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Breckland District Council

Water Cycle Study Update

Final Draft Report

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Abbreviation	Description
AMP	Asset Management Plan
AWS	Anglian Water Services
BAP	Biodiversity Action Plan
BGS	British Geological Society
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CRC	Carbon Reduction Commitment
CSH	Code for Sustainable Homes
DEFRA	Department for Environment, Food and Rural Affairs
DO	Dissolved Oxygen
DPD	Development Plan Document
DWF	Dry Weather Flow
DWI	Drinking Water Inspectorate
EIB	European Investment Bank
GI	Green Infrastructure
GWR	Greywater Recycling
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
LFE	Low Flow Enterprise (low flow model)
LLFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
LPA	Local Planning Authority
Ml	Mega Litre (a million litres)
NE	Natural England
NH4	Ammonium
NPPF	National Planning Policy Framework
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)

OR	Occupancy Rate
P	Phosphorous
PE	Population Equivalent
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RoC	Review of Consents (under the Habitats Directive)
RQP	River Quality Planning (tool)
RWH	Rainwater Harvesting
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
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP09	United Kingdom Climate Projections 2009
UKTAG	United Kingdom Technical Advisory Group (to the WFD)
UKWIR	United Kingdom Water Industry Research group
UWWTD	Urban Wastewater Treatment Directive
WCS	Water Cycle Study
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
WwTW	Wastewater Treatment Works

Executive Summary

Background

A detailed Water Cycle Study (WCS) was completed for Breckland District Council in 2010 and assessed growth as planned in the Local Development Framework (LDF) for implications on the water environment and water infrastructure provision in the District. The WCS acted as a key evidence base to the development of the LDF to demonstrate workable solutions to water environment and water infrastructure constraints as a result of proposed growth levels and locations.

With a revision to the growth strategy proposed for the subsequent Local Plan development in 2015, and selection of preferred site allocations in 2016, an update to the assessment of water environment and water infrastructure provision was required, taking into account differences in growth targets and locations as well as changes in infrastructure capacity and planning to that assessed in 2010. This report provides the conclusions of this updated assessment in a revised 2017 WCS for the District.

Wastewater Strategy

Wastewater treatment and water quality

Assessment of the revised growth locations and numbers has demonstrated that additional treatment capacity will be required at four Wastewater Treatment Works (WwTW) serving the District as a result of additional wastewater likely to be generated by the proposed growth. Improvements or new discharge permits are required at these WwTW to ensure that water quality targets, set to meet the requirements of European legislation such as the Water Framework Directive (WFD) and Habitats Directive (HD) are not exceeded within the rivers which will receive the additional treated wastewater flow. This affects growth proposed in Attleborough, Dereham, Garboldisham (Elm Grove) and Watton.

Improvements required at the WwTW serving Watton and Garboldisham (Elm Grove)are relatively straightforward and readily achievable within the limits of conventional treatment methods and would not present a barrier to growth, nor affect phasing of development in these locations.

When considering all growth at the end of the plan period for Attleborough, the WwTW would require the implementation of new and improved treatment technologies to ensure that water quality in the receiving river can continue to meet the required legislative targets. Anglian Water Services (in conjunction with water companies nationally) are currently undertaking a programme of treatment trials to test enhanced technology aimed at achieving improved treatment quality on discharge. The outcome of trials to date suggests that treatment quality required to meet in-stream water quality targets will be attainable and that in the next water company investment period (2020 to 2025), these solutions could be implemented. This suggests that a workable solution in the long term can be achieved to ensure that growth proposed for Attleborough is sustainable. In the short to medium term (to 2022), sufficient capacity is available to serve the initial planned phasing of growth proposed in Attleborough.

The solution for Dereham WwTW is for the continued management of treatment headroom through several measures including: reducing water use (and hence wastewater generation) within the existing property in the town; and, monitoring changes in occupancy rate. If headroom is exceeded, enhanced treatment technologies as proposed for Attleborough would be considered to ensure downstream water quality targets are met. The overall solution requires ongoing discussion between Breckland District Council, the Environment Agency and Anglian Water Services regarding the planned phasing of growth in Dereham. The WCS update recommends that all applications for development proposals in Dereham are accompanied by a pre-development enquiry with Anglian Water Services to demonstrate that sufficient capacity is available to treat wastewater from the proposals.

Wastewater network capacity

This WCS update has considered capacity in the wastewater network which will move wastewater from new development to the WwTW treatment facilities.

A preferred set of allocations have not yet been identified. Therefore, a high level exercise was undertaken by Anglian Water Services for a large number of potential sites to determine where capacity in the piped wasetwater network may be limited and will need contributions from developers. The potential allocation sites with capacity limitations have been

highlighted within the WCS update and the exercise has demonstrated that a majority of sites across the assessed settlements w would require at least some upgrades with the exception of Mattishall, Yaxham and Old Buckenham where only some sites would require upgrades.

Although these upgrades should not been seen as a constraint to development, developers would need to contribute sums towards the required enhancements, and in some sites within Great Ellingham and Weeting, a strategic solution may be required which could affect phasing. The WCS update recommends that all applications for development proposals for sites highlighted with a potential constraint are accompanied by a pre-development enquiry with Anglian Water Services to demonstrate that sufficient capacity is available to transfer wastewater for treatment and to demonstrate where a developer needs to financially contribute to that provision.

Water supply

Water resource availability

Raw water availability within the District is currently limited and issuing of licences to abstract water from the District's rivers and underlying aquifers is restricted by the Environment Agency in all conditions expect high river flows. As a result, supply of water for additional demand from new development is dependent on strategic management of resources by Anglian Water Services.

Anglian Water Services has set out how future demand in the District will be met as part of its current Water Resources Management Plan (2015). A twin-track approach is proposed whereby existing demand is managed and new supply sources are provided. Demand would be managed through a reduction of leakage within the supply network and through reductions in consumption via water efficiency measures. The preferred option for additional resources is a winter storage reservoir in the Norfolk Fens in the longer term. Anglian Water Services has confirmed that the level of growth assessed within the WCS update is factored into the current Water Resources Management Plan which has been approved by the Environment Agency and Defra. The WCS update therefore concludes that a sufficient sustainable water supply is available to meet planned demand without impacting adversely on the environment.

Water efficiency

The WCS Update has shown that water availability within the District is finite and that, to compliment proposals within Anglian Water Service's Water Resources Management Plan, consideration is given towards minimising water use in planned development through the use of development control policy and contributing to management of demand from the existing population within the District.

To set out how this could be achieved, the WCS update has considered the feasibility of attaining a 'water neutral' position in the District, whereby the District's total demand for water at the end of the plan period is equal to (or less than) current demand levels in 2017. The assessment demonstrated that water neutrality is theoretically attainable by the end of the plan period, but would require new development to be built to the highest efficiency specifications based on technologies (such as greywater recycling) which are not yet widely adopted in the UK. It would also require an extensive and expensive programme of retrofit of water use control measures and systems to existing properties throughout the District, for which a funding source has not been identified. Although water neutrality is unlikely to be a feasible option for the District, the WCS update has provided a 'pathway' for how the District could move towards a more neutral position, including requirements for policy, funding and technological requirements and has made a recommendation that consideration is given to a policy for new development being built to the optional Building Regulations standards for water efficiency in some locations, particularly where this could also contribute to a reduction in wastewater treatment pressures, such as Dereham.

1 Introduction

1.1 Background

Breckland District Council is currently preparing a new Local Plan for the District which will set the local housing target, set the spatial strategy and allocate land for development. This updated Water Cycle Study (WCS) is an important part of the evidence base that will help to inform site selection over the period plan period 2011 – 2036.

The WCS will help Breckland District Council determine the most appropriate locations for development (with respect to water infrastructure and the water environment) to be identified in the Local Plan. The objective of the WCS update is to identify any constraints on planned housing growth that may be imposed by the water cycle. The WCS then identifies 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 Breckland WCS History

The Breckland Water Cycle Study (WCS) was previously reported in a Phase 1 Outline WCS for Thetford (May 2008) and a Phase 1 outline WCS for remaining growth in the District (November 2008) followed by a Phase 2 detailed WCS for the whole District (Including Thetford) in 2010. Since these studies were completed, Breckland Council are proposing a more dispersed housing strategy than was assessed in 2010. This has the potential to present new or different water cycle constraints. This updated WCS forms a review and update of the previous Phase 1 and Phase 2 WCS incorporating these planning changes.

In addition to the planning changes, a number of key documents and policies informing the previous WCS have been updated or newly introduced, including the National Planning Policy Framework (NPPF), the Anglian Basin Management Plan (RBMP) and Anglian Water Service's (AWS) updated Water Resource Management Plan (WRMP). As such, the evidence upon which the previous WCS conclusions and recommendations were founded has changed and need to be revisited.

This WCS update has been produced to support the selection of preferred sites to support the preferred broad spatial strategy of growth. Information on preferred allocations was not available at the time of completion, therefore the WCS update does not assess in detail, the infrastructure requirements of individual site allocations; only a high level assessment of site specific infrastructure has been included for the long-list of potential allocations. The report aim is to present an assessment of the key strategic Water Services infrastructure (WSI) and water environment constraints and potential strategic solutions which would allow the broad spatial strategy of growth to proceed with respect to water and wastewater issues. Once the preferred site allocations are identified, further assessment of site specific infrastructure may be required to support the Local Plan

1.3 Study Drivers

There two key overarching drivers shaping the direction of the study as a whole:

- Deliver sustainable water management: ensure that provision of WSI and mitigation is sustainable and contributes to the overall delivery of sustainable growth and development;
- Water Framework Directive compliance – to ensure that growth, through abstraction of water for supply and discharge of treated wastewater, does not prevent waterbodies in Breckland (and more widely) from achieving the objectives of the Water Framework Directive (WFD).

A summary table of the other legislative drivers shaping the study is included in Appendix A for reference.

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:

- Breckland District Council Level 1 Strategic Flood Risk Assessment (SFRA, 2016) which has been updated in parallel with this WCS update;

- Norfolk Biodiversity Action Plan; and
- AWS 2014 WRMP.

1.3.1 Climate Change

One of the key drivers for delivering sustainable water management is the future uncertainty caused by the effects of climate change on water supplies, flood risk and wastewater management

Nationally, climate change is predicted to have the greatest effect on the East of England. Therefore, Breckland District is likely to experience hotter drier summers and warmer wetter winters. This is likely to have a significant effect on environmental conditions and will increase the impact of human activity on the water environment. It is therefore essential that issues of water management and climate change should be viewed in a more holistic way to reflect the interdependency of services and resources that we receive from the natural environment, and plan for their future use accordingly.

Environmental sustainability and more efficient use of natural resources should be a key aspiration for Breckland District Council. In order to achieve these objectives, it is essential that development and WSI built today considers the future potential impacts of climate change and incorporates adaptive measures to improve future resilience. Investing in infrastructure to adapt to the likely impacts of climate change now could provide long-term cost savings and avoid having to deal with expected climate change impacts in the future, e.g. by providing more climate-resilient infrastructure and 'space for water' now, it is possible to protect societies and economies (to some extent) from its potential impacts such as surface water flooding[1].

1.4 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. A starting assumption of 124l/h/d has been agreed with Anglian Water to calculate wastewater generation and water use per person based on Anglian WRMP regional average in the Norfolk Rural WRZ. 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.

1.5 Report Structure

There are several water cycle elements that have been considered in this WCS update. 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 potential allocation site and hence these elements have been summarised and reported at the 'settlement area' level with high level information included for each potential growth site. These elements include:

- Wastewater network; and
- Flood risk;

This report has therefore been set out in the following way to assist its presentation as a 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 of wastewater and water supply (Chapters 3 and 4);

[1] The Stern Review on the Economics of Climate Change reported that the benefits of strong and early action outweigh the economic costs of not acting. *"Adaptation to climate change – that is, taking steps to build resilience and minimise costs – is essential. It is no longer possible to prevent the climate change that will take place over the next two to three decades, but it is still possible to protect our societies and economies from its impacts to some extent – for example, by providing better information, improved planning and more climate-resilient crops and infrastructure."*

- a summary of how the site specific water cycle elements have been assessed, WSI and water environment issues within Settlement Area assessments (Chapters 5); and,
- policy and other recommendations (Chapter 6).

2 Proposed Growth

2.1 Growth Targets

The plan period extends to 2036 and growth up to this point has been the focus of the WCS assessments. However, the Local Plan would look to allocate sites within the market towns of Thetford and Attleborough where build out would extend beyond 2036. In relation to wastewater treatment capacity, this WCS has considered both the local plan period growth and the growth that would be delivered beyond 2036, giving a total assessed housing figure of 18,433.

The total housing figure of 18,433 represents has been calculated from a total of:

- recent completions and outstanding commitments;
- allocations up to 2036; and
- allocations with phasing beyond 2036.

The total built prior to the commencement of this WCS update (2011-2015) have been included within the total assessed as a precautionary approach on the basis that some of the dwellings may not yet be occupied and baseline demand and wastewater flow data used within the assessments is unlikely to include all of this built development. The numbers both committed/completed and allocated for each settlement are summarised in Table 2-1.

