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EB 107A

Chelmsford City Water Cycle Study Update

Chelmsford City Council

January 2018

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	January 2017	Draft	JR	Jon Robinson	Director
1	April 2017	Final	JR	Jon Robinson	Director
2	November 2017	Draft (Housing numbers update)	CP	Carl Pelling	Associate Director
3	January 2018	Final Draft (Housing numbers update)	CP	Carl Pelling	Associate Director

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List of Acronyms

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
CBA	Cost Benefit Analysis
CCC	Chelmsford City Council
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CLG	Communities and Local Government
CRC	Carbon Reduction Commitment
DEFRA	Department for Environment, Food and Rural Affairs
DWF	Dry Weather Flow
EA	Environment Agency
EFI	Environmental Flow Indicator
ESW	Essex & Suffolk Water
GI	Green Infrastructure
GWR	Greywater Recycling
HA	Highways Agency
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
LNR	Local Nature Reserve
LPA	Local Planning Authority
Ml	Mega Litre (a million litres)
NE	Natural England
NPPF	National Planning Policy Framework
OAHN	Objectively Assessed Housing Need
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
ONS	Office for National Statistics
OR	Occupancy Rate
P	Phosphorous
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RNAG	Reason for Not Achieving Good
RoC	Review of Consents (under the Habitats Directive)
RQP	River Quality Planning (tool)
RWH	Rainwater Harvesting
S106	Section 106 (Town and Country Planning Act 1990)
SAC	Special Area for Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPZ	Source Protection Zone
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
WRC	Water Recycling Centre
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

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Non-Technical Summary

Chelmsford City Council is expected to experience significant growth, particularly in relation to domestic development over the period 2021 to 2036. This growth represents a challenge in ensuring that both the water environment and water services infrastructure has the capacity to sustain this level of growth and development proposed.

This Chelmsford City Water Cycle Study (WCS) update forms an important part of the evidence base that will help Chelmsford City Council determine the most appropriate options for development within the City area (with respect to water infrastructure and the water environment) to be identified in the Council's New Local Plan from 2021 to 2036. This WCS update has been informed by a previous Phase 1 (2010) and Phase 2 (2011) WCS which were undertaken to account for the Local Plan period until 2021.

Planned future growth across the Chelmsford City Area has been assessed with regards to water supply capacity, sewage capacity and environmental capacity. Any water quality issues, associated water infrastructure upgrades, and potential constraints have subsequently been identified and reported. This WCS provides information at a level suitable to demonstrate that there are workable solutions to key constraints to deliver future development for all development sites (committed and allocations), including recommendations on the policy required to deliver it.

Wastewater Strategy

Wastewater Treatment

The WCS identifies that in total, three Water Recycling Centres (WRCs) will serve the proposed future development across the City Area. Table 1 below provides an indication of the WRCs which have available capacity and those that are likely to require changes to permits that control discharge and potentially infrastructure upgrades.

Table 1. WRC summary

WRC	Phasing of Development
Chelmsford	Flow and treatment capacity for growth under all growth scenarios with some capacity available for further growth.
Great Leighs	Limited flow capacity under all growth scenarios, therefore growth upgrades and careful development phasing will be required. Treatment process upgrades using conventional and possibly non-conventional treatment technologies will be required to meet river quality targets. Permit setting recommended for phosphate.
South Woodham Ferrers	Limited flow capacity under all growth scenarios, therefore growth upgrades and careful development phasing will be required. Treatment process upgrades will also be required using conventional treatment technologies to meet river quality targets.

Two WRCs (Great Leighs and South Woodham Ferrers) under specific growth scenarios do not have sufficient capacity to accept all future development proposed within the plan period. Therefore solutions are required in order to accommodate the growth to ensure that the increased wastewater flow discharged does not impact on the current quality of the receiving watercourses, their associated ecological sites and also to ensure that the watercourses can still meet with legislative requirements.

The detailed assessments have shown that improvements to Great Leighs and South Woodham Ferrers WRCs will be required to maintain compliance with Water Framework Directive (WFD) water quality standards within the receiving watercourses, and that these improvements are possible using wastewater treatment technologies currently available (conventional). This demonstrates that an engineering solution for wastewater treatment is feasible and hence treatment capacity should not be seen as a barrier to growth.

The phasing of developments draining to these WRCs will need to be discussed between Chelmsford City Council and Anglian Water Services to ensure the WRC's have sufficient treatment process capacity (which may be dependent on timing of upgrades) to accommodate the growth in line with Anglian Water Service's asset management plans.

The WCS has concluded feasible solutions are possible to ensure environmental conditions and legislative objectives are met. However, this WCS recommends that Chelmsford City Council, the Environment Agency, and

Anglian Water Services should work together to determine when solutions will implemented and hence conclude when and how much development can be accommodated across the City Area in the early phases of the Local Plan delivery period.

To ensure that the planned level of development within the plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that policy is included within the New Local Plan to ensure that these matters are addressed at a strategic level.

Water Supply Strategy

Based on the growth assessed, the WCS has concluded that, allowing for the planned resource management of Essex & Suffolk Water's supply areas in the City Area, the water supply company would have adequate water supply to cater for growth over the plan period.

However, the WCS has identified that, according to the Environment Agency water stressed areas – final classification (2013), the Essex & Suffolk Water supply area is an area of 'serious water stress[1]'. Hence there is a key driver requiring that water demand is managed across the area for all new development, in order to assist in achieving long term sustainability in terms of water resources.

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

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

Five water neutrality scenarios have been proposed and assessed to demonstrate what is required to achieve different levels of neutrality in the City Area. The assessment concluded that measures should be taken to deliver the first step on the neutrality pathway; the following initial measures are therefore suggested by the WCS:

- Ensure all housing is water efficient, with new housing development meeting the mandatory national standard as set out in the Building Regulations;
- Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 10% of the existing housing stock, with easy fit water saving devices; and,

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

Overall Impact of Development

Overall, the WCS concludes there are no significant constraints with respect to water service infrastructure and the water environment to deliver the New Local Plan development, on the basis that strategic water resource options and wastewater solutions are developed in advance of development coming forward.

[1] According to the new Environment Agency methodology shown in the Environment Agency water stressed areas- final classification (2013), https://www.gov.uk/government/publications/water-stressed-areas-2013-classification, areas of serious water stress are identified where: (a) the current household demand for water is a high proportion of the current effective rainfall which is available to meet demand or (b) the future household demand for water is likely to be a high proportion of the effective rainfall available to meet that demand. When an area is designated as being in 'serious water stress', the water company for that area must make a plan to manage demand for water effectively.

1. Introduction

1.1 Background

Chelmsford is a large urban area located in the County of Essex. The administrative area of Chelmsford City Council covers Chelmsford city centre in addition to a number of urban areas including South Woodham Ferrers, focus growth areas around Beaulieu and Channels, and the major satellite villages of Boreham, Broomfield, Danbury, Galleywood, Great Leighs and Writtle. In the Chelmsford City Area, Wastewater Recycle Centres (WRCs) discharge into both fluvial and tidal watercourses.

Chelmsford City Council was identified as a major growth area, particularly in relation to domestic redevelopment, in the Chelmsford Phase 2 Water Cycle Study (2011)[2]. This updated Water Cycle Study (WCS) is an important part of the evidence base that will help to identify sites with the potential for development throughout the New Local Plan period from 2021 to 2036.

The aim of this WCS is to aid the Council in determining the most appropriate locations for development with respect to water infrastructure and the water environment. The new Local Plan will supersede the current Local Plan which set a target of 16,000 dwellings to be developed between 2011 and 2021. As part of the development of the new Local Plan, the WCS and associated Strategic Flood Risk Assessment (SFRA) will both form a revised evidence base.

The objective of the WCS 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 City Area is not compromised.

1.2 WCS History

Chelmsford Borough Council (now City Council) commissioned Phase 1 (2010)[2] and Phase 2 (2011)[3] Water Cycle Studies (WCS) to account for the Local Plan period until 2021.

These studies helped provide supporting evidence to inform Chelmsford Borough's Local Development framework, by outlining the 2011 capacity of water services infrastructure (phase 1) and completing an environmental capacity assessment to consider planned growth until 2021 (phase 2).

Together the previous WCS', with reference to wastewater found that:

- Development to the North of Chelmsford will require a dedicated sewer direct to Chelmsford Water Recycling Centre (WRCs) to avoid increasing the risk of sewer flooding within the centre of the city.
- Chelmsford WRC is operating close to the limit of conventional treatment capacity and will require an extension, requiring investment to accommodate flows from additional housing developments proposed.
- Upgrades would be required on the existing waste water system in Chelmsford to accommodate proposed development and prevent the risk of surface water flooding.
- Growth to the level (16,000 dwellings) proposed by 2021 would not make it more difficult for the River Chelmer to achieve good ecological status.
- At Wickford WRC consent tightening is recommended to ensure 'no deterioration' specifically for the Biological Oxygen Demand (BOD) indicator.

Chelmsford City Council is currently updating its Local Plan for the period 2021-2036, requiring the new growth target scenarios to be considered in an updated capacity and resource assessment.

[2] Halcrow (2010) Chelmsford Water Cycle Study – Phase 1
[3] Halcrow (2011) Chelmsford Water Cycle Study – Phase 2

1.3 Study Governance

This WCS has been carried out with the guidance of the Steering Group established at the project inception meeting held on 11th February 2016 comprising the following organisations:

- Chelmsford City Council;
- Anglian Water Services (AWS); and,
- Environment Agency.

The following organisations are not part of the Steering Group, but are consultees for the WCS:

- Natural England (NE); and,
- Essex and Suffolk Water (ESW).

1.4 WCS Update Scope

This WCS update provides information at a level suitable to ensure that there are workable solutions to deliver growth for the preferred development allocations, including the policy required to deliver it. The planned future growth across Chelmsford City Council, has been assessed with regards to water supply capacity, sewage capacity, any water quality issues and infrastructure upgrades that may be required to identify any potential constraints to the water cycle which such development may pose.

The following sets out the key objectives of the WCS:

- provide a strategy for wastewater treatment across the City Area which determines if solutions to wastewater treatment are required and if the solutions are viable in terms of balancing environmental capacity with cost;
- describe how the wastewater treatment strategy might impact phasing of development;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine whether additional water resources, beyond those already planned by AWS and ESW are required to support growth;
- determine upgrades required to water supply infrastructure relative to potential options for growth through collaboration with AWS and ESW;
- consider whether growth can be delivered and achieve a 'neutral water use' condition;
- provide a pathway to achievement of water neutrality;
- determine impact of infrastructure and mitigation provision on housing delivery phasing; and
- provide policy recommendations.

1.5 Key Assumptions and Conditions

1.5.1 Water Company Coverage

Two water companies operate within the City Area; AWS is the wastewater undertaker for the City Area and ESW supplies the potable water.

1.5.2 Water Use

For all wastewater and water supply assessments, an assumption was made on the likely use per new household going forward in the plan period. It was agreed with Chelmsford City Council and AWS that a value of 150l/h/d would be used to calculate wastewater generation and water use per person. This value also takes into account employment growth figures as growth locations have not been determined yet.

It is acknowledged that this figure exceeds the current Building Regulations requirement of 125l/h/d for all new homes. However, in their asset planning AWS will continue to assume this higher water use for new homes as their analysis has shown that even when homes are built to a standard of 125l/h/d, the average household use

increases over time due to various factors. AWS are required under their remit to the industry regulator Ofwat, to plan for the expected actual use. Therefore, it is important that conclusions made on infrastructure capacity within this study are consistent with AWS planning strategies.

1.5.3 Household Occupancy Rate

The latest Office for National Statistics (ONS) population projections[4] and household projections[5] have been used to determine the occupancy rate of each household coming forward in the plan period, and have been provided in Table 2 below.

Table 2. Calculation of Occupancy Rate

	Projection for 2036
Population	197,568
Number of households	86,120
Calculated Occupancy Rate (people per household)	2.29

Source: ONS

1.5.4 Wastewater Treatment

As a wastewater treatment provider, AWS are required to use the best available techniques (defined by the Environment Agency as the best techniques for preventing or minimising emissions and impacts on the environment) to ensure emission limit values stipulated within each WRCs permit conditions are met.

Through application of the best available technologies in terms of wastewater treatment, the reliable limits of conventional treatment (LCT) have been determined for the key parameters of Biochemical Oxygen Demand (BOD)[6], ammonia and phosphate, and are provided in Table 3.

Table 3. Reliable limits of conventional treatment technology for wastewater

Determinand	LCT
Ammonia	1.0 mg/l 95 percentile limit[7]
BOD	5.0 mg/l 95 percentile limit
Phosphate	0.5 mg/l annual average[8]

1.6 Report Structure

The first stage of the WCS process is set out in Section 3 of this document and outlines the total proposed number of dwellings which will need to be catered for in terms of water supply and wastewater treatment. Understanding what the level of growth is and where it might be located informs the second stage of the study (reported in Section 4), assessing the current wastewater treatment facilities in regards to both capacity and compliance with legislation and environmental permits. The results of the assessment will identify the WRCs which are at capacity or have remaining capacity. The wider, supporting environment has also been considered, including climate change and local ecology.

In parallel to the wastewater assessment, Section 5 outlines water resource planning targets, discusses current and proposed water efficient measures and introduces the concept of water neutrality.

Ultimately, recommendations have been made as part of the WCS (Section 6) in regards to wastewater, water supply, surface water management and flood risk, ecology and stakeholder liaison.

[4] 2014-based Subnational Population Projections (ONS) (May 2016). Available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29

[5] 2014-based Household Projections to 2039 for England (ONS) (July 2016). Available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

[6] Amount of oxygen needed for the biochemical oxidation of the organic matter to carbon dioxide in 5 days. BOD is an indicator for the mass concentration of biodegradable organic compounds

[7] Considered within the water industry to be the current LCT using best available techniques

[8] Environment Agency (2015) Updated River Basin Management Plans Supporting Information: Pressure Narrative: Phosphorus and freshwater eutrophication

2. Study Drivers

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

a. Delivering sustainable water management – ensure that provision of WSI and mitigation is sustainable and contributes to the overall delivery of sustainable growth and development and that the Local Plan meets with the requirements of the National Planning Policy Framework (NPPF) with respect to water; and

b. Water Framework Directive (WFD) compliance – to ensure that growth, through abstraction of water for supply and discharge of treated wastewater, does not prevent waterbodies within the City Area (and more widely) from achieving the standards required of them as set out in the WFD River Basin Management Plans (RBMPs).

A full list of the key legislative drivers shaping the study is detailed in a summary table in Appendix A for reference. However, it is important to note that the key driver for this study is WFD compliance.

Other relevant studies that have a bearing on the provision of water services infrastructure for development are provided in Appendix B and include, but are not limited to, key documents including the Chelmsford City Council SFRA (currently being updated), AWS' and ESW's WRMP and the Environment Agency's latest Anglian River Basin Management Plan (RBMP) (2015).

2.1 OFWAT Price Review

The price review is a financial review process governed by the Water Services Regulatory Authority (Ofwat) - the water industry's economic regulator. Ofwat determines the limits that water companies can increase or decrease the prices charged to customers over consecutive five year periods.

Figure 1 summarises the timescale in the build up towards the next price review. The price limits for the next period (2020 to 2025) will be set at the end of 2019 to take effect on 1st April 2020 and is referred to as Price Review 19 (PR19). Each water company will submit a Business Plan (BP) for the next period which will be assessed by Ofwat, before being agreed. Price limit periods are referred to as AMP (Asset Management Plan) periods, with the current AMP period being referred to as AMP6.

Figure 1. Proposed timescales for PR19 (Water 2020) programme[9]

As the wastewater undertaker for the City Area, AWS has a general duty under Section 94 of the Water Industry Act 1991 to provide effectual drainage which includes providing additional capacity as and when required to accommodate planned development. However this legal requirement must also be balanced with the price controls as set by the regulatory body Ofwat which ensure AWS has sufficient funds to finance its functions, and at the same time protect consumers' interests. The price controls affect the bills that customers pay and the sewerage services consumers receive, and ultimately ensure wastewater assets are managed and delivered efficiently.

Consequently, to avoid potential inefficient investment, AWS generally do not provide additional infrastructure to accommodate growth until there is certainty that development is due to come forward.

[9] Water 2020: Regulatory framework for wholesale markets and the 2019 price review (December 2015)

2.2 Water Framework Directive

The environmental objectives of the WFD, as published in the Environment Agency's RBMPs and relevant to this WCS are:

- to prevent deterioration of the status of surface waters and groundwater;
- to achieve objectives and standards for protected areas; and,
- to aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status.

These environmental objectives are legally binding, and all public bodies should have regard to these objectives when making decisions that could affect the quality of the water environment. The Environment Agency publishes the status and objectives of each surface waterbody on the Catchment Data Explorer[10], and describes the status of each waterbody as detailed in Table 4.

