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AECOM

North Essex Garden Communities Integrated Water Management Strategy

Stage 1 Report

FINAL

Braintree District Council, Colchester Borough Council and Tendring District Council

August 2017

Quality information

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Revision History

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0	June 2017	Draft	JLRobinson	Jon Robinson	Director
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List of Acronyms

AWS	Anglian Water Services
BOD	Biochemical Oxygen Demand
CAMS	Catchment Abstraction Management Strategy
DWF	Dry Weather Flow
EA	Environment Agency
EFI	Environmental Flow Indicator
l/h/d	Litres/head/day (a water consumption measurement)
LCT	Limits of Conventional Treatment
Ml	Mega Litre (a million litres)
NPPF	National Planning Policy Framework
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
ONS	Office for National Statistics
P	Phosphorous
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RQP	River Quality Planning (tool)
RZ	Resource Zone (Anglian Water)
SFRA	Strategic Flood Risk Assessment
SSP	Shared Strategic Plan
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
WCS	Water Cycle Study
WFD	Water Framework Directive
WRC	Water Recycling Centre
WRMP	Water Resource Management Plan
WRMU	Water Resource Management Unit (in relation to CAMS)
WRZ	Water Resource Zone (Affinity Water)

Executive Summary

A significant amount of development is proposed within the three garden communities proposed for North Essex: the West of Braintree (WoB), the Colchester Braintree Border (CBB) and Tendring Colchester Border (TCB). The proposals are located in areas of largely undeveloped greenfield, and the scale and location of development poses a number of significant challenges around provision of water supply, wastewater services and management of flood risk.

An Integrated Water Management Strategy (IWMS) has therefore been commissioned to meet the needs of the authority partnership and to provide an evidence base to support the Shared Strategic Plan (SSP).

This report represents Stage 1 of the IWMS. Its principal aim is to demonstrate that there are feasible strategic level solutions for water supply and wastewater treatment that could be delivered to serve the proposed growth without impacting on environmental legislation. It has identified and assessed a range of potential strategic level options for wastewater treatment and water supply, and for wastewater treatment, has demonstrated which can be achieved within the limits of environmental capacity.

Four types of potential wastewater treatment options which have been assessed for each garden community:

- Option 1 - All garden community growth to be served by an existing large scale treatment facility;
- Option 2 - All garden community growth to be served by upgrading existing local treatment facilities;
- Option 3 - All garden community growth to be served by the construction of a new treatment facility for each garden community; and
- Option 4 - All garden community growth to be served by one new strategic treatment facility.

As part of the assessment, a high level review of route options for new strategic sewer mains required to connect the garden communities to the different treatment facility options has been undertaken, considering local topography and environmental designations, and is detailed for key options in the following sections.

For each option, the treatment capacity at each facility and the potential water quality impacts from the various treated wastewater discharge options have been assessed. The assessments concluded that there are workable wastewater options which could be implemented for each of the three garden communities in North Essex which would not impact on the water quality targets of receiving waterbodies. These options have been summarised in Table A. The assessments for WoB have identified two potential wastewater options.

Table A - Preferred Wastewater options for each garden community

Garden community	Option	Description
WoB	1	100% WoB growth to be treated at Bocking Wastewater Recycling Centre
WoB	3	New WRC with the treated effluent split 10/90 between River Brain at Rayne WRC and River Blackwater at Bocking WRC
CBB	1	Directing all growth to Colchester WRC
TCB	1,2	Directing all growth to Colchester WRC

The water supply assessment reviewed statutory Water Resource Management Plans (WRMP) produced by both Anglian Water and Affinity Water serving the area. The study established that the additional water demand from the growth proposed within the three garden communities can potentially be accommodated through a combination of the additional supply options identified in Anglian Water's WRMP, including demand reduction and water efficiency measures. The feasible water supply options include:

- Colchester water reuse - Effluent from the Colchester Water Recycling Centre would be treated to an extremely high standard and discharged to the River Colne to supplement river flows and permit increased abstraction;
- East Suffolk transfer - The transfer of water from Ipswich to Colchester via a new 22km long pipeline;
- Amendment to Ardleigh Reservoir Operation – Making more water available from the reservoir to supply the garden communities;

- Groundwater development - Utilising an existing licenced borehole in the Colchester area;
- Ardleigh reservoir extension - An extension to the existing Ardleigh reservoir utilising disused mineral abstraction pits to provide additional storage; and
- East Suffolk transfer.