Table 2-1 - Summary of housing figures to be assessed and their spatial distribution in the District

Settlement Area	Commitments and completions	Allocations up to 2036	Allocations post 2036	Total Housing Numbers assessed
Key Settlements				
Thetford	416	3,250	1,750	5,416
Attleborough	1,665	2,650	1,350	5,665
Market Towns				
Dereham	790	750	0	1,540
Swaffham	862	700	0	1,562
Watton	905	400	0	1,305
Local Service Centres				
Ashill	40	50	0	90
Banham	63	55	0	118
Bawdeshall	6	30	0	36
Garboldisham	8	35	0	43
Great Ellingham	48	40	0	88
Harling	124	85	0	209
Hockering	43	25	0	68
Kenninghall	33	35	0	68
Litcham	6	20	0	26
Mattishall	36	105	0	141
Narborough	107	40	0	147
Necton	226	75	0	301
North Elmham	36	55	0	91
Old Buckenham	19	50	0	69

Settlement Area	Commitments and completions	Allocations up to 2036	Allocations post 2036	Total Housing Numbers assessed
Shipdham	180	80	0	260
Sporle	28	35	0	63
Swanton Morley	81	85	0	166
Weeting	127	0	0	127
Yaxham	70	25	0	95
Rural Area				
Rural Area combined	589	150	0	739
TOTALS	6,508	8,825	3,100	18,433

3 Wastewater Treatment Assessment

3.1 Wastewater Treatment Assessment Approach

Increases in 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 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.

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 Breckland

Wastewater treatment in the district is provided via WwTWs operated and maintained by AWS, 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), most settlements tend to have their own designated WwTW, hence numerous WwTWs are affected by growth in the district. Table 3-1 provides a summary of the WwTW where additional growth is allocated and the settlements associated with that growth.

The settlement areas have been grouped into the WwTW catchments within which they are located. As final site allocations are yet to be confirmed, development within a settlement is assumed to be served by the WwTW covering the majority of that settlement. In some cases the location of a site on the periphery of a settlement could mean it is more efficiently served by an alternate WwTW. This is particularly the case with potential development around Dereham and nearby settlements. Sites in Weeting also have the potential to be served by Brandon WwTW although all development has been assumed to connect to Weeting WwTW until preferred allocations are identified.

Table 3-1 - Summary of housing figures to be assessed by WwTW

WwTW	Settlement Area	Commitments and completions	Allocations to 2036	Allocations beyond 2036	Total Housing Numbers per settlement	Total Housing by WWTW
Attleborough	Attleborough	1,665	2,650	1,350	5,665	5,665
Bylaugh - near church	Bawdeswell	6	30	0	36	202
	Swanton Morley	81	85	0	166	
Dereham	Dereham	790	750	0	1,540	1540
East Harling	Harling	124	85	0	209	277
	Kenninghall	33	35	0	68	
Garboldisham - Elm Grove	Garboldisham	8	35	0	43	43
Great Ellingham	Great Ellingham	48	40	0	88	88
Hockering - by A47	Hockering	43	25	0	68	68
Litcham	Litcham	6	20	0	26	26
Mattishall	Mattishall	36	105	0	141	236

WwTW	Settlement Area	Commitments and completions	Allocations to 2036	Allocations beyond 2036	Total Housing Numbers per settlement	Total Housing by WWTW
	Yaxham	70	25	0	95	
Narborough	Narborough	107	40	0	147	147
Necton	Necton	226	75	0	301	364
	Sporle	28	35	0	63	
North Elmham	North Elmham	36	55	0	91	91
Old Buckenham STW	Banham	63	55	0	118	187
	Old Buckenham	19	50	0	69	
Shipdham - Carbrooks Road	Shipdham	180	80	0	260	260
Swaffham	Swaffham	862	700	0	1,562	1,562
Thetford	Thetford	416	3,250	1,750	5,416	5,416
Watton	Watton	905	400	0	1305	1395
	Ashill	40	50	0	90	
Weeting	Weeting	127	0	0	127	127
N/A	All other parishes	589	150	0	739	0
TOTAL		6,508	8,825	3,100	18,433	17,694

3.1.2 Management of WwTW Discharges

All WwTWs are issued with a permit 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 permit determines the maximum number of properties that can be connected to a WwTW catchment. When discharge permits 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 'permitted headroom'. The quality conditions applied to the discharge permit 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 permitted headroom is usable[2] and would not affect downstream water quality. This headroom therefore determines how many properties can be connected to the WwTW before a new discharge permit would need to be issued (and hence how many properties can connect without significant changes to the treatment infrastructure).

When a new discharge permit 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 permitted 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.

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

The primary legislative drivers which determine the quality conditions of any new permit 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 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 waterbody3; 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 permitted 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 permit to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in 6.3.2Appendix B.

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 on-going 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 abstraction licences and discharge permit 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 permit 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 permit. As a result of this process, restrictions on some discharge permits 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.

Where permitted headroom at a WwTW would be exceeded by proposed levels of growth, an assessment exercise has been undertaken in this WCS to determine whether Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would be adversely affected. The scope of this assessment also includes non-Habitats Directive sites designated at a national (SSSI) and local level (LNRs).

3.1.5 Increased Flood Risk

As well as the consideration of water quality, increases in discharge of treated flow need to be assessed for impacts on flood risk within the receiving waterbody. Some watercourses which receive treated wastewater have limited hydraulic capacity, and flood levels downstream may be increased as a result of additional flow.

3.1.6 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:

[3] 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

  - 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 for WwTWs;
- where the conditions are achievable, indicate where infrastructure upgrades are required to be undertaken by AWS to meet the new permit conditions and implications of these upgrades on proposed development; and
- where the conditions are not achievable, indicate where there are alternative solutions for treatment in that catchment which would need to be perused by AWS.
- 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 B.

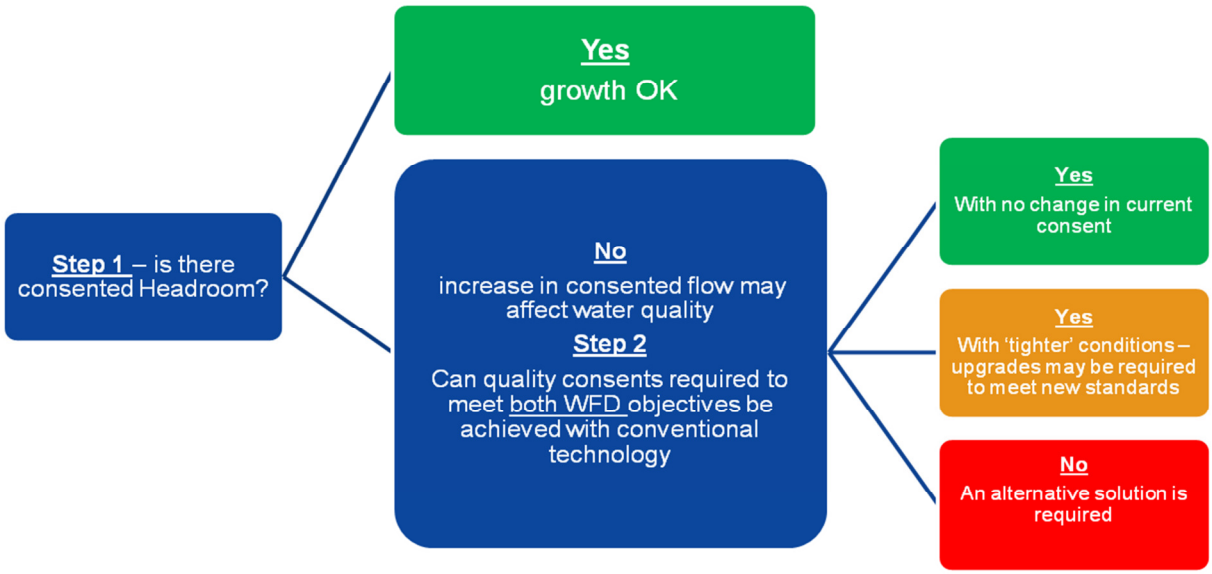
- a headroom calculation spreadsheet was developed; and,
- a water quality modelling procedure was agreed with the Environment Agency using Environment Agency software (RQP) designed for determining discharge permit conditions.

3.1.7 Assessment Results 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 – WFD objectives will not be adversely affected. Growth can be accepted with no changes to the WwTW infrastructure or permit required.
- Amber – in order to meet WFD objectives, changes to the discharge permit are required, and upgrades may be required to WwTW infrastructure which may have phasing implications;
- Red - in order to meet WFD objectives changes to the discharge permit 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



3.2 Wastewater Treatment Assessment – Results

This section presents the wastewater treatment assessment results. Catchments where growth can be accepted within the current permitted headroom have been reported together in a single subsection, whilst those requiring a new permit and hence a water quality or flood risk calculation, have been reported in individual subsections.

3.2.1 WwTW with Permitted 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 3-2 details the WwTW where existing permitted headroom is sufficient to accommodate all of the proposed growth and hence no significant infrastructure upgrades are required to deliver the proposed growth levels in these locations.

Growth in these catchments and for the scenarios stipulated 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 3-2 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.

Table 3-2 – WwTW with permitted headroom after growth to 2026

Relevant WwTW	Settlement Area(s)	Current Permitted DWF (m3/d)	Current estimated DWF (m3/d)	Future 2036 DWF after Growth (m3/d)	Headroom Assessment	
					2036 Headroom Capacity (m3/d)	Approximate Residual Housing Capacity after Growth (2036)
Bylaugh - near church	Bawdeswell & Swanton Morley	690	341	394	296	1,138
East Harling	Harling & Kenninghall	738	347	419	319	1,225
Great Ellingham	Great Ellingham	194[4]	102	125	69	265
Great Hockham LT Hockham Rd	Hockham	113	99	99	14	54
Hockering - by A47	Hockering	150	67	85	65	251
Litcham	Litcham	255	174	181	74	285
Mattishall	Mattishall & Yaxham	720	564	625	95	363
Mundford	Mundford	300	263	263	37	142
Narborough	Narborough	250	136	174	76	291
Necton	Necton & Sporle	858	397	492	366	1,407
North Elmham	North Elmham	262	176	200	62	239
Old Buckenham STW	Banham & Old Buckenham	550	250	299	251	965
Shipdham - Carbrooks Road	Shipdham	430	310	378	52	201
Swaffham	Swaffham	1602	648	1,055	547	2,102
Thetford	Thetford	8810	6183	7,593	1,217	4,672
Weeting	Weeting	420	133	166	254	1,103

[4] Great Ellingham WwTW's permitted flow is under review by the Environment Agency, with this flow limit in place until 2018.

3.2.2 WwTW without Permitted Headroom

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

Table 3-3 – WwTW without Permitted Headroom after growth to 2036

Relevant WwTW	Current Permitted DWF (m3/d)	Current estimated DWF (m3/d)	Future 2036 DWF after Growth (m3/d)	Headroom Assessment	
				2036 Headroom Capacity (m3/d)	Approximate Residual Housing Capacity after Growth (2036)
Attleborough	2500	2028	3,503	-1,003	-3,852
Dereham	3767	3707	4,108	-341	-1,310
Garboldisham - Elm Grove	7	12	23	-16	-62
Watton	2650	2645	3,008	-358	-1,376

All of the WwTWs listed in Table 3-3 above required water quality modelling to determine whether the quality permits 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 B. For each WwTW where a non-conventional treatment solution is likely to be required, an ecological assessment has been included where there is potential for a Habitats Directive site downstream of the discharge to be affected.

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

3.2.2.1 Attleborough

Attleborough WwTW has some available flow headroom in its existing discharge permit and can accept growth of approximately 1,800 dwellings (from the 4,000 allocated), after which the volumetric discharge permit will be exceeded. Unless additional headroom can be made available in the catchment after 1,800 dwellings, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric permit conditions, and by a total volume of 1,003m^3/d by the end of the plan period.

WFD Compliance

Water quality modelling has shown that in order to maintain the current WFD status of the River Thet with predicted discharge volumes (from new connections), the permit conditions on discharge quality for ammonia and phosphate would need to be tighter than they currently are. The calculations show that the permit conditions should be set at a 2.5mg/l 95 percentile limit for ammonia[5] and less than a 0.5mg/l mean limit for Phosphate[6].

The theoretical condition for phosphate is considered to be beyond the limits of conventional treatment. Therefore discharge of all additional flow to the River Thet, when considering growth in the Attleborough catchment is not possible and a long-term solution would be required at this WwTW. However, modelling based on the current wastewater flows have shown that in order to maintain the current quality of the River Thet, the permit conditions on discharge quality should theoretically be tighter than they currently are, irrespective of growth.

The theoretical quality condition for phosphate is therefore considered to be beyond the limits of conventional treatment under both a pre-growth and growth inclusive scenario. The modelling has demonstrated that the current phosphate permit condition would need to be equivalent to 0.1 mg/l, to maintain the existing status of the River Thet. The results therefore suggest that the WwTW is treating discharge to a higher standard than the current permit condition for phosphate.