Table 4. Description of status in the WFD

Status	Description
High	Near natural conditions. No restriction on the beneficial uses of the water body. No impacts on amenity, wildlife or fisheries.
Good	Slight change from natural conditions as a result of human activity. No restriction on the beneficial uses of the water body. No impact on amenity or fisheries. Protects all but the most sensitive wildlife.
Moderate	Moderate change from natural conditions as a result of human activity. Some restriction on the beneficial uses of the water body. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the water body. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

Source: Environment Agency RBMPs

[10] http://environment.data.gov.uk/catchment-planning/

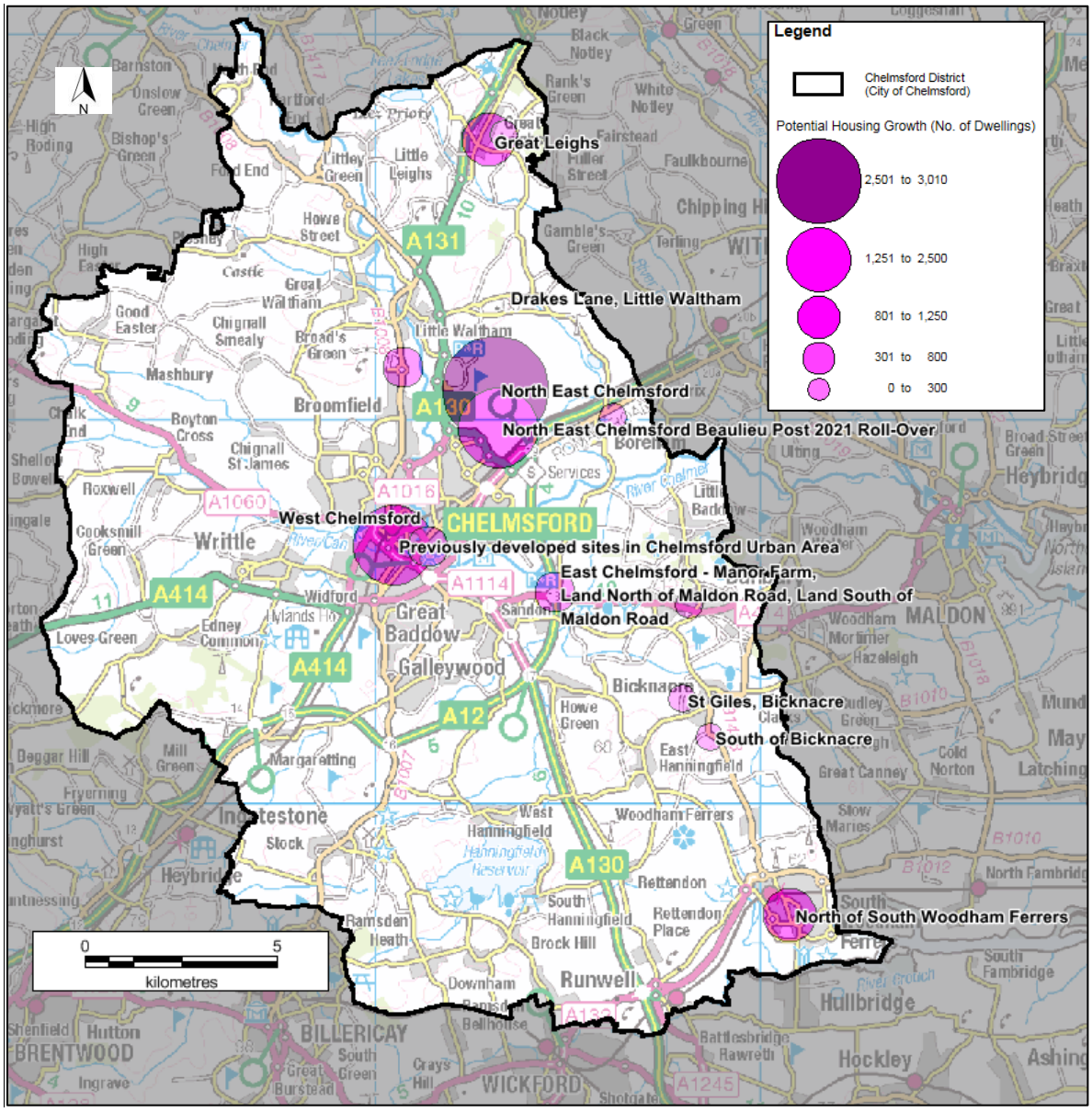
3. Proposed Growth

3.1 Preferred Growth Strategy

The purpose of the WCS is to assess the potential impact of increased development upon the water environment and WSI across the City Area, including water resources, wastewater infrastructure, water quality and ecological issues. The increased development is to accommodate the minimum housing requirement for the Council. Chelmsford City Council's revised spatial approach of future expected development are detailed in the New Local Plan 2021-2036, which at the time of undertaking this WCS, was in development. These growth figures therefore form the basis for the WCS.

The administrative area of Chelmsford City Council covers Chelmsford City in addition to the planned growth areas of Beaulieu and Channels, South Woodham Ferrers and the major satellite villages including Boreham, Broomfield, Danbury, Galleywood, Great Leighs and Writtle. Figure 2 illustrates Chelmsford City Councils administrative boundary, main towns, villages and proposed development locations within the City Area.

Figure 2. Proposed development locations and quantity of dwellings



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3.2 Housing Growth Scenarios

The Objectively Assessed Housing Need (OAHN) Study for Chelmsford identified 14,000 dwellings would be required in the City Area from 2021 to 2036 (933 dwellings per annum)[11]. This target will be met under the new Local Plan which sets out the strategy for growth. The Updated Spatial Strategy – Development Locations and Allocations[12], identifies 13,995 dwellings in the City Area from 2021 to 2036 including 1,400 dwellings which are considered as windfall sites. This WCS has assessed a total of 12,629 dwellings (Updated Spatial Strategy figures excluding windfall sites).

Table 5 provides an overview of the number of dwellings to be built within the plan period and therefore assessed as part of the WCS.

Table 5. Summary of housing figures to be assessed

Settlement Area	Chelmsford Local Plan – Consultation Allocations (2021-2036)	
	Dwellings	Plots/Pitches for travelling showpeople[13]
Previously developed sites in Chelmsford Urban Area	2,205	
West Chelmsford	800	5
East Chelmsford - Manor Farm, Land North of Maldon Road, Land South of Maldon Road	400	
Lockside, Navigation Rd, Waterhouse Lane, Writtle Telephone Exchange, Galleywood Reservoir	188	
Peninsula	421	
North East Chelmsford	3,000	9
Great Leighs	1,100	5
North of Broomfield	650	
Drakes Lane, Little Waltham		10
North East Chelmsford Beaulieu Post 2021 Roll-Over	2,424	
Great leighs - Land East of Main Road	100	
East of Boreham	145	
North of South Woodham Ferrers	1,000	5
South of Bicknacre	30	
Danbury	100	
St Giles, Bicknacre	32	
Total	**12,595**	**34**

[11] Chelmsford Local Plan: Issues and Options Consultation Document. (2015). Available at: http://www.chelmsford.gov.uk/sites/chelmsford.gov.uk/files/files/files/documents/files/ISSUES%20AND%20OPTIONS%20CONSULTATION%20DOCUMENT%20NOV%202015.pdf

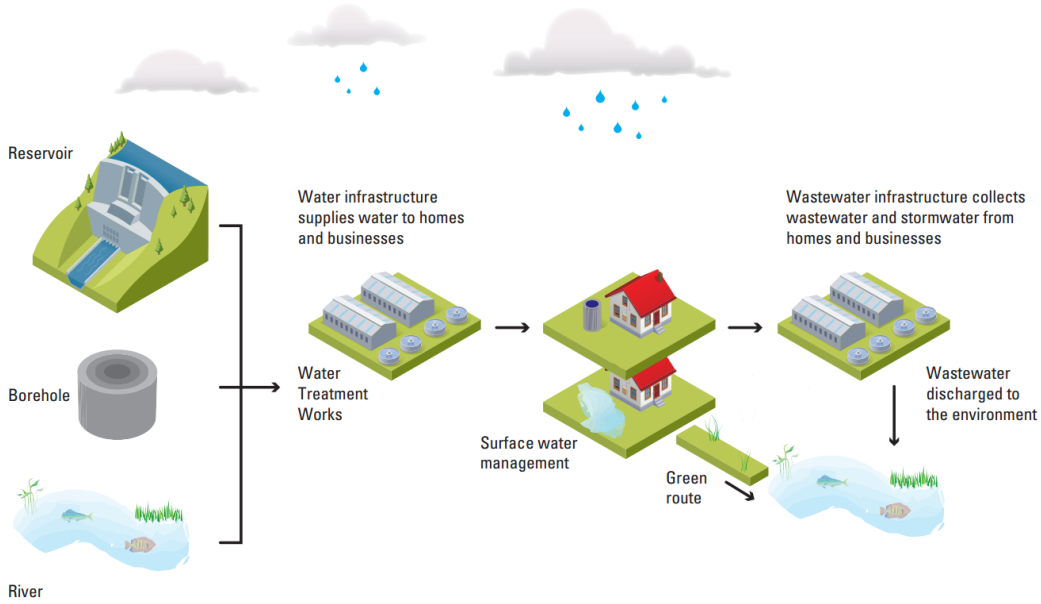
[12] Provided by Chelmsford City Council on the 11th of October 2017

[13] Chelmsford City Council have confirmed that the 34 plots and pitches for the travelling show people are classified as permanent and therefore are considered as part of this WCS

4. Wastewater Treatment

4.1 Wastewater in the City Area

Figure 3. The water environment and infrastructure components[14]



A broad overview of the water cycle and the role of water and wastewater infrastructure within the cycle is illustrated in Figure 3. Wastewater is generally produced following the use of potable water in homes, businesses, industrial processes and in certain areas can include surface water runoff.

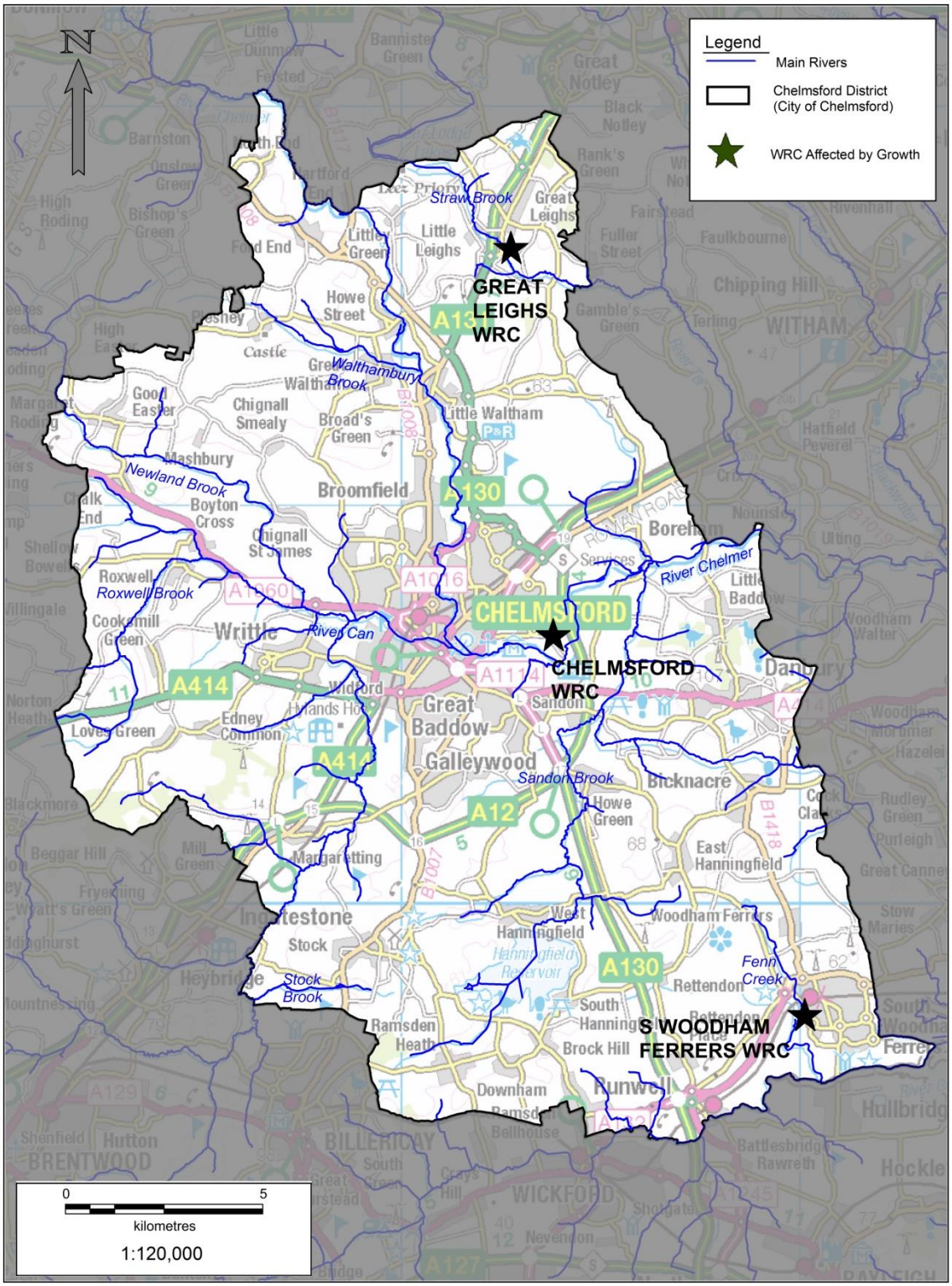
Wastewater treatment in the City Area is provided via wastewater infrastructure (WRCs) operated and maintained by AWS, ultimately discharging treated wastewater to a nearby fluvial watercourse. Each of the WRCs is connected to a network of wastewater pipes (the sewerage system) which collects wastewater generated by homes and businesses to the WRC; this is defined as the WRCs 'catchment'.

Wastewater from the City Area is treated at eight WRCs. The following three WRC catchments are expected to receive additional wastewater as a result of growth and their location illustrated in Figure 4:

- Chelmsford WRC;
- Great Leighs WRC; and
- South Woodham Ferrers WRC.

[14] Adapted from the Sustainable Urban Drainage Scottish Working Party's Water Assessment and Drainage Assessment Guide (2016)

Figure 4. Location of WRC's affected by Local Plan development



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4.2 Management of WRC Discharges

All WRCs are issued with a permit to discharge by the Environment Agency, which sets out conditions on the maximum volume of treated wastewater that it can discharge and also limits on the quality of the treated discharge. These limits are set in order to protect the water quality and ecology of the receiving waterbody. They

also dictate how much wastewater each WRC can accept, as well as the type of treatment processes and technology required at the WRCs to achieve the quality permit limits.

The flow element of the discharge permit determines an approximation of the maximum number of properties that can be connected to a WRC catchment. When discharge permits are issued, they are generally set with a flow 'headroom', which acknowledges that allowance needs to be made for future development and the additional wastewater generated. This allowance is referred to as '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, up to the maximum permitted flow of the discharge permit.

For the purposes of this WCS, the assumption is applied that the permitted headroom is usable[15] and would not affect downstream water quality. This headroom therefore determines how many additional properties can be connected to the WRC catchment before AWS would need to apply for a new or revised discharge permit (and hence how many properties can connect without significant changes to the treatment infrastructure).

When a new or revised 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 remain unchanged, the increased flow of wastewater received at the WRC would result in an increase in the pollutant load[16] 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 provide a higher standard of treatment may result in an increase in the intensity of treatment processes at a WRC, which may also require improvements or upgrades to be made to the WRC 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 not achievable with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

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

4.3 WFD Compliance

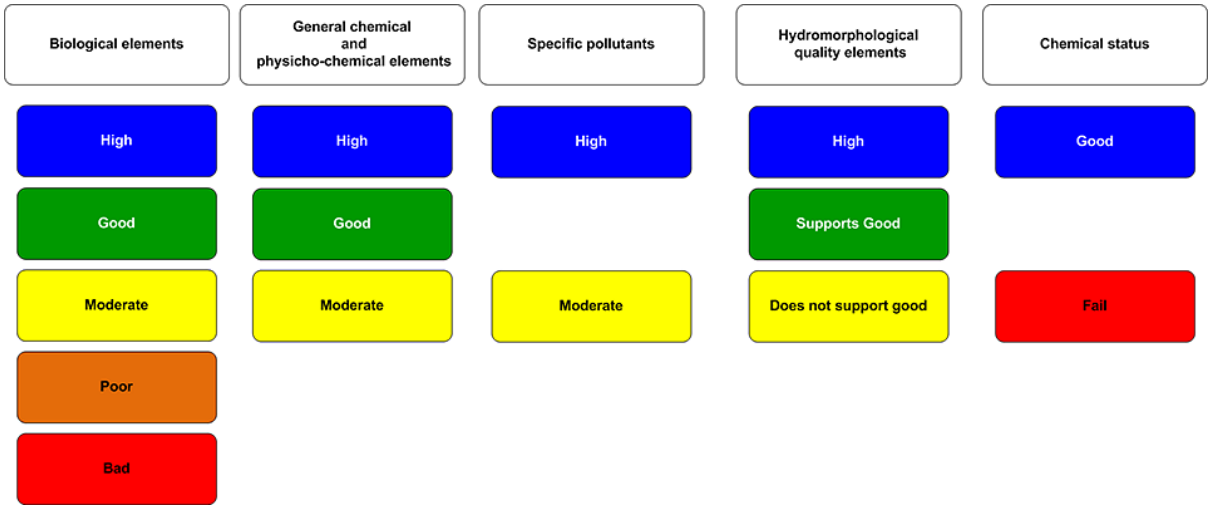
The definition of a waterbody's overall WFD 'status' is a complex assessment that combines standards for chemical quality and hydromorphology (habitat and flow conditions), with the ecological requirements of an individual waterbody catchment. A waterbody's 'overall status' is derived from the classification hierarchy made up of 'elements', and the type of waterbody will dictate what types of elements are assessed within it. The following is an example of the classification hierarchy and Figure 5 illustrates the classifications applied within the hierarchy;

Overall water body status or potential

- Ecological or Chemical status (e.g. ecological)
  - Component (e.g. biological quality elements)
    - Element (e.g. fish)

[15] In some cases, there is a hydraulic restriction on flow within a WRC which would limit full use of the maximum permitted headroom.
[16] Concentration is a measure of the amount of a pollutant in a defined volume of water, and load is the amount of a substance discharged during a defined period of time.

