows

that would need to be imposed on STW at the time the growth causes the flow consent to be exceeded. No deterioration is an absolute requirement of the WFD and any development must not result in a decrease in quality downstream from the current status.

The second stage was to establish the discharge consent standards that would be required to meet future Good Status under the WFD in the downstream waterbody. This assessment was only carried out for WwTWs discharging to waterbodies where the current status is less than Good (i.e. currently Moderate, Poor or Bad). This would be the discharge consent standard that may need to be applied in the future, subject to the assessments of 'technical feasibility' and 'disproportionate cost. Such assessments would be carried out as part of the formal Periodic Review process overseen by OFWAT in order to confirm that the proposed improvement scheme is acceptable.

*Step 1 – 'No Deterioration'*

A calculation was undertaken to determine if the receiving watercourse can maintain 'No Deterioration' downstream from the current quality with the proposed growth within limits of conventional treatment technology, and what consent limits would be required. If 'No Deterioration' could be achieved, then a proposed discharge consent standard was calculated which will be needed as soon as the growth causes the WwTW flow consent to be exceeded, see Table A2-1.

*Step 2 – Meeting Future 'Good' Status*

For all WwTW where the current downstream quality of the receiving watercourse *is less than good*, a calculation was undertaken to determine if the receiving watercourse could achieve future 'Good Status', with the proposed growth within limits of conventional treatment technology and what consent limits would be required to achieve this.

The assessment of attainment of future 'Good Status' assumed that other measures will be put in place to ensure 'Good Status' upstream, so that the modelling assumed upstream water quality is at the mid point of the 'Good Status' for each element and set the downstream target as the lower boundary of the 'Good Status' for each element.

If 'Good' could be achieved with growth with consents achievable within the limits of conventional treatment, then a proposed discharge consent standard which may be needed in the future has been given in Table A2-2.

If the modelling showed that the watercourse could not meet future 'Good' status with the proposed growth within limits of conventional treatment technology, a further assessment step three was undertaken.

*Step 3 – Is Growth the Factor Causing failure to meet future 'Good Status'?*

In order to determine if it is growth that is causing the failure to attain future 'Good Status' downstream, the modelling in step 2 was repeated, but without the growth in place (i.e. using current flows) as a comparison.

If the watercourse could not meet 'Good Status' without growth (assuming the treatment standard were improved to the limits of conventional treatment technology), then it is not the growth that would be preventing future 'Good Status' being achieved and the 'No Deterioration' consent standard given in Table A2-1. (Step 1) above would be sufficient to allow the proposed growth to proceed.

If the watercourse could meet 'Good Status' without growth, then it is the growth that would be preventing future 'Good Status' being achieved. Therefore consideration needs to be

given to whether there are alternative treatment options that would prevent the future failure to attain 'Good Status'.

The methodology is designed to look at the impact of proposed growth alone, and whether the achievement of 'Good Status' will be compromised. It is important that STW have an understanding of what consents may be necessary in the future. The RBMP and Periodic Review planning processes will deal with all other issues of disproportionate costs.

**TABLE A2-1: 'NO DETERIORATION' ASSESSMENT**

| | Bideford on Avon WwTW | | | Butlers Marston WwTW | | | Cherington WwTW | | | Gaydon WwTW | | | Ilmington WwTW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** |
| River Downstream of Discharge | | | | | | | | | | | | | | | |
| No Determination Target | H | H | P | H | H | P | H | H | G | H | G | P | H | H | M |
| Designated Salmonid Fishery? | No | | | No | | | No | | | No | | | No | | |
| River Quality Target (90%ile or AA) | 4.0 | 0.3 | 1.0 | 4.0 | 0.3 | 1.0 | 4.0 | 0.3 | 1.0 | 4.0 | 0.6 | 1.0 | 4.0 | 0.3 | 0.25 |
| Current Consent | | | | | | | | | | | | | | | |
| Current DWF ($m^3$/day) | 1878 | | | 120 | | | 365 | | | 110 | | | 210 | | |
| Consent Limits (95%ile or AA) | 25 | 10 | 4 | 10 | - | - | 25 | 10 | - | 25 | 10 | - | 15 | - | - |
| Discharge Quality Required | | | | | | | | | | | | | | | |
| Future DWF ($m^3$/day) | 1888 | | | 138 | | | 418 | | | 120 | | | 213 | | |
| Effluent Quality Required (95%ile or AA) | No Change Required | No Change Required | No Change Required | No Change Required | 11.6 | 21.1 | No Change Required | 5.27 | 0.93 | 16.23 | 2.78 | 3.93 | No Change Required | 3.08 | 1.28 |
| Will Growth prevent WFD 'No Deterioration' being achieved? | | No | | | No | | | No | | | No | | | No | |

**TABLE A2-2: IMPROVEMENT TO 'GOOD STATUS' ASSESSMENT**

| | Bideford on Avon WwTW | | | Butlers Marston WwTW | | | Cherington WwTW | | | Gaydon WwTW | | | Ilmington WwTW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** |
| River Downstream of Discharge | | | | | | | | | | | | | | | |
| No Determination Target | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G |
| Designated Salmonid Fishery? | No | | | No | | | No | | | No | | | No | | |
| River Quality Target (90%ile or AA) | - | - | | - | - | 0.12 | - | - | - | - | - | 0.12 | - | - | 0.12 |
| Current Consent | | | | | | | | | | | | | | | |
| Current DWF ($m^3$/day) | 2348 | | | 120 | | | 365 | | | 110 | | | 210 | | |
| Consent Limits (95%ile or AA) | | | 6.9 | | | 2.26 | | | | | | 0.41 | | | 0.68 |
| Discharge Quality Required | | | | | | | | | | | | | | | |
| Future DWF ($m^3$/day) | 2360 | | | 138 | | | 418 | | | 120 | | | 213 | | |
| Effluent Quality Required (95%ile or AA) | | | 6.9 | | | 1.98 | | | | | | | | | |
| Will Growth prevent WFD 'No Deterioration' being achieved? | | No | | | No | | | | | | No | | | No | |

**TABLE A2-1: 'NO DETERIORATION' ASSESSMENT**

| | Long Compton WwTW | | | Napton WwTW | | | Tysoe WwTW | | | Wellesbourne WwTW | | | Priors Marston WwTW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** |
| River Downstream of Discharge | | | | | | | | | | | | | | | |
| No Determination Target | H | H | M | M | H | M | H | H | M | H | H | P | | | |
| Designated Salmonid Fishery? | No | | | No | | | No | | | No | | | No | | |
| River Quality Target (90%ile or AA) | 4.0 | 0.3 | 0.25 | 6.5 | 0.3 | 0.25 | 4.0 | 0.3 | 0.25 | 4.0 | 0.3 | 1.0 | 5.0 | 0.3 | 0.12 |
| Current Consent | | | | | | | | | | | | | | | |
| Current DWF ($m^3$/day) | 165 | | | 197 | | | 181 | | | 1559 | | | 152 | | |
| Consent Limits (95%ile or AA) | 25 | - | - | 15 | 10 | - | 25 | - | - | 10 | 10 | 4 | 20 | 9 | - |
| Discharge Quality Required | | | | | | | | | | | | | | | |
| Future DWF ($m^3$/day) | 171 | | | 201 | | | 202 | | | 1567 | | | 170 | | |
| Effluent Quality Required (95%ile or AA) | No Change Required | 3.93 | 1.33 | No Change Required | 4.35 | 1.39 | No Change Required | 2.7 | 0.97 | No Change Required | 2.46 | No Change Required | No Change Required | 1.24 | 0.26 |
| Will Growth prevent WFD 'No Deterioration' being achieved? | No | | | No | | | No | | | No | | | No (based on current WwTW performance) | | |

**TABLE A2-2: IMPROVEMENT TO 'GOOD STATUS' ASSESSMENT**

| | Long Compton WwTW | | | Napton WwTW | | | Tysoe WwTW | | | Wellesbourne WwTW | | | Priors Marston WwTW??? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** | **BOD** | **Ammonia** | **Phosphate** |
| River Downstream of Discharge | | | | | | | | | | | | | | | |
| No Determination Target | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G |
| Designated Salmonid Fishery? | No | | | No | | | No | | | No | | | No | | |
| River Quality Target (90%ile or AA) | - | - | 0.12 | 5 | - | 0.12 | - | - | - | - | - | 0.12 | - | - | - |
| Current Consent | | | | | | | | | | | | | | | |
| Current DWF ($m^3$/day) | 165 | | | 197 | | | 365 | | | 110 | | | | | |
| Consent Limits (95%ile or AA) | - | - | 0.73 | 35.5 | - | 0.75 | - | - | 0.55 | - | - | 0.46 | | | |
| Discharge Quality Required | | | | | | | | | | | | | | | |
| Future DWF ($m^3$/day) | 171 | | | 201 | | | 418 | | | 120 | | | | | |
| Effluent Quality Required (95%ile or AA) | - | - | | 34.56 | - | | - | - | | - | - | | | | |
| Will Growth prevent WFD 'No Deterioration' being achieved? | No | | | No | | | | | | No | | | | | |