[5] Currently at 4mg/l in the existing permit, to be tightened to 3mg/l during AMP6
[6] Currently at 1mg/l in the existing permit

Over performance of a WwTW does occur, as WwTWs are designed with a future design load in mind leaving capacity for growth. In addition, the WwTW will be designed to accommodate high flows and low temperatures during winter when biological treatment processes are less efficient. This means during higher temperature periods and/or lower flow periods, there will be excess 'treatment capacity'. Consequently, the current level of treatment at the WwTW has proved to be sufficient to maintain the current status of the receiving watercourse, and it is possible that with treatment upgrades, the WwTW could continue treating to this higher standard.

No modelling was required to assess the impact of growth on preventing Future Good Status being reached in the River Thet as all physico-chemical quality elements are already at Good Status or above.

Upgrade Requirements and Phasing

The phosphate condition required for the new permit requires upgrades at Attleborough WwTW.

A 'No Deterioration' P removal scheme at Attleborough WwTW is included within AWS' current business plan cycle (AMP6 – running from 2015 to 2020) this would aim to deliver a treatment solution, using non-conventional methods, to allow the WwTW to meet a more stringent P permit condition. The implementation of the scheme is dependent on the results of ongoing national water company trials into the efficacy of such non-conventional methods of treatment (due to report in 2017), hence it is more likely that the scheme would be operational in the next business planning cycle (AMP7- running from 2020 to 2025). Although development phasing is not readily available for this WCS update, discussion with the Environment Agency and AWS suggests that the available headroom within the WwTW should be sufficient to allow growth to 2021 to connect prior to the flow permit conditions being exceeded and a new solution needing to be in place.

Ecological Assessment

A review of hydrologically linked Habitats Directive site has determined that there are no sites downstream of the discharge point that would be affected by water quality changes as a result of the preferred solution

Flood Risk Implications

Assessment of the hydraulic capacity of the River Thet to cope with additional flow was completed and reported in the Outline Breckland WCS in 2008. The Outline study concluded that the additional flow would have a negligible effect on flood levels and extent for all assessed flood events (up to the 1 in 100 year with an allowance for climate change).

The Outline WCS assessed a similar number of new connections than is being considered for this updated WCS. Therefore, the conclusions from the Outline WCS remain valid for this WCS update and the required additional discharges from the WwTW can be concluded to not increase flood risk to receptors downstream on the River Thet.

RAG Assessment

On the basis that a potential treatment solution has been identified, a RAG rating of amber has been applied for the purposes of this WCS to demonstrate that a potential constraint exists and a solution to upgrade treatment processes will be required to ensure growth can be delivered without affecting WFD objectives.

3.2.2.2 Dereham

Dereham WwTW has some available flow headroom in its existing discharge permit and can accept growth of approximately 230 dwellings, after which volumetric discharge permit will be exceeded. Unless additional headroom can be made available in the catchment after 230 dwellings, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric permit conditions, and by a total volume of 341 m^3/d by the end of the plan period.

WFD Compliance

Water quality modelling has shown that in order to maintain the current WFD status of the Wendling Beck with predicted discharge volumes (from new connections), the permit conditions on discharge quality for ammonia and phosphate would need to be tighter than they currently are. The calculations show that the permit conditions should be set at 1mg/l 95 percentile limit for ammonia[7] and less than a 0.5mg/l mean limit for Phosphate[8].

[7] Currently at 4mg/l in the existing permit
[8] Currently at 1mg/l in the existing permit

The theoretical condition for phosphate is considered to be beyond the limits of conventional treatment. Therefore discharge of all additional flow to the Wendling Beck, when considering growth in the Dereham catchment is not possible and a long-term solution would be required at this WwTW. However, modelling based on the current wastewater flows have shown that in order to maintain the current quality of the Wendling Beck, the permit conditions on discharge quality should theoretically be tighter than they currently are, irrespective of growth.

The theoretical quality condition for phosphate is therefore considered to be beyond the limits of conventional treatment under both a pre-growth and growth inclusive scenario. The modelling has demonstrated that the current phosphate permit condition would need to be equivalent to 0.1 mg/l, to maintain the existing status of the River Thet. The results therefore suggest that the WwTW is treating discharge to a higher standard than the current permit condition for phosphate.

Over performance of a WwTW does occur, as WwTWs are designed with a future design load in mind leaving capacity for growth. In addition, the WwTW will be designed to accommodate high flows and low temperatures during winter when biological treatment processes are less efficient. This means during higher temperature periods and/or lower flow periods, there will be excess 'treatment capacity'. Consequently, the current level of treatment at the WwTW has proved to be sufficient to maintain the current status of the receiving watercourse, and it is possible that with treatment upgrades, the WwTW could continue treating to this higher standard.

No modelling was required to assess the impact of growth on preventing Future Good Status being reached in the Wendling Beck as all physico-chemical quality elements are already at Good Status or above.

Upgrade Requirements and Phasing

The phosphate condition required for the new permit is likely to require a new solution at Dereham WwTW. Following the conclusion of the initial assessment undertaken for this detailed WCS, a review of the Dereham flow figures was undertaken and discussed with Breckland DC and AWS as there is a significant difference between the measure DWF figure and the revised permit applied for.

AWS have undertaken a review of their predictions for changes in the Dereham catchment population growth and have determined that with predicted movement of the population in Dereham, the overall occupancy rate of dwellings across the town will fall. This coupled with greater water efficiency from existing housing stock (as a result of demand management proposals in the WRMP) would reduce water demand from existing population, allowing a limited increase in overall housing stock after the available headroom is exceeded (after 2021). This would prevent the need for the new proposed permit to be altered.

In order for this solution to be appropriate, the growth trajectory to be developed for Dereham will need to be limited to a number of units per annum between 2021 and 2036 (or when the existing permitted flow is exceeded) to be agreed between Breckland District Council, AWS and the Environment Agency.

It also provides a strong evidence base that water consumption within Dereham should be minimised through the use of specific policy on water efficiency and usage targets for new property.

Ecological assessment

Dereham WwTW discharges to the Wendling Beck which is a tributary of the River Wensum SAC. The SAC is approximately 8.5km downstream of Dereham WwTW.

The River Wensum was designated as an SAC for:

- watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*;
- Desmoulin`s whorl snail - *Vertigo moulinsiana*;
- Brook lamprey - *Lampetra planeri*; and
- Bullhead - *Cottus gobio*.

The Environment Agency concluded in their RoC process for the River Wensum that nutrient enrichment of the River Wensum was a matter for concern, especially as phosphorous concentrations were shown to be elevated above acceptable standards. The Environment Agency further suggested that discharge permits have been shown to contribute nearly 75% of all phosphorous loads to the river system. In their RoC for the river, the Environment Agency identified

twenty sources of phosphorous that were contributing nearly 95% the phosphorous loading to the River Wensum catchment, of which many were WwTWs. Of the twenty permits, fourteen WwTW accounted for nearly 62% of point source loads and Dereham WwTW was one of the works identified as making a significant contribution to the overall 'in combination' adverse effect on integrity of the SAC.

The conclusions of the Environment Agency RoC process led to improvements to many of the WwTWs within the Wensum catchment (including Dereham) to reduce the phosphate concentrations in their discharged effluent to acceptable levels (which have been determined to be 1 mg/l) and thereby ensure that the overall phosphate concentration in the River Wensum SAC falls below the identified damage thresholds for the species and habitats for which the SAC was designated. However, because the increase in wastewater to be treated at Dereham WwTW as a result of the additional development leads to a requirement for a new discharge permit, a solution beyond conventional treatment is required to ensure no detriment to the downstream River Wensum SAC and ensure compliance with the Habitats Directive.

This WCS has determined that the preferred solution to cater for the planned level of growth in the Dereham WwTW catchment is the continued management of treatment headroom through further water efficiency measures (as set out in AWS' WRMP), monitoring of the change in water use and occupancy rate within the town, and controlled phasing of the proposed housing trajectory. These measures should ensure sufficient treatment headroom into the future to cater for the proposed growth.

Should the proposed solution prove insufficient to supply treatment headroom, it is likely that a scheme similar to that proposed at Attleborough would be required to provide treatment using non-conventional methods, to allow the WwTW to meet a more stringent P permit condition. A combination of these measures should be sufficient to ensure no detriment to the River Wensum SAC. Should the housing targets proposed increase significantly beyond those proposed in this study, then this position would need to be reviewed.

Flood Risk Implications

Assessment of the hydraulic capacity of the Wendling Beck to cope with additional flow was completed and reported in the Outline Breckland WCS in 2008. The Outline study concluded that the additional flow would have a negligible effect on flood levels and extent for all assessed flood events (up to the 1 in 100 year with an allowance for climate change).

The Outline WCS assessed a similar number of new connections than is being considered for this updated WCS. Therefore, the conclusions from the Outline WCS remain valid for this WCS update and the required additional discharges from the WwTW can be concluded to not increase flood risk to receptors downstream on the Wendling Beck.

RAG Assessment

On the basis that a potential solution has been identified, a RAG rating of amber has been applied for the purposes of this WCS to demonstrate that a potential constraint exists and a solution to limit annual completions will be required to ensure growth can be delivered without affecting WFD objectives to 2036.

3.2.2.3 Garboldisham (Elm Grove)

Garboldisham (Elm Grove) WwTW has no available flow headroom in its existing discharge permit. Unless additional headroom can be made available in the catchment, any growth draining to the WwTW would cause the WwTW to continue to exceed its existing volumetric permit conditions, and by a total volume of 16m^3/d by the end of the plan period.

WFD Compliance

Water quality modelling has shown that in order to maintain the current WFD status of the Little Ouse with predicted discharge volumes (from new connections), a new permit condition on discharge quality for ammonia would not be required. The calculations show that a new permit condition should be set at a 3.0mg/l mean limit for phosphate[9].

The theoretical conditions for BOD, ammonia and phosphate are considered to be within the limits of conventional treatment.

The modelling has shown that the growth would not prevent Future Good Status being reached in the Little Ouse for BOD as it could not be reached with current discharge levels.

[9] No phosphate sampling data exists for the discharge, therefore, a worst case assumption has been made that the phosphate quality of the discharge is approximately 5mg/l mean limit.

Thus, this WCS has shown that a technically feasible engineering solution can be delivered to accommodate all of the growth proposed within the Garboldisham (Elm Grove) WwTW catchment (based on the housing numbers that the council has provided for use in the WCS).

RAG Assessment

The growth in the Garboldisham (Elm Grove) WwTW catchment is given an Amber status on the basis that upgrades are required, but are within the limit of conventional treatment and should be considered in Anglian Water's business plan going forward. Upon application of the revised discharge permit, AWS should determine potential impact of the additional discharge on flood risk.

3.2.2.4 Watton

Watton WwTW has available flow headroom in its existing discharge permit but could only accept growth of approximately 19 dwellings, after which volumetric discharge permit will be exceeded. Unless additional headroom can be made available in the catchment after 19 dwellings, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric permit conditions, and by a total volume of 358m^3/d by the end of the plan period.

WFD Compliance

Water quality modelling has shown that in order to maintain the current WFD status of the Watton Brook with predicted discharge volumes (from new connections), the permit conditions on discharge quality for BOD and ammonia would need to be tighter than they currently are. The calculations show that the permit conditions should be set at 12mg/l 95 percentile limit for BOD[10] and 3mg/l mean limit for ammonia[11]. The theoretical conditions for both BOD and ammonia are considered to be within the limits of conventional treatment. No change would be required in the phosphate permit to ensure no deterioration in status

The modelling has shown that the growth would not prevent Future Good Status being reached in the Watton Brook for Phosphate as it could not be reached with current discharge levels.

Thus, this WCS has shown that a technically feasible engineering solution can be delivered to accommodate all of the growth proposed within the Watton WwTW catchment (based on the housing numbers that the council has provided for use in the WCS).

Upgrade Requirements and Phasing

The change of both the BOD and ammonia condition required for the new permit is likely to require process upgrades at Watton WwTW. AWS have confirmed planned AMP6 investment, including a revised Ammonia permit of 3.3 mg/l (no deterioration policy) by April 2017. Only a small further improvement will be required to accommodate growth further to 2036.

Flood Risk Implications

Watton WwTW currently discharges to the Watton Brook. Previous assessments have shown the physical capacity of the Watton Brook is likely to be sufficient to accommodate the additional wastewater discharge generated by the growth in the town, without increasing flood risk downstream.

RAG Assessment

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

[10] Currently at 15mg/l in the existing permit
[11] Currently at 6mg/l in the existing permit, with a 'no deterioration' permit limit of 3.3mg/l in 2017

3.3 Climate Change, Water Quality and Adaptation

Table 3-4 provides a summary of the potential climate change adaptation and mitigation measures that could be considered in Breckland District with regards to water 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 3-4 – Water quality and wastewater potential climate change adaption and mitigation

Potential Climate Change	Potential Impact	Adaptation and Mitigation Measures	Lead Organisation				Timescale for Action
			BDC	EA	AWS	NE	
Temperature Rise	• Decrease in Dissolved Oxygen in rivers – impact on river ecology and wildlife • Faster wastewater asset deterioration • 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 • Insufficient infrastructure capacity – storm tanks, CSOs etc. • 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 • More frequent low river flows • Less dilution in rivers for wastewater discharge • Reduced risk to rivers from combined sewer outflows • Tightening of discharge permit • 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 permits		✓	✓		Medium
Increase in weather extremes (heatwaves, intense rainfall, storms)	• Increased flooding and risk of service loss • Increased clean-up costs • Inability of infrastructure to cope • 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

3.4 Wastewater Summary

Table 3-5 provides a summary of the RAG assessment of the WwTWs within the Breckland WCS study area.