Stage 1 of the IMWS has identified feasible and deliverable strategic options for water supply and wastewater demonstrating that the quantum of proposed growth can be accommodated with infrastructure investment.

Further assessment work will be required, either as a Stage 2 to the IWMS or similar study work to consider each of the garden communities in more detail, and identify and determine site specific water management measures which can serve to minimise demand for the strategic options as far as possible and set out how surface water and flood risk can be managed on site in an integrated way.

1. Introduction

1.1 Background

A significant amount of development is proposed within the three garden communities proposed for North Essex; the West of Braintree (WoB), the Colchester Braintree Border (CBB) and Tendring Colchester Border (TCB), with the potential for up to 43,720 homes across the three proposed locations. The proposals are located in areas of largely undeveloped greenfield, and the scale and location of development poses a number of significant challenges around provision of water supply, wastewater services and management of flood risk.

It is therefore essential to understand, plan and implement new fully integrated water services infrastructure to support the proposed development to avoid sewer and surface water flooding and increase water supply security in a more sustainable way, in order to avoid environmental damage. A coordinated and collaborative approach to investment and maintenance of infrastructure solutions between the relevant stakeholders will be required to meet this aim and an Integrated Water Management Strategy (IWMS) has therefore been commissioned to develop the framework for achieving this aim.

1.1.1 Preceding studies

Water Cycle Studies (WCS) have been completed for the Borough of Colchester and the District of Braintree to support the authorities' Local Plans covering growth up to 2033. These studies demonstrated that water supply and wastewater infrastructure solutions are feasible to support the planned growth in these timeframes without impacting in water based environmental legislation.

However, the WCS only included the proportion of garden community growth likely to come forward within the Local Plan period (i.e. up to 2033) whereas, a significant proportion of the garden community growth is expected to occur beyond 2033.

Therefore, the full potential quantum of growth that the garden communities could deliver does not have identified solutions for the treatment of wastewater, provision of water supply and assessment of impact and compliance with water based environmental legislation. It is therefore essential that the IWMS fully addresses the long-term impact of growth within the garden communities, supporting the development of the authority partnerships' developing Shared Strategic Plan (SSP).

1.1.2 Legislative and policy drivers

The growth within the garden communities will need to comply with EU Directives, UK legislation, planning policy and guidance on water. 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 Stage 1 report is WFD compliance.

1.2 IWMS scope

1.2.1 Stages of the IWMS

An IWMS approach is being undertaken to meet the needs of the authority partnership and to support the SSP, building on the Local Plan WCS for Colchester and Braintree Districts. The IWMS also builds on and utilises the Strategic Flood Risk Assessments (SFRA) for the Borough of Colchester and District of Braintree in addition to the garden community Concept Feasibility Studies.

The IWMS is to be undertaken in three stages:

- Stage 1 – initial evidence base for the SSP;
- Stage 2 – Outline IWMS;
- Stage 3 – where needed, a detailed IWMS delivery plan for preferred strategy.

1.2.2 Stage 1 IWMS – initial evidence base for the SSP

This stage of the study acts as a preliminary assessment of strategic level options to provide wastewater services and water resource to meet the scale of development proposed. Its principal aim is to demonstrate that there are strategic level feasible solutions that could be delivered without impacting on environmental legislation, thereby providing evidence to the SPP on overall deliverability of the proposals.

This will then inform the development of the Outline IWMS (Stage 2) that considers each of the garden communities in more detail and aims to identify and determine site specific water management measures which can serve to minimise demand for the strategic options as far as possible and set out how surface water and flood risk can be managed on site in an integrated way.