Key: Green Value – No change to current consent required, Amber Value – Consent tightening required, but within limits of conventionally applied treatment processes, Red Value – Not achievable within limits of conventionally applied treatment processes

## APPENDIX 3: RECOMMENDED DEVELOPER CHECKLIST FOR COMPLIANCE WITH THE WATER CYCLE STRATEGY

| DEVELOPER CHECKLIST KEY | |
|---|---|
| | Water Cycle Strategy Recommended Policy |
| | Environment Agency and Natural England Policy and Recommendations |
| | Local Policy |
| | National Policy or Legislation |

| DEVELOPER CHECKLIST | | | |
|---|---|---|---|
| | **Flood Risk Assessment Checklist** | | **Policy or Legislation** |
| 1 | Is the Development within Flood Zones 2 or 3 as defined by the flood zone mapping in the SFRA, or where SFRA coverage is not available, the published Environment Agency flood risk maps? | Y - go to 5<br>N - go to 2 | NPPF, Flood & Water Management Act |
| 2 | Development is within Flood Zone 1:<br>Site larger than 1 Ha?<br>Site smaller than 1 Ha? | <br>Y - go to 5<br>Y - go to 3 | |
| 3 | Is the development residential with 10 or more dwellings or is the site between 0.5Ha and 1Ha? | Y - go to 6<br>N - go to 4 | |
| 4 | Is the development non-residential where new floor space is 1,000m2 or the site is 1 Ha or more | Y - go to 6<br>N - go to 7 | |
| 5 | The development either constitutes major development or is considered to be in a high risk flood zone and requires a Flood Risk Assessment (NPPF, Local Planning Policy and the relevant SFRA) and the Environment Agency are required to be consulted. | Go to 8 | |
| 6 | The development constitutes major development and is likely to require a Flood Risk Assessment (in accordance with NPPF, Local Planning Policy and the relevant SFRA) but the Environment Agency may not be required to be consulted (further advice is available via the Environment Agency's Flood Risk Standing Advice webpage). | Go to 8 | |
| 7 | An FRA is unlikely to be required for this development, although a check should be made against the SFRA and with the LPA to ensure that there is no requirement for a FRA on the grounds of critical drainage issues. Does the SFRA or does the LPA consider a Flood Risk Assessment (FRA) is required? | Y – go to 8<br>N – go to 9 | |
| 8 | Has an FRA been produced in accordance with Local Planning Policy, Environment Agency standing advice and the relevant SFRA? | Y/N or N/A | |

| | Surface Water Checklist | | Policy or Legislation |
|---|---|---|---|
| 9 | A) What was the previous use of the site?<br><br>B) What was the extent of impermeable area, both before and after development? | <br><br>% before % after | Environment Agency Requirement for FRA. |
| 10 | If development is on a Greenfield site, have you provided evidence that post development run-off will not be increased above the Greenfield runoff rates and volumes using SuDS attenuation features where feasible (see also 18 onwards).<br><br>If development is on a brownfield site, have you provided evidence that the post development run-off rate has not been increased, and as far as practical, will be decreased below existing site runoff rates using SuDS attenuation features where feasible (see also 17 onwards). | Y/N or N/A<br><br>Y/N or N/A | Local Planning Policy |
| 11 | Is the discharged water only surface water (e.g. not foul or from highways)?<br><br>If no, has a discharge consent been applied for? | Y/N<br><br>Y/N | Water Resources Act 1991 |
| 12 | A) Does your site increase run-off to other sites?<br><br>B) Which method to calculate run-off have you used? | Y/N | Local Planning Policy |
| 13 | Have you confirmed that any surface water storage measures are designed for varying rainfall events, up to and including, a 1 in 100 year + climate change event? | Y/N | Local Planning Policy |
| 14 | For rainfall events greater than the 1 in 100 year + climate change, have you considered the layout of the development to ensure that there are suitable routes for conveyance of surface flows that exceed the drainage design? | Y/N | Local Planning Policy |
| 15 | Have you provided layout plans, cross section details and long section drawings of attenuation measures, where applicable? | Y/N | |
| 16 | If you are proposing to work within 20m of a main river or 8m of any watercourse have you applied, and received Flood Defence Consent from the Environment Agency? | Y/N or N/A | Water Resources Act 1991<br>Land Drainage Act 1991 |
| 17 | The number of outfalls from the site should be minimised. Any new or replacement outfall designs should adhere to standard available from the local area Environment Agency office. Has the guidance been followed? | Y/N | Guidance Driven by the Water Resources Act 1991 |

| | Sustainable Drainage Systems (SuDS) Checklist | | Policy or Legislation |
|---|---|---|---|
| 18 | A) Has the SuDS hierarchy been considered during the design of the attenuation and site drainage? Provide evidence for reasons why SuDS near the top of the hierarchy have been disregarded.<br><br>B) Have you provided detail of any SuDS proposed with supporting information, for example, calculations for sizing of features, ground investigation results and soakage tests? See CIRIA guidance for more information.<br>http://www.ciria.org.uk/suds/697.htm<br><br>C) Have you checked that any proposed SUDS (including maintenance and adoption requirements) meet with the minimum requirements of the SuDS Approving Body (SAB) where applicable? | Y/N | |
| 19 | A) Are Infiltration SuDS to be promoted as part of the development? If Yes, the base of the system should be set at least 1m above the groundwater level and the depth of the unsaturated soil zones between the base of the SuDS and the groundwater should be maximised.<br><br>B) If Yes – has Infiltration testing been undertaken to confirm the effective drainage rate of the SuDS?<br><br>C) Have you ensured that any proposed soakaways are no greater than 2m below existing ground level? | Y/N<br><br>Y/N | Local Planning Policy Flood & Water Management Act |
| 20 | A) Are there proposals to discharge clean roof water direct to ground (aquifer strata)?<br><br>B) If Yes, have all water down-pipes been sealed against pollutants entering the system form surface runoff or other forms of discharge? | Y/N<br><br>Y/N | |
| 21 | A) Does proposed surface water drainage require use of smaller drains/channels to connect to a main river?<br><br>B) If yes, has the relevant drainage authority been consulted? | Y/N<br><br>Y/N | WCS policy suggestion |
| 22 | Have you shown that drainage will be 100% above ground, or where not possible due to housing densities, land take etc) provided evidence as to why it is not possible. | Y/N | |

| | | | |
|---|---|---|---|
| 23 | Is the development area in a Source Protection Zone (SPZ) or a safeguard zone? | If Y go to 24<br>If N go to 25 | |
| 24 | A) Is the development area within an inner zone (SPZ1)?<br><br>B) If yes, discharge of Infiltration of runoff from car parks, roads and public amenity areas is likely to be restricted – has there been discussion with the Environment Agency as to suitability of proposed infiltration SuDS? | Y/N<br><br>Y/N | Groundwater Regulations 1998<br>Article 7 of the Water Framework Directive |
| 25 | A) For infill development, has the previous use of the land been considered?<br><br>B) Is there the possibility of contamination or potential for pollution?<br><br>C) If yes, infiltration SuDS may not be appropriate and remediation of the land may be required. A Groundwater Risk Assessment is likely to be required. Has this been undertaken before the drainage design is considered in detail? | Y/N<br><br>Y/N<br><br>Y/N | NPPF |
| 26 | Have oil separators been designed into the highway and car parking drainage?<br>Environment Agency Pollution Prevention Guideline 3: http://publications.environment-agency.gov.uk/pdf/PMHO0406BIYL-e-e.pdf | Y/N | Environment Agency Pollution Prevention Guideline 3 |
| 27 | Have you considered whether any of the SuDS proposed can be linked to Green Infrastructure plans as set out in the Water Cycle Study for Stratford-on-Avon District? | Y/N | WCS policy suggestion |
| | **Water Consumption Checklist** | | **Policy or Legislation** |
| 28 | Have you provided the expected level of water consumption to meet the minimum of Code for Sustainable Homes Level as set out in the draft Core Strategy? http://www.planningportal.gov.uk/england/professionals/buildingregs/sustainablehomes/ | Y/N | WCS policy suggestion |
| 29 | Is the proposed development likely to achieve a water consumption of less than or equal to 125 l/h/d as consistent with the Communities and Local Government Building Regulations Part G (2009)? http://www.communities.gov.uk/publications/planningandbuilding/partg2009divisionalletter and http://www.planningportal.gov.uk/uploads/br/BR_PDF_draftADG_2009.pdf | Y/N | |
| 30 | Have you provided details of water efficiency methods to be installed in houses? | Y/N | |