Table 3-5 – Wastewater Treatment Summary

WwTW	Is Headroom Available for all planned growth to 2036?	Is there a flood risk concern with additional discharge?	Is a quality permit update possible within LCT?	Solution Available?
Attleborough	No	No	No	Yes – with significant new investment
Bylaugh - near church	Yes	No	N/A	
Dereham	No	No	No	Yes - with significant new investment
East Harling	Yes	No	N/A	
Garboldisham -Elm Grove	Limited	No	Yes	Yes – with minor process upgrades
Great Ellingham	Yes	No	N/A	
Great Hockham LT Hockham Rd	No	No	Yes	Yes – with minor process upgrades
Hockering - by A47	Yes	No	N/A	
Litcham	Yes	No	N/A	
Mattishall	Yes	No	N/A	
Mundford	Yes	No	N/A	
Narborough	Yes	No	N/A	
Necton	Yes	No	N/A	
North Elmham	Yes	No	N/A	
Old Buckenham STW	Yes	No	N/A	
Shipdham - Carbrooks Road	Yes	No	N/A	
Swaffham	Yes	No	N/A	
Thetford	Yes	No	N/A	
Watton	No	No	Yes	Yes – with minor process upgrades
Weeting	Yes	No	N/A	

4 Water Supply Strategy

4.1 Introduction

Water supply for Breckland District Council area is provided by AWS. An assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems has been completed to update the previous findings of the Outline Breckland WCS[12]. The assessment has been based on the Environment Agency's Catchment Management Strategies (CAMS). Breckland District Council falls within two CAMS:

- The Cam and Ely Ouse CAMS[13]; and,
- The Broadland CAMS[14].

This Study has used the final version of AWS' 2015 Water Resources Management Plans (WRMP)[15] 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 AWS WRMP.

In reviewing the final AWS 2015 WRMP and through liaison with AWS it has been established that the growth figures assessed for this WCS update are catered for in the 2036 prediction of demand in the relevant Planning Zones under average conditions within the WRMP.

4.2 Catchment Management Strategies (CAMS)

The Environment Agency manages water resources at the local level through the use of CAMS.

Within the CAMS, the Environment Agency's assessment of the availability of water resources is based on a classification system that gives a resource availability status which indicates:

- The relative balance between the environmental requirements for water and how much is licensed for abstraction;
- Whether water is available for further abstraction; and
- Areas where abstraction needs to be reduced.

The categories of resource availability status are shown in Table 4-1. The classification is based on an assessment of a river system's ecological sensitivity to abstraction-related flow reduction. This classification can then be used to assess the potential for additional water resource abstractions.

[12] Scott Wilson (2008) Breckland Water Cycle Study: Outline Study, Breckland Council. November 2008
[13] Cam and Ely Ouse Abstraction Licensing Strategy, March 2013
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289824/LIT7706_89dabb.pdf
[14] Broadland Abstraction Licensing Strategy, February 2013
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289841/LIT_7743_9e67bc.pdf
[15] Anglian Water Services - Water Resources Management Plan, Main Report (2015)
http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf

Table 4-1 – CAMS resource availability status categories

Indicative Resource Availability Status	License Availability
Water Available	Water is likely to be available at all flows including low flows. Restrictions may apply.
No Water Available	No water is available for further licensing at low flows. Water may be available at higher flows with appropriate restrictions.
Over Licensed	Current actual abstraction is such that no water is available at low flows. If existing licences were used to their full allocation they could cause unacceptable environmental damage at low flows. Water may be available at high flows, with appropriate restrictions.
Over Abstracted	Existing abstraction is causing unacceptable damage to the environment at low flows. Water may still be available at high flows, with appropriate restrictions.

The classification for each of the surface waters and groundwater bodies (Water Resource Management Units) in the Breckland area is summarised in Table 4-2.

Table 4-2 – CAMS resource availability classification

River – WRMU	Surface Water (flow exceedance scenarios)				Groundwater
	Q30	Q50	Q70	Q95	
River Thet and Chalk (AP13)					
River Tud at New Costessey (AP10)					
Upper River Wissey and Chalk (AP15)					
Lower River Wissey and Chalk (AP16)					

AP – Assessment Point

The majority of rivers (including the River Thet and Wissey) are defined as being over-licensed during periods of low flows (Q70 and A95) In the case of groundwater, the River Thet, Wissey and Tud and the groundwater from the Chalk are interconnected and the resource availability status incorporates them both. There is no new water available for groundwater abstractions.

This analysis indicates that there are limited options for local abstractions specific to individual development sites. Some high flow abstraction would be possible, but this would not provide sufficient water resource to support demand in a dry year and hence new development is reliant upon water supply sources strategically by AWS or potentially inset water companies.

4.3 Water Resource Planning

AWS has produced an updated 2015 WRMP covering the Breckland District. WRMPs are a statutory document demonstrating how water companies are managing the balance between available supply and future demand over a 25 year plan. The documents are subject Strategic Environmental Assessment, Habitats Regulation Assessment and ultimately approval by the Secretary of State every 25 years. They are therefore a key document for a WCS as they set out an environmentally assessed and approved plan for how demand for water from growth within a water company's supply area can be met. 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.

AWS 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). AWS undertake resource modelling to calculate if there is likely to be a surplus of available water or a deficit in each WRZ by 2040, once additional demand from growth and other factors such as climate change are taken into account.

4.4 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 population projections are based on the housing figures used within this report and assuming an occupancy rate of 2.1. This occupancy rate has been used as a conservative estimate to determine likely water use once all proposed development has been built. This, coupled with projecting to 2036, results in a larger population estimate by the end of plan period than set out in the County's Population, Housing and Employment Forecasts for Breckland. Using a conservative estimate allows for uncertainty in estimates of water use and population increases into the future.

The projections were derived as follows:

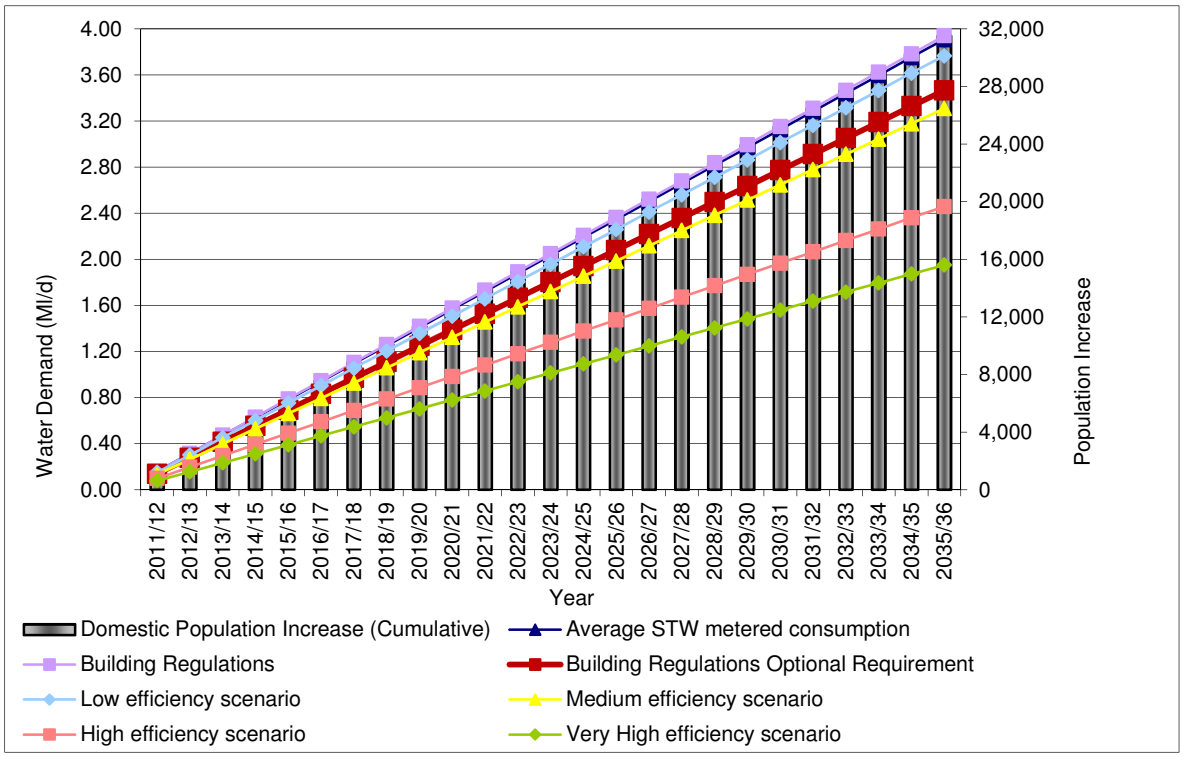
- Projection 1 – Average AWS metered consumption – New homes would use 131 l/h/d16, this reflects the planning consumption used by AWS to maintain security of supply;
- Projection 2a – Building Regulations – New homes would conform to (and not use more than) Part G of the Building Regulations requirement of 125 l/h/d;
- Projection 2b – Building Regulations Optional Requirement – Only applies where a condition that the new home should meet the optional requirement is imposed as part of the process of granting planning permission. Where it applies, new homes would conform to (and not use more than) Part G of the Building Regulations optional requirement of 110 l/h/d;
- Projection 3 – Low Efficiency Scenario – New homes would achieve 120 l/h/d (to reflect the now superseded Code for Sustainable Homes Level17 of 1 or 2);
- Projection 4 – Medium Efficiency Scenario – New homes would achieve 105 l/h/d (to reflect the now superseded Code for Sustainable Homes Level of 3 or 4);
- Projection 5 – High Efficiency Scenario – New homes would achieve 80 l/h/d (to reflect the now superseded Code for Sustainable Homes Level of 5 or 6); and,
- Projection 6 – Very High Efficiency Scenario – 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 1.95 and 3.91l/d by 2036. The projections are shown in Figure 4-1.

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

[17] Although the Code for Sustainable Homes is superseded, it has been used as a guideline for achievable water use targets for the water efficiency scenarios.

Figure 4-1 – Range of water demands across plan period in Breckland depending on efficiency levels of new homes



4.4.1 Planned Water Availability Summary

The 2015 WRMP for AWS has been used to summarise water availability to meet the projected demand for the Breckland District covering the planning period to 2040 and any additional resource capacity that may be required to meet this demand.

4.4.1.1 Anglian Water –Water Resource Zone

Breckland District is located within the Norfolk Rural Water Resource Zone. Water within this area is supplied via groundwater that is pumped from the Chalk aquifer. For this WRZ, AWS predict that in the last year of AMP6 (2019/20) there will be a supply demand surplus of 8.5Ml/d In 2012/13. The resource zone also remains in surplus over the whole of the WRMP period. The total number of household customers within the resource zone which were billed on the basis of measured supplies was 75%.

AWS have identified their preferred schemes to maintain this supply demand balance with the Norwich Rural RZ, as detailed in the WRMP.

- Development of a new winter storage reservoir in the Norfolk Fens. This would store water abstracted from the River Ouse during the winter for year-round treatment and distribution. Since the resources of the Ouse are already used to support the Ely Ouse Essex Transfer, careful consideration of the available yield would be required. If support is necessary, it is possible that a raw water transfer from the River Trent could be developed. This would link the Trent, Nene and Ouse, enabling resources to be transferred from the Trent basin to the south and east, to support supply-systems in East Anglia;
- Associated with the above, the development of trading based infrastructure, either between water companies in East Anglia or between water companies and other third parties. In part, this could be based on connectivity infrastructure which is delivered to improve the resilience of supply-systems in East Anglia; and
- In the event that a large asset such as the Norfolk Fens reservoir is developed, significant reductions in leakage and levels of consumption would also likely be required.
- A series of targeted programmes to reduce demand reduction in residential and commercial property.

Since development within the District is not proposed to exceed that for which AWS are planning, the conclusions of the WRMP can be used to conclude that a sustainable supply of water is available to meet the demands of the planned growth within the Local Plan to 2036. However, there are several key drivers for ensuring that water use in the

development plan period is minimised as far as possible through the adoption of water efficiency policy. This WCS therefore includes an assessment of the feasibility of achieving a 'water neutral' position after growth across the District. This is set out in the following subsections.

4.5 Drivers and Justification for Water Efficiency

4.5.1 Water Stress

In 2013, the AWS supply area was classified by the Environment Agency as an 'Area of serious water stress'[18] based on a 'Water Exploitation Index' as derived by the European Environment Agency. Part of this classification is based on climate change effects as well as increases in demand driven by Local Plan growth targets. In addition, the key sources of raw water (rivers and aquifers) supplying Breckland District Council are considered to be at (or very 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. This is reflected in the strategic nature of water resource schemes proposed by AWS to maintain a supply and demand surplus.