Figure 5. WFD status classifications used for surface water elements



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 WFD status of a waterbody[17]; and
- Development must not prevent a waterbody from achieving its future target status (usually at least Good status).

It is not acceptable to allow a deterioration from High status to Good status, even though the overall target of Good status as required under the WFD is still maintained, this would still represent a deterioration. In addition, if a waterbody's overall status is less than Good as a result of another element, it is not acceptable to justify a deterioration in another element because the status of a waterbody is already less than Good.

Where permitted headroom at a WRC would be exceeded by proposed growth, a water quality modelling assessment has been undertaken to determine the quality conditions that would need to be applied to the a new or revised discharge permit to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in Appendix C.

4.4 Habitats Directive

The Habitats Directive and the associated UK 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 that could be impacted by anthropogenic manipulation of the water environment.

Where permitted headroom at a WRC would be exceeded by proposed levels of growth, a Habitats Regulations assessment exercise has been undertaken in this WCS to ensure that Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would not be adversely affected. The scope of this assessment also includes non-Habitats Directive sites such as nationally designated Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNRs). This assessment is reported in Section 4.9 of this chapter (Ecological Appraisal).

[17] 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

4.5 Wastewater Assessment Overview

4.5.1 Approach

An increase in residential and employment growth will have a corresponding increase in the volume and flow of wastewater generated within the City Area and hence it is essential to consider:

- **Infrastructure Capacity:** defined in this WCS as the ability of the wastewater infrastructure to collect, transfer and treat wastewater from homes and business.
  - What new infrastructure is required to provide for the additional wastewater treatment?
  - Is there sufficient treatment capacity within existing wastewater infrastructure treatment facilities (WRCs)?
- **Environmental Capacity:** defined in this WCS as the water quality needed in receiving waterbodies to protect the aquatic environment and its wildlife. This is ultimately based on water quality targets required to protect wildlife.
  - Can the waterbodies receiving the WRC discharge 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.

4.5.2 Methodology

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

In order to complete the following steps, the following assessment techniques were developed (details of the procedures can be found in Appendix C);

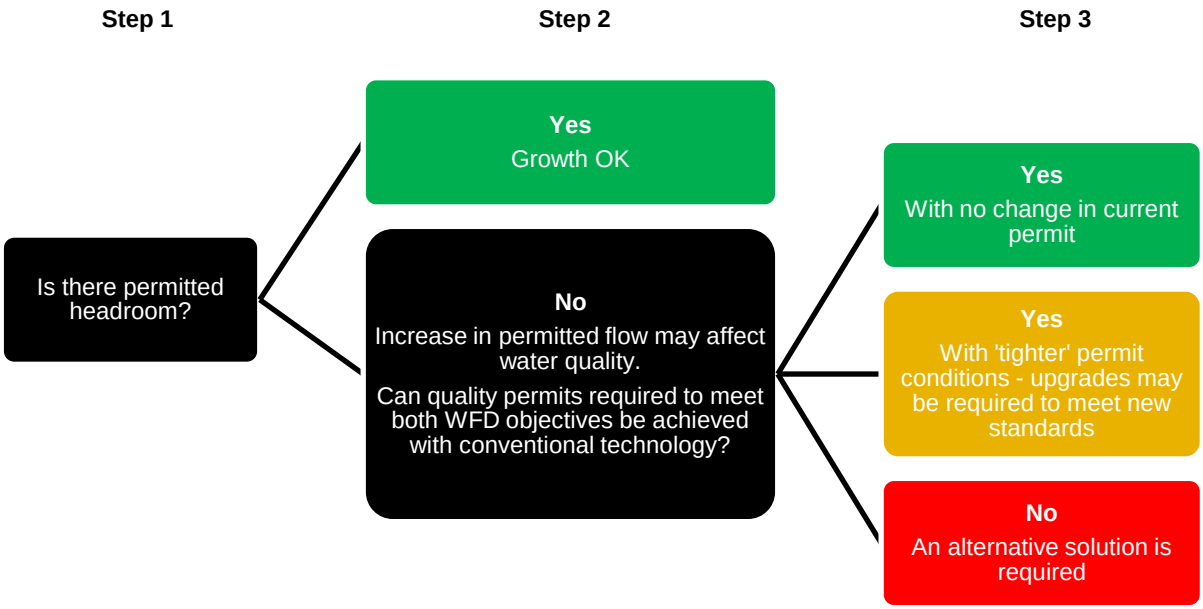
- A flow headroom calculation spreadsheet was developed; and,
- A water quality modelling procedure was agreed with the Environment Agency using Environment Agency software (RQP) designed for determining discharge permit quality conditions.

4.5.3 Assessment Results

The results for each WRC assessment 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 6.

- **Green** – WFD objectives will not be adversely affected. Growth can be accepted with no significant changes to the WRC infrastructure or permit required.
- **Amber** – in order to meet WFD objectives, changes to the discharge permit are required, and upgrades may be required to WRC 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 6. RAG Assessment process diagram for infrastructure capacity



4.6 WRC Headroom Assessment

The assessment results are presented in this section and have been reported in the following order;

- Further detail on WRC catchments where growth can be accepted within the current permitted flow headroom have been reported together in Section 4.6.1;
- Further detail on those WRCs requiring a new discharge permit and hence a water quality assessment have been reported in Section 4.6.2 and 4.6.2.1.

4.6.1 WRC with Permitted Headroom

The volume of wastewater, measured as Dry Weather Flow (DWF), which would be generated from the proposed housing and employment growth over the plan period within each WRC catchment has been calculated and compared to the treatment capacity at each WRC. DWF is a measure of the flow of foul water only to a WRC (excludes additional flow as a result of excessive rainfall or groundwater infiltration entering the sewer network).

Table 6 details the WRCs where existing permitted headroom is sufficient to accommodate all of the proposed growth and hence no wastewater treatment infrastructure upgrades are required to deliver the proposed growth in these locations.

Growth in these WRC catchments would not compromise either of the WFD objectives and hence there is no barrier to delivering the proposed growth. These WRCs are assessed as Green in the RAG assessment and therefore do not require any further assessment.

Table 6 also provides an approximation of the number of additional dwellings that could be connected before the flow condition of the discharge permit would be exceeded.

4.6.2 WRC without Permitted Headroom

The calculations of flow headroom capacity found that two WRCs would not have sufficient headroom once all the growth within the WRC catchment is accounted for as detailed in Table 7. These WRCs would exceed their maximum permitted DWF under their existing discharge permits. Additional headroom can be made available through an application by AWS for a new or revised discharge permit from the Environment Agency.

To ensure that the increase in permitted DWF required to serve the proposed growth would not impact on downstream WFD requirements, water quality modelling has been undertaken for the WRCs listed in Table 7 to determine whether theoretically achievable quality conditions can be applied to a revised discharge permit.

The results of the water quality modelling are provided in Section 4.6.2.1 with detailed results from the modelling provided in Appendix C.

Table 6. WRC with permitted headroom capacity

WRC Catchment	Current DWF Permit (m^3/d)	Current DWF (m^3/d)	Headroom Capacity by 2021		Quantity of proposed dwellings	Future 2036 DWF after growth (m^3/d)	Headroom Assessment after growth (2036)	
			DWF in 2021 (m^3/d)	Calculated Headroom (m^3/d)			Headroom Capacity (m^3/d)	Approx. residual housing capacity
Chelmsford	52,050	34,129	38,795[18]	13,255	***10,419***	***42,380***	***9,670***	***28,100***

Table 7. WRC without permitted headroom capacity

WRC Catchment	Current DWF Permit (m^3/d)	Current DWF (m^3/d)	Headroom Capacity by 2021		Quantity of proposed dwellings	Future 2036 DWF after growth (m^3/d)	Headroom Assessment after growth (2036)	
			DWF in 2021 (m^3/d)	Calculated Headroom (m^3/d)			Headroom Capacity (m^3/d)	Approx. residual housing capacity
South Woodham Ferrers	3,900	3,601	No additional flow (3,601)	299	***1,005***	***3,947***	***-47***	***-136***
Great Leighs	650	590	No additional flow	60	***1,205***	***1,005***	***-355***	***-1031***

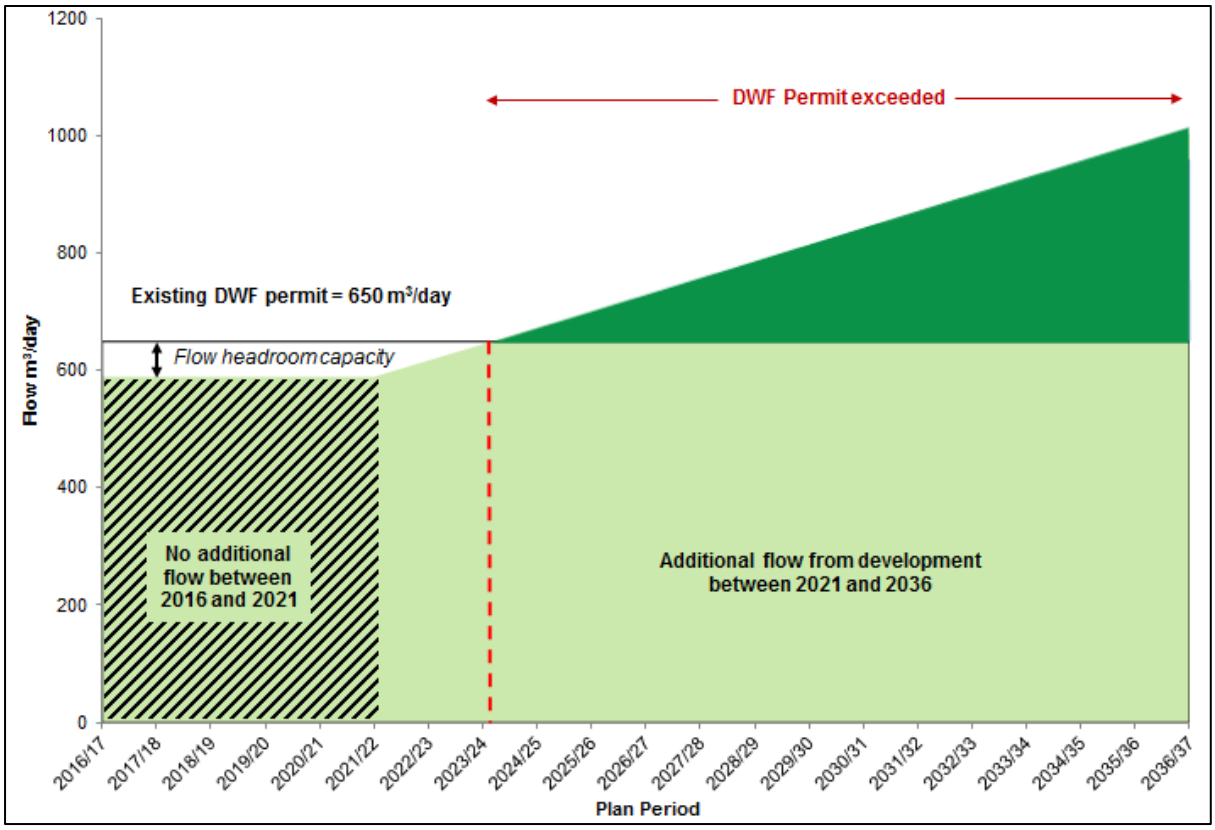
[18] An additional 54 litres per second was estimated due to growth within the Chelmsford WRC catchment up to 2021, equivalent to an additional 4,666m^3/d.

4.6.2.1 Great Leighs WRC

The headroom assessment has demonstrated that Great Leighs WRC currently has sufficient flow headroom in its existing discharge permit to accept development of approximately 170 dwellings[19], after which the discharge permit will be exceeded. Based on a linear housing trajectory, the existing discharge permit will be exceeded in 2024, as shown in Figure 7.

Unless additional flow headroom can be made available at the WRC to accept development beyond 170 dwellings, further development connecting to the WRC would result in the existing discharge permit being exceeded, and by a total volume of 360m^3/d (equivalent to approximately 1,030 dwellings) by the end of the plan period as shown in Figure 7.

Figure 7. Great Leighs WRC DWF across plan period and DWF permit exceedance



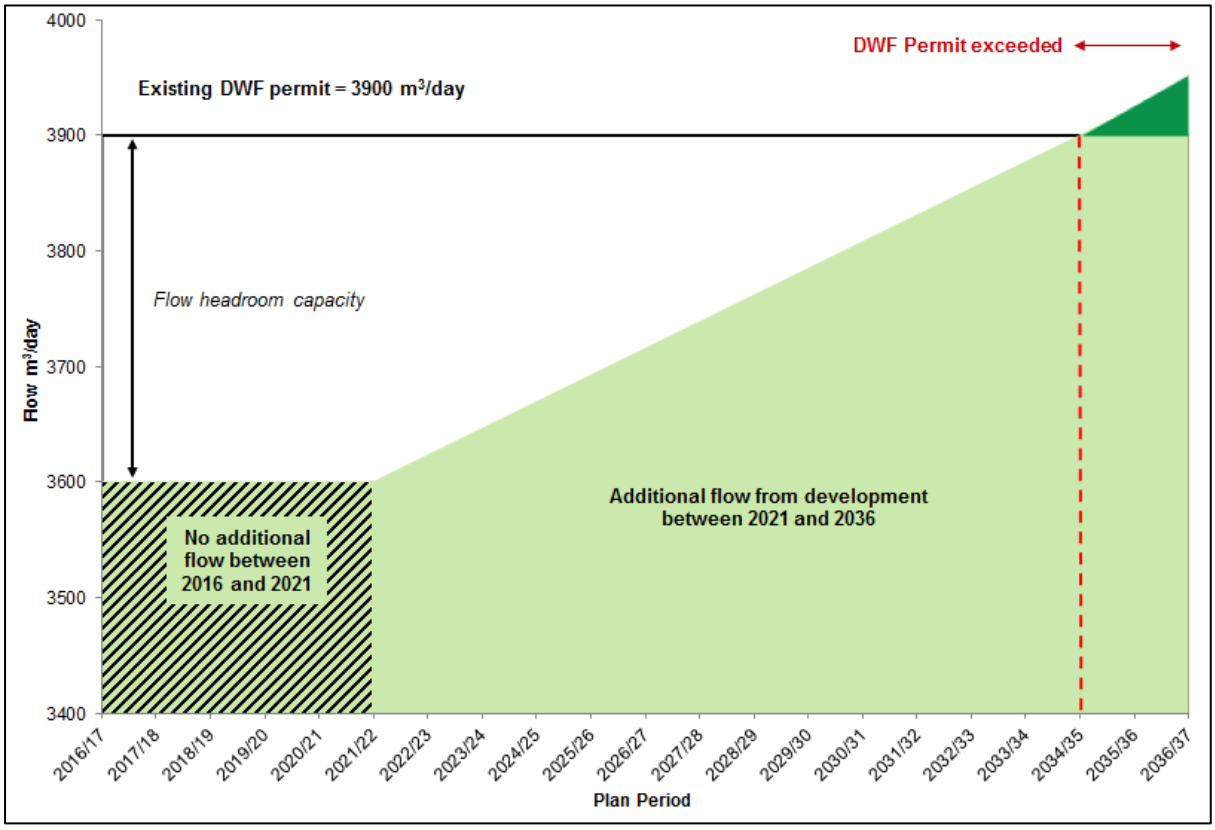
4.6.2.2 South Woodham Ferrers WRC

The headroom assessment has demonstrated that South Woodham Ferrers WRC currently has sufficient flow headroom in its existing discharge permit to accept development of approximately 870 dwellings[19], after which the discharge permit will be exceeded. Based on a linear housing trajectory, the existing discharge permit will be exceeded in2035, as shown in Figure 8.