| | | | |
|---|---|---|---|
| 31 | A) Have you confirmed whether the development will utilise rainwater harvesting and/or required tank sizes? (see http://www.environment-agency.gov.uk/homeandleisure/drought/38559.aspx and http://publications.environment-agency.gov.uk/pdf/GEHO0108BNPN-E-E.pdf)<br><br>B) Have you considered linkage of SuDS to rainwater harvesting or other water efficiency measures? | Y/N<br><br>Y/N | |
| 32 | Have you confirmed whether grey water recycling is to be utilised and provided details? | Y/N | |
| 33 | Have you provided details of any proposed measures to increase public awareness and community participation in water efficiency? | Y/N | |
| | **Pollution Prevention Checklist** | | **Policy or Legislation** |
| 34 | Have you provided details of construction phase works, for example method statement, outlining pollution control and waste management measures? See Environment Agency Pollution Prevention Guidelines 2, 5, 6 and 21 (http://www.environment-agency.gov.uk/business/topics/pollution/39083.aspx) and DTI Site Waste Management Plan, (http://www.constructingexcellence.org.uk/resources/publications/view.jsp?id=2568) | Y/N | Environment Agency Pollution Prevention Guidelines 2, 5, 6 and 21 |
| 35 | A) Have you provided details of pollution prevention measures for the life of the development, such as oil and silt interceptors?<br><br>B) Have you considered whether permeable pavement areas are protected from siltation?<br><br>C) Have you provided details of maintenance – as with the SuDS? | Y/N<br><br>Y/N<br><br>Y/N | WCS policy suggestion |
| | **Sewerage Checklist** | | **Policy or Legislation** |
| 36 | Have you provided evidence to confirm that sewerage capacity is available via a pre-development enquiry with Severn Trent Water? | Y/N | WCS policy suggestion |
| 37 | A) Have sewers been designed in line with 'sewers for adoption'?<br><br>B) Have discussions regarding adoption and maintenance of on site sewers taken place with Severn Trent Water? | Y/N | Water Industry Act & Flood & Water Management Act |

| | **Conservation / Enhancement of Ecological Interest Checklist** | | **Policy or Legislation** |
|---|---|---|---|
| 38 | Have you considered that SuDS should link to green Infrastructure to maximise environmental enhancement and amenity? And in addition that any green infrastructure, such as the surface water system, links to the neighbouring green infrastructure (River Corridors) to assist the creation and maintenance of green corridors? | Y/N | WCS policy suggestion |
| 39 | A) Have you shown the impacts your development may have on the water environment?<br><br>B) Is there the potential for beneficial impacts? Have you considered, where possible the design of SuDS to deliver water quality improvements in the receiving watercourse or aquifer? | Y/N<br><br>Y/N | Town and Country Planning Regulations 1999 |
| 40 | Have you confirmed all ponds within 500m of the site boundary have been surveyed for presence of great-crested newt populations? | Y/N | Habitats Directive |

## APPENDIX 4: ECOLOGICAL BACKGROUND FOR STAUTORY DESIGNATED SITES

### Sherbourne Meadows SSSI

Sherbourne Meadows comprises a series of eight adjoining unimproved fields lying on either side of Sherbourne Brook. Seven of the fields have a long history of management as hay meadows, the other is now grazed. Five of the fields along the brook, on alluvium overlying the Mercia Mudstone, have a vegetation characteristic of meadow foxtail - great burnet flood meadow. The other three fields on higher land not adjoining the brook have ridge and furrow topography and overlie Mercia Mudstone. Their herb-rich neutral grassland vegetation is of the common knapweed Đ crested dog's-tall meadow and pasture type.

There is evidence that in the nineteenth century these grassland types were widespread and common in some parts of Britain, particularly in the Midlands and also southern England in the case of flood-meadows. In the twentieth century, however, they have declined very severely as a result of agricultural improvement.

The extent of flood meadows has been further reduced by neglect of common meadow rights and from gravel extraction. Sherbourne Meadows is the largest area of unimproved neutral grassland in Warwickshire.

The award associated with the meadow foxtail Đ great burnet community is species rich with a great diversity of herbs. It shows some variation in composition throughout the site due to local drainage conditions. Sixteen species of grass have so far been recorded and characteristically no single one of them appears dominant. The most abundant species are meadow foxtail Alopecurus pratensis, crested dog's-tail Cynosurus cristatus, red fescue Festuca rubra, yellow oat-grass Trisetum flavescens and perennial rye-grass Lolium perenne. Other species that are very frequent are sweet vernal-grass Anthoxanthum odoratum, Yorkshire-fog Holcus lanatus, cock's foot Dactylis glomerata and common bent Agrostis capillaris. The density of herbs in the sward is exceptionally high with great burnet Sanguisorba officinalis, ribwort plantain Plantago lanceolata, common knapweed Centaurea nigra, red clover Trifolium pratense and meadow buttercup Ranunculus acris all generally abundant.

Other species characteristic of this grassland which occur frequently include quaking grass Briza media, meadowsweet Filipendula ulmaria, meadow vetchling Lathyrus pratensis and rough hawkbit Leontodon hispidus.

The common knapweed - crested dog's-tail community on the higher fields away from the brook also has a herb-rich sward which is low growing and especially tight on the ridges. The community is the lady's bedstraw Galium verum type subcommunity having lady's bedstraw present as an occasional and yellow oat-grass as a frequent component of the sward. Twelve species of grass have so far been recorded, none of which shows overall dominance. Red fescue, common bent and crested dog's tail are co-dominant with three other species, sweet vernal-grass, cock's-foot and Yorkshire-fog almost as frequent and quaking-grass is a constant occasional species.

Amongst the herb species in the sward there is a high proportion of leguminous herbs with common bird's-foot-trefoil Lotus corniculatus, white clover Trifolium repens and red clover being the most abundant species. Other species which are frequent include common knapweed, ribwort plantain, meadow buttercup, bulbous buttercup Ranunculus bulbosus and yellow rattle Rhinanthus minor. In places a marked zonation exists between the two neutral grassland communities.

Mature hedges with large hedgerow trees, particularly along the brook, serve to protect the site from surrounding improved fields and provide additional habitats for wildlife.

**Welford Field SSSI**

Welford Field is an unimproved field which lies in the flood plain of the River Avon on its south bank in a large river bend near Welford-on-Avon. It is a herb-rich neutral grassland overlying alluvial clays which exhibit a distinct calcareous influence from the close proximity of the Lias limestone to the north. The field has a characteristic flood meadow community of meadow foxtail Alopecurus pratensis and great burnet Sanguisorba officinalis, where traditional hay meadow management has been applied to seasonally flooded land with alluvial soils.

There is evidence that in the nineteenth century this grassland type was widespread and common in some parts of Britain, particularly in the Midlands and also southern England in the case of flood meadows. In the twentieth century, however, they have declined severely as a result of agricultural improvement, the neglect of common meadow rights and from gravel extraction. Welford Field is now one of the seven last remaining flood meadow sites known in Warwickshire.

The meadow has a sward that is species rich with a diversity of herbs and grasses.

Amongst the many species of grass found in the meadow characteristically none of them appears dominant. The most abundant species are meadow foxtail, red fescue Festuca rubra and Yorkshire fog Holcus lanatus. The density and variety of herbs in the sward is exceptionally high with great burnet, common knapweed Centaurea nigra, meadowsweet Filipendula ulmaria and meadow vetchling Lathyrus pratensis all generally abundant.

Lady's bedstraw Galium verum also grows in abundance in the meadow, this is unusual because in most flood meadows it is a rare component of the sward.

Welford Field is exceptional amongst the Warwickshire flood meadows in having herb species characteristic of more calcareous sites such as the lady's bedstraw but also salad burnet Sanguisorba minor grows in equal abundance to the great burnet. Other grasses in this meadow include soft brome Bromus hordeaceus, cock's-foot Dactylis glomerata, rough meadow-grass Poa trivialis and yellow oat-grass Trisetum flavescens. Meadow barley Hordeum secalinum is also found occasionally although unusual in flood meadows it is characteristic of many unimproved meadows in Warwickshire.

**River Blythe SSSI**

The 39 kilometre stretch of the River Blythe, from the point at which Spring Brook exits from under the Stratford-upon-Avon to Birmingham railway line to its confluence with the River Tame, is a particularly fine example of a lowland river on clay.