4.5.2 Sustainability Drivers

A further driver is Breckland District Council 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 Local Plan more widely.

4.5.3 Climate Change and Availability of Water

In their 2015 WRMP, AWS highlight that over the planning period the key water resources challenges they face are from the impacts of growth and climate change. Overall, AWS predict their supply-demand balance could be at risk from adverse changes which may be as large as approximately 50% of their 2011/12 Distribution Input.

It is predicted that climate change will further reduce the available water resources in Breckland as rainfall patterns change to less frequent, but more extreme, rainfall events in the summer months, and winter rainfall patterns become more frequent and intense.

In their Strategic Direction Statement, AWS state that climate change is the biggest single risk facing their business over the next 25 years. Customers expect AWS 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.

AWS reported that the changes most significant for managing water resources in their supply area are:

- the increase in rainfall in the winter;
- reduction in the summer rainfall; and
- increases in summer temperatures that will reduce the length of the winter recharge season and potentially increase the demand for water.

At a strategic level, AWS highlighted that it will be important to store more run-off from winter rainfall and to enhance the natural groundwater recharge.

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

4.5.3.1.1 Impact on Supplies

AWS have undertaken analysis of the impacts of climate change on the future availability of their water resources on both their groundwater and surface water sources, and incorporated these results into their assessment of deployable output.

The analysis involved processing median, best and worst case scenarios through a number of recognised climate change models, for 25 groundwater and 10 surface water sources considered vulnerable to the potential impacts of climate change on source yield. The results identified a more significant impact on surface water source yield (reservoir and direct intake) than for groundwater. The modelling results also indicated that in some cases potential groundwater yield could increase, as the climate change scenarios not only predict higher temperatures but increased periods of prolonged and heavy rainfall.

4.5.3.1.2 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. AWS 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. The effect of peak demand varies between WRZ due to factors such as the location of holiday resorts and heavy industry and socio-economic factors reflected in the type and age of housing stock and customers' behaviour.

Although AWS have planned for the anticipated impacts of climate change, the view of AWS 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. Planning Policy has a significant role to play in helping to achieve this.

4.6 Water Neutrality Assessment

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[19]. 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 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 in some cases,
- 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.

For the majority of new development, in order for the water neutrality concept to work, the additional (albeit reduced) 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 Breckland District Council as a whole.

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

4.6.2 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[20]. 6.3.2Appendix D provides more detail on the different types of device or system along with the range of efficiency savings they could deliver.

4.6.3 Achieving Total Neutrality – is it feasible?

Even when considering neutrality within an existing planning area, it is recognised by the Environment Agency[21] that achievement of total water neutrality (100 per cent) 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.

This WCS update 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 6.3.2Appendix D, and highlights the importance of developing local policy in Breckland for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

4.6.4 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:

- 125 l/h/d for all new homes[22];
- No mandatory efficiency target for non-domestic property; and
- Continued meter installation in existing homes as planned in AWS' WRMP up to 2040.

The existing level of metering within the AWS region is 75%. AWS' future target for meter penetration[23] on domestic water meters is 90% by 2040.

The WRMP assumes this metering rate will continue to the target of 90% of customers metered by 2040. Therefore, the Water Neutrality scenarios could assume a further 10% meter penetration within the existing housing stock by the end of the plan period in line with AWS' WRMP.

The water neutrality scenarios have been developed based on the District as a whole when assessing the scenarios.

4.6.4.1 Very High Scenario

The scenario has been developed as a context to demonstrate what is required to achieve the full aspiration of water neutrality. In reality, achieving 100% meter penetration across the District is unlikely, due to a proportion of existing properties which either have complicated plumbing or whose water is supplied by bulk (i.e. flats), making it difficult for meter installation.

The key assumptions for this scenario are that 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 District.
- It would require:
    - A significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;

[20] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[21] Environment Agency (2009) *Water Neutrality, an improved and expanded water management definition*
[22] Building regulations Part G Requirement
[23] proportion of properties within the AWS supply area which have a water meter installed

- Strong local policy within the Local Plan 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.

4.6.4.2 High Scenario

The key assumptions for this scenario are that a high water neutrality percentage[24] 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; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

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.

4.6.4.3 Medium Scenario

The key assumptions for this scenario are that the water neutrality percentage achieved is at least 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 Local Plans in the UK.

It would require:

- Uptake of retrofitting water efficiency measures to be reasonably high (20%) in the District; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

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.

4.6.4.4 Low Scenario

The key assumptions for this scenario are that the water neutrality percentage achieved is low but would only 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 would require:

- Uptake of retrofitting water efficiency measures to be fairly low (10%); and
- A relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders.

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.

4.6.5 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 Breckland District was calculated to be 14.8 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

[24] 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

research undertaken by groups and organisations such as Waterwise, UKWIR[25], 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 (6.3.2Appendix D).

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

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting to existing homes;
- Stage 2 – total demand post growth without any assumed water efficiency retrofitting to existing homes, but with the effect of metering additional metering (beyond AWS plans) applied; and,
- Stage 3 – total demand post growth with metering and water efficient retrofitting applied to existing homes.

Table 4-3 details the results. If neutrality is achieved, the result is displayed as green. If it is not, but is within 20%, it is displayed as amber and red if not achieved. The percentage of total neutrality achieved per scenario is also provided.

Table 4-3 – Results of the Neutrality Scenario Assessments

New Homes demand projections	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering effect (Ml/d)	Total demand after metering & retrofitting (Ml/d)	% Neutrality Achieved
Projection 1: Average metered consumption	3.91	18.80	18.51	18.51	8%
Projection 2a: Building Regulations Mandatory	3.94	18.83	18.54	18.54	7%
Projection 2b: Building Regulations optional requirement	3.40	18.31	18.03	18.03	20%
Projection 3: Low efficiency scenario	3.77	18.65	18.37	18.25	15%
Projection 4: Medium efficiency scenario	3.31	18.20	17.72	17.01	46%
Projection 5: High efficiency scenario	2.46	17.35	16.87	15.42	87%
Projection 5: Very High efficiency scenario	1.95	16.84	16.36	14.33	114%

* prior to demand management for existing housing stock

The results show that to achieve the neutrality percentages for the four water neutrality scenarios:

- The Very High water neutrality Scenario (100% neutrality) would require new homes to meet the Very High efficiency scenario (62 l/h/d);
- The High water neutrality Scenario (50 to 100% neutrality) would require new homes to meet the High efficiency scenario (80 l/h/d);
- The Medium water neutrality Scenario (approx. 50% neutrality) would require new homes to meet the Medium efficiency scenario (105 l/h/d);
- The Low water neutrality Scenario (approx. 20% neutrality) would require new homes to meet the optional requirement under the Building Regulations scenario (110 l/h/d);

4.6.6 Delivery Requirements – Technological

The details of what is required technologically to meet each of the efficiency scenarios in terms of new build are included in Table 4-4.

[25] UKWIR – The United Kingdom Water Industry Research group, attended and part funded by all major UK water companies

Table 4-4 – 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 6.3.2Appendix D.

4.6.7 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 D.

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 D for supporting information.

4.6.8 Neutrality scenario costs

Using the information compiled, the financial costs per scenario has been calculated and are included in Table 4-5. It should be noted that these are only estimate costs.

Table 4-5 – Estimated Cost of Neutrality Scenarios

Neutrality Scenario	New Homes		Existing Properties					Costs Summary		
	Numbers	Efficiency cost	No. to be metered	Metering cost	Percentage population Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	15,007	-	5,717	£2,858,700	10%	5,747	£285,870	-	£3,144,570	£3,144,570
Medium	15,007	£1,875,875	5,717	£2,858,700	20%	11,435	£1,886,742	£1,875,875	£4,745,442	£6,621,317
High	15,007	£39,693,515	5,717	£2,858,700	25%	14,294	£3,144,570	£39,693,515	£6,003,270	£45,696,785
Very High	15,007	£60,103,035	5,717	£2,858,700	35%	20,011	£4,402,398	£60,103,035	£7,261,091	£67,364,133

4.6.9 Carbon Cost Considerations

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 6.3.2Appendix D on the methodology used to calculate carbon equivalents of energy used.

The WRMP Direction 2007[26] and WRP Guideline[27] require details of the greenhouse gas emissions that are likely to arise through the delivery of a water company's proposed WRMP. AWS estimated these from calculation of greenhouse gases as tonnes of carbon dioxide equivalent (tCO2e) for the base year 2011-12 of 180,538 tCO2e for drinking water treatment and distribution. For subsequent years the value of 0.34 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 Breckland, the value of 0.34 tCO2e/Ml has been used.

4.6.9.1 Results

The information was used alongside estimates of energy used in recycling technology[28] to provide a carbon cost for each of the WN scenarios for Breckland 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 90m2 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 low WN (120l/h/d) home. Therefore, energy used per home is the same for 'business as usual' (i.e. building regulations) and the low WN scenario.

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	681.00	1.87	17.21	17.21
Low	Level 1/2	0.12	-0.04	681.00	1.87	17.21	17.16
Medium	Level 3/4	0.71	-0.25	582.00	1.59	14.70	14.45
High	Level 5/6	1.45	-0.52	578.00	1.58	14.60	14.08
Very High	Level 5/6	2.03	-0.73	614.90	1.68	15.54	14.81

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 very high scenario is offset by the savings made in using less water in line with the very high efficiency scenario; however the additional energy required for greywater recycling in the very high scenario makes this scenario higher in CO_2 emissions than the high WN scenario. This suggests that in order to

[26] WRMP Regulations Statutory Instrument 2007 No. 727, WRMP Direction 2007, WRMP (No.2) Direction 2007, WRMP (No.2) (Amendment) Direction 2007, WRMP Direction 2008
[27] Water resources planning guideline, Environment Agency, November 2008, http://www.environment-agency.gov.uk/business/sectors/39687.aspx
[28] Environment Agency (2010) Energy and carbon implications of rainwater harvesting and greywater recycling

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.

4.6.10 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 'medium' scenario would be favoured and sets out what would be required to support this strategy. This 'medium' WN scenario would allow a WN target of 50% to be reached if all the households that remain unmetered in 2040 are additionally metered. The medium scenario is considered to require a significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures, as well as the adoption of new local policy within the Local Plan 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.

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.

4.6.11 Delivery Requirements – Policy

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

In order to meet the water neutrality target scenario given above, specific planning policy will be required and recommendations are presented in section 6:

When considering planning applications for new development (regardless of size), the planning authority and statutory 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 sufficient to meet 105l/h/d.

Undertaking retrofitting and water audits must work in parallel with the promotion and education programme. Further recommendations on how to achieve it are included in Section 4.6.12 below, including recommended funding mechanisms.

4.6.12 Delivery Requirements – Partnership Approaches

Housing association partners should be targeted with a programme of retrofitting water efficient devices, to showcase the policy and promote the benefits. This should be a collaborative scheme between Breckland District Council, AWS and Waterwise. In addition, 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.

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.

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

- working with AWS to help with its water efficiency initiative, which has seen leaflets distributed directly to customers and at events across the region each year;
- 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 Initiative29;
- 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 Breckland 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.

4.6.12.1 Responsibility

The recommendations above are targeted at Breckland District Council and AWS, 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:

- responsibility for ensuring planning applications are compliant with the recommended policies lies with Breckland 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 Breckland District Council through the planning application process (as above);
- responsibility to ensure continuing increases in the level of water meter penetration lies with AWS;
- responsibility for developing a plan to retrofit devices lies with both Anglian Water (as per their WRMP targets) and with Breckland District Council;
- responsibility for promoting water audits lies with Breckland 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 Breckland District Council, and AWS, 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.

4.6.12.2 Retrofitting funding options

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 company's water resource management plans and will have to undergo a cost-benefit analysis.

Breckland District Council could consider developer contributions to through S106 agreements.

[29] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

Section 106 (S106) of the Town and Country Planning Act 1990[30] allows an authority 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 Breckland District Council could be funded through this mechanism; 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)[31]. Breckland District Council should consider a similar scheme, although this would require the agreement of AWS.

4.6.12.3 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[32]. 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.

[30] http://www.legislation.gov.uk/ukpga/1990/8/contents
[31] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[32] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

5 Settlement Area Assessments

5.1 Introduction

Following the assessment of wastewater treatment capacity and water resources at the district level, this section of the WCS presents high level infrastructure capacity issues for key potential development sites as of November 2014.

The assessment of capacity has been undertaken on a settlement scale based on indicative capacity and site layout. Until a preferred set of allocation sites has been determined, it is not feasible to determine the combined constraints from the potential combinations of sites which could come forward. Therefore, the statements on capacity should only be taken as an indicative assessment of constraints at the time of Local Plan making, made to inform the allocation of sites.

Each developer for each site will still need to request pre-planning enquiries from AWS in order to confirm capacity and any specific solutions required before proceeding with site plans and designs, and any subsequent planning application.