Unless additional flow headroom can be made available at the WRC to accept development beyond 870 dwellings, further development connecting to the WRC would result in the existing discharge permit being exceeded, and by a total volume of 50m^3/d (equivalent to approximately 140dwellings) by the end of the plan period as shown in Figure 8.

[19] Calculated based on the key assumptions

Figure 8. South Woodham Ferrers WRC DWF across plan period and DWF permit exceedance



4.7 Water Quality Assessment

The WRCs which have been identified as having insufficient permitted flow headroom, discharge directly into either freshwater inland waterbodies or tidally influenced saline waterbodies. Statistical based water quality modelling (using RQP software) has been performed to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate for freshwater inland waterbodies. Load standstill calculations have been used to determine the future permit conditions for BOD of freshwater inland waterbodies and all future permit conditions for tidally influenced saline waterbodies which will ensure the current water quality is maintained. This approach follows Environment Agency guidelines and best practice.

A summary of the results and proposed infrastructure upgrades required are included in the following subsections for each of the WRCs (listed in Table 7) where:

- Development will use up all available flow headroom capacity in the existing DWF permit and will cause the DWF permit to be exceeded; or
- The existing DWF permit is already being exceeded (i.e. currently no available flow headroom capacity) and development is proposed within the WRC catchment.

Under each WRC, the following detail is provided:

- Environmental baseline for receiving watercourse;
- WFD compliance assessment – No Deterioration;
- WFD compliance assessment – Achieve Future Target Status;
- Infrastructure upgrade requirements;
- Phasing of upgrades; and
- Overall RAG assessment.

4.7.1 Great Leighs WRC

4.7.1.1 Environmental Baseline

Great Leighs WRC discharges to the River Ter (GB105037033940). The River Ter currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status to 2021. Its current overall status is limited to Moderate due to the status of phosphate. The current status for ammonia is 'High'.

4.7.1.2 WFD Compliance – No Deterioration

As Great Leighs WRC discharges to the freshwater River Ter, a range of scenarios have been modelled, as agreed with the Environment Agency (see Appendix C for details), to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions. The revised discharge permit quality conditions are presented in Table 8 below.

Table 8. Required permit quality conditions for Great Leighs WRC by the end of the plan period

Determinant	Current permit quality condition (mg/l)	Future permit quality condition required to (mg/l)			
		Limit to 10% deterioration	Load Standstill	No deterioration in status	Achieve Future Target Status
BOD (mg/l 95%ile)	**15**	N/A	**9.7**	N/A	N/A
Ammonia (mg/l 95%ile)	**3.0**	**0.54**	N/A	**2.13**	N/A
Phosphate (mg/l annual average)	None	**4.97**	N/A	**7.03**	N/A

Modelling has been undertaken to take account of the increased wastewater flows from the proposed development, whilst limiting deterioration to no more than 10% of the current downstream quality[20]. The results show that a new phosphate quality condition (currently no phosphate condition) on the discharge permit would be required to ensure the 10% deterioration limit is adhered to. The tighter phosphate quality condition can be achieved with current conventional treatment technologies (within the limits of conventional treatment) and would also ensure no deterioration in phosphate status.

For ammonia, the results show that a new quality condition cannot be achieved with current conventional treatment technologies (beyond the limits of conventional treatment). It is therefore not technically feasible to limit deterioration to 10% for ammonia. Currently, the level of ammonia treatment at Great Leighs WRC (approximately 0.6 mg/l) indicates that the WRC is capable of treating beyond what is considered achievable with conventional treatment technologies (considered to be 1.0mg/l). A tighter ammonia quality condition of 0.5 mg/l may require non-conventional treatment technologies (beyond the limits of conventional treatment), which may not be cost beneficial when balancing environmental capacity with the cost of treatment. Consequently, further modelling has been undertaken outlining the ammonia quality conditions required at Great Leighs WRC to ensure no deterioration in status.

Further modelling has been undertaken, taking into account increased wastewater flows from development, , to determine the most appropriate ammonia and phosphate quality conditions required to only ensure no deterioration in ammonia and phosphate status (i.e. irrespective of the 10% deterioration limit). The results show that a new phosphate quality condition of 7mg/l would be required to ensure no deterioration in the phosphate WFD status. The phosphate quality conditions are less stringent than those required to limit deterioration to no more than 10% and are achievable with current conventional treatment technologies. Tightening of the ammonia permit quality condition would be required under the future growth scenario to a limit of 2.1mg/l. The phosphate quality conditions are less stringent than those required to limit deterioration to no more than 10% and are achievable with current conventional treatment technologies.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition of9.6mg/l would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can also be achieved with current conventional treatment technology (within limits of conventional treatment).

[20] This is required by the Environment Agency for freshwater discharges to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

4.7.1.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future 'Good' Ecological status being reached in the River Ter, due to an alternative objective of 'Moderate' Ecological status being set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to an unfavourable balance between costs and benefits to resolve the less than Good status of phosphate. A detailed explanation for the reason behind the alternative objective has been provided in Appendix F.

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Ter have been provided in Table 9 below.

Table 9. Reasons for not achieving good status on the River Ter (GB105037033940)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (continuous)	Probable	Phosphate	Moderate at 2021

The River Ter currently has high phosphorous concentrations attributable to 'continuous sewage discharge', preventing the waterbody from achieving 'Good' Ecological status.

4.7.1.4 Infrastructure Upgrade Requirements

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WRC are likely to be required before 2024 when based on a linear projection of development under the growth scenario or before development of approximately 1,030 dwellings comes forward and are connected to the WRC catchment. The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) and AMP 8 (2025-2030) asset planning periods, in line with revised quality conditions for ammonia, BOD and phosphate.

By the end of the plan period, the future permit quality conditions detailed in Table 8, will be required to ensure deterioration is either limited to 10% of current water quality, or at least ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS at some point in the future. This demonstrates that a technical solution is feasible.

The current treatment performance of the WRC in terms of ammonia is well within its current ammonia quality condition, demonstrating that the WRC is capable of achieving a much higher quality discharge. Agreement should be sought between the Environment Agency and AWS on the ability of the WRC to accept all proposed growth within the plan period and that a technical solution is feasible to maintain its current ammonia discharge quality. Alternative solutions may need to be considered by Chelmsford City Council should this not be feasible, such as connecting development sites to alternative WRC catchments where feasible and subject to environmental and infrastructure capacity.

4.7.1.5 Phasing of Upgrades

This WCS focuses on growth between 2021 and 2036 which is encompassed by Asset Management Plan 7 (AMP7) and AMP8. AWS are currently preparing for AMP7 which will outline their investment programme from April 2020 to 2025. AWS's approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development proposed will come forward during the plan period before improvements to WRC assets can be justified and funding sought.

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) and to feed into future investment programmes (AMP8) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.7.1.6 Overall RAG Assessment

Great Leighs WRC

The development in the Great Leighs WRC catchment is given an Amber status based on the following requirements:

- A revised DWF discharge permit;
- Revised quality condition for BOD;
- A new phosphate quality condition;
- Investigation into the ammonia treatment capacity of the WRC; and
- Treatment process upgrades at the WRC to achieve the revised quality conditions.

If the above requirements are met, it would ensure development does not compromise the water quality objectives and could mostly be achieved with current conventional treatment technologies. Non-conventional ammonia treatment technologies may potentially be required, but due to the current treatment performance of the WRC, conventional treatment technologies may be sufficient. Funding for the upgrades is not required immediately and can be planned for by AWS as certainty on the quantum of development improves.

4.8 South Woodham Ferrers WRC

4.8.1.1 Environmental Baseline

South Woodham Ferrers WRC discharges to Fenn Creek which forms part of the Crouch Estuary (GB520503704100). The Crouch Estuary currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status to 2021. Its current overall status is limited to 'Moderate' due to the 'Moderate' status of Dissolved Inorganic Nitrogen (DIN), which is also expected to remain 'Moderate' status to 2021. The current status for Dissolved Oxygen (DO) is 'Good', and is expected to remain 'Good' status to 2021, although this is a decline in quality since the 2009 'High' status achieved.

4.8.1.2 WFD Compliance – No Deterioration

As South Woodham Ferrers WRC discharges to the Fenn Creek which forms part of the Crouch Estuary, load standstill calculations have been used to determine the future BOD, ammonia and copper permits[21]. As this is a saline system the revised quality condition helps achieve the DO no deterioration target and the revised ammonia quality condition helps achieve the DIN no deterioration target. The assessed number of dwellings is 1,005.

The revised discharge permit quality conditions are presented in Table 10 below.

[21] Included in assessment as requested by the Environment Agency, due to Copper having been identified in the Dangerous Substances Directive review.

Table 10. Required permit quality conditions for South Woodham Ferrers WRC by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to (mg/l)	
		Ensure no deterioration in status (Load Standstill)	Achieve future target status
BOD (mg/l 95%ile)	**10.0**	9.9	N/A
Copper (mg/l 95%ile)	**17.0**	16.8	N/A
DIN (mg/l 95%ile)	**3.0**	3	N/A

The results of the load standstill calculations for BOD and copper showed that revised (tighter) quality conditions on the discharge permit would be required to maintain the current quality downstream. The tighter BOD and copper quality conditions can be achieved with current conventional treatment technology (within limits of conventional treatment). The results for ammonia showed that no change would be needed to the current permit in order to maintain the current downstream quality.

4.8.1.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future 'Good' Ecological status being reached in the Crouch Estuary due to an alternative objective of 'Moderate' Ecological status being set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to an unfavourable balance between costs and benefits to resolve the less than Good status of DIN. A detailed explanation for the reason behind the alternative objective has been provided in Appendix F.

The RNAG as outlined in the Anglian RBMP, relevant to the Crouch Estuary have been provided in Table 11 below.

Table 11. Reasons for not achieving good status on the Crouch Estuary (GB520503704100)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (continuous)	Suspected	Dissolved Inorganic Nitrogen (DIN)	Moderate at 2021

4.8.1.4 Upgrade Requirements

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WRC are likely to be required before 2035 when based on a linear projection of growth development or before development of approximately 140 dwellings comes forward and are connected to the WRC catchment. The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) and AMP 8 (2025-2030) asset planning periods, in line with revised quality conditions for BOD (to achieve DO status) and copper.

Until such time as the revised quality conditions are agreed with the Environment Agency and process upgrades are delivered by AWS, development may need to be restricted to a rate to be agreed with AWS to ensure that additional flow can be treated and discharged without compromising WFD targets in the Crouch Estuary.

By the end of the plan period, the future permit quality conditions detailed in Table 10 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS at some point in the future.

4.8.1.5 Phasing of Upgrades

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) and to feed into future investment programmes (AMP8) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.8.1.6 Overall RAG Assessment

South Woodham Ferrers WRC

The development in the South Woodham Ferrers WRC catchment is given an Amber status based on the following requirements:

- revised quality condition for BOD and copper,
- process upgrades at the WRC to achieve the revised quality conditions.

The above requirements would ensure development does not compromise the WFD objective of no deterioration in status and could be achieved with current conventional treatment technologies. The requirements listed above would be necessary from 2035 to ensure development can be delivered without compromising WFD objectives. Funding for the upgrades is not required immediately and can be planned for by AWS as certainty on the quantum of development improves.

4.9 Ecological Appraisal

WRCs that do not need to change their current discharge permits are not discussed in this appraisal. This is on the basis that the ecological impacts of those permits that do not require change should have already been considered as part of the permitting process and/or (for internationally important wildlife sites) through the Environment Agency's Review of Permits process.

To undertake this appraisal, those WRCs that would exceed current discharge permits to accommodate the planned future development were identified. Having done this, the receiving watercourses for those WRCs were traced downstream from the WRC discharge location. Where a receiving watercourse enters, or passes adjacent to, a wildlife site that has potential to be vulnerable to changes in hydrology (based on the information available such as citations), these are identified and discussed in the following section. The discussion relating to individual WRCs includes, where required, recommendations to ensure that future development does not adversely affect wildlife sites. Where available, reasons for designation of the wildlife sites have been gathered primarily from the following sources:

- Joint Nature Conservation Committee (JNCC);
- Natural England (NE); and
- Chelmsford City Council.

For non-statutory wildlife sites, it is common for them to lack specific citations which can create difficulty in identify the specific interest features. Where no citation is available and only a site name exists, an online search was undertaken to determine the key habitats present. If the online search did not identify habitats present then the precautionary principal has been used. Where it was not possible to determine if a site was hydrologically linked to the watercourse (i.e. merely in close proximity), the site was included in the discussion of the assessment as a precaution.

Following this process, sixteen statutory and two non-statutory designated sites have been identified as being hydrologically connected to WRCs that are unable to meet expected development needs during the Plan period without a change to their discharge permits. These WRCs are: Great Leighs and South Woodham Ferrers. The designated sites connected to these WRCs (even if just located adjacent to the watercourse but not confirmed to be hydrologically dependent upon it) are (listed alphabetically):

- Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ),
- Blackwater Estuary Site of Special Scientific Interest (SSSI),
- Blackwater Estuary (Mid Essex Coast Phase 4) Special Protection Area (SPA)/ Ramsar,
- Crouch and Roach Estuaries SSSI,
- Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar and SPA,
- Dengie (Mid-Essex Coast Phase 1) SPA, Ramsar,

- Essex Estuaries Special Area of Conservation (SAC),
- Fen Creek Marsh Local Wildlife Site (LWS),
- Foulness (Mid-Essex Coast Phase 5) SPA, Ramsar,
- Foulness SSSI,
- Lowley's Farm Meadow, Little Leighs LWS,
- Outer Thames Estuary SPA and potential SPA (pSPA) extension,
- River Ter SSSI, and
- The Cliff, Burnham-on-crouch SSSI.

All other designated sites identified within the City Area are remote from watercourses into which WRCs discharge treated effluent. The ecological background to the statutory designated sites, including the details of the interest features and relevant condition assessments (where available), is provided in Appendix E.

4.9.1 Impact on Designated Sites

Table 12 identifies the two WRCs that do not have sufficient headroom to accommodate the proposed increase in development within their catchments and lists the wildlife sites that contain linking pathways to each relevant WRC. As such, they would exceed their maximum permitted DWF under their existing discharge permits. These WRCs are:

- Great Leighs WRC, and
- South Woodham Ferrers WRC.

Table 12. Wildlife Sites that contain linking pathways to each relevant WRC

WRC	Wildlife Site	Comments
Great Leighs (discharges into the River Ter; flows into the River Chelmer)	Lowley's Farm Meadow, Little Leighs LWS	0.4km downstream of the River Ter
	River Ter SSSI	1.1km downstream of the River Ter
	Blackwater, Crouch, Roach and Colne Estuaries MCZ	20.75km downstream on the River Chelmer
	Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI	22.55km on the River Chalmer
South Woodham Ferrers (discharges Fenn Creek; flows into River Crouch)	Crouch and Roach Estuaries SSSI, Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar and SPA, Essex Estuaries SAC	Adjacent to WRC
	Fenn Creek Marsh LWS	0.8km downstream of Fenn Creek
	The Cliff, Burnham-on-crouch SSSI, Outer Thames Estuary Extension pSPA	22.0km downstream on the river Crouch
	Dengie (Mid-Essex Coast Phase 1) SPA, Ramsar, Foulness (Mid-Essex Coast Phase 5) SPA, Ramsar and Foulness SSSI	23.5km downstream on the river Crouch

4.9.1.1 Great Leighs WRC

It is estimated that this WRC will have a permitted flow headroom capacity for approximately 170 homes by 2021 (baseline year). However, by the end of the Plan period (2036) it is modelled that planned development within the WRC catchment will result in an exceedance of the permitted flow headroom capacity by 55%, resulting in an exceedance of permitted effluent discharge volume and quality.

Great Leighs WRC discharges into the River Ter, a freshwater system. After 0.4km the River Ter flows past **Lowley's Farm Meadow LWS**. No citation is available for this site for this commission. From reviewing aerial photography, habitats associated with this site are likely to receive flood water from the River Ter and so are

vulnerable to changes in levels of phosphate and nitrogen (from nitrification of ammonia) carried within the floodwaters. **Nitrogen** is the principal growth-limiting nutrient in terrestrial habitats. Elevated levels of nitrogen in terrestrial habitats can result in increased plant growth of species that can readily take advantage of the increased levels of nitrogen. This is likely to result in these plant species outcompeting less competitive plant species, thus potentially altering the species composition of the site. 1.1km downstream of the WRC discharge is the **River Ter SSSI**. The SSSI is a lowland stream with a low base flow discharge and high flood peaks. For the freshwater environments such as those associated with this SSSI, **phosphate** is the principal growth-limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. Increased levels of **Biochemical Oxygen Demand (BOD)** can result in lower oxygen levels in watercourses which in turn can result in death of plants and animals. Further, in addition to **phosphate** related concerns, even relatively low levels of ammonia can be toxic to plants and animals resulting in death.