The Blythe has a wide range of natural structural features such as riffles, pools, small cliffs and meanders. These features are combined with a high diversity of substrate types ranging from fine silt and clay in the lower reaches to sands and gravels in the upper and middle reaches and in the riffles. The structure of this river is very variable and its importance is increased because of the rarity of such examples in lowland Britain.

The diverse physical features of the Blythe are mirrored by its diverse plant communities.

The mean number of plant species found in any 1 km stretch is above average for a lowland river, as is the number of species recorded for the whole length of the river.

Botanically, the Blythe is one of the richest rivers in lowland England with the most species-rich sections containing as many species as the very richest chalk streams.

Unlike many lowland rivers, the Blythe shows a clear succession of plant communities from its source to its confluence with the Tame. The substratum in the upper reaches is frequently composed of loose gravel and the margins still retain a high density of trees and shrubs. The vegetation in the channel is, therefore, shade-impoverished but algae and some flowering plants such as waterweeds Elodea spp. and water-starworts Callitriche spp. provide seasonal cover. The habitats in these upper reaches are important for their invertebrates.

Downstream, the trees and shrubs on the margins become fewer but still remain at a higher density than most lowland rivers. As the river becomes deeper and wider and the shading from trees is reduced, the flora becomes rich and varied. In the shallow, fast-running stretches with gravel beds, water-crowfoots Ranunculus fluitans and R. penicillatus var. calcareus grow in profusion with Ôblanket-weedÕ algae which are abundant through the summer months. Where larger stones are present a rich encrusting algal flora develops along with the fresh water sponge Ephydatia fluviatilis.

There is a rich flora in stretches with a moderate rate of flow over a clay bottom. The emergent common clubrush Schoenoplectus lacustris and branched bur-reed Sparganium erectum occur here alongside submerged species of pondweed Potamogeton pectinatus, P. perfoliatus and P. crispus, lesser bur-reed Sparganium emersum, spiked water-milfoil Myriophyllum spicatum and many other less common species. On the margins, sedges Carex spp. are frequent alongside species of sweet-grass Glyceria spp., reed canary-grass Phalaris arundinacea and many other flowering plants.

In the lower reaches where shallow stretches alternate with deeper, slower sections, the flora is diverse. Alongside many of the species recorded upstream are flowering rush Butomus umbellatus, arrowhead Sagittaria sagittifolia and yellow water-lily Nuphar lutea.

The marginal flora is rich with mats of aquatic vegetation encroaching from the banks into the water. Amphibious bistort Polygonum amphibium, great yellow-cress Rorippa amphibia and reed sweet-grass Glyceria maxima are typical constituents of this community.

Several damp, unimproved meadows occur along the length of the river. They receive some of their water from annual flooding and are largely dependent upon the river for the maintenance of a high water-table. Rushes Juncus spp., sedges and tufted hair grass Deschampsia cespitosa are usually the dominant species along with moisture-loving herbs such as meadowsweet Filipendula ulmaria, marsh marigold Caltha palustris and wild angelica Angelica sylvestris. There are several small areas of wet alder Alnus glutinosa and willow Salix spp. woodland which have a varied ground flora and are an integral part of the river system.

The river supports a diverse invertebrate community with a wide range of molluscs, oligochaetes and caddisflies. The most notable species is the pea-shell cockle Pisidium moitessierianum which is at the western edge of its range here. The dragonflies are also well represented with the beautiful demoiselle Calopteryx virgo being the least common of the species found.

## APPENDIX 5: WATER NEUTRALITY

Water Neutrality is defined in Chapter 4. This appendix provides supplementary information and guidance behind the processes followed.

**Twin-Track Approach**

Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible. At the same time measures are taken, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[64], including:

- cistern displacement devices;
- flow regulation;
- greywater recycling;
- low or variable flush replacement toilets;
- low flow showers;
- metering;
- point of use water heaters;
- pressure control;
- rainwater harvesting;
- variable tariffs;
- low flows taps;
- water audits;
- water butts;
- water efficient garden irrigation; and,
- water efficiency promotion and education.

The varying costs and space and design constraints of the above mean that they can be divided into two categories, measures that should be installed for new developments and those which can be retrofitted into existing properties. For example, due to economies of scale, to install a rainwater harvesting system is more cost effective when carried out on a large scale and it is therefore often incorporated into new build schools, hotels or other similar buildings. Rainwater harvesting is less well advanced as part of domestic new builds, as the payback periods are longer for smaller systems and there are maintenance issues. To retrofit a rainwater harvesting system can have very high installation costs, which reduces the feasibility of it.

However, there are a number of the measures listed above that can be easily and cheaply installed into existing properties, particularly if part of a large campaign targeted at a number of properties. Examples of these include the fitting of dual-flush toilets and low flow showers

[64] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.

heads to social housing stock, as was successfully carried out in Preston by Reigate and Banstead Council in conjunction with Sutton and East Surrey Water and Waterwise[65].

**The Pathway Concept**

The term 'pathway' is used here as it is acknowledged that, to achieve any level of neutrality, a series of steps are required in order to go beyond the minimum starting point for water efficiency which is currently mandatory for new development under current and planned national planning policy and legislation.

Whilst it is compulsory that all new homes are given a rating under the Government's Code for Sustainable Homes (CSH), only affordable housing has a minimum rating that must be achieved (Code Level 3); there is no statutory requirement under the Code for all other new housing to have a low water use specification as previous government proposals to make different levels compulsory have been postponed pending government review. For non-domestic development, there is no statutory requirement to have a sustainability rating with the Building Research Establishment Environmental Assessment Method (BREEAM) only being mandatory where specified by a public body in England such as:

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- NHS buildings for new buildings and refurbishments;
- Department for Children, Schools and Families for all projects valued at over £500K (primary schools) and £2million (secondary schools);
- English Partnerships (now incorporated into the Homes and Communities Agency) for all new developments involving their land; and,
- Office of Government Commerce for all new buildings;

Therefore, other than potential local policies delivered through the LDF process, the only water efficiency requirements for new development are through the Building Regulations[66] where new homes must be built to specification to restrict water use to 125l/h/d. However, the key aim of the Localism Bill is to decentralise power away from central government towards local authorities and the communities they serve. It therefore creates a stronger driver for local authorities such as Stratford-on-Avon District Council to propose local policy to address specific local concerns. New local level policy is therefore key to delivering aspirations such as water neutrality and the proposed Localism Bill will assist in providing the legislative mechanism to achieve this in Stratford-on-Avon District Council.

In addition to the steps required in new local policy, the use of a pathway to describe the process of achieving water neutrality is also relevant to the other elements required to deliver it, as it describes the additional steps required beyond 'business as usual' that both developers and stakeholders with a role (or interest) in delivering water neutrality would need to take e.g.

- the steps required to deliver higher water efficiency levels on the ground (for the developers themselves); and,
- the partnership initiative that would be required beyond that normally undertaken by local authorities and water companies in order to minimise existing water use from the current housing and business stock.

[65] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk
[66] Part G of the Building Regulations

Therefore, the pathway to neutrality described in this section of the WCS requires a series of steps covering:

- technological inputs in terms of physically delivering water efficiency measures on the ground;
- local planning policies which go beyond national guidance; and,
- partnership initiatives and partnership working.

The following sections outline the types of water efficiency measures which have been considered in developing the technological pathway for the water neutrality target scenarios.

**Improving Efficiency in Existing Development**

**Metering**

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 14.56l/h/d or 33.5l per household, assuming an occupancy rate of 2.3[67] for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker Review)[68]. The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table A5-1).

**TABLE A5-1: CHANGE IN TYPICAL METERED AND UNMETERED HOUSEHOLD BILLS**

| 2009-10 Metered | 2009-10 Unmetered | 2014-15 Metered | 2014-15 Unmetered | % change Metered | % change Unmetered |
|---|---|---|---|---|---|
| 348 | 470 | 336 | 533 | -3 | 13 |

**Low or Variable Flush Toilets**

Toilets use about 30 per cent of the total water used in a household[69]. An old style single flush toilet can use up to 13 litres of water in one flush. New, more water-efficient dual-flush toilets can use as little as 2.6 litres[70] per flush. A study carried out in 2000 by Southern Water and the Environment Agency[71] on 33 domestic properties in Sussex showed that the average dual flush saving observed during the trial was 27 per cent, equivalent to a volumetric saving of around 2.6 litres per flush. The study suggested that replacing existing toilets with low or variable flush alternatives could reduce the volume of water used for toilet flushing by approximately 27 per cent on average.