The following sets out the steps for Stage 1:

- Step 1: Defining the baseline conditions, including water based constraints and opportunities within each garden community which will also inform the later stages of the IWMS development;
- Step 2: Determining the water balance within each garden community, defining the available water and wastewater flows feeding into and leaving the study area;
- Step 3: Potential Strategic Level Options Identification; identifying and assessing a range of potential strategic level options for wastewater treatment and water supply, which can be achieved within the limits of environmental capacity. The information will be provided at a level suitable to ensure that there are solutions to deliver growth for the garden communities.

This report sets out the assessment work completed and the conclusions from the Stage 1 IWMS. The anticipated scope of the later IWMS stages is set out below.

1.2.3 Stage 2 IWMS – outline IWMS and masterplanning support

The solutions identified in Stage 1 will be taken into the Stage 2 Outline IWMS which will develop a range of delivery option strategies for each garden community based on a series of potential wastewater, water supply surface water management and flood risk measures. The delivery option strategies will be developed from the measures considering an integrated approach to managing water demand, wastewater generation and flood risk to support developing masterplans for each garden community. The preferred measures would be identified and agreed in liaison with the partner authorities, the Environment Agency and Anglian Water Services (AWS).

1.2.4 Stage 3 IWMS – a detailed IWMS delivery plan for preferred strategy

Stage 3 of the IWMS would be to identify the preferred option delivery strategy through a detailed costing process and a multi-criterion analysis of the option scenarios based on several deliverability, environmental and feasibility criteria and would set out a detailed delivery and consultation strategy. The need for the Stage 3 study will be determined from the outcomes of Stages 1 and 2.

1.3 Strategy governance and stakeholder engagement

This IWMS is being developed in collaboration and consultation with key partners, integral to the delivery and management of water infrastructure for the North Essex Garden Communities. Figure 1-1 identifies the organisations which have been involved in the development of Stage 1 of this IWMS.

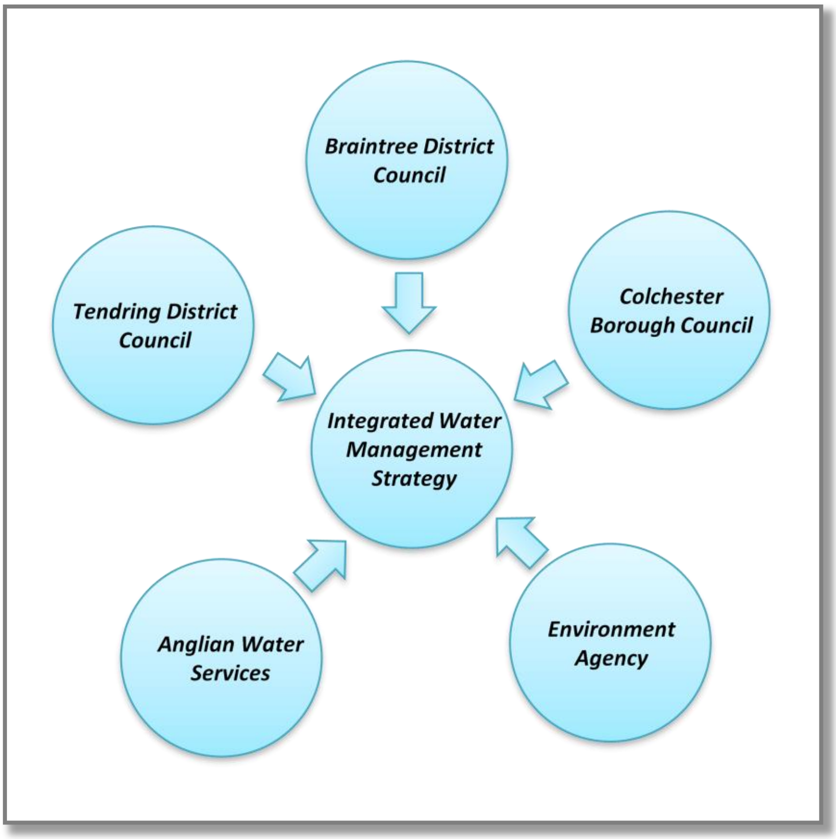


Figure 1-1 Organisations involved in the development of the Stage 1 IWMS

1.4 Existing evidence base

The following studies, reports and discussions have been used to inform the baseline conditions and option review for Stage 1 to date:

- Braintree District Council WCS, March 2017;
- Colchester Borough Council WCS, December 2016;
- North Essex Garden Communities Concept Feasibility study, Volume 3 Options and Evaluation (AECOM, 2016);
- Liaison with Masterplanning team for the West of Braintree (WoB) garden community;
- Braintree/Colchester/Tendring Publication Draft Local Plan. Part 1 Shared Strategic Plan (16^{th} June 2017)
- Braintree Level 1 and Level 2 SFRA update;
- Colchester Level 1 and Level 2 SFRA update;
- Environment Agency Water Quality data (provided previously for the Braintree and Colchester Water Cycle Studies);
- Environment Agency's latest Anglian River Basin Management Plan (RBMP) (2015).
- Meeting with AWS to discuss potential wastewater options (2nd May 2017);
- AWS Water Resource Management Plan (WRMP) 2014; and
- Affinity Water WRMP 2014.

2. Garden communities proposed development

2.1 Planning context

Three new garden community developments are proposed in North Essex, which cross boundaries of three administrative areas: Braintree District Council, Colchester Borough Council and Tendring District Council. These settlements will provide a major long term supply of new housing and employment growth for North Essex, within the local planning period (up to 2033) and beyond.

Figure 2-1 shows the location of the three potential garden coummnities. The majority of the West of Braintree (WoB) garden community will be located within the Braintree District administrative area, adjacent to the border with Uttesford District Council. The majority of the Colchester Braintree Border (CBB) garden community is located within Colchester Borough, with the southeastern part of the development within Braintree District. The majority of the Tendring Colchester Border (TCB) garden community is located within Tendring District, with northwestern and southwestern areas of the proposal within Colchester Borough.

The garden communities are planned to complete beyond the current 2033 Local Plan period. The purpose of this stage 1 IWMS is to assess the potential wastewater services and water resource strategic level options required to meet the scale of development proposed across the Study Area beyond 2033, without impacting on environmental legislation.