The River Ter flows into the River Chelmer, which more than 20km downstream from the discharge point flows into the **Blackwater, Crouch, Roach and Colne Estuaries MCZ, Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI**. Due to the estuarine conditions and dynamic tidal processes, water conditions are essentially cold and relatively turbid with high levels of water movement and wave action. As such, inflows into the estuarine sites are constantly changing and water is flushed away from the area dispersing any waste water and associated sedimentation, phosphates, ammonia and Biochemical Oxygen Demand (BOD). In addition, the conditions described above tend to result in the various Essex estuaries being less susceptible to excessive macro-algal summer growth and winter persistence (and thus smothering of underlying sediments) than the estuaries in the warmer, clearer, calmer waters of the south coast such as the Solent estuaries, notwithstanding their generally hyper-nutrified status. This is supported by the analyses contained in several of the Environment Agency's Stage 3 Review of Consents reports for these estuaries. As such, the features for which these sites are designated (see Appendix E) are likely to be affected by wastewater discharge to a much smaller extent than other estuarine sites, particularly at distances of more than 20km, with consequent extensive dilution.

However, it should be noted that the increase in inorganic dissolved nitrogen has potential to affect the oyster populations for which the MCZ is designated[22]. It is also noted that the MCZ is located more than 20 km distant from the WRC discharge point, so nitrogen associated with waste water discharge is likely to have been significantly diluted. Nonetheless, cumulative effects from multiple sources could affect the ability of the MCZ to achieve its target for dissolved inorganic nitrogen.

The No Deterioration Assessment identifies that for ammonia it is not technically possible using current conventional treatment technology to achieve a 10% no deterioration target. For phosphate it is technically possible to achieve no more than 10% deterioration in current phosphate even with the proposed future growth, thus ensuring no deterioration in WFD status. As such, the current targets could still be met and there would be no significant negative effect from the future growth compared to the current situation.

With reference to the general water quality of inorganic dissolved nitrogen in the Blackwater Estuary downstream; the deterioration in ammonia concentrations in upstream waterbodies (between 10% and the status threshold) should be taken into account when a decision is to be made on a revised ammonia quality condition for Great Leighs WRC.

For ammonia, BOD and phosphate, permit tightening will be required to ensure that permitted discharge quality thresholds do not deteriorate significantly, but this is considered to be possible within the limits of Best Available Technology. It is concluded that further restriction of ammonia discharges from this WRC has not been identified as being essential to help the MCZ achieve its target status.

4.9.1.2 South Woodham Ferrers WRC

It is estimated that this WRC will have a permitted flow headroom capacity for approximately 870 homes by 2021 (baseline year). However, by the end of the Plan period (2036) it is modelled that planned development within the WRC catchment will result in an exceedance of the permitted flow headroom capacity by 1%, resulting in an exceedance of permitted effluent discharge volume and quality.

[22]Natural England. Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ). Supplementary advice on conserving and restoring site features https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/455508/Blackwater_Crouch_Roach_and_Colne_Estuaries_MCZ_Supplementary_Advice.pdf

This WRC discharges directly into tidally influenced waterways of Fenn Creek and the **Crouch and Roach Estuaries SSSI, Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar and SPA** and into the **Essex Estuaries SAC**. After 0.8km Fenn Creek enters **Fenn Creek LWS**. Due to the estuarine conditions and tidal processes, water conditions are essentially cold and relatively turbid with high levels of water movement and wave action. Inflows into the estuaries are constantly changing and water is flushed away from the area dispersing any waste water, and associated nutrients including **dissolved oxygen (DO) and dissolved inorganic nitrogen (DIN)**. DO in the water enables water-breathing animals to respire and produce energy to live. A reduction in **DO** in a saline waterway could result in reduced health or death of animals and plants present, and changes in species composition. An increase of **DIN** has potential to cause phytoplankton and opportunistic macroalgae blooms, which can lead to reduced dissolved oxygen availability in estuarine conditions and eutrophication, potentially resulting in reduced oxygen and death of flora and fauna.

In theory, due to the dynamic nature of the coastal and estuarine process within these designated sites, any WRC by-products will be quickly and frequently diluted and dispersed, thus not impacting upon the designated features and sites. As such, the features for which this site is designated (see Appendix E) are either relatively insensitive to the effects of an increase in waste water discharge or are likely to be affected to a minimal extent.

Approximately 22km downstream on the River Couch enters **The Cliff, Burnham-on-crouch SSSI** and the **Outer Thames Estuary Extension pSPA**. Beyond this at 23.5km downstream of the River Couch is **Dengie (Mid-Essex Coast Phase 1) SPA and Ramsar** and **Foulness (Mid-Essex Coast Phase 5) SPA, Ramsar and Foulness SSSI**. At these further distances, and due to the tidal and essentially marine nature of the sites, any effects of waste water discharge will have been sufficiently diluted to not impact upon the designated features of these wildlife sites.

The No Deterioration Assessment identified that to ensure future DO, DIN and copper quality downstream is maintained, tightening of the respective DO and copper quality conditions is required. The levels of tightening of the quality conditions required to maintain current quality of DO, DIN and copper downstream are possible within the limits of conventional technology.

4.9.2 Impacts on Ecology Outside Designated Sites

Whilst the above assessment is primarily focused on the impact on ecologically designated sites, the following section discusses ecology outside of designated sites. The limitations of a WCS make it impossible for such a discussion to be exhaustive or spatially very specific.

In addition to impacts on designated sites, a range of other UK species listed under the Natural Environment and Rural Communities (NERC) Act (2006) Section 41 and / or Essex Biodiversity Action Plan (BAP) species or otherwise protected/notable species that are found in Essex can be affected by wastewater discharge. These include:

- Water vole (Arvicola amphibious) (protected through Wildlife & Countryside Act 1981 and a NERC S41 species BAP species),
- Grass snake (Natrix natrix)(partially protected through Wildlife & Countryside Act 1981),
- Common toad (Bufo bufo) (NERC S41 species),
- Great crested newt (Triturus cristatus) (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a NERC S41 species),
- Birds such as bittern (Botaurus stellaris)(a NERC S41 species), kingfisher (Alcedo atthis), lapwing (Vanellus vanellus) and snipe (Gallinago gallinago) (protected through Wildlife & Countryside Act 1981), and
- Otter (Lutra lutra) (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a NERC S41 species and Essex BAP species).

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

- Floodplain and coastal grazing marsh,
- Reedbeds,
- Coastal saltmarsh, and
- Rivers & streams.

All of these habitats and species are present (or possibly present) in the City Area.

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

The assessment in the previous section on designated wildlife sites identified that wildlife sites assessed that were close enough to the WRC discharge points to be vulnerable to changes in discharge volumes includes both freshwater and terrestrial features, which were thus limited by phosphate, ammonia (nitrogen via nitrification of ammonia) and BOD levels. Phosphates are the primary limiting nutrient in freshwater systems; where levels are high it can lead to the death of aquatic plants and animals via the process of eutrophication. The impacts of ammonia on freshwater systems can result in death of plants and animals. In terrestrial and marine habitats the primary limiting compound is nitrogen (from nitrified ammonia) which can result in less competitive plant species being out competed by plant species that are more able to assimilate nitrogen for growth. Reduced BOD levels can result in lower oxygen levels in watercourses that can result in death to plants and animals. In addition, the assessment in the previous sections identified that wildlife sites associated with estuarine conditions were close enough to the discharge points to be potentially vulnerable to changes in DO and DIN. Lower levels of DO can result in lower oxygen levels for use by organisms and can result in their death. In estuarine conditions increased levels of DIN can result in algal blooms and subsequent eutrophication, potentially resulting in reduced oxygen and death of flora and fauna. However due to the dynamic nature of estuaries, it is considered that it is likely that nutrients will be rapidly flushed, mixed with surrounding water and dispersed.

Levels of development identified during the Plan period have potential (albeit probably only cumulatively with the existing exceedances) to have an adverse effect on wildlife of the receiving freshwater, terrestrial and estuarine habitats and watercourses downstream and avoidance measures will be required as already outlined.

4.9.3 Ecological Opportunities Associated with Proposed Development Locations

To ensure that the planned level of development within the Plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that policy is included within the Local Plan to ensure that these matters are addressed at a strategic level and water quality at these locations will be improved to suitable WFD levels and permit levels. This may include the requirement for new infrastructure to be in place prior to the delivery of new development or the need for phased infrastructure to ensure that the WRCs can accommodate the increased capacity and not result in a detrimental impact upon wildlife features.

Further to recommended policy, it is also recommended that where ecological risks resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.

4.10 Wastewater Summary

WRCs which are shown to exceed their volumetric permits have undergone water quality modelling (Great Leighs and South Woodham Ferrers). The results demonstrate that there is environmental capacity for the proposed options for growth as long as permit changes and related process upgrades are undertaken.

Therefore, from a WFD perspective there is capacity to accept growth and comply with current WFD targets based on the limits achievable with current technology. However, environmental capacity should be considered to be ultimately limited on the basis that limitations on current treatment technologies are preventing the optimal target of future good status from being achieved. The capability and performance of treatment technologies are likely to improve over time, and hence capacity for additional wastewater flow would need to be reconsidered in the context of achieving good status up to the end of the plan period and beyond.

Table 13 provides a summary of the RAG assessment of the WRCs within the City Area which have been assessed as not having sufficient headroom to accommodate growth.

Table 13. Water Recycling Centres assessment summary

WRC	Watercourse	WFD ID	Is headroom available for the calculated growth?	Is a revised quality condition required?		Technically feasible to…		Overall RAG
						Ensure no deterioration in status?	Limit deterioration to 10% or less?	
Great Leighs	River Ter	GB105037033940	Headroom only up to approximately 170 dwellings	Ammonia	Yes	Yes	No	Treatment process upgrades using conventional and possibly non-conventional treatment technologies will be required to meet river quality targets. Permit setting recommended for phosphate.
				BOD	Yes		N/A	
				Phosphate	Yes		Yes	
South Woodham Ferrers	Fenn Creek, part of Crouch Estuary	GB520503704100	Headroom only up to approximately 870 dwellings	Ammonia	No	Yes	N/A	Treatment process upgrades will be required using conventional treatment technologies to meet river quality targets.
				BOD	Yes		N/A	
				Copper	Yes		N/A	

5. Water Supply Strategy

5.1 Introduction

Water supply for the City Area is provided by ESW. An assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems has been completed within this WCS. The assessment has been based on the Environment Agency's Essex Catchment Abstraction Licensing Strategy; it is important to note that this considers raw water resources within the study area as well as those used outside of the study area by ESW to supply the study area with potable water.

This study has used the final version of ESWs 2014 WRMP[23] 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 ESW's WRMP.

5.2 Abstraction Licensing Strategies

An assessment of the existing environmental baseline with respect to available resources in the aquifers and the main river systems has been completed based on the Environment Agency's abstraction licensing strategies.

The Environment Agency manages water resources at the local level through the use of abstraction licensing strategies. Within the abstraction licensing strategies, 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 within the authority area of Chelmsford are shown in Table 14. 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.

Table 14. CAMS water resource availability status categories

Indicative Resource Availability Status	License Availability
Water available for licensing	There is more water than required to meet the needs of the environment. New licences can be considered depending on local and downstream impacts.
Restricted water available for licencing	Full Licensed flows fall below the Environmental Flow Indictors (EFIs). If all licensed water is abstracted there will not be enough water left for the needs of the environment. No new consumptive licences would be granted. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available if you can 'buy' (known as licence trading) the entitlement to abstract water from an existing licence holder.
No water available for licencing	Recent actual flows are below the EFI. This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status (as required by the Water Framework Directive No further consumptive licences will be granted. Water may be available if you can buy (known as licence trading) the amount equivalent to recently abstracted from an existing licence holder.

The classification for each of the Water Resource Management Units (WRMU) as defined in the Essex abstraction licensing strategy[24]in the City Area as well as the River Stour where Chelmsford's water supply is currently partially sourced by ESW, has been summarised for surface waterbodies in Table 15

[23] Essex and Suffolk Water Resources Management Plan (2014) https://www.eswater.co.uk/_assets/documents/ESW_Final_Published_PR14_WRMP_Report_-_V3_-_08OCT14.pdf
[24] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/636594/ALS_2017_Essex.pdf

Table 15. CAMS surface waterbody resource availability classification

River – WRMU	Surface Water (flow exceedance scenarios)			
	Q30	Q50	Q70	Q95
AP19 Rivers Wid/Can				
AP2 River Stour				

Rivers Wid/Can is defined as having no water available for licencing during periods of low flow (Q70-Q95). During periods of higher flow (Q30) a restricted amount of water is available for licencing. This analysis indicates that there is potential for local abstractions during periods of higher flow. This may be beneficial to supplying water resources. The River Stour is defined as having no water available for licensing at all levels of flow. At present supply for Chelmsford is abstracted from the River Stour and Abberton Reservoir.

Within the Essex CAMS, the status of groundwater resource availability is guided by surface water resource availability thus the status of a surface water body also applies to those groundwater bodies directly beneath it and also those it influences. On this basis the above availability of surface water resources demonstrated in Table 15 applies to the groundwater resources within the vicinity of the City Area.

5.3 Water Resource Planning

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

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

Water companies manage available water resources within key zones, called Water Resource Zones (WRZ). These zones share the same raw resources for supply and are interconnected by supply pipes, treatment works and pumping stations. As such the customers within these zones share the same available 'surplus of supply' of water when it is freely available; but also share the same risk of supply when water is not as freely available during dry periods (i.e. deficit of supply). Water companies undertake resource modelling to calculate if there is likely to be a surplus of available water or a deficit in each WRZ by 2040, once additional demand from growth and other factors such as climate change are taken into account.

5.4 Water Resource Planning in the City Area

ESW are yet to confirm 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 (refer to AECOM's position statement below). The WCS update therefore concludes that a sufficient sustainable water supply is available to meet planned demand without impacting adversely on the environment.

AECOM Position Statement - January 2018

AECOM's review of the Essex and Suffolk Water (ESW) Water Resource Management Plan (WRMP) suggests that the proposed Chelmsford growth figures have been accounted for within the WRMP, although due to growth figures not being explicitly stipulated per District, confirmation is required from ESW that this is in fact the case.

5.5 Demand for Water

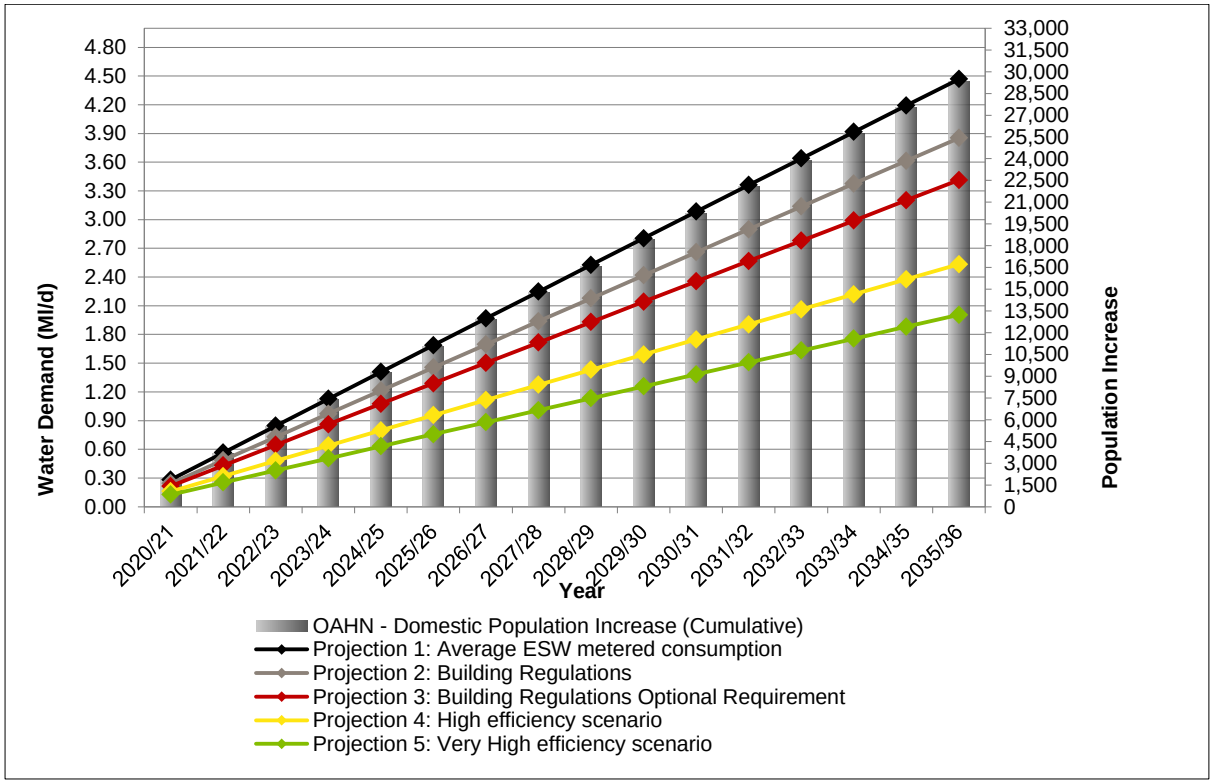
Likely increases in demand in the City Area have been calculated using five different water demand projections based on different rates of water use for new homes that could be implemented through potential future policy. Employment growth has also been accounted for and based on the assumption of 887 jobs per year[25] throughout the plan period, with a consumption rate of 16l litres per job per day (l/job/d).