[67] 2.3 is used for existing properties as opposed to 2.1 for new properties – the latter reflects changes in population over time.
[68] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/
[69] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[70] http://www.lecico.co.uk/
[71] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000

**Cistern Displacement Devices**

These are simple devices which are placed in the toilet cistern by the user, which displace water and therefore reduce the volume that is used with each flush. This can be easily installed by the householder and are very cheap to produce and supply. Water companies and environmental organisations often provide these for free.

Depending on the type of devices used (these can vary from a custom made device, such bag filled with material that expands on contact with water, to a household brick) the water savings can be up to 3 litres per flush.

**Low Flow Taps and Showers**

Flow reducing aerating taps and shower heads restrict the flow of water without reducing water pressure. Thames Water estimates that an aerating shower head can cut water use by 60 per cent with no loss of performance[72].

**Pressure Control**

Reducing pressure within the water supply network can be an effective method of reducing the volume of water supplied to customers. However, many modern appliances, such as Combi boilers, point of use water heaters and electric showers require a minimum water pressure to function. Careful monitoring of pressure is therefore required to ensure that a minimum water pressure is maintained. For areas which already experience low pressure (such as those areas with properties that are included on a water company's DG2 Register) this is not suitable. Limited data is available on the water savings that can be achieved from this method.

**Variable tariffs**

Variable tariffs can provide different incentives to customers and distribute a water company's costs across customers in different ways.

The Walker review assessed variable tariffs for water, including:

- rising block tariff;
- a declining block tariff;
- a seasonal tariff; and,
- time of day tariff.

A rising block tariff increases charges for each subsequent block of water used. This can raise the price of water to very high levels for customers whose water consumption is high, which gives a financial incentive to not to consume additional water (for discretionary use, for example) while still giving people access to low price water for essential use.

A declining block tariff decreases charges for each subsequent block of water used. This reflects the fact that the initial costs of supply are high, while additional supply has a marginal additional cost. This is designed to reduce bills for very high users and although it weakens incentives for them to reduce discretionary water use, in commercial tariffs it can reflect the economies of scale from bulk supplies.

[72] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

A seasonal tariff reflects the additional costs of summer water supply and the fact that fixed costs are driven largely by the peak demand placed on the system, which is likely to be in the summer.

Time-of-day tariffs have a variable cost per unit supply according to the time of the day when the water is used; this requires smart meters. This type of charging reflects the cost of water supply and may reduce an individual household's bill; it may not reduce overall water use for a customer.

**Water Efficient Appliances**

Washing machines and dishwashers have become much more water efficient over the past twenty years; whereas an old washing machine may use up to 150 litres per cycle, modern efficient machines may use as little as 35 litres per cycle. An old dishwasher could use up to 50 litres per cycle, whereas modern models can use as little as 10 litres. However, this is partially offset by the increased frequency with which these are now used. It has been estimated[73] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

The Water Efficient Product Labelling Scheme provides information on the water efficiency of a product (such as washing machines) and allows the consumer to compare products and select the efficient product. The water savings from installation of water efficient appliances therefore vary, depending on the type of machine used.

**Non-Domestic Properties**

There is also the potential for considerable water savings in non-domestic properties; depending on the nature of the business water consumption may be high e.g. food processing businesses. Even in businesses where water use is not high, such as B1 Business or B8 Storage and Distribution, there is still the potential for water savings using the retrofitting measures listed above. Water audits are useful methods of identifying potential savings and implementation of measures and installation of water saving devices could be funded by the asset owner; this could be justified by significant financial savings which can be achieved through implementation of water efficient measures. Non-domestic buildings such as warehouses and large scale commercial (e.g. supermarkets) property have significant scope for rainwater harvesting on large roof areas.

There is significant potential for water efficiency in the agricultural sector from rainwater harvesting. The Environment Agency guide for farmers[74] illustrates the potential benefits to both the environment and the farmer from the installation of a RWH system. For example, a farm growing soft fruit in polytunnels could harvest 5,852m$^3$ of water per year from 120 hectares of tunnels, which could give the following benefits:

- better soil drainage between the tunnels,
- improved humidity levels inside them; and,
- an improvement in plant health through the use of harvested water.

**Water Efficiency in New Development**

The use of efficient fixtures and fittings as described in above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions

[73] Water Efficiency Retrofitting: A Best Practice Guide, Waterwise, 2009, www.waterwise.org.uk
[74] Rainwater Harvesting: an on-farm guide, Environment Agency, 2009

that use of efficient fixtures and fitting has in new builds is to consider what is required in terms of installation of the fixtures and fittings at different ranges of specification to ensure attainment of code levels under the CSH water use requirements. The Cambridge WCS[75] gave a summary of water use savings that can be achieved by the use of efficient fixtures and fittings, as shown below in Table A5-2.

**TABLE A5-2: SUMMARY OF WATER SAVINGS BORNE BY WATER EFFICIENCY FIXTURES AND FITTINGS**

| Component | 150 l/h/d Standard Home | 130 l/h/d | 120 l/h/d CSH Level 1/2 | 115 l/h/d | 105 l/h/d CSH Level 3/4 | 80 l/h/d CSH Level 5/6 |
|---|---|---|---|---|---|---|
| Toilet flushing | 28.8 | 19.2b | 19.2 b | 16.8d | 16.8 d | 8.4 + 8.4 f |
| Taps | 42.3 a | 42.3 a | 31.8 a | 31.8 a | 24.9 a | 18 a |
| Shower | 30 | 24 | 24 | 22 | 18 | 18 |
| Bath | 28.8 | 25.6c | 25.6 c | 25.6 c | 25.6 c | 22.4 e |
| Washing machine | 16.7 | 15.3 | 15.3 | 15.3 | 15.3 | 7.65 + 7.65 f |
| Dishwasher | 3.9 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Recycled water | - | - | - | - | - | -16.1 |
| Total per head | 150.5 | 130 | 119.5 | 115.1 | 104.2 | 78 |
| Outdoor | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 |
| TOTAL PER HOUSEHOLD | 366.68 | 319.3 | 293.52 | 284.14 | 257.41 | 195.58 |

- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e 120 litre bath
- f rainwater/greywater harvesting
- g Assumed garden use

Table 2 highlights that in order for Code Level 5 and 6 to be achieved for water use under the CSH (80 l/h/d); water re-use technology (rainwater harvesting and/or greywater recycling) needs to be incorporated into the development.

In using the BRE Water Demand Calculator[76], the experience of URS/Scott Wilson BREEAM/CHS assessors is that it is theoretically possible to get close to 80l/h/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This

[75] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[76] http://www.thewatercalculator.org.uk/faq.asp

includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that Code Level 5 and 6 can be reached without some form of water recycling.

**Rainwater Harvesting**

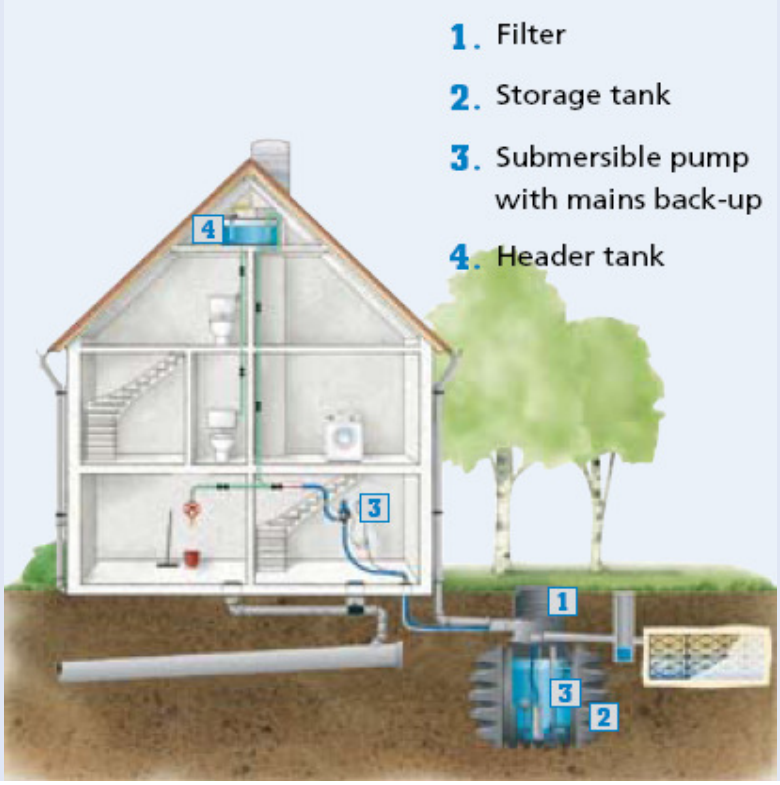
Rainwater harvesting (RWH) is the capture and storage of rain water that lands on the roof of a property. This can have the dual advantage of both reducing the volume of water leaving a site, thereby reducing surface water management requirements and potential flooding issues, and be a direct source of water, thereby reducing the amount of water that needs to be supplied to a property from the mains water system.