2.2 Growth scenarios for testing

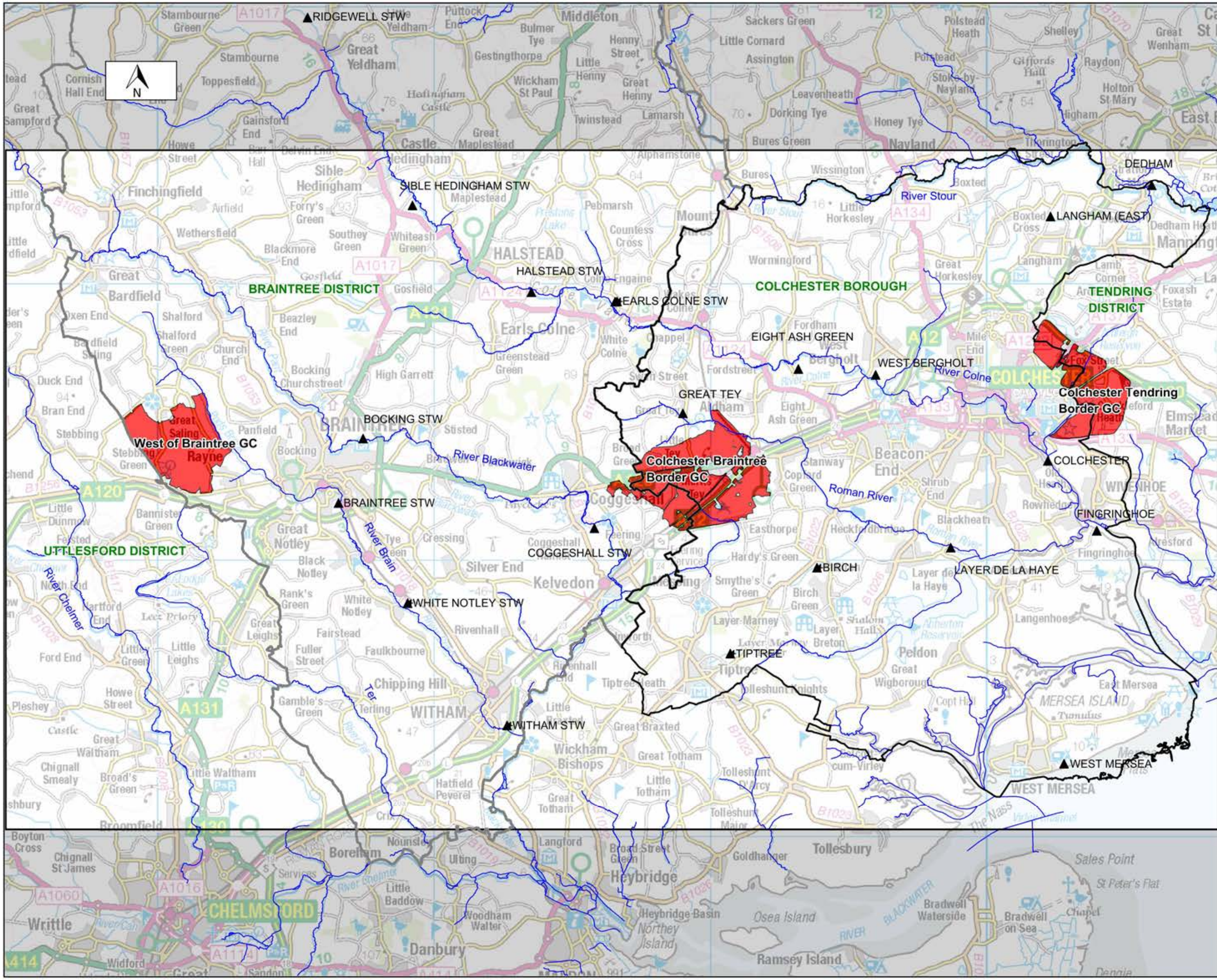
The planning figures for the north Essex garden communities in Table 2-1Table 2-1 were provided by the WoB garden community Masterplanning team and Colchester Council for this assessment, and were a best estimate as of April 2017 when the modelling assessments for the Stage 1 IWMS were completed. These figures show the maximum potential house numbers and employment areas for each of the garden communities as of April 2017. It should be noted that these figures are subject to change through the development of the councils' local plans.

Table 2-1 North Essex garden communities maximum planning figures (as of April 2017)

Garden Community	Total Proposed Development	
	Homes	Employment (ha)
West of Braintree (WoB)	12,350	13
Colchester Braintree Borders (CBB)	24,000	40
Tendring Colchester Borders (TCB)	8,500	30

2.2.1 Key development assumptions

Estimates of total additional water demand and wastewater flow was calculated from the new homes using an occupancy rate of 2.28, based on assumptions applied in the Braintree Water Cycle Study (2017). The employment area was converted into jobs based on the same ratio as used in the Braintree Water Cycle Study (2017), which was derived by assigning a percentage of the total projected employment growth in the local plan to each of the proposed employment sites, based on the size (hectare) of each site (i.e. the larger the site, the greater the proportion of full time employment jobs allocated).



THE DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IT IS SUBJECT TO AMENDMENT

- Colchester Borough Boundary
- Braintree District Boundary
- Garden Community Boundary
- Main Rivers
- ▲ Water Recycling centres

Purpose of Issue: FINAL

Braintree District Council | Tendring District Council | Colchester Borough Council

Drawing Title: LOCATION

Drawn	Checked	Approved	Date
ChB	JB	CP	02/08/2017

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Drawing Number: FIGURE 2-1 | Rev: 02

3. Baseline conditions

Understanding the water environment, flood risk and infrastructure baseline is a key step in the IWMS process as it allows the identification of constraints as well as opportunities which will shape decisions on which water management measures are feasible and most appropriate across the garden communities.

A full baseline assessment has been completed covering the three garden communities to support the Stage 1 IWMS for the garden communities and to set the baseline context for future stages of the IWMS.