The projections were derived as follows:

- **Projection 1** – Average ESW metered consumption – New homes would use 146l/h/d, this reflects the planning consumption used by ESW to maintain security of supply;
- **Projection 2** – Low Scenario (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 3** – Medium Scenario (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 4** – 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 5** – 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 2.00 and 4.47 Ml/d by 2036. The projections are shown in Figure 9.

Figure 9. Range of water demands across plan period in the City Area depending on efficiency levels of new homes



[25] as provided by Chelmsford City Council from the Issues and Options Local Plan Consultation Document.

5.6 Planned Water Availability Summary

The final 2015 WRMP for ESW has been used to summarise water availability to meet the projected demand for the City Area covering the planning period to 2040.

5.6.1 Essex Water Resource Zone (WRZ)

The ESW Essex WRZ is supplied using mainly surface water obtained from the Chelmer, Blackwater, Stour and Roman Rivers which support two pumped storage reservoirs. A small portion of groundwater is supplied via Chalk wells and underground sources.

For this WRZ, ESW predicted there to be a supply-demand surplus of 63.61Ml/d (during the Dry Year Annual Average) by the end of AMP9 (2034/35) and a surplus of 63.61 Ml/d by 2040.

5.6.1.1 Supply-Demand Strategy

As ESW have predicted a surplus in the Essex WRZ, no supply-demand strategy has been proposed for this WRZ.

5.7 Water Efficiency Plan

As well as providing additional supply resource, it is important to ensure that the existing resources are used as efficiently as possible to reduce demand. AWS is planning a series of demand management measures and a number of improvements to existing infrastructure and resources. The majority of these measures will be undertaken in AMP6 (2015-2020). Lowering water consumption levels is considered to be a priority in offsetting resource development.

Proposed demand management measures across the WRZ include:

- Completing water efficiency audits;
- ESW retrofit projects including H2eco and ecoFIT;
- Water metering; and,
- Leakage reduction.

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 City Area.

5.8 Drivers and Justification for Water Efficiency

In 2013, ESW supply areas were classified by the Environment Agency as an 'Area of serious water stress'[26] 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. This creates a very strong driver for new homes in the next 25 years to be made as efficient as economically possible to safeguard the future resources to be made available by ESW in the City Area.

5.8.1 Managing Climate Change and Availability of Water

It is predicted that climate change will further reduce the available water resources in the City Area. Rainfall patterns are predicted to change to less frequent, but more extreme, rainfall events.

ESW have recognised the risk climate change poses to the two crucial areas of their business, abstraction and distribution of water. The impact of climate change on groundwater poses the most significant risks to long term supply/demand balance due to reductions in rainfall, particularly during consecutive seasons, reducing the amount of groundwater recharge that occurs.

[26] Environment Agency (2013). Water Stressed Areas – Final Classification. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

Customers expect ESW 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.

In planning for future water resources availability, ESW has accounted for the impacts of climate change within their supply-demand forecasts.

Additionally, it is recognised that piping of surface water can be detrimental to groundwater recharge in comparison to discharging water to ground via infiltration techniques. As discussed further in section 6.1.3 below Essex County Council as LLFA are encouraging prioritisation of drainage via infiltration through their Sustainable Drainage Systems Design Guide (2016), even where it is only feasible for partial drainage of a site.

5.8.1.1 Impact on Supply

ESW has 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 impact of a worst case climate change scenario on water resources over the plan period within the ESW Essex WRZ is estimated at an increase 4.16 Ml/d by 2040.

5.8.1.2 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. ESW has accounted for the impact on the peak demand and the longer duration effect of a dry year through forecasting the increased demand of water and accounting for it in their plans.

Although ESW have planned for the anticipated impacts of climate change, the view of ESW 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.

5.9 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[27]. 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
- 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.

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

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

5.9.1 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, 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 City Area, a number of measures and devices are available[28]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted. Appendix D provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

5.9.2 Achieving Total Neutrality – is it feasible?

When considering neutrality within an existing planning area, it is recognised by the Environment Agency[29] that achievement of total water neutrality (100%) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

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

5.9.3 Metering Assumptions

Installing water meters within existing residential properties is an important element of ESWs WRMP to manage their customers' demand for water. ESWs metering programme as described in the WRMP has been applied to the four water neutrality scenarios (outlined in Section 5.9.4) and details the level of additional metering that could be undertaken.

The 2019-2020 metering target within the ESW Essex WRZ is 65.2%. ESW's future target for meter penetration[30] on domestic water meters is 83% by 2036. As stated in the ESW WRMP, meter installation will continue to the target of 85% of domestic water supplies to be metered by 2040.

5.9.4 Water Neutrality Scenarios

5.9.4.1 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 City Area 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 (16%) in the City Area.

[28] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[29] Environment Agency (2009) Water Neutrality, an improved and expanded water management definition
[30] proportion of properties within the ESW Essex WRZ which have a water meter installed

It would require:

- Meter installation into all existing residential properties (100% meter penetration);
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;
- Strong local policy within the Local Plan's on restriction of water use in new homes on a local authority scale which is currently unprecedented in the UK; and
- All new development to include water recycling facilities across the City Area.

5.9.4.2 High Scenario

The key assumptions for this scenario are that a high water neutrality percentage[31] 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:

- Meter installation up to the maximum planned (up to 2040) as per ESW WRMP (85% meter penetration);
- Uptake of retrofitting water efficiency measures to be high (15%) in relation to studies undertaken across the UK;
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required; and
- All new development would need to include rainwater harvesting.

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.

5.9.4.3 Medium Scenario

The key assumptions for this scenario are that the water neutrality percentage[31] achieved is close to 45%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:

- Meter installation as per ESW WRMP by 2036 (83% meter penetration);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be reasonably moderate (10%) in the study area; 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.

5.9.4.4 Low Scenario

The key assumptions for this scenario are that the water neutrality percentage[31] achieved is low but would require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement.

It would require:

[31] 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

- Meter installation as per ESW WRMP by 2036 (83% meter penetration);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be fairly low (5%); 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.

5.9.5 Neutrality Scenario Assessment Results

To achieve total water neutrality (WN), the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, existing demand in the study area was calculated to be 26.3 Ml/d.

For each neutrality option and scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise, UKWIR[32], the Environment Agency and OFWAT to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (Appendix D).

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

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting for the differing levels of water efficiency in new homes;
- Stage 2 – total demand post growth with effect of metering applied for the differing levels of water efficiency in new homes; and,
- Stage 3 – total demand post growth with metering and water efficient retrofitting applied to existing homes for the differing levels of water efficiency in new homes. The results are provided in Table 16. If neutrality is achieved, the result is displayed green. If neutrality is not achieved, but is within 5%, the result is displayed amber, and red if neutrality above the 5% threshold is not achieved. The percentage of total neutrality achieved per scenario is also provided.

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

Table 16. Results of the Neutrality Scenario Assessments

WN Scenario	New Homes demand projections	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering (Ml/d)	Total demand after metering & retrofitting (Ml/d)	% Neutrality Achieved
Baseline	Projection 1: Average ESW metered consumption	4.47	30.76	**30.49**	**30.49**	6%
Low	Projection 2a: Building Regulations	3.85	30.15	**29.88**	**29.88**	20%
	Projection 2b:Building Regulations + retrofit	3.85	30.15	**29.88**	**26.69**	24%
Medium	Projection 3a: Building Regulations optional requirement	3.41	29.71	**29.44**	**29.44**	30%
	Projection 3b: Optional requirement + retrofit	3.41	29.71	**29.44**	**28.76**	45%
High	Projection 4: High efficiency	2.53	28.33	**28.52**	**27.15**	81%
Very High	Projection 5: Very High efficiency	2.00	28.30	**27.74**	**26.30**	100%

* prior to demand management for existing housing stock

The results show that total neutrality is only achieved by applying the Very High WN scenario, requiring new homes to use water at a rate of 62 l/h/d. The Medium WN scenario would give a minimum of 30% neutrality which would require only new homes to be designed to use water at a rate of 110 l/h/d (Projection 3a). A further 15% neutrality (up to 45%) could be achieved through retrofitting 10% of the existing housing stock with water efficiency fittings equivalent to the optional requirement standard.

5.9.6 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 City Area, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development.

Using the information compiled, the financial costs per neutrality scenario has been calculated and are included in Table 17. It should be noted that these are only estimated costs based on strategic level research into water efficiency implementation and cost.

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Table 17. Estimated Cost of Neutrality Scenarios

Neutrality Scenario	New Homes		Existing Properties					Costs Summary		
	No.	Efficiency cost	No. to be metered	Metering cost	Population Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	12,629	-	13,038	£ 6,519,160	5%	3,835	£ 191,740	-	£ 6,710,900	£ 6,710,900
Medium	12,629	£ 113,661	13,038	£ 6,519,160	10%	7,670	£ 1,457,224	£ 113,661	£ 7,967,384	£ 8,090,045
High	12,629	£ 34,060,413	13,038	£ 6,519,160	15%	11,504	£ 2,530,968	£ 34,060,413	£ 9,050,128	£ 43,110,541
Very High	12,629	£ 51,741,013	13,038	£ 6,519,160	16%	12,271	£ 2,699,699	£ 51,741,013	£ 9,218,859	£ 60,959,872

5.9.7 Preferred Strategy – Delivery Pathway

It can be seen from the results in Table 16 that water neutrality can be achieved under a Very High WN scenario. While this is achievable in theory, this would come with significant cost both to the developer, but also a funded partnership through the significant need for retrofitting of existing homes and enhanced metering. It is recommended that a water neutrality target of Medium (Projection 3a and 3b) be set for the study area as a whole in order to balance the objective of achieving a more water neutral position as well as limiting the cost implications of implementing such an initiative.

In order to achieve this WN target and enhance sustainable development moving forward, policy should be developed that ensures all new housing is as water efficient as possible and that objectives are set that new housing development is required to achieve the Building Regulations optional requirement water use of 110 l/h/d. Non-domestic buildings should as a minimum reach 'Good' BREEAM status. Further details of how a target of 110 l/h/d can be achieved are detailed in Appendix D.

To further promote 'water neutrality' in the study area, it is recommended policy 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, equivalent to the fittings as described for use in new dwellings under the Building Regulations optional requirement.

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

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

5.9.8 Delivery Requirements – Policy

In order to meet the medium 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 to try to limit water use to 110 l/h/d (optional Building Regulations requirements), including (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances.

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

5.9.9 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 Chelmsford City Council, ESW, 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.

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, the council should implement an awareness and education campaign, which could include the following:

- working with ESW 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;
- 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 the study area, but rather should be used to support a targeted scheme aimed at a specific residential group.

5.9.9.1 Responsibility

The recommendations above are targeted at Chelmsford City Council and ESW, 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 detailed in Table 18.

Table 18. Responsibility for implementing water efficiency

Responsibility	Responsible stakeholder
Ensure planning applications are compliant with the recommended policies	Chelmsford City Council
Fitting water efficient devices in accordance with policy	Developers
Provide guidance and if necessary enforce the installation of water efficient devices through the planning application process	Chelmsford City Council
Ensure continuing increases in the level of water meter penetration	ESW
Retrofit devices within council owned housing stock	Chelmsford City Council
Retrofit devices within privately owned housing stock (via section 106 agreements)	Developers
Promote water audits and set targets for the number of businesses that have water audits carried out. Allocate a specific individual or team within the council to be responsible for promoting and undertaking water audits and ensuring the targets are met. The same team or individual could also 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.	Chelmsford City Council
Educate and raise awareness of water efficiency	Chelmsford City Council and ESW

A major aim of the education and awareness programme, 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. For further information see Section 6.1.2. 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.

5.9.9.2 Retrofitting funding options

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

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

Chelmsford City Council could consider developer contributions to the Community Infrastructure Levy (CIL) or through S106 agreements or even through development of an offset policy. Part 11 of the Planning Act 2008[33] (c. 29) ("the Act") provides for the imposition of a charge to be known CIL. This is a local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe than the use of CIL is appropriate.

Section 106 (S106) of the Town and Country Planning Act 1990[34] allows a local planning authority (LPA) to enter into a legally-binding agreement or planning obligation with a landowner in association with the granting of planning permission, known as a Section 106 Agreement. These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required across the study area could be funded through these mechanisms; they therefore need to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company)[35]. Chelmsford City Council should consider a similar scheme, although this would require the agreement of ESW.

5.9.9.3 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[36]. 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.

[33] http://www.legislation.gov.uk/ukpga/2008/29/contents
[34] http://www.legislation.gov.uk/ukpga/1990/8/contents
[35] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[36] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

6. Water Cycle Strategy Recommendations and Policy

The following policy recommendations are made and should be considered by Chelmsford City Council to ensure that the Chelmsford 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 in the South Woodham Ferrers WRC catchment

It is recommended that a policy is developed by Chelmsford City Council that requires all developers to provide evidence to them that they have consulted with AWS regarding wastewater treatment capacity, and the outcome of this consultation, prior to development approval. The Council should consider the response from AWS when deciding if the expected timeframe for the development site in question is appropriate.

WW2 – Development in the Great Leighs WRC catchment

It is recommended that a policy is developed by Chelmsford City Council that requires all developers to provide evidence to them that they have consulted with AWS regarding wastewater treatment capacity, and the outcome of this consultation, prior to development approval. The Council should consider the response from AWS when deciding if the expected timeframe for the development site in question is appropriate.

Planning permission for all Major Development proposed to drain to Great Leighs WRC during the plan period should be subject to consultation with both the Environment Agency and AWS, and discharge of any conditions imposed by the Environment Agency. The Environment Agency should also be satisfied that the development can be accommodated either within the limits of capacity at the WRC or by sufficient capacity being made available, and that the requirements of the WFD will not be compromised. Options to be considered in consultation with AWS may include (but not limited to) limiting growth until ammonia treatment technology improves, reducing planned growth, diverting wastewater flows, or investigating unconventional treatment technologies.

WW3 – Treatment Capacity Review

It is recommended that Chelmsford City Council continues to update AWS on future development phasing and changes to growth allocations to ensure that plans for WRC upgrades in response to permit change requirements or flow capacity constraints take account of the most up to date planning position, to ensure capacity has not been used up by other developments within a WRC catchment.

6.1.2 Water Supply

WS1 – Water Efficiency in new homes and buildings

In order to move towards a more ‘water neutral position’ and to enhance sustainability of development coming forward, a policy could be developed that ensures all housing is as water efficient as possible, and that new housing development could go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements. 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

It is recommended that a policy be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use to move towards the higher water neutrality scenarios.

6.1.3 Surface Water Management and Flood Risk

SWM1 – Sewer Separation

Developers should ensure foul and surface water from new development and redevelopment are kept separate where possible. Surface water should be discharged as high up the following hierarchy of drainage options as reasonably practicable, before a connection to the foul network is considered:

- into the ground (infiltration);
- to a surface waterbody;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

Where sites which are currently connected to combined sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken.

SWM2 – SuDS and Green Infrastructure

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

SWM3 – SuDS and Water Efficiency

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

SWM4 – Linkages to SWMP and SFRA

Developers should ensure SuDS design supports the findings and recommendations of the latest Chelmsford SFRA once published and Essex County Council's Sustainable Drainage Systems Design Guide (2016).

SWM5 – Water Quality Improvements

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

6.1.4 Ecology

ECO1 – Biodiversity Enhancement

It is recommended that Chelmsford City Council include a policy within its Local Plan which commits to seeking and securing (through planning permissions etc.) enhancements to aquatic biodiversity in the study area through the use of SuDS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities).

6.2 Further Recommendations

6.2.1 Stakeholder Liaison

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

6.2.2 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 ESW's WRMP (the next full review is due in 2019, although interim reviews are undertaken annually);

- Periodic review 2019 (PR19) (AWS' business plan for AMP7 – 2020 to 2025); and
- Updates to the RBMPs (next plan due in 2020).

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Appendix A Policy and Legislative Drivers Shaping the WCS

Directive/Legislation/Guidance	Description
Birds Directive 2009/147/EC	Provides for the designation of Special Protection Areas.
Building Regulations Approved Document G – sanitation, hot water safety and water efficiency (March 2010)	The current edition covers the standards required for cold water supply, water efficiency, hot water supply and systems, sanitary conveniences and washing facilities, bathrooms and kitchens and food preparation areas.
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 for unitary and county councils to adopt SuDS for new developments and redevelopments. • 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.
Making Space for Water, 2004	Outlines the Government's strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England. The policy aims to reduce the threat of flooding to people and property, and to deliver the greatest environmental, social and economic benefit.
National Planning Policy Framework	Planning policy in the UK is set by the National Planning Policy Framework (NPPF). 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, 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. 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 Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[37], 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[38]. Standards, and water body classifications are published via River Management Plans (RBMP) the latest of which were completed in 2015.
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.