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure A5-1 below gives a diagrammatic representation of a typical domestic system[77].

The level to which the rainwater is treated depends on the source of the rainwater and the purpose for which it has been collected. Rainwater is usually first filtered to remove larger debris such as leaves and grit. A second stage may also be incorporated into the holding tank; some systems contain biological treatment within the holding tank, or flow calming devices on the inlet and outlets will allow heavier particles to sink to the bottom, with lighter debris and oils floating to the surface of the water. A floating extraction system can then allow the clean rainwater to be extracted from between these two layers[78].

[77] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[78] Aquality Rainwater Harvesting brochure, 2008

**FIGURE A5-1: A TYPICAL DOMESTIC RAINWATER HARVESTING SYSTEM**




A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[79], approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table A5-3.

**TABLE A5-3: RWH SYSTEMS SIZING**

| Number of occupants | Total water consumption | Roof area ($m^2$) | Required storage tank ($m^3$) | Potable water saving per head (l/d) | Water consumption with RWH (l/h/d) |
|---|---|---|---|---|---|
| 1 | 110 | 13 | 0.44 | 15.4 | 94.6 |
| 1 | 110 | 10 | 0.44 | 12.1 | 97.9 |
| 1 | 110 | 25 | 0.88 | 30.8 | 79.2 |
| 1 | 110 | 50 | 1.32 | 57.2 | 52.8 |
| 2 | 220 | 25 | 0.88 | 15.4 | 94.6 |
| 2 | 220 | 50 | 1.76 | 30.8 | 79.2 |

[79] Sustainable water management strategy for Northstowe, WSP, December 2007

**TABLE A5-3: RWH SYSTEMS SIZING**

| Number of occupants | Total water consumption | Roof area ($m^2$) | Required storage tank ($m^3$) | Potable water saving per head (l/d) | Water consumption with RWH (l/h/d) |
|---|---|---|---|---|---|
| 3 | 330 | 25 | 1.32 | 9.9 | 100.1 |
| 3 | 330 | 50 | 1.32 | 19.8 | 90.2 |
| 4 | 440 | 25 | 1.76 | 7.7 | 102.3 |
| 4 | 440 | 50 | 1.76 | 15.4 | 94.6 |

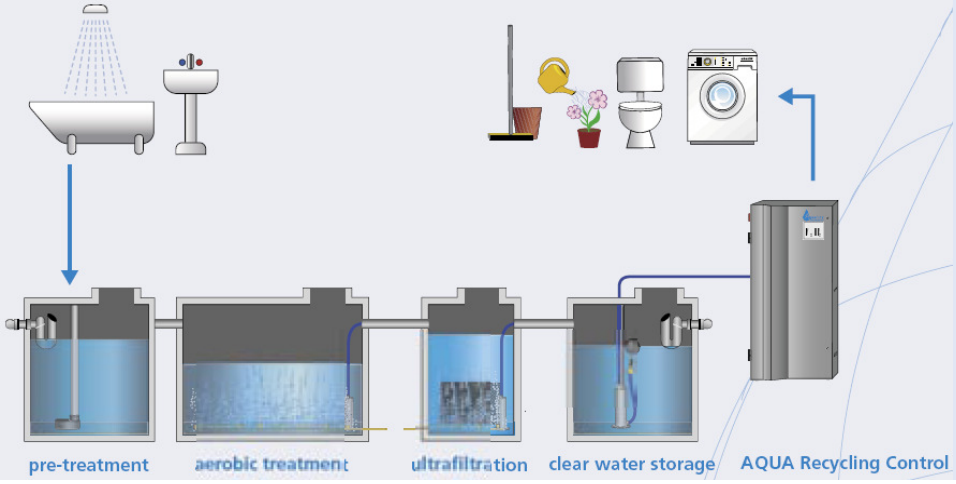
A family of four, with an assumed roof area of 50$m^3$, could therefore expect to save 61.6 litres per day if a RWH system were installed.

**Greywater Recycling**

Greywater recycling (GWR) is the treatment and re-use of wastewater from shower, bath and sinks for use again within a property where potable quality water is not essential e.g. toilet flushing. Recycled greywater is not suitable for human consumption or for irrigating plants or crops that are intended for human consumption. The source of greywater should be selected by available volumes and pollution levels, which often rules out the use of kitchen and clothes washing waste water as these tend to be most highly polluted. However, in larger system virtually all non-toilet sources can be used, subject to appropriate treatment.

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. Figure A5-2 below gives a diagrammatic representation of a typical domestic system[80].

**FIGURE A5-2: A TYPICAL DOMESTIC GREYWATER RECYCLING SYSTEM**




[80] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk

Combined rainwater harvesting and greywater recycling systems can be particularly effective, with the use of rainwater supplementing greywater flows at peak demand times (e.g. morning and evenings).

The Northstowe sustainable water management strategy calculated the volumes of water that could be made available from the use GWR. These were assessed against water demand calculated using the BRE Water Demand Calculator[81].

Table A5-4 demonstrates the water savings that can be achieved by GWR. If the toilet and washing machine are connected to the GWR system a saving of 37 litres per person per day can be achieved.

**TABLE A5-4: POTENTIAL WATER SAVINGS FROM GWR**

| Appliance | Demand with Efficiencies (l/h/day) | Potential Source | Greywater Required (l/h/day) | Out As | Greywater available (80% efficiency) (l/h/day) | Consumptions with GWR (l/h/day) |
|---|---|---|---|---|---|---|
| Toilet | 15 | Grey | 15 | Sewage | 0 | 0 |
| Wash hand basin | 9 | Potable | 0 | Grey | 7 | 9 |
| Shower | 23 | Potable | 0 | Grey | 18 | 23 |
| Bath | 15 | Potable | 0 | Grey | 12 | 15 |
| Kitchen Sink | 21 | Potable | 0 | Sewage | 0 | 21 |
| Washing Machine | 17 | Grey | 17 | Sewage | 0 | 0 |
| Dishwasher | 4 | Potable | 0 | Sewage | 0 | 4 |
| TOTAL | 103 | | 31 | | 37 | 72 |

The treatment requirements of the GWR system will vary, as water which is to be used for flushing the toilet does not need to be treated to the same standard as that which is to be used for the washing machine. The source of the greywater also greatly affects the type of treatment required. Greywater from a washing machine may contain suspended solids, organic matter, oils and grease, detergents (including nitrates and phosphates) and bleach. Greywater from a dishwasher could have a similar composition, although the proportion of fats, oils and grease is likely to be higher; similarly for wastewater from a kitchen sink. Wastewater from a bath or shower will contain suspended solids, organic matter (hair and skin), soap and detergents. All wastewater will contain bacteria, although the risk of infection from this is considered to be low[82].

[81] http://www.thewatercalculator.org.uk/faq.asp
[82] Centre for the Built Environment, www.cbe.org.uk

Treatment systems for GWR are usually of the following four types:

- basic (e.g. coarse filtration and disinfection);
- chemical (e.g. flocculation);
- physical (e.g. sand filters or membrane filtration and reverse osmosis); and,
- biological (e.g. aerated filters or membrane bioreactors).

Table A5-5 below gives further detail on the measures required in new builds and from retrofitting, including assumptions on the predicted uptake of retrofitting from the existing housing and commercial building use.