An overview of the baseline conditions for each garden community are presented in Sections 3.1 to 3.3 of this report. Detailed baseline maps for the study area have been developed through a review of existing GIS information for the Study Area and are provided in Appendix B for the following:

- Figure B1 – Topography
- Figure B2 – Bedrock Geology
- Figure B3 – Superficial Deposits
- Figure B4 – Wastewater network
- Figure B5 – Water Resource Zones
- Figure B6 - Source Protection Zones
- Figure B7 – Fluvial Flood Risk
- Figure B8 – Environmental Designations

3.1 West of Braintree (WoB) garden community

The proposed WoB garden community has an approximate area of 770 ha. It is located adjacent to the A120 dual trunk road, approximately 5km west of the centre of Braintree and is to the north of the village of Rayne. Pods Brook flows to the east and the village of Great Saling to the north. The villages of Stebbing and Stebbing Green are located to the west of the garden community.

A description of the water environment and infrastructure baseline conditions for WoB are provided in Table 3-1.

Table 3-1 Water cycle baseline in WoB garden community

Water environment or infrastructure element	WoB garden community baseline description
Catchment detail	The WoB garden community is located within the Combined Essex Management Catchment as defined by the Anglian Region River Basin Management Plan. The proposed location for the garden community is located within two separate river catchments, with the catchment boundary located north to south through the proposed location. The east of the site is located within the River Blackwater catchment, whilst the west of the site drains into the Chelmer catchment. Both river catchments drain southwards discharging to the Blackwater Estuary. The garden community is proposed within the upper proportion of both river catchments.
Topography, Land Use and Infrastructure	The WOB garden community is located north of the A120 approximately 5km west of Braintree. The majority of the land is currently used for agriculture and is undeveloped. A small number of detached residential properties are located within the landscape. 90ha of the land in the southern part of the site has been designated for mineral extraction. The site is 65m-105m above sea level and predominantly slopes from north west to south east. Pods Brook is located within the valley to the east of the site (see Appendix B Figure B1). The topography on the east of the WOB garden community area slopes downwards towards Pods Brook. An unnamed ordinary watercourse is located to the west of the WOB garden community area, draining into the River Ter. The topography along the edge of the unnamed watercourse is 45m-70m above sea level. Water from the site would flow east into Pods Brook and west into the unnamed watercourse.

Water environment or infrastructure element	WoB garden community baseline description
Geology and Groundwater	The bedrock geology across the Garden Community is Thames Group and is comprised of silty clays/mudstone, sandy silts and sandy clayey silts. The superficial geology is comprised of Lowestoft Formation, with a small area of head and alluvium to the east of the site, along the course of Pod's Brook. The clay silts in the bedrock and the alluvium deposits in the superficial geology have a low permeability. A secondary undifferentiated aquifer is present in the superficial deposits in the garden community. The garden community is not located in a source protection zone. The minor aquifer in the south of the garden community has a high groundwater vulnerability risk.
Watercourses	Pods Brook is a designated Environment Agency main river and is part of the River Blackwater catchment. Pods Brook runs along the eastern edge of the site. The River Ter is also a designated main river and is located approximately 0.145 km south of the garden community. An unnamed ordinary watercourse is located to the south west of the garden community and flows from north to south into the River Ter to form part of the River Ter catchment. An unnamed ordinary watercourse is located in the north east of the garden community and flows from east to west into Pods Brook.
Drainage and Wastewater Network	There is no existing surface water or foul drainage network covering the garden community. Rayne WRC is the closest WRC to the site and is located approximately 1 km to the east of the proposal boundary. Rayne WRC discharges to the River Blackwater.
Water Resources and Water Supply	The garden community would be located within the Anglian Water supply area, located in the South Essex Water Resource Zone (WRZ). A WRZ is a self-contained area in which all water resources can be shared. The South Essex WRZ covers the southern part of Essex including the towns of Braintree and Colchester. The WRZ is supplied from groundwater sources and surface water from the River Colne.
Environmental Designations	There are no hydrologically connected environmentally designated sites within close proximity to the WoB garden community.
Flood Risk	The majority of the WoB garden community is defined as Flood Zone 1 Low Probability of flooding from rivers. Flood zone mapping shows that Flood Zone 2 and 3 associated with Pods Brook extends across the eastern edge of the garden community. An area of Flood Zone 2 and 3 associated with an unnamed ordinary watercourse extends across a small area to the south of the garden community. There is no risk of tidal flooding. A number of surface water flow paths are located along the edge and the centre of the garden community. Flow paths of low to high surface water flood risk flow from the centre to the east of the site into Pods Brook. Two other flow paths of low to high surface water flooding risk flow from the north to the south of the site before joining the unnamed watercourse at the south of the site. There are also small areas of low to high surface water ponding located around the site. The garden community is within the 0%-<50% range for susceptibility to Groundwater Flooding. The garden community is not at risk from Reservoir flooding.