[37] 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.
[38] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B Relevant Planning Documents to the WCS

Category	Document Name	Publication Date
Water	Environment Agency Anglian River Basin District. River Basin Management Plan	2015
Environment	Chelmsford Biodiversity Action Plan 2013-2017	2013
Environment	Essex Biodiversity Action Plan 2010-2020	2011
Housing	Mid-Essex Objectively Assessed Housing Need Study for Chelmsford City Council	2016
Local Plan	Chelmsford New Local plan - covering 2021 – 2036 (in consultation)	2016
Planning	Chelmsford Town Centre: Area Action Plan 2001-2021	2008
Flood Risk	Environment Agency North Essex Catchment Flood Management Plan	2009
Water	Essex & Suffolk Final Water Resource Management Plan 2015 - 2020	2014
Climate Change	United Kingdom Climate Projections 2009 (UKCP09)	2009
Water	Chelmsford Water Cycle Study 2011-2021: Phase 1 & 2 (2011)	2011

Appendix C WRC Capacity Assessment results

C.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 a calculated Occupancy Rate (OR) of 2.29 people per household and an average consumption of 150 l/h/d (as set out in Section 1.5) which includes an additional allowance for employment growth (location of employment growth is unknown at this stage) and infiltration;
- WRC current flows were taken as the current measured dry weather flow (DWF) (Q80) as provided by AWS. Future 2036 flows were calculated by adding the volume of additional wastewater generated by new dwellings to the current permitted DWF value;
- WRC current discharge quality was taken as the current permitted limits for each water quality element. Figures for the mean and standard deviation of each element were calculated based on these permit levels using RQP 2.5 software (discussed further below),
- River flow data for the RQP modelling has been calculated using data provided by the Environment Agency – data was provided as mean flow and Q95 ,
- Raw water quality data for modelling was provided by Environment Agency water quality planners. The WFD 'no deterioration' target for each WRC are the downstream status, for each water quality element, based on river monitoring data for the most recent three years of sampling data. 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 WRC) and downstream (the discharge) inputs. Details are provided below along with the full results and outputs from the water quality modelling,
- The Environment Agency provided the most up to date WFD status.
- 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
  - 0.5mg/l for Phosphate.

C.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 Environment Agency require two parts to the 'No Deterioration' assessment to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

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 WRCs discharging to waterbodies where the current status of either the ammonia, BOD or phosphate element 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.

C.3 Headroom Assessment

The permitted flow headroom capacity within an existing permit is assumed to be usable, therefore the following steps have been applied to calculate approximately how much available headroom each WRC has:

1. Determine the quantity of growth within a WRC catchment to determine the additional flow expected at each WRC;
2. Calculate the additional wastewater flow generated at each WRC;
3. Calculate the remaining permitted flow headroom at each WRC;
4. Determine whether the growth can be accommodated within existing headroom by applying the scoping criteria detailed in Table C-1.

Table C-1. Scoping criteria

Scoped In	Scoped Out
WRCs where flow headroom is exceeded as a result of growth	WRCs where flow headroom is not exceeded as a result of growth
WRCs which already exceed their flow permit and receive any additional flow from growth	WRCs which already exceed their flow permit but do not receive any additional flow from growth[39]

C.4 Water Quality Assessment

For those WRCs which are scoped in (headroom is exceeded), modelling has been undertaken to determine the new quality conditions required for each WRC discharge permit to ensure:

- No deterioration of more than 10% of the current water quality of the receiving waterbody, or if this is not technically feasible,
- No deterioration from the current WFD status of the receiving waterbody, and
- The future target WFD status is not compromised by growth.

Table C-2 provides detail on each of the calculation steps and the sequence in which these are performed.

The Environment Agency require 'no deterioration' calculations C1 and C3 for freshwater discharges to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

Step 1 – 'No Deterioration' – C1, C2 and C3

Calculations were undertaken to first determine if deterioration can be limited to 10% of the current downstream quality. If this was not achievable within current limits of technology, the second step determines if the receiving watercourse can maintain no deterioration downstream from the current status with the proposed growth within limits of conventional treatment technology, and what permit limits would be required.

Table C-2. Step 1 – 'No Deterioration' – C1, C2 and C3

Ref	Calculation Name	Calculation Detail	Reason for Calculation
C1	Limit deterioration to 10%	No deterioration from current downstream quality + 10% with future effluent flow	To determine if it is technically feasible to limit deterioration to no more than 10% of the current downstream water quality
C2	No deterioration (Current)	No deterioration from current status with current effluent flow	To calculate what quality condition is currently needed to avoid deterioration in the current status downstream with the current flow

[39] If a WRC does not receive any growth, the assessment for the WRC is not within the scope of a WCS.

C3	No deterioration (Future)	No deterioration from current status with future effluent flow	To calculate what quality condition is needed in the future (post-growth) to avoid deterioration in the current status downstream with future flow
C6	Load Standstill	Required future quality permits with future effluent flow for coastal or estuarine waterbodies	To be used where the above calculations are not applicable such as for tidal discharges and calculating BOD quality conditions

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 WRC flow permit to be exceeded, see Table B1.

Step 2 – Meeting Future 'Good' Status – C4 and C5

For all WRC where the current downstream quality of the receiving watercourse is less than good, and the future objective is above its current status, a calculation was undertaken to determine if the receiving watercourse could achieve future status, with the proposed growth within limits of conventional treatment technology and what permit limits would be required to achieve this.

The receiving waterbodies of all modelled WRCs have demonstrated to meet their future status and therefore this test was not required.

C.5 Assessment Tables

Appendix D Water Neutrality

Water Neutrality is defined in Section 5.9, and the assumptions used outlined in Section 1.5. This appendix provides supplementary information and guidance behind the processes followed.

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. At the same time measures are taken, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[40], 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 Waterwise[41].

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 Environmental Assessment Method (BREEAM), only being mandatory where specified by a public body in England such as:

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- NHS buildings for new buildings and refurbishments;
- Department for Children, Schools and Families for all projects valued at over £500K (primary schools) and £2million (secondary schools);

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

- 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 a Local Plan, the only water efficiency requirements for new development are through the Building Regulations[42] 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 to propose local policy to address specific local concerns.

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

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 50l per household per day, assuming an occupancy rate of 2.3[43] 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 view)[44]. 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 D-1).

Table D-1: Change in typical metered and unmetered household bills

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

Low or Variable Flush Toilets

Toilets use about 30 per cent of the total water used in a household[45]. 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[46]per

[42] Part G of the Building Regulations
[43] 2.3 is used for existing properties and new properties
[44] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/
[45] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[46] http://www.lecico.co.uk/

flush. A study carried out in 2000 by Southern Water and the Environment Agency[47] 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.

Cistern Displacement Devices

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

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

Low Flow Taps and Showers

Flow reducing aerating taps and shower heads restrict the flow of water without reducing water pressure. Thames Water estimates that an aerating shower head can cut water use by 60 per cent with no loss of performance[48].

Pressure Control

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

Variable tariffs

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

The Walker review assessed variable tariffs for water, including:

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

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

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

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

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

Water Efficient Appliances

[47] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000
[48] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

Washing machines and dishwashers have become much more water efficient over the past twenty years; whereas an old washing machine may use up to 150 litres per cycle, modern efficient machines may use as little as 35 litres per cycle. An old dishwasher could use up to 50 litres per cycle, whereas modern models can use as little as 10 litres. However, this is partially offset by the increased frequency with which these are now used. It has been estimated[49] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

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

Non-Domestic Properties

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

Water Efficiency in New Development

The use of efficient fixtures and fittings as described in above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions 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 building regulation and building regulation optional water use requirements. Part G of The Building Regulations 2010 has been used to develop these figures. For 80l/h/d and 62l/h/d houses, The Building Regulations Water Efficiency Calculator has been used in association with the Department of Communities and Local Government – Housing Standard Review (September 2014). These are shown below in Table D-2.

Table D-2: Summary of water savings borne by water efficiency fixtures and fittings

Component	Building Regulations 125 l/h/d	Building Regulations Optional Target 110 l/h/d	High 80 l/h/d	62 l/h/d (water recycling)
Toilet flushing	18.7 b	12.3 d	12.3 d	12.3 d
Taps	22.7 a	20.5 a	15.3 a	15.3 a
Shower	39.8	31.8	23.9	23.9
Bath	18.5 c	17.0 f	14.5 h	14.5 h
Washing Machine	15.6	15.6	15.6	15.6
Dishwasher	4.1	4.1	4.1	4.1
Recycled water			-13.4 e	-26.8 g
External Use	5	5	0	0
Total per head	124.4	106.3	77.3	63.9
Total per household	261.3	223.3	162.4	134.2

- a Combines kitchen sink and wash hand basin
- b 6/4 litre dual-flush toilet (f) recycled water
- c 185 litre bath
- d 4/2.6 litre dual flush toilet

[49] Water Efficiency Retrofitting: A Best Practice Guide, Waterwise, 2009, www.waterwise.org.uk

- e Rainwater harvesting for external and toilet use
- f 170 litre bath
- g Rainwater/greywater harvesting for toilet, external and washing machine
- h 145 litre bath

Table D-2 highlights that in order for high and very high efficiencies to be achieved for water use under 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[50], 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 or lower can be reached without some form of water recycling.

Rainwater Harvesting

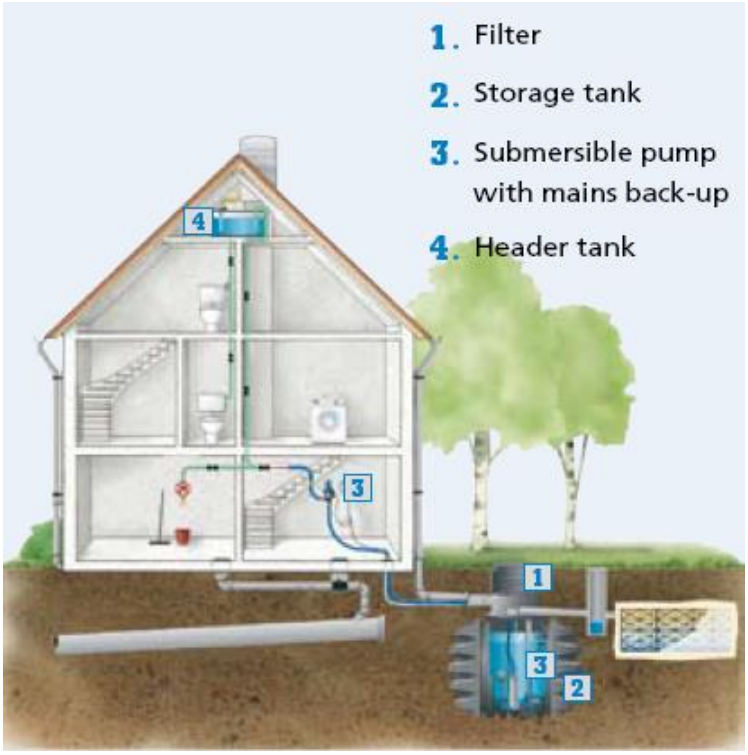
Rainwater harvesting (RWH) is the capture and storage of rain water that lands on the roof of a property. This can have the dual advantage of both reducing the volume of water leaving a site, thereby reducing surface water management requirements and potential flooding issues, and be a direct source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

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure D-1 below gives a diagrammatic representation of a typical domestic system[51].

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[52].

[50] http://www.thewatercalculator.org.uk/faq.asp
[51] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[52] Aquality Rainwater Harvesting brochure, 2008

Figure D-1: A typical domestic rainwater harvesting system



A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[53], 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 D-3.

Table D-3: Rainwater Harvesting Systems Sizing

Number of occupants	Total water consumption	Roof area (m2)	Required storage tank (m3)	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

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 were installed.

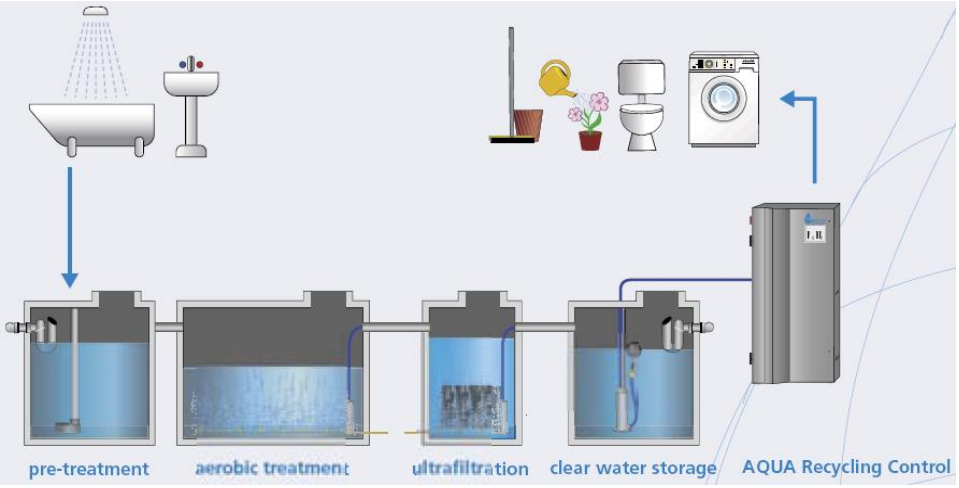
Greywater Recycling

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

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

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 D-2 below gives a diagrammatic representation of a typical domestic system[54].

Figure D-2: 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[55].

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

Table D-4: Potential water savings from greywater recycling

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

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

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[56].

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 D-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.

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

Table D-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	Water Efficient Fixtures and Fittings
Low (Building Regulations)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	83%	None
Low (Building Regulations + Retrofit)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	83%	5% take up across study area: - WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Basin taps 6 l/min - Sink taps 8 l/min
Medium (Building Regulations Optional Requirement)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	83%	None
Medium (Building Regulations Optional Requirement + Retrofit)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	83%	10% take up across study area: - WC 4/2.6 litres dual flush - Shower 8 l/min - Basin taps 5 l/min - Sink taps 6 l/min
High	80	- WC 4/2.6 litres dual flush;	Rainwater harvesting	85%	15% take up across study area:

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	Water Efficient Fixtures and Fittings
		- Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram			- WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min
Very High	62	- WC 4/2.6 litres dual flush; - Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	Rainwater harvesting and Greywater recycling	100%	16% take up across study area: - WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min

D.4 Financial Cost Considerations for Water Neutrality scenarios

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

New Build Costs

The Department for Communities and Local Government (DCLG) published the Housing Standards Review in September 2014. A cost impacts report[57] formed part of this publication, providing the costs of the proposed standards, including the proposed Building Regulations optional requirement water efficiency standard.

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

Table D-6: Building Regulation Specification and costs

	1B Apartment	2B Apartment	2B Terrace	3B Semi-detached	4B Detached
Cost all dwellings (extra over usual industry practice)					
Water, Code Level 1	-	-	-	-	-
Water, Code Level 2	-	-	-	-	-
Water, Code Level 3	£6	£6	£6	£9	£9
Water, Code Level 4	£6	£6	£6	£9	£9
Water, Code Level 5	£900	£900	£2,201	£2,697	£2,697
Water, Code Level 6	£900	£900	£2,201	£2,697	£2,697
Alternative standards					
Rainwater only	£887	£887	£2,181	£2,674	£2,674

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

Water Recycling

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

Table D-7: Costs of greywater recycling systems

Cost	Cost	Comments
Installation cost	£1,750	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[58]
	£2,000	For a single dwelling[59]
	£800	Cost per house for a communal system[60]
	£2,650	Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[61]
Operation of GWR	£30 per annum[62]	

[57] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf

[58] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008

[59] http://www.water-efficient-buildings.org.uk/?page_id=1056

[60] http://www.water-efficient-buildings.org.uk/?page_id=1056

[61] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008

[62] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

Cost	Cost	Comments
Replacement costs	£3,000 to replace23	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 Colchester Borough will be of a size large enough to consider communal recycling facilities, an approximation has been made of an average per house cost (£1,400) using the cost of a single dwelling (at £2,000) and cost for communal (at £800). This has been used for the assessment of cost for a greywater system in a new property required for the 'very high' neutrality scenario.

Installing a Meter

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

Retrofitting of Water Efficient Devices

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

Table D-8: Water saving methods

Water Saving Method	Approximate Cost per House (£)	Comments/Uncertainty
Variable flush retrofit toilets	£50 - £140	Low cost for 4-6 litre system and high cost for 2.6-4 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.

Appendix E Designated Site Background Detail

E.1 River Ter SSSI

This reach of the River Ter is designated as a lowland stream with a distinctive floor regime. It is a draining low-lying catchment on a glacial till. The SSSI has a low base flow discharge but high flood peaks. The stream exhibits many features of a lowland stream including pool-riffle sequences, bank erosion, bedload transport and dimensional adjustments to flooding frequency.

E.2 Blackwater Estuary Ramsar, SPA and SSSI

The site is one of the largest estuarine complexes in East Anglia. The site consists of intertidal mudflats fringed by saltmarsh, shingle and shell banks as well as offshore islands. Blackwater estuary also contains terrestrial habitats such as sea walls grassland, ancient grazing marsh and associated fleet and ditch systems as well as semi-improved grassland all of which are of high conservation interest. This rich mosaic of habitats supports an outstanding assemblage of nationally scarce plants and a nationally important assemblage of rare invertebrates. Internationally and nationally important numbers of overwintering waterbirds winter at the site including raptors, geese ducks and waders. The site is also important for breeding terns.