**TABLE A5-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO**

| WN Scenario | New development requirement | | | | Retrofitting existing development | |
|---|---|---|---|---|---|---|
| | New development Water use target (l/h/d) | Relevant CSH target | Water Efficient Fixtures and Fittings | Water Recycling technology | Metering Penetration assumption (a) | Water Efficient Fixtures and Fittings (b) |
| Business as usual | 125 | Building Regs only | - 3-6 litre dual flush toilet;<br>- Low aeration taps;<br>- 160 litre capacity bath;<br>- High efficiency washing machine | None | 90% | None |
| Low | 120 | Level 1/2 | - 3-6 litre dual flush toilet;<br>- Low spec aeration taps;<br>- 160 litre capacity bath;<br>- low spec low flow shower head<br>- High efficiency dishwasher<br>- High efficiency washing machine | None | 100% | - 3-6 litre dual flush toilet or cistern device fitted;<br>- 10% take up across district |
| Medium | 105 | Level 3/4 | - 3-4.5 litre dual flush toilet;<br>- Medium spec aeration taps;<br>- high spec low flow shower head;<br>- 160 litre capacity bath;<br>- high spec flow shower head<br>- High efficiency dishwasher<br>- High efficiency washing machine | None | 100% | - 3-4.5 litre dual flush toilet or cistern device fitted;<br>- medium spec aerated taps fitted<br>- 20% take up across district |

**TABLE A5-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO**

| WN Scenario | New development requirement | | | | Retrofitting existing development | |
|---|---|---|---|---|---|---|
| | New development Water use target (l/h/d) | Relevant CSH target | Water Efficient Fixtures and Fittings | Water Recycling technology | Metering Penetration assumption (a) | Water Efficient Fixtures and Fittings (b) |
| High | 78 | Level 5/6 | - 3-4.5litre dual flush toilet;<br>- High spec aeration taps;<br>- high spec low flow shower head;<br>- 120 litre capacity bath;<br>- high spec low flow shower head<br>- High efficiency dishwasher<br>- High efficiency washing machine | Rainwater harvesting | 100% | - 3-4.5 litre dual flush toilet or cistern device fitted;<br>- high spec aerated taps fitted<br>- high spec low flow shower head fitted<br>- 25% take up across district |
| Very High | 62 | Level 5/6 | - 3-4.5litre dual flush toilet;<br>- High spec aeration taps;<br>- high spec low flow shower head;<br>- 120 litre capacity bath;<br>- high spec low flow shower head<br>- High efficiency dishwasher<br>- High efficiency washing machine | Rainwater harvesting and Greywater recycling | 100% | - 3-4.5 litre dual flush toilet or cistern device fitted;<br>- high spec aerated taps fitted<br>- high spec low flow shower head fitted<br>- 35% take up across district |

a: only the additional metering beyond business as usual has been accounted for (i.e. 10%)
b: refers to fittings above that are included in a standard home using approximately 150l/h/d

**Financial Cost Considerations for Water Neutrality scenarios**

The financial cost of delivering the technological requirements of each neutrality scenario have been calculated from available research and published documents.

**New Build Costs**

Costs for water efficiency in new property have been provided based on homes achieving different code levels under the CSH based on the cost analysis undertaken by CLG[83] and as set out in Table A5-6.

**TABLE A5-6: CSH SPECIFICATIONS AND COSTS**

| Code Level | Estimated water consumption (l/h/d) | Specification | Cost | |
|---|---|---|---|---|
| | | | Additional Cost (£) | Cumulative Cost (£) |
| 1 and 2 | 120 | 2 x 6/4 litre flush toilets<br>4 x taps with flow regulators (2.5 l/m)<br>1 x shower 6 litres/min<br>1 x standard bath (90 litres per use)<br>1 x standard washing machine*<br>1 x standard dishwasher* | £0 | £0 |
| 3 and 4 | 105 | As Level 1 and 2, except:<br>2x4/2.5 litre flush toilets<br>1x smaller shaped bath | £125 | £125 |
| 5 and 6 | 80 | Houses<br>As Level 3 and 4, except:<br>Rainwater harvesting<br>2 x 6/4 litre flush toilets | £2,520 | £2,645 |
| | | Apartments<br>As Level 3 and 4, except:<br>Rainwater harvesting<br>2 x 6/4 litre flush toilets | £680 | £805 |

Notes: *Additional cost of washing machine and dishwasher is assumed to be zero as these fittings are 'standard' industry performance. Therefore, if they are typically installed by house builder there would be no additional cost over their current specifications.

An additional cost was required for the 'very high' neutrality scenario that included for greywater recycling as well as rainwater harvesting and this is detailed in the following section.

**Water Recycling**

Research into the financial costs of installing and operating GWR systems gives a range of values, as show in Table A5-7.

[83] CLG (2008) Cost Analysis of the Code for Sustainable Homes

| TABLE A5-7: COSTS OF GWR SYSTEMS | | |
|---|---|---|
| **Cost** | **Cost** | **Comments** |
| Installation cost | £1,750 | Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[84] |
| | £2,000 | For a single dwelling[85] |
| | £800 | Cost per house for a communal system[86] |
| | £2,650 | Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[87] |
| Operation of GWR | £30 per annum[88] | |
| Replacement costs | £3,000 to replace[23] | It is assumed a replacement system will be required every 25 years |

There is less research and evidence relating to the cost of community scale systems compared to individual household systems, but it is thought that economies of scale will mean than larger scale systems will be cheaper to install than those for individual properties. As shown above, the Cost review of the Code for Sustainable Homes indicated that the cost of installing a GWR system in flats is less than the cost for a semi-detached house. Similarly, the Water Efficient Buildings website estimates the cost of installing a GWR system to be £2,000 for a single dwelling and £800 per property for a share of a communal system.

As it is not possible to determine how many of the outstanding housing developments in Stratford-on-Avon District will be of a size large enough to consider communal recycling facilities, an approximation has been made of an average per house cost (£1,400) using the cost of a single dwelling (at £2,000) and cost for communal (at £800). This has been used for the assessment of cost for a greywater system in a new property required for the 'very high' neutrality scenario.

**Installing a Meter**

The cost of installing a water meter has been assumed to be £500 per property[89]. It is assumed that the replacement costs will be the same as the installation costs (£500), and that meters would need to be replaced every 15 years[90].

[84] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[85] http://www.water-efficient-buildings.org.uk/?page_id=1056
[86] http://www.water-efficient-buildings.org.uk/?page_id=1056
[87] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[88] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[89] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[90] Environment Agency Publication - Science Report – SC070010: Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

### Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England[91], costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table A5-8 below.

**TABLE A5-8: WATER SAVING METHODS**

| Water Saving Method | Approximate Cost per House (£) | Comments/Uncertainty |
|---|---|---|
| Variable flush retrofit toilets | £50 - £140 | Low cost for 3-6 litre system and high cost for 3-4.5 litre system. Needs incentive to replace old toilets with low flush toilets. |
| Low flow shower head scheme | £15 - £50 | Low cost for low spec shower head; high costs for high spec. Cannot be used with electric, power or low pressure gravity fed systems. |
| Aerating taps | £10 - £20 | Low cost is med spec, high cost is high spec. |

Toilet cistern displacement devices are often supplied free of charge by water companies and this is therefore also not considered to be an additional cost.

### Neutrality scenario costs

Using the above information, the financial costs per scenario has been calculated and are included in Table A5-9.

[91] Ref – Water Efficiency in the South East of England

**TABLE A5-9: ESTIMATED COST OF NEUTRALITY SCENARIOS**

| Neutrality Scenario | CSH – Code Level | Outstanding Homes | | Existing Properties | | | | | Costs Summary | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Numbers | CSH cost | No. to be metered (10% existing) | Metering cost | Retrofit % | No. to retrofit | Retrofit cost | Developer | Non developer | Total |
| Low | 1 or 2 | 5,600 | - | 16,802 | £8,401,000 | 10% | 5420 | £271,000 | - | £8,672,000 | £8,672,000 |
| Medium | 3 or 4 | 5,600 | £700,000 | 16,802 | £8,401,000 | 20% | 10,840 | £1,788,600 | £700,000 | £10,189,600 | £10,889,600 |
| High | 5 or 6 (RWH) | 5,600 | £14,812,000 | 16,802 | £8,401,000 | 25% | 13,550 | £2,981,000 | £14,812,000 | £11,382,000 | £26,194,000 |
| Very High | 5 or 6 (RWH & GWR) | 5,600 | £22,428,000 | 16,802 | £8,401,000 | 35% | 18,970 | £4,173,400 | £22,428,000 | £12,574,400 | £35,002,400 |

### Carbon Cost Considerations

As described in this section, there are sustainability issues to consider when deciding on a policy for promotion of water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable.

Whilst being water efficient is a key consideration of this study, due to the wider vision for sustainable growth, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development

It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings.

In order to give an overview of the likely sustainability of each of the WN scenarios, a 'carbon cost' has been applied to each of the scenarios based on the water efficiency measures proposed for new homes, and the retrofitting of existing.