3.2 Colchester Braintree Border (CBB) garden community

The CBB garden community has an approximate area of 1200 ha. It is located approximately 5km west of the centre of Colchester, on the A120, connecting Colchester (and the A12) with Braintree and Stansted Airport to the west. Marks Tey railway station and the village of Copford are located in the east of the garden community. The Roman River is located in the north of the garden community and the village of Coggeshall to the west.

A description of the water environment and infrastructure baseline conditions for CBB are provided in Table 3-2.

Table 3-2 Water cycle baseline CBB garden community

Water environment or infrastructure element	CBB garden community baseline description
Catchment detail	The CBB garden community is located within the Combined Essex Management Catchment as defined by the Anglian Region River Basin Management Plan. The proposed location for the garden community is located within two separate river catchments, with the catchment boundary located north-west to south-east through the proposed location. The south of the site is located within the River Blackwater catchment, whilst the north of the site drains into the Colne catchment. The River Blackwater catchment drains southwards discharging to the Blackwater Estuary. The River Colne drains south east into the North Sea. The garden community is proposed within the upper proportion of the river catchment.
Topography, Land Use and Infrastructure	The majority of the land is currently used for productive agriculture which includes drainage ditches and areas of mature trees. The village of Marks Tey is located to the east of the site, in and around the A120, A12 and the railway line to the south of the village. There are a number of detached farm buildings located to the north of the site that are currently accessible through country lanes. The site is 10m-50m above sea level and slopes from north west to south east (see Appendix B Figure B1). The topography of the garden community area slopes downwards to the south and south west, towards Coggeshall.
Geology and Groundwater	The bedrock geology across the CBB Garden Community is Thames Group and is comprised of silty clays/mudstone, sandy silts and sandy clayey silts. The superficial geology is predominantly comprised of Lowestoft Formation to the south of the garden community, with small areas of Kesgrave Catchment Subgroup, Alluvium, Cover Sand, Head and Interglacial Lacustrine Deposits in the north of the site. The clay silts in the bedrock have a low permeability. A secondary undifferentiated aquifer is present in the superficial deposits in the garden community. The garden community is not located in a source protection zone.
Watercourses	Domsey Brook is an Environment Agency designated main river that forms part of the River Blackwater catchment. The Brook flows from north west to south east across the southern part of the CBB garden community. A number of unnamed ordinary watercourses are located in the southern part of the site and flow south west into the Domsey Brook. The Roman River is part of the catchment for the River Colne. The Roman River flows from west to east through the north east of the garden community. A number of unnamed ordinary watercourses (located to the north of the garden community) flow south into the Roman River.
Drainage and Wastewater Network	There is no existing drainage network covering the garden community. Coggeshall WRC and Great Tey WRC are the closest wastewater treatment facilities to the CBB Garden Community and are located approximately 1.5 km to the north and 2.9 to the south west of the proposal boundary. Coggeshall WRC discharges to the River Blackwater and the Great Tey WRC discharges into the Roman River.
Water Resources and Water Supply	The CBB garden community is located in the Anglian Water South Essex and Central Essex WRZ. Potable water for the CBB garden community would be provided by Anglian Water.
Environmental Designations	There are no hydrologically connected environmentally designated sites within close proximity to the CBB garden community.