The Blackwater Estuary SPA is a moderately-sized, sheltered south-facing estuary, which extends from Youghal New Bridge to the Ferry Point peninsula, close to where the river enters the sea. It comprises a section of the main channel of the River Blackwater to Ballynaclash Quay. At low tide, intertidal flats are exposed on both sides of the channel. On the eastern side the intertidal channel as far as Kinsalebeg and Moord Cross Roads is included, while on the west side the site includes part of the estuary of the Tourig River as far as Kilmagner.

The intertidal sediments are mostly muds or sandy muds, reflecting the sheltered conditions of the estuary. Green algae (Ulva spp.) are frequent on the mudflats during summer, and Bladder Wrack (Fucus vesiculosus) occurs on the upper more stony shorelines. The sediments have a macrofauna typical of muddy sands, with polychaete worms such as Lugworm (Arenicola marina), Ragworm (Hediste diversicolor) and the marine bristle worm (Nephtys hombergii) being common. Salt marshes fringe the estuarine channels, especially in the sheltered creeks.

The wetlands within the site are of special conservation interest and supports populations of waterbirds that are of special conservation interest. The site supports an internationally important population of Blacktailed Godwit with a further seven species within nationally important populations: Wigeon, Golden plover, Lapwing, Dunlin, Bar-tailed godwit, curlew and redshank. Little egret, golden plover and bar-tailed godwit are listed on Annex I of the E.U. Birds Directive.

The SPA is designated for:

- Summer: little terns (Sterna albifrons)
- Wintering: avocet (Recurvirostra avosetta), Golden Plover (Pluvialis apricaria), Hen Harrier (Circus cyaneus) and Ruff (Philomachus pugnax).
- Supports internationally and nationally populations of overwintering waterfowl Over supporting 109,815 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Great Crested Grebe (Podiceps cristatus), Golden Plover (Pluvialis apricaria), Ruff Philomachus pugnax), Dark-bellied Brent Goose (Branta bernicla bernicla), Shelduck (Tadorna tadornaI), Ringed Plover (Charadrius hiaticula), Grey Plover (Pluvialis squatarola), Dunlin (Calidris alpina alpina), Avocet (Recurvirostra avosetta), Redshank (Tringa totanusI), Curlew (Numenius arquata), Cormorant (Phalacrocorax carbo), Wigeon (Anas penelope), Teal (Anas crecca), Pintail (Anas acuta), Shoveler (Anas clypeata), Goldeneye (Bucephala clangula), Red-breasted Merganser (Mergus serrator), Lapwing (Vanellus vanellus), Black-tailed Godwit (Limosa limosa islandica).

The Ramsar is designated for:

- Ramsar criteria 1: contains rare or unique example of natural wetland type of international importance:
  - Qualifies due to the diversity of saltmarsh habitat (3,237 ha)
- Ramsar criteria 2: supports internationally important vulnerable, endangered or critically endangered ecological communities

  - The invertebrate fauna includes 16 Red Data Book species including the endangered water beetle (Paracymus aeneus)

- Ramsar criteria 3: contains internationally important populations of plant or animal species important for maintaining biological diversity
  - Contains saltmarsh plant communities covering a range of variation in Britain.
- Ramsar criterion 6: species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation):
  - Species with peak counts in winter: dark-bellied brent goose (Branta bernicla bernicla), black-tailed godwit (Limosa limosa islandica), grey plover (Pluvialis squatarola), dunlin (Calidris alpine alpine)

E.3 Essex Estuaries SAC

This is a typical, undeveloped, coastal plain estuarine system with associated open coast mudflats and sandbanks. The site comprises the major estuaries of the Colne, Blackwater, Crouch and Roach rivers. Essex Estuaries contains a very wide range of characteristic marine and estuarine sediment communities and some diverse and unusual marine communities in the lower reaches, including rich sponge communities on mixed, tide-swept substrates. Subtidal areas have a very rich invertebrate fauna, including the reef-building worm (Sabellaria spinulosa), the brittlestar (Ophiothrix fragilis), crustaceans and ascidians.

There are extensive intertidal mudflats and sandflats in estuaries and at Dengie Flats and Maplin Sands. The area includes a wide range of sediment flat communities, from estuarine muds, sands and muddy sands to fully saline, sandy mudflats with extensive growths of eelgrass (Zostera spp.) on the open coast. Glasswort (Salicornia spp.) saltmarsh forms an integral part of the transition from the extensive and varied intertidal mud and sandflats through to upper salt meadows. The area of pioneer marsh includes gradation into extensive cord-grass (Spartina spp.) swards, including the most extensive remaining stand of the native small cordgrass (Spartina maritima) in the UK and possibly in Europe at Foulness Point. Other smaller stands are found elsewhere in the estuary complex, notably in the Colne estuary, where it forms a major component of the upper marsh areas.

Extensive upper saltmarshes remain, including Atlantic salt meadows with floristic features typical of this part of the UK. Golden samphire (Inula crithmoides) is a characteristic species of these marshes, occurring both on the lower marsh and on the drift-line. Mediterranean saltmarsh scrub occurs principally as a strandline community or at the foot of sea-walls. The local variant of this vegetation, which features sea-lavenders (Limonium spp.) and sea-heath (Frankenia laevis), occurs at one location, Colne Point.

The SAC is designated for:

- Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
- Estuaries
- Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi). (Mediterranean saltmarsh scrub)
- Mudflats and sandflats not covered by seawater at low tide. (Intertidal mudflats and sandflats)
- Salicornia and other annuals colonising mud and sand. (Glasswort and other annuals colonising mud and sand)
- Sandbanks which are slightly covered by sea water all the time. (Subtidal sandbanks)
- Spartina swards (Spartinion maritimae). (Cord-grass swards)

E.4 Blackwater, Crouch, Roach and Colne Estuaries MCZ

Blackwater, Crouch, Roach and Colne Estuaries MCZ is located on the Essex coast. It extends from the mean high water mark to where the estuary mouths join the North Sea, and is the largest inshore MCZ covering an area of 284 km2.

The site protects one of the largest estuaries in the East of England and includes the Blackwater, the largest tidal river in Essex. There are already a number of designations within the area including Sites of Special Scientific Interest, the Essex Estuaries Special Area of Conservation and Mid Essex coast Special Protection Area.

These existing sites protect extensive areas of mudflats and saltmarsh, which support a wide range of species including internationally and nationally important numbers of waterfowl such as Brent Goose and Curlew. The MCZ will build upon these existing designations, by offering protection to features such as the native oyster which are not already protected.

The MCZ is designated for:

- Intertidal mixed sediments
- Native oyster (Ostrea edulis) beds
- Native oyster (Ostrea edulis)
- Clacton Cliffs and Foreshore

E.5 Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar, SPA and SSSI

The River Crouch lies between the ridges of London Clay and the River Roach is set between brick earth and patches of sand and gravel. The intertidal zone along the River Crouch and Roach is squeezed between the seal walls along both banks and the river channel which leaves a narrow strip of tidal mud. This is utilised by significant numbers of wintering waterbirds; specifically Dark-bellied brent goose (Branta branta bernicla).

The Crouch and Roach estuaries are designated as a Ramsar sites as it supports thirteen nationally scarce plant species including: slender hare's ear (Bupleurum tenuissimum), divided sedge (Carex divisa), sea barley (Hordeum marinum), golden-samphire (Inula crithmoides), laxflowered sea-lavender (Limonium humile), curved hard-grass (Parapholis incurva), Borrer's saltmarsh grass (Puccinellia fasciculata), stiff saltmarsh grass (Puccinellia rupestris), spiral tasselweed (Ruppia cirrhosa), one-flowered glasswort (Salicornia pusilla), small cord-grass (Spartina maritima), shrubby sea-blite (Suaeda vera) and sea clover (Trifolium squamosum). Several important invertebrate species are also present on the site, including scarce emerald damselfly (Lestes dryas), the shorefly (Parydroptera discomyzina), the rare soldier fly (Stratiomys singularior), the large horsefly (Hybomitra expollicata), the beetles (Graptodytes bilineatus) and (Malachius vulneratus), the ground lackey moth (Malacosoma castrensis) and (Eucosoma catoprana). The site is also known to support a peak count of approximately 16970 waterfowl species and is designated for its population of Dark-bellied brent goose. Dark-bellied brent goose feed along both estuaries, on both grazing marsh and arable land using The areas of permanent, ley and rotational grassland included within the Crouch and Roach Estuaries SSSI. The inter-tidal mud adjacent to these areas of grassland is also of great importance to the geese, as they use the inter-tidal area for roosting, congregating, bathing and feeding.

The site also has some areas of grazing marsh landward of the sea wall. This is a characteristic, but increasingly uncommon, habitat in the county. These grazing marshes are used by large numbers of Skylark (Alauda arvensis) and Corn Bunting (Miliaria calandraV. Some of the grazing marsh has been intensively improved and has therefore lost most of its botanical interest. This improved grassland however provides excellent grazing for the internationally important numbers of Dark-bellied Brent Geese (Branta bernicla)which use the estuary.

E.6 The Cliff, Burnham-on-Crouch SSSI

The site contains a fossil avifauna of the Lower Eocene age of two species that include (Coturnipes coopri) and (Parvicuculus minor). This site is of value for expanding knowledge of small Eocene birds and avian evolution. The site also contains preserved material of fish species assemblages similar to Sheppey including shark and haxanchids.

E.7 Outer Thames Estuary Extension pSPA

The Outer Thames Estuary SPA is being considered by Natural England for site extension as the site regularly supports more than 1% of the Great Britain breeding populations of three species listed in Annex 1 of the Birds Directive including red throated divers, little tern, and common tern. The surrounding marine environment of the coastal SPAs is an important foraging ground during the

breeding season. The extension of the site covers important foraging areas for breeding common and little tern.

E.8 Dengie (Mid-Essex Coast Phase 1) Ramsar, SPA and NNR

Dengie is a large and remote area of tidal mudflat and saltmarsh at the eastern end of the Dengie peninsula, between the Blackwater and Crouch Estuaries. The saltmarsh is the largest continuous example of its type in Essex. Foreshore, saltmarsh and beaches support an outstanding assemblage of rare coastal flora. It hosts internationally and nationally important wintering populations of wildfowl and waders, and in summer supports a range of breeding coastal birds including rarities. The formation of cockleshell spits and beaches is of geomorphological interest.

Dengie qualifies as a Ramsar site due to its populations of Dark-bellied brent goose, grey plover (Pluvialis squatarola) and Red knot (Calidris canutus islandica). The site also qualifies due to the extent and diversity of saltmarsh habitat as well as support a number of rare plant and animal species. The Dengie has 11 species of nationally scarce plants: sea kale (Crambe maritima), sea barley (Hordeum marinum), golden samphire (Inula crithmoides), lax flowered sea lavender (Limonium humile), the glassworts (Sarcocornia perennis) and (Salicornia pusilla), small cord-grass (Spartina maritima), shrubby sea-blite (Suaeda vera), and the eelgrasses (Zostera angustifolia, Z. marina and Z. noltei). The invertebrate fauna includes the following Red Data Book species: a weevil (Baris scolopacea), a horsefly (Atylotus latistriatus) and a jumping spider (Euophrys browning).

E.9 Foulness (Mid-Essex Coast Phase 5) Ramsar, SPA and SSSI

Foulness is part of an open coast estuarine system comprising grazing marsh, saltmarsh, intertidal mudflats and sandflats which support nationally rare and nationally scarce plants, and nationally and internationally important populations of breeding, migratory and wintering waterfowl.

The flats are of national and international importance as winter feeding grounds for nine species of wildfowl and wader, with the islands, creeks and grazing land forming an integral part as sheltered feeding and roosting sites.

Foulness qualifies as a Ramsar site due to its spring/autumn population of common redshank (Tringa totanus totanus) and wintering populations of dark bellied brent goose, Eurasian oystercatcher (Hematopus ostralegus ostralegus), grey plover (Pluvialis squatarola), red knot (Calidris canutus islandica) and bar-tailed godwit (Limosa lapponica lapponica). This site also qualifies due to the extent and diversity of saltmarsh habitat that supports a number of nationally-rare and nationally-scarce plant species, and British Red Data Book invertebrates.

The SPA is designated for:

- Breeding populations of Avocet (Recurvirostra avosetta), Common Tern (Sterna hirundo), Little Tern (Sterna albifrons) and Sandwich Tern (Sterna sandvicensis);
- Wintering populations of Avocet, Bar-tailed Godwit (Limosa lapponica), Golden Plover (Pluvialis apricaria), Hen Harrier (Circus cyaneus), Dark-bellied Brent Goose (Branta bernicla bernicla), Grey Plover (Pluvialis squatarola), Knot (Calidris canutus) and Oystercatcher (Haematopus ostralegus),;
- Redshank (Tringa totanus) on passage
- Supports internationally and nationally populations of overwintering waterfowl of at least 20,000 waterfowl including; Redshank (Tringa totanus), Curlew (Numenius arquata), Black-tailed Godwit (Limosa limosa islandica), Dunlin (Calidris alpina alpina), Lapwing (Vanellus vanellus), Wigeon (Anas penelope), Shelduck (Tadorna tadorna), Little Grebe (Tachybaptus ruficollis), Knot (Calidris canutus), Grey Plover (Pluvialis squatarola), Oystercatcher (Haematopus ostralegus), Dark-bellied Brent Goose (Branta bernicla bernicla), Bar-tailed Godwit (Limosa lapponica), Golden Plover (Pluvialis apricaria), Avocet (Recurvirostra avosetta).

Appendix F Reason for Alternative Objective

Where certain conditions apply and are met then alternative objectives have been set for water bodies; these involve taking an extended time period to reach the objective or meeting a lower status or a combination of both. In some water bodies it is recognised that time constraints on putting actions in place, or the time taken for the environment to respond once actions are implemented, mean that the objective will only be achieved over more than one river basin management planning cycle. An objective of less than good status is set where:

- there is currently no solution to the problem;
- the costs of taking action exceed the benefits; and/or,
- background conditions in the environment mean achieving good status is not possible.

F.1 Justification for 'Moderate' Ecological Status Objective for River Ter

Section 5.4 of the Anglian RBMP Part 2: River basin management planning overview and additional information[63] sets out the specific circumstances for the particular elements and the justification behind the alternative objective. The individual sub-element 'Phosphate' of the River Ter (GB105037033940) waterbody has had alternative objective of 'Moderate' status to be maintained to 2021. This has then been applied to the overall waterbody, which has an objective of maintaining 'Moderate' Ecological status to 2021.

The reason the alternative objective has been set is described as '**Disproportionately expensive - Unfavourable balance of costs and benefits**'.

The explanation for the use of this exemption, as detailed in Table 6 of the Anglian RBMP, is provided below.

Engineering measures and technologies to improve water quality of discharges from sewage treatment works can have high costs relative to other measures within a catchment bundle of measures. Although these measures can be technically feasible, the cost of implementation can exceed the benefits to be gained from achieving good status. This is especially true in cases where improvements are limited to an individual water body which limits the overall relative benefit in the catchment.

In these circumstances a less stringent objective has been set under Article 4(5).

This exemption has been used when the environmental and socioeconomic needs served by the sewage treatment works to dispose of sewage cannot be achieved by other means which are a significantly better environmental option not entailing disproportionate costs, as required by article 4(5)(a).

F.2 Justification for 'Moderate' Ecological Status Objective for Crouch Estuary

The individual sub-element 'Dissolved Inorganic Nitrogen' of the Crouch Estuary (GB520503704100) waterbody has had alternative objective of 'Moderate' status to be maintained to 2021. This has then been applied to the overall waterbody, which has an objective of 'Moderate' Ecological potential to be maintained to 2021.

The reason the alternative objective has been set is described as '**Disproportionately expensive - Unfavourable balance of costs and benefits**'.

The explanation for the use of this exemption, as detailed in Table 6 of the Anglian RBMP, is provided below.

For…dissolved inorganic nitrogen in estuaries and coastal waters, targeted regulatory measures (for example, water industry nutrient removal schemes) require sufficient evidence of a eutrophication problem to justify the measure. If a water industry sewage works is a major source of relevant nutrient and nutrient removal would be required to improve status to good but there is insufficient evidence of biological eutrophication impacts within the downstream water body or catchment then there is no environmental problem to solve and the costs of taking action would exceed the benefits.

[63] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500573/Part_2_River_basin_management_planning_process_overview_and_additional_information.pdf

In these circumstances a less stringent objective has been set under Article 4(5). Less certainty of eutrophication does not preclude consideration of non-regulatory or voluntary approaches to address other nutrient sources.

For some shellfish waters the benefits to be gained from achieving compliance is less than the cost of implementing the most cost effective and technically feasible measures needed to deliver the improvements by 2021. Such measures include, for example, installation of UV disinfection at sewage treatment works and action to reduce the pollution of run-off from agricultural land.

In these circumstances an extended deadline for achieving the objectives has been set under Article 4(4).