### Methodology

A joint study by the Environment Agency and the Energy Saving Trust[92] assessed the energy and carbon implications of the installation of water saving devices (Table A5-10). The report initially calculated a baseline water consumption figure for existing housing stock, using the following assumptions:

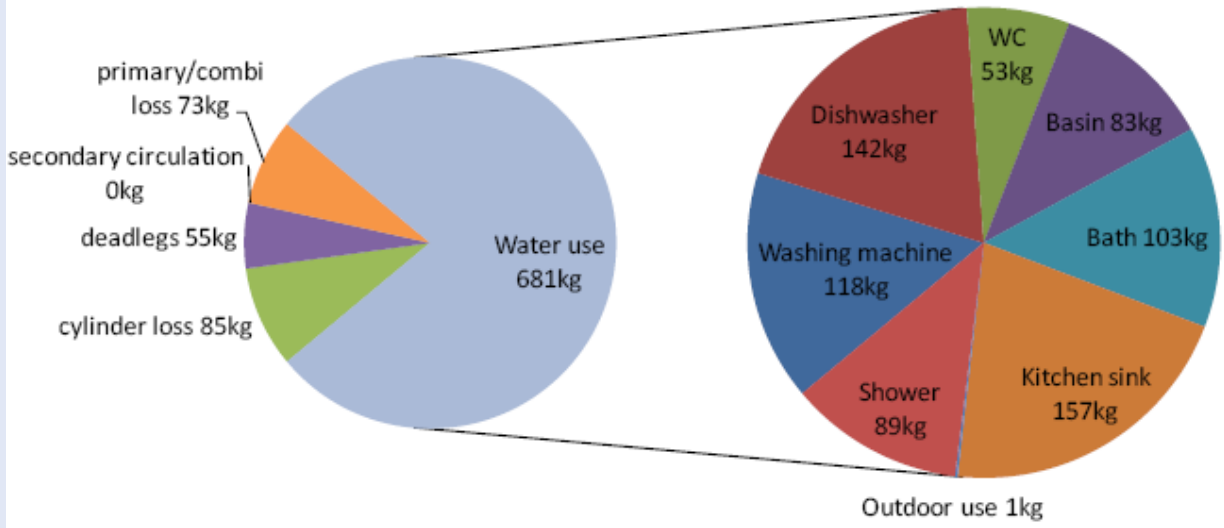
**TABLE A5-10: BASELINE ENERGY CONSUMPTION ASSUMPTIONS**

| Device | Volume of water per use (litres) | Frequency of use (per person per day) |
|---|---|---|
| Toilet | 9.4 | 4.66 |
| Kitchen Taps | 59 | Taps taken as volume/day, 40% cold |
| Basin taps hot | 42 | Taps taken as volume/day, 30% cold |
| Bath | 70 | 0.21 |
| Washing machine | 50 | 0.34 |
| Shower | 25.7 | 0.59 |
| Dishwasher | 21.3 | 0.29 |

[92] Quantifying the energy and carbon effects of water saving, Full technical report, Environment Agency and the Energy Saving Trust, 2009

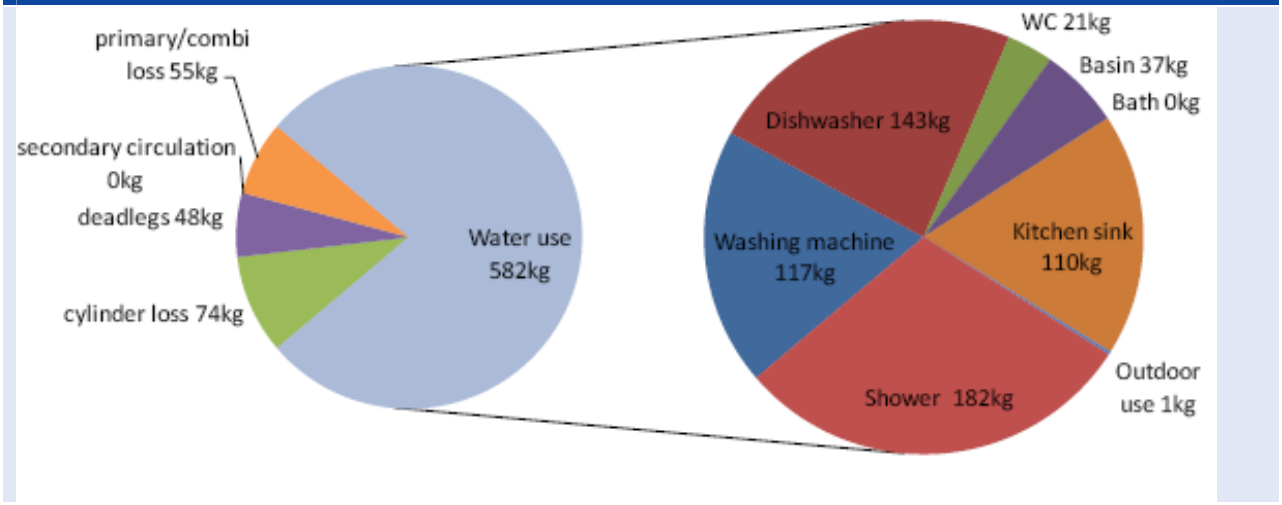
The study then modelled the $CO_2$ emissions from this 'standard' existing dwelling, as shown below in Figure A5-3. Appliances requiring hot water using appliances dominate, but water use for toilet flushing produces 53kg of $CO_2$ emissions per year (approximately 50 per cent from water company emissions and 50 per cent due to heat loss as cold mains water in the toilet cistern heats to room temperature).

**FIGURE A5-3: $CO_2$ EMISSIONS FROM A 'STANDARD' EXISTING DWELLING**



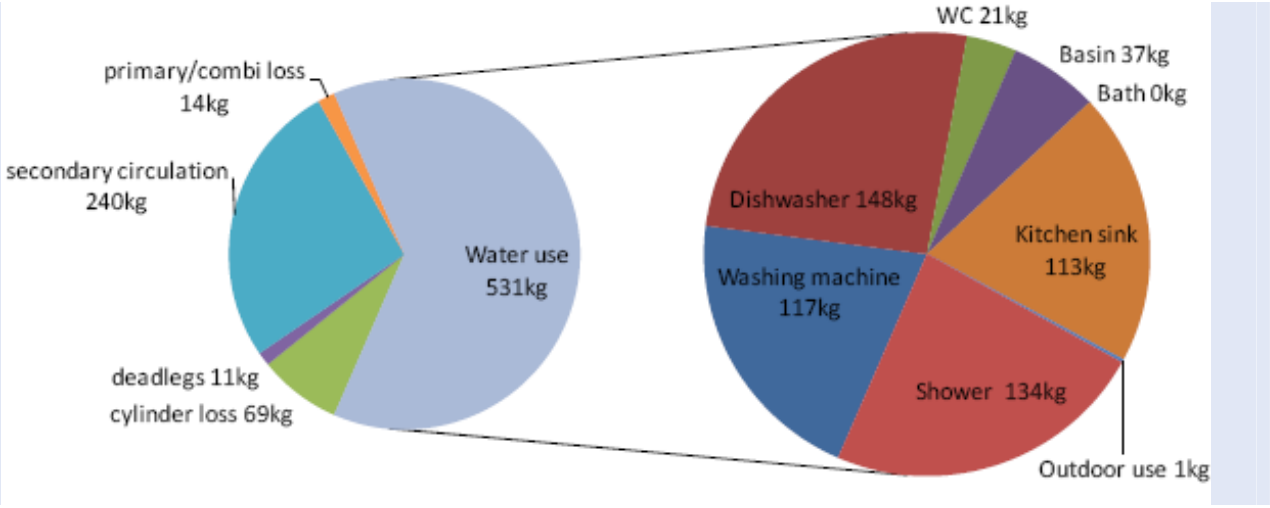

The study then assessed the impacts on this baseline figure of 681 kg $CO_2$ for water use from a home which has water use compliant with CfSH level 3/4 (Figure A5-4).

**FIGURE A5-4: $CO_2$ EMISSIONS FROM A CFSH LEVEL 3/4 DWELLING**



The study then assessed the impacts of a home which has water use compliant with CfSH level 5/6 (Figure A5-5).

**FIGURE A5-5: $CO_2$ EMISSIONS FROM A CFSH LEVEL 5/6 DWELLING**




It can therefore be seen that the carbon cost of achieving Levels 3/4 and 5/6 compares favourably to the baseline scenario of current average water use of 681kg/$CO_2$. CfSH level 3/4 represents a carbon saving of 99 kg/$CO_2$ and CfSH Level 5/6 represents a carbon saving of 150 kg/$CO_2$.

The energy savings from water efficiency measures within the home would be offset to a certain degree by increased energy demands of RWH or GWR systems, which have been shown to be required to meet CfSH Level 5/6. Energy savings for STW from not treating additional water to potable standard, as with the conventional mains water supply, can be thought of to be simply a transfer of energy consumption away from the STW to the individual householders. While STW will benefit from this reduction in energy demand, which will assist with meeting its Carbon Reduction Commitment (CRC) (as laid down in 2007's Energy Reduction White Paper[93]), the expense will be passed to householders.

For households with the GWR/RWH required for CfSH Levels 5/6, any financial benefits to householders experienced through a reduction in water bills (for metered properties) will be offset by the increased expense of energy bills for pumping and treating water in GWR and RWH systems.

[93] Meeting the Energy Challenge - A White Paper on Energy, May 2007, Department of Trade and Industry

## LIMITATIONS

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