5.2 Settlement areas in Breckland

In order to assess the potential development sites across Breckland District, the sites have been grouped together where they would be served by the same WWTW 'Settlement Areas' (Table 5-1). Where data is available, each site has then been individually assessed, within each of these settlement areas.

Table 5-1 – Settlement Areas in Breckland

	Settlement Area (WwTW)	Included settlements
1	Attleborough	Attleborough
2	Bylaugh - near church	Bawdeswell, Swanton Morley
3	Dereham	Dereham, Beetley
4	East Harling	Harling, Kenninghall
5	Garboldisham -Elm Grove	Garboldisham
6	Great Ellingham	Great Ellingham
7	Great Hockham LT Hockham Rd	Hockham
8	Hockering - by A47	Hockering
9	Litcham	Litcham
10	Mattishall	Mattishall, Yaxham
11	Mundford	Mundford
12	Narborough	Narborough
13	Necton	Necton, Sporle
14	North Elmham	North Elmham
15	Old Buckenham STW	Banham, Old Buckenham
16	Shipdham - Carbrooks Road	Shipdham
17	Swaffham	Swaffham
18	Thetford	Thetford
19	Watton	Watton, Saham Toney

5.4 Settlement Assessment methodologies

5.4.1 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 foul flows from the new development to the WwTW for treatment.

The capacity of the existing sewer network is an important consideration for growth, as in some cases the existing system is already at, or close to its design capacity. Further additions of foul water 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.

AWS has undertaken an internal assessment of the capacity of the network system using local operational knowledge. The results are presented for each of the Settlement Areas in the following sections. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 5-2.

Table 5-2 – Key for wastewater network RAG assessment

Development is likely to be possible without upgrades, or upgrades are already underway	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 an solution required to prevent further CSO discharges or sewer flooding

5.4.2 Flood Risk

5.4.2.1 Fluvial

The flood risk to each of the potential allocation sites has been considered using the updated SFRA (2016) flood maps. A green coding has been applied if the majority of the strategic site is within Flood Zone (FZ) 1, whilst an amber coding has been applied if there are significant areas in FZ 2 or 3 and hence specific mitigations may need to be applied by developers.

5.4.2.2 Surface Water Flood Risk

Norfolk County Council is the Lead Local Flood Authority (LLFA) for Breckland. They have produced a county wide Local Flood Risk Management Strategy (LFRMS) which reviews the local flood risks in Breckland, although no detailed Surface Water Management Plans have been produced in Breckland District at the time of this report. Settlements identified with the highest number of properties at risk from surface water flooding are included below in Table 5-3.

Table 5-3 – Breckland District Settlement Ranking (properties at risk), 2011

Settlement	Properties at risk
East Dereham	610
Thetford	420
Attleborough	230
Kenninghall	180
Narborough	130
Weeting	100
Saham Toney	100

5.5 Settlement Area 1 – Ashill

Table 5-4 – Ashill Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town/village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[001]005	Land to the east of Watton Road	5	0.18	Ashill	Will require enhancement to treatment capacity	1
LP[001]008	Land west of Hale Road	20	1	Ashill	Will require enhancement to treatment capacity	1

Figure 5-1 – Ashill Settlement Area

5.6 Settlement Area 2 – Banham (near Church)

Table 5-5 – Banham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[003]003	Land South of Greyhound Lane, Banham	15	1.2	Banham	Enhancements likely to be required	1
LP[003]004	Land south of Heath Road	4	0.14	Banham		1
LP[003]005	Land adjacent to Hillcrest, Mill Road	21	0.71	Banham		1

Figure 5-2 Banham Settlement Area

5.7 Settlement Area 3 – Bawdeswell

Table 5-6 – Bawdeswell Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[004]005	Land west of Reepham Road	66	2.2	Bawdeswell		1
LP[004]007	Land off Reepham Road	54	1.79	Bawdeswell		1
LP[004]008	N/A	36	1.6	Bawdeswell		1

Figure 5-3 – Bawdeswell Settlement Area

5.8 Settlement Area 4 – Dereham

Table 5-7 – Dereham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[025]003	Land at Yaxham Road and Dumpling Green	513	17.1	Dereham	Will require enhancement to treatment capacity	1
LP[025]005	Land adjacent to Green Farm, Yaxham Road	15	0.5	Dereham		1
LP[025]007	Land adjacent to Rose Farm, Norwich Road.	60	2.3	Dereham		1
LP[025]011	Land at Toftwood Garden Centre, 155 Shipdham Road	130	5.7	Dereham		1
LP[025]023	Land southeast of Swanton Road	216	11.22	Dereham		1
LP[025]024	Reads Nurseries, Kingston Road	126	4.2	Dereham	May require enhancement to treatment capacity	1

Figure 5-4 – Dereham Settlement Area

5.9 Settlement Area 5 – Garboldisham

Table 5-8 – Garboldisham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Name	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[031]004	Land to the west of Hopton Road (South)	25	1	Garboldisham	May require enhancement to treatment capacity	1
LP[031]005	Land to the west of Hopton Road (North)	10	0.46	Garboldisham	May require enhancement to treatment capacity	1

Figure 5-5 – Garboldisham Settlement Area

5.10 Settlement Area 6 – Great Ellingham

Table 5-9 – Great Ellingham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[037]016	Land along Hingham Road and Attleborough Road	47	1.57	Great Ellingham		1
LP[037]020	Land adjacent to Bury Hall	76	2.53	Great Ellingham		1

Figure 5-6 – Great Ellingham Settlement Area

5.11 Settlement Area 7 – Harling

Table 5-10 – Harling Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[042]008	Land west of Garboldisham Road	12	0.4	Harling		1

Figure 5-7 – Harling Settlement Area

5.12 Settlement Area 8 – Hockering (by A47)

Table 5-11 – Hockering Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[044]004 A	Land off the Street, Hockering	24	0.81	Hockering		1
LP[044]004 B	Land to the east of Heath Road	25	0.8	Hockering		1

Figure 5-8 – Hockering Setlement Area

5.13 Settlement Area 9 – Kenninghall

Table 5-12 – Kenninghall Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[051]003	Land off Powell Close	15	0.6	Kenninghall		1
LP[051]004	Land east of Street Farm Barn	139	4.63	Kenninghall		1
LP[051]005	Land south of the Allotment Gardens	21	0.71	Kenninghall		1
LP[051]008	Land to the south of Wood Close	20	1.14	Kenninghall		1
LP[051]010	Land west of Lopham Road	57	1.9	Kenninghall		1

Figure 5-9 – Kenninghall Settlement Area

5.14 Settlement Area 10 – Litcham

Table 5-13 – Litcham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[054]005 A	Land adjacent to 10 Church Street	33	1.12	Litcham		1
LP[054]005 B	Land to the north of Litcham Hall	20	2.8	Litcham		1

Figure 5-10 – Litcham Settlement Area

5.15 Settlement Area 11 – Mattishall

Table 5-14 – Mattishall Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[061]015	Land west of Rayners Farm	10	0.33	Mattishall		1
LP[061]019	Malthouse Buildings, Norwich Road	65	4	Mattishall		1
LP[061]022	Land at Rayners Way	8	0.27	Mattishall		1
LP[061]025	Land sotuh of Dereham Road	21	0.71	Mattishall		1

Figure 5-11 – Mattishall Settlement Area

5.16 Settlement Area 12 – Necton

Table 5-15 – Necton Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[067]003	Land west of Ramm's lane	0.6	0.6	Necton		1
LP[067]004	Land north of School Road	0.3	0.3	Necton		1
LP[067]005	Land off 5 Brackenwoods	4.8	4.8	Necton		1
LP[067]005a	Land off 5 Brackenwoods	1.07	1.07	Necton		1
LP[067]007	Land of Hale Road	30	1.47	Necton		1
LP[067]010	Land off North Pickenham Road	20	1.65	Necton		1
LP[067]011	Land between North Pickenham Road and Masons Drive	25	1.2	Necton		1

Figure 5-12 – Necton Settlement Area

5.16.1

5.17 Settlement Area 13 – North Elmham

Table 5-16 – North Elmham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[070]001	Land at Holt Road	16	2.45	North Elmham		1
LP[070]007	Land to the north of Eastgate Street	29	0.96	North Elmham		2, 3
LP[070]008	Land to the south of Eastgate Street	40	1.7	North Elmham		1

Figure 5-13 – North Elmham Settlement Area

5.18 Settlement Area 14 – Old Buckenham

Table 5-17 – Old Buckenham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[074]006	Land west of Attleborough Road	10	0.3	Old Buckenham		1
LP[074]014	Land off St Andrew's Close	20	0.9	Old Buckenham		1

Figure 5-14 – Old Buckenham Settlement Area

5.19 Settlement Area 15 – Shipdham (Carbrooks Road)

Table 5-18 – Shipdham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[085]002	Old Nursery, Land behind Old Post Office	23	1	Shipdham		1
LP[085]006	Land west of Brick Kiln Lane	55	2.4	Shipdham		1
LP[085]009	31 Market St & Land west of Swan Lane	101	3.36	Shipdham		1

Figure 5-15 – Shipdham Settlement Area

5.20 Settlement Area 16 – Sporle

Table 5-19 – Sporle Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[092]004	Seven Acres, The Street	79	2.64	Sporle		1
LP[092]005	Land to the North of Essex Farm	35	2.1	Sporle		1

Figure 5-16 – Sporle Settlement Area

5.21 Settlement Area 17 – Swaffham

Table 5-20 – Swaffham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[097]006	Land off new Sporle Road	51	2.1	Swaffham		1
LP[097]008	Land north of Mill House	90	3	Swaffham		1
LP[097]009	Land to the east of Brandon Road	175	9.57	Swaffham		1
LP[097]010	Land to the south of Norwich Road	185	6.84	Swaffham		1
LP[097]013	Land off Sporle Road	130	6.07	Swaffham		1
LP[097]014	Land west of Brandon Road	370	12.34	Swaffham		1
LP[097]018	Land to the north of Norwich Road	165	5.88	Swaffham		1

Figure 5-17 – Swaffham Settlement Area

5.22 Settlement Area 18 – Swanton Morley

Table 5-21 – Swanton Morley Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[098]002	Land west of Manns Lane	54	1.8	Swanton Morley		1
LP[098]003	Land corner of Green Lane and Manns lane	87	2.9	Swanton Morley		1
LP[098]013	Land off Rectory Road	85	4.23	Swanton Morley		1
LP[098]014	Land east of Manns lane	111	3.7	Swanton Morley		1
LP[098]016	land south of Hoe Road east	57	1.9	Swanton Morley		1

Figure 5-18 – Swanton Morley Settlement Area

5.23 Settlement Area 19 – Watton

Table 5-22 – Watton Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[104]001	Land adjacent to Linden Court	42	1.4	Watton		1
LP[104]008	Land east of Saham Road	132	4.4	Watton		1
LP[104]015	Land north of Norwich Road	84	2.8	Watton		1
LP[104]017	Land to the east of Merton Road	141	4.7	Watton		1

Figure 5-19 – Watton Settlement Area

5.24 Settlement Area 20 – Yaxham

Table 5-23 – Yaxham Site Assessments

Site Information					Foul Network Analysis	Flood Risk
Site Ref	**Site Name**	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Town / village**	**Foul Sewerage Network Capacity**	**EA Flood Zone**
LP[113]005	Land west of Gagman's Lane	30	1	Yaxham		1
LP[113]007	Land to the north of Norwich Road	25	1.2	Yaxham		1

Figure 5-20 – Yaxham Settlement Area

6 Water Cycle Strategy Recommendations and Policy

The following policy recommendations are made and should be considered by Breckland District Council to ensure that the Breckland Local Plan considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, and phasing of growth.

6.1 Policy Recommendations Overview

6.1.1 Wastewater

WW1 – Development Phasing – Attleborough and Dereham,
The proposed growth in Attleborough and Dereham requires a new solution to be identified by the Environment Agency and AWS. The council should only give planning permission if both the Environment Agency and AWS have indicated that they are satisfied that the development can be accommodated until this solution is in place.

WW2 – Development and Sewerage Network
Development at sites indicated in the WCS to have potentially limited sewer network capacity (shown as Amber) should be subject to a pre-development enquiry with AWS to determine upgrades needed prior to planning permission being granted.

6.1.2 Water Supply

WS1 – Water Efficiency in new homes
In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, a policy should be developed that ensures all housing is as water efficient as possible, and that new housing development should go beyond Building Regulations, ideally to 110 l/h/d. Non-domestic buildings should as a minimum reach 'Good' BREEAM status.

WS2 – Water Efficiency Retrofitting
In order to move towards a more 'water neutral position', a policy could be developed to carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings with the aim to move towards delivery of 10% of the existing housing stock with easy fit water savings devices

WS3 – Water Efficiency Promotion
In order to move towards a more 'water neutral position', a policy could be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

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 Breckland District. This checklist also guides developers in what they need to do in order to comply with water and flood risk legislative and policy requirements. This checklist is included in Appendix C.

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 (ideally) be reviewed on a bi-annual basis as development progresses and changes are made to the various studies and plans that support it; these include:

- five yearly reviews of AWS' WRMP (the next full review is due in 2019, although interim reviews are undertaken annually);
- second round of RBMP updates due by early 2016; and,
- Periodic Review 2019 (PR19) (AWS' business plan for AMP7 – 2020 to 2025).

Appendix A. Legislative Drivers Shaping the WCS Update

Directive/Legislation/Guidance	Description
Birds Directive 2009/147/EC	Provides for the designation of Special Protection Areas.
Building Regulations Approved Document H – October 2015	Sets out minimum requirements regards water consumption design and specification for new residential buildings
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: • 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. • To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing means to make Lead Local Flood Authorities statutory consultees with regards to drainage provision for all major new development. • 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. • To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges. • 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.
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.

Directive/Legislation/Guidance	Description
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. 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.
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 permitting framework in the UK. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[33], 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 status[34]. These were published in River Basin Management Plans (RBMP) initially in 2009, with a further round of Plans published in 2016.
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.

[33] 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.
[34] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B. WwTW Capacity Assessment Results

B.1 Modelling assumptions and input data

Several key assumptions have been used in the water quality and permit 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 131 l/h/d
- WwTW current flows were taken as the current permitted dry weather flow (DWF). Future 2036 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.1, a consumption value of 131l/h/d and allowance for an increase in infiltration) to the current permitted DWF value;
- WwTW current discharge quality was taken as the current permitted limits for each water quality element. Where an element did not have a permitted limit, Ammonia was modelled as 10 mg/l and Phosphate as 4mg/l based on common permitted limits in other locations. Figures for the mean and standard deviation of each element were calculated based on these permit 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 Q9535. 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.
- Raw water quality data for modelling was provided by Environment Agency water quality planners. The WFD 'no deterioration' target for each WwTW are the downstream status, for each water quality element, based on river monitoring data collected between 2012 and 2015. Actual data was used in preference over the published status in the RBMP. The mean value and standard deviation was calculated, using this raw data for BOD, Ammonia and Phosphate where available for both the upstream (of the WwTW) and downstream (the discharge) inputs. Details are provided below along with the full results and outputs from the water quality modelling in Table B-1 and Table B-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.

B.2 Assessment Techniques

Modelling of the quality permits 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 permit standards that would be required to meet 'No Deterioration'. This would be the discharge permit limit that would need to be imposed on AWS at the time the growth causes the flow permit 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 permit 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 permit 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.

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

B.2.1 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 permit limits would be required. If 'No Deterioration' could be achieved, then a proposed discharge permit standard was calculated which will be needed as soon as the growth causes the WwTW flow permit to be exceeded.

B.2.2 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 permit 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 permits achievable within the limits of conventional treatment, then a proposed discharge permit standard which may be needed in the future has been given in Table B-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.

B.2.3 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' permit standard given in Table E-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 AWS have an understanding of what permits may be necessary in the future. The RBMP and Periodic Review planning processes will deal with all other issues of disproportionate costs.

Table B-1 - 'No Deterioration' Assessment

	Watton			Garboldisham (Elm Grove)			Attleborough				Dereham		
	BOD	**Ammonia**	**Phosphate**	**BOD**	**Ammonia**	**Phosphate**	**BOD**	**Ammonia**	**Phosphate**	**UKTAG**	**BOD**	**Ammonia**	**Phosphate**
River Downstream of Discharge													
No Deterioration Target	High	Good	Poor	Poor	High	Good	High	High	Good	Good	High	High	Good
Designated Salmonid Fishery?		No			No			No				No	
River Quality Target (90%ile or AA)	4.00	0.60	1.00	9.00	0.30	0.09	4	0.60	0.12	0.092	4.00	0.30	0.09
Current Permit													
Current DWF (m^3/day)		2650			7			2500				3769	
Permit Limits (95%ile or AA)	15	6	2	25	-	-	10	3	1	1	10	4	1
Discharge Quality Required													
Future DWF (m^3/day)		2917			138			3310				3963	
Effluent Quality Required (95%ile or AA)	**12.3**	**3.0**	**5.1**	**25**	**25.3**	**2.9**	**11.7**	**2.5**	**0.1**	**N/A**	**11.4**	**1.1**	**0.1**
Will Growth prevent WFD 'No Deterioration' being achieved?		**No**			**No**			**Yes – solution required**				**Yes – solution required**	

Table B-2 – Improvement to 'Good Status' Assessment

	Watton				Garboldisham (Elm Grove)	
	Phosphate		**UKTAG**		**BOD**	
River Downstream of Discharge						
WFD Status Target	Good	Moderate	Good	Moderate	Good	Moderate
Designated Salmonid Fishery?						
River Quality Target (90%ile or AA)	0.12	0.25	0.092	0.216	5	6.5
Current Permit						
Current DWF (m^3/day)	2650				7	
Permit Limits (95%ile or AA)	0.3	1.1	**0.2**	**1**	**2390**	**1669**
Discharge Quality Required						
Future DWF (m^3/day)	2917				23	
Effluent Quality Required (95%ile or AA)	0.3	**1.03**	**0.19**	**0.93**	**753**	**524**
Will Growth prevent WFD 'Improvement to Good'?		**No**				**No**

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

Appendix C. Recommended Developer Checklist for Compliance with the WCS

Developer checklist key	
	Water Cycle Strategy Recommendation
	Environment Agency and Natural England Requirement
	Local Policy
	National Policy or Legislation

	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 N - go to 2	NPPF, Flood & Water Management Act
2	Development is within Flood Zone 1: Site larger than 1 Ha? Site smaller than 1 Ha?	 Y - go to 5 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 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 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, Lead Local Flood Authority requirements 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 and Norfolk County Council). Irrespective of the requirement for an FRA, a drainage strategy will be required to support the planning application as Lead Local Flood Authorities are now statutory consultees on drainage issues for all major development.	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 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? B) What was the extent of impermeable area, both before and after development?	 % 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). 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 Y/N or N/A	NPPF, Local Planning Policy and LLFA requirements
11	Is the discharged water only surface water (e.g. not foul or from highways)? If no, has a discharge permit been applied for?	Y/N Y/N	Water Resources Act 1991 and Environmental Permitting Regulations
12	A) Does your site increase run-off to other sites? 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 using the latest Environment Agency guidance on climate change (see the National Planning Practice Guidance website)?	Y/N	Local Planning Policy & LLFA requirements
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 & LLFA requirements
15	Have you provided layout plans, cross section details and long section drawings of attenuation measures, where applicable?	Y/N	
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. 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. http://www.ciria.org.uk/suds/697.htm C) Have you checked that any proposed SUDS (including maintenance and adoption requirements) meet with the minimum requirements of the LLFA SuDS Guidance?	Y/N	Local Planning Policy Flood & Water Management Act and LLFA requirements
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. B) If Yes – has Infiltration testing been undertaken to confirm the effective drainage rate of the SuDS? C) Have you ensured that any proposed soakaways are no greater than 2m below existing ground level?	Y/N Y/N	
20	A) Are there proposals to discharge clean roof water direct to ground (aquifer strata)? 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 Y/N	
21	A) Does proposed surface water drainage require use of smaller drains/channels to connect to a main river? B) If yes, has the relevant drainage authority been consulted?	Y/N 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 If N go to 25	Groundwater Regulations 1998 Article 7 of the Water Framework Directive
24	A) Is the development area within an inner zone (SPZ1)? 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 Y/N	

25	A) For infill development, has the previous use of the land been considered? B) Is there the possibility of contamination or potential for pollution? 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 Y/N Y/N	NPPF
26	Have oil separators been designed into the highway and car parking drainage? 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 Breckland District?	Y/N	WCS policy suggestion
	Water Consumption Checklist		**Policy or Legislation**
28	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)?	Y/N	WCS policy suggestion
29	Have you provided details of water efficiency methods to be installed in houses?	Y/N	
30	A) Have you confirmed whether the development will utilise rainwater harvesting and/or required tank sizes? B) Have you considered linkage of SuDS to rainwater harvesting or other water efficiency measures?	Y/N Y/N	
31	Have you confirmed whether grey water recycling is to be utilised and provided details?	Y/N	
32	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
33	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,	Y/N	Environment Agency Pollution Prevention Guidelines 2, 5, 6 and 21
34	A) Have you provided details of pollution prevention measures for the life of the development, such as oil and silt interceptors? B) Have you considered whether permeable pavement areas are protected from siltation? C) Have you provided details of maintenance – as with the SuDS?	Y/N Y/N Y/N	WCS policy suggestion
	Sewerage Checklist		**Policy or Legislation**
35	If your site proposals are within Attleborough or Dereham, have you provided evidence to confirm that sewerage capacity is available via a pre-development enquiry with Anglian Water Services?	Y/N	WCS policy suggestion
36	A) Have sewers been designed in line with 'sewers for adoption'? B) Have discussions regarding adoption and maintenance of on-site sewers taken place with Anglian Water Services?	Y/N	Water Industry Act & Flood & Water Management Act
	Conservation / Enhancement of Ecological Interest Checklist		**Policy or Legislation**
37	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
38	A) Have you shown the impacts your development may have on the water environment? 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 Y/N	Town and Country Planning Regulations 1999
39	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 D.Water Neutrality

D.1 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 to reduce water use in existing development, such as retrofitting of water efficient devices on existing homes and business.

In order to reduce water consumption and manage demand for the limited water resources within the Borough, a number of measures and devices are available[36], 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 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 Waterwise37.

D.2 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.

There are no statutory requirements for 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

[36] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[37] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

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;
- Department of Health for new healthcare buildings and refurbishments;
- Department for Education 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 Local Plan, the only water efficiency requirements for new development are through the Building Regulations[38] where new homes must be built to specification to restrict water use to 125l/h/d or 110l/h/d where the optional requirement applies. However, the key aim of the Localism Act 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 Breckland 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 Localism Act provides the legislative mechanism to achieve this in Breckland.

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, for example:

- 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.
- 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.

D.3 Improving Efficiency in Existing Development

D.3.1 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 12.41l/h/d or 33.5l per household per day, assuming an occupancy rate of 2.7[39] 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)[40]. 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 E-1).

[38] Part G of the Building Regulations
[39] 2.7 is used for existing properties and new properties. This figure was agreed with LBC prior to the assessment.
[40] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/

Table E-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

D.3.2 Low or Variable Flush Toilets

Toilets use about 30 per cent of the total water used in a household[41]. 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[42] per flush. A study carried out in 2000 by Southern Water and the Environment Agency[43] 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.

D.3.3 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. These can be easily installed by householders and are very cheap to produce and supply. Water companies and environmental organisations often provide these for free.

Depending on the type of device used (which 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.

D.3.4 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[44].

D.3.5 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.

D.3.6 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:

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

[41] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[42] http://www.lecico.co.uk/
[43] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000
[44] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

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.

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; however, it may not reduce overall water use for a customer.

D.3.7 Water Efficient Appliances

Washing machines and dishwashers have become much more water efficient over the past twenty years. An old washing machine may use up to 150 litres per cycle, whereas 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[45] 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 a washing machine) and allows the consumer to compare products and select the most efficient product. The water savings from installation of water efficient appliances vary depending on the type of machine used.

D.4 Non-Domestic Properties

There is also the potential for considerable water savings in non-domestic properties. Depending on the nature of a business, water consumption may be high, for example 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.

D.5 Water Efficiency in New Development

The use of efficient fixtures and fittings as described above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions 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 water use requirements under the Building Regulations or the optional requirement. The Cambridge WCS[46] gave a summary of water use savings that can be achieved by the use of efficient fixtures and fittings, as shown below in Table E-2.

[45] Water Efficiency Retrofitting: A Best Practice Guide, Waterwise, 2009, www.waterwise.org.uk
[46] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010

Table E-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	115 l/h/d	105 l/h/d	80 l/h/d
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 E-2 highlights that in order to achieve water use around 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[47], the experience of AECOM 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 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 80l/h/d can be reached without some form of water recycling.

D.5.1 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.

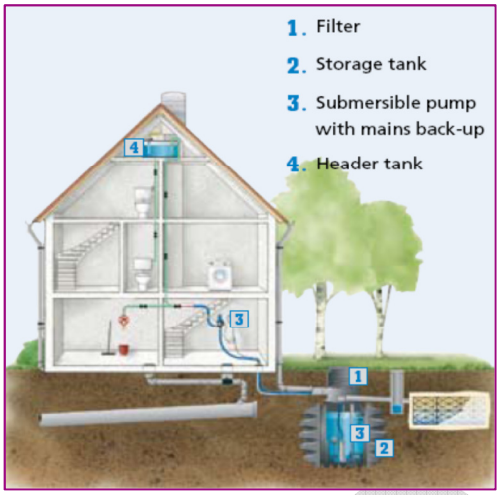
RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water

[47] http://www.thewatercalculator.org.uk/faq.asp

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 E1 below gives a diagrammatic representation of a typical domestic system[48].

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 that 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[49].

Figure E 1 – A typical domestic rainwater harvesting system



A sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[50], 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 E-3.

Table E-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
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

[48] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[49] Aquality Rainwater Harvesting brochure, 2008
[50] Sustainable water management strategy for Northstowe, WSP, December 2007

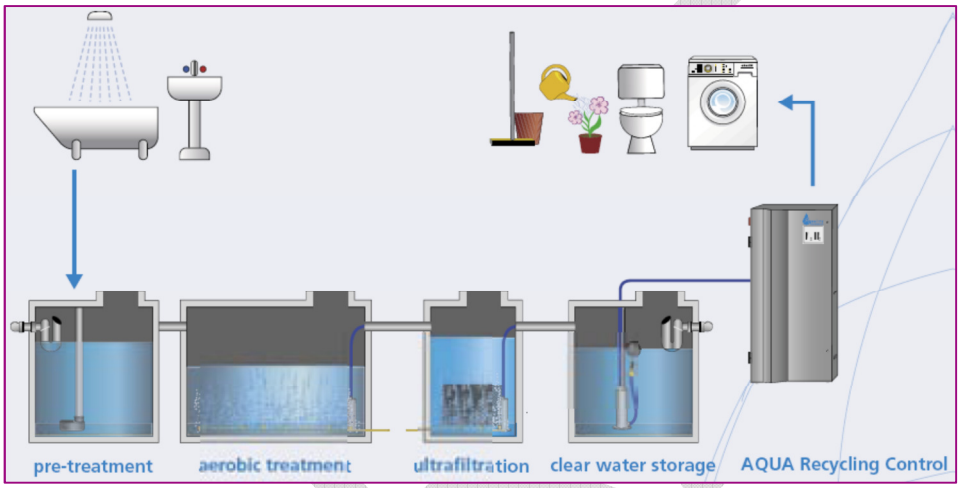
A family of four, with an assumed roof area of 50m^3, could therefore expect to save 61.6 litres per day if a RWH system was installed.

D.5.2 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 E-2 below gives a diagrammatic representation of a typical domestic system[51].

Figure E2 – A typical domestic greywater recycling system



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[52].

Table E-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.

[51] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[52] http://www.thewatercalculator.org.uk/faq.asp

Table E-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[53].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 E-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.

[53] Centre for the Built Environment, www.cbe.org.uk

Table E-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)	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption (a)	Water Efficient Fixtures and Fittings (b)
Business as usual Building Regs	125	- 3-6 litre dual flush toilet; - Low aeration taps; - 160 litre capacity bath; - High efficiency washing machine	None	90%	None
Low	120	- 3-6 litre dual flush toilet; - Low spec aeration taps; - 160 litre capacity bath; - Low spec low flow shower head; - High efficiency dishwasher; - High efficiency washing machine	None	100%	- 3-6 litre dual flush toilet or cistern device fitted; - 10% take up across the Borough
Medium	105	- 3-4.5 litre dual flush toilet; - Medium spec aeration taps; - High spec low flow shower head; - 160 litre capacity bath; - High efficiency dishwasher; - High efficiency washing machine	None	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - medium spec aerated taps fitted - 20% take up across the Borough
High	78	- 3-4.5litre dual flush toilet; - High spec aeration taps; - High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head; - High efficiency dishwasher; - High efficiency washing machine	Rainwater harvesting	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - high spec aerated taps fitted - high spec low flow shower head fitted - 25% take up across the Borough
Very High	62	- 3-4.5litre dual flush toilet; - High spec aeration taps; - High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head; - High efficiency dishwasher; - High efficiency washing machine	Rainwater harvesting and Greywater recycling	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - high spec aerated taps fitted - high spec low flow shower head fitted - 35% take up across the Borough

D.6 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.

D.6.1 New Build Costs

Costs for water efficiency in new property has previously been provided based on homes achieving the different code levels under the CSH based on the cost analysis undertaken by DCLG[54] and as set out in Figure E 3.

Figure E 3 – 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 4 x taps with flow regulators (2.5 l/m) 1 x shower 6 litres/min 1 x standard bath (90 litres per use) 1 x standard washing machine* 1 x standard dishwasher*	£0	£0
3 and 4	105	As Level 1 and 2, except: 2x4/2.5 litre flush toilets 1x smaller shaped bath	£125	£125
5 and 6	80	Houses As Level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	£2,520	£2,645
		Apartments As Level 3 and 4, except: Rainwater harvesting 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 greywater recycling as well as rainwater harvesting and this is detailed in the following section.

[54] DCLG (2008) Cost Analysis of the Code for Sustainable Homes

D.6.2 Water Recycling

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

Table E-7 Costs of GWR systems

Cost	Cost	Comments
Installation cost	£1,750 £2,000 £800 £2,650	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[55] For a single dwelling[56] Cost per house for a communal system[57] Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[58]
Operation of GWR	£30 per annum[59]	
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 Breckland 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.

D.6.3 Installing a Meter

The cost of installing a water meter has been assumed to be £500 per property[60]. 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[61].

D.6.4 Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England[62], costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table E-8 below.

[55] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[56] http://www.water-efficient-buildings.org.uk/?page_id=1056
[57] http://www.water-efficient-buildings.org.uk/?page_id=1056
[58] Code for Sustainable Homes: A Cost Review, Department for Communities and Local Government, 2008
[59] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[60] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[61] Environment Agency Publication - Science Report – SC070010: Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[62] Environment Agency (2007) Water Efficiency in the South East of England

Table E-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.

D.6.5 Neutrality scenario costs

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

Table E-9 Estimated Cost of Neutrality Scenarios

Neutrality Scenario	Costs Summary		
	Developer	Non developer	Total
Low	-	£4,086,115	£4,086,115
Medium	£2,198,125	£6,166,319	£8,364,444
High (RWH)	£46,512,325	£7,800,765	£54,313,090
Very High (RWH & GWR)	£70,427,925	£9,435,211	£79,863,136

D.7 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.

D.7.1 Methodology

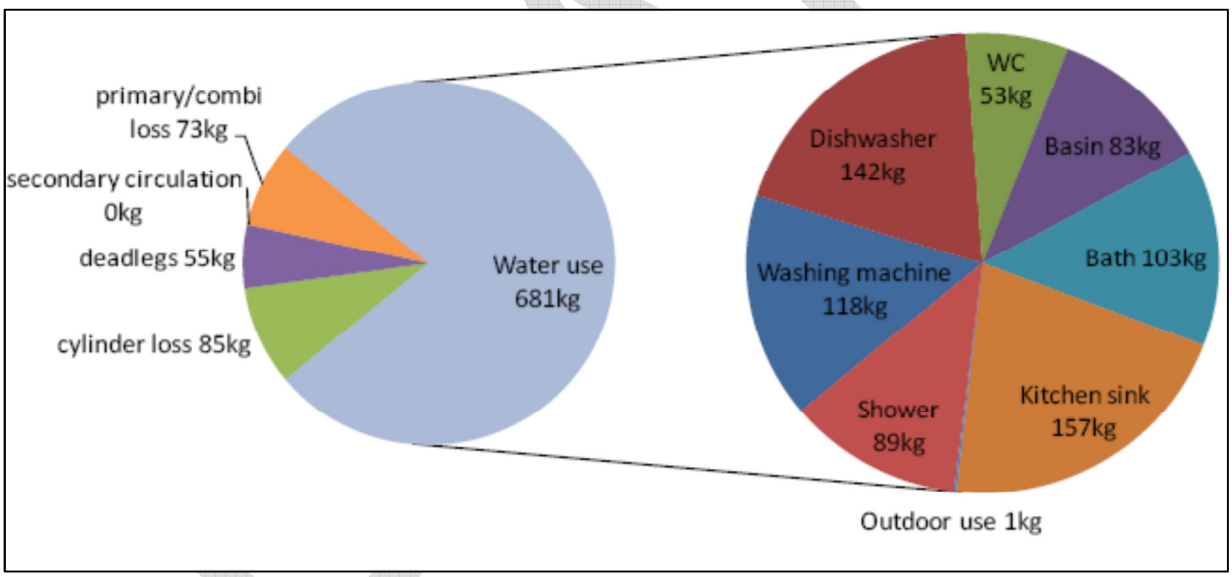
A joint study by the Environment Agency and the Energy Saving Trust[63] assessed the energy and carbon implications of the installation of water saving devices (Table E-10). The report initially calculated a baseline water consumption figure for existing housing stock, using the following assumptions:

Table E-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

The study then modelled the CO_2 emissions from this 'standard' existing dwelling, as shown below in Figure E 4. 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).

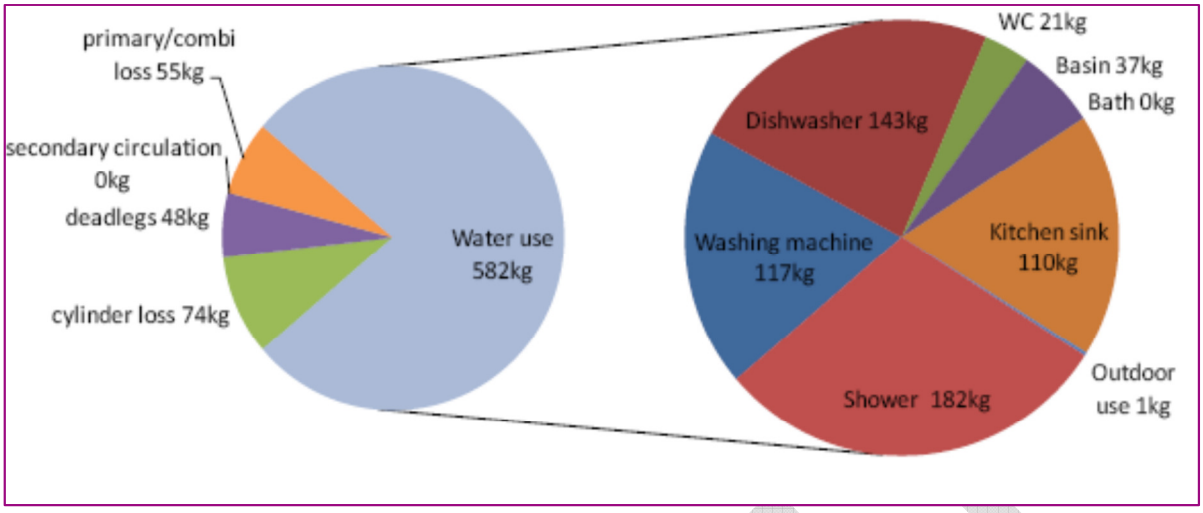
Figure E 4 – CO2 emissions from a 'standard' existing dwelling



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 of 105 l/h/d (Figure E 5).

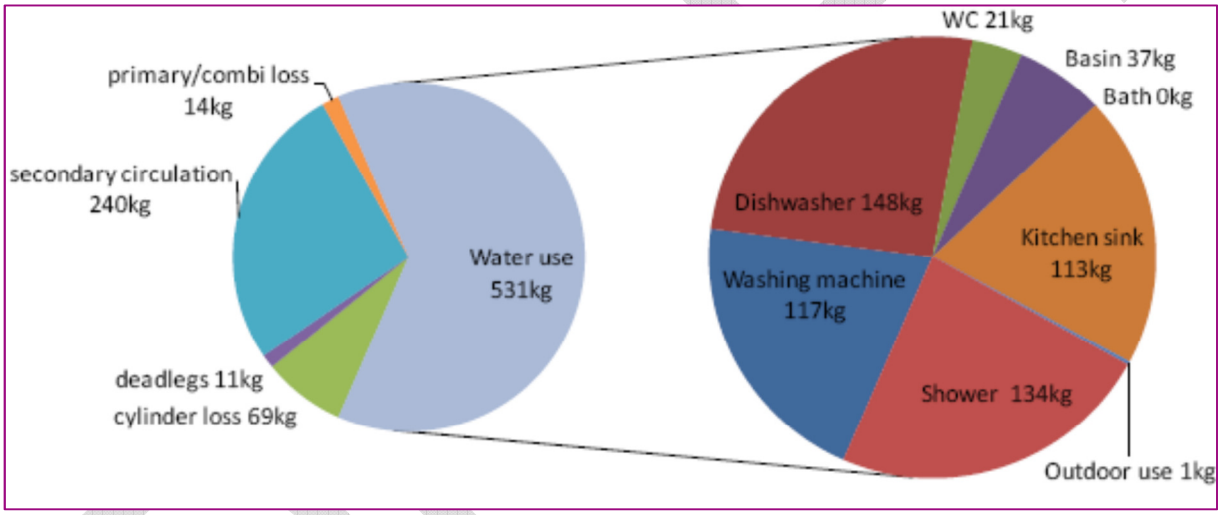
[63] Quantifying the energy and carbon effects of water saving, Full technical report, Environment Agency and the Energy Saving Trust, 2009

Figure E 5 – CO2 emissions from a CSH Level 3/4 dwelling



The study then assessed the impacts of a home which has water use of80 l/h/d (Figure E 6).

Figure E 6 – CO2 emissions from a CSH Level 5/6 dwelling



It can therefore be seen that the carbon cost of achieving water efficiency levels of105l/h/d and 80l/h/d compares favourably to the baseline scenario of current average water use of 681kg/CO_2. 105l/h/d represents a carbon saving of 99 kg/CO_2 and 80l/h/d 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. Energy savings for AfW 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 AfW to the individual householders. While AfW 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[64]), the expense will be passed to householders.

For households with the GWR/RWH, 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.

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