Water environment or infrastructure element	CBB garden community baseline description
Flood Risk	The majority of the CBB garden community is defined as Flood Zone 1 Low Probability of flooding from rivers. Flood zone mapping shows that Flood Zone 2 and 3 associated with the Roman River extends across the north western area of the garden community along the course of the river. An area of Flood Zone 2 and 3 associated with the Domsey Brook extends from the centre to the south of the garden community. There is no risk of tidal flooding. A number of surface water flow paths are located along the edge and the centre of the garden community. Flow paths of low to high surface water flood risk flow south, along the edge of the course of the Domsey Brook. There are also significant areas of low to high surface water flood risk along the course of the Roman River. The majority of flow paths on the garden community follow the course of the ordinary watercourses that flow through the site. There are also small areas of low to high surface water ponding located around the garden community. The garden community is not at risk from groundwater and Reservoir flooding.

3.3 Tendring Colchester Border (TCB) garden community

The Tendring Colchester Border (TCB) garden community has an approximate area of 700 ha. It is located on the eastern boundary of Colchester's urban area and is broadly defined by the strategic road corridors of the A120 in the north and the A133 to the south, with the village of Elmstead Market to the east. The garden community currently consists of productive agricultural farmland and associated field hedgerows and areas of mature tree stands. The area is traversed by a number of narrow country lanes, and the A137 Harwich Road in the north west of the search area and adjacent Great Eastern Mainline railway (GEML). The local authority boundary of Colchester Borough Council and Tendring District Council cuts through the site in a deviating north-south direction, with the majority of the land area located within the Tendring district.

A description of the water environment and infrastructure baseline conditions for TCB are provided in Table 3-3.

Table 3-3 Water cycle baseline TCB garden community

Water environment or infrastructure element	TCB garden community baseline description
Catchment detail	The TCB garden community is located within the Combined Essex Management Catchment as defined by the Anglian Region River Basin Management Plan. The proposed location for the garden community is located within the River Colne catchment. Salary Brook flows from north to south through the TCB proposed site and drains into the River Colne. The River Colne drains south east into the North Sea. The proposal is located near to tidal reaches of the river.
Topography, Land Use and Infrastructure	The TCB garden community is located on the urban edge of the town of Colchester and the rural edge of the District of Tendring. The site is predominantly agricultural land with trees and hedgerows. A number of rural country lanes run through the site as well as the A120 along the north eastern edge of the TCB garden community and the A137 that runs through the north of the site. The Great Eastern Mainline Railway runs through the north of the site. The site is 10m-50m above sea level and slopes from north west to the south and south west, Salary Brook is located within the valley to the west of the site (see Appendix B Figure B1). The topography along the Salary Brook is lower than in other areas of the site. Water from the site would flow west towards the Salary Brook and south towards the edge of the garden community.
Geology and Groundwater	The bedrock geology across the TCB Garden Community is Thames Group and is comprised of silty clays and silts. The superficial geology is predominantly comprised of Cover Sand, Kesgrave Catchment Subgroup and Alluvium. The clay silts in the bedrock have a low permeability. A secondary B aquifer is present in the superficial deposits under the garden community. The garden community is not located in a source protection zone. The minor aquifer in the garden community has an intermediate groundwater vulnerability risk.
Watercourses	Salary Brook is an Environment Agency designated main river that is part of the River Colne catchment. Salary Brook flows from north west to south east, across the southern part of the TCB garden community. A number of unnamed ordinary watercourses are located in the southern part of the garden community and flow west into the Salary Brook.

Water environment or infrastructure element	TCB garden community baseline description
Drainage and Wastewater Network	The north of the site has an existing drainage network. There is no existing drainage network covering the rest of the garden community. Colchester STW and Langham STW are the closest STW to the TCB garden community. Anglian Water is the waste water undertaker for the area. Colchester STW is located approximately 1.7 km to the south west of the proposal boundary and Langham STW is located approximately 6.2 km. Colchester STW discharges to the River Colne and Langham STW discharges into the Black Brook.
Water Resources and Water Supply	TCB garden community straddles the water supply boundary between AWS (South Essex WRZ) and Affinity Water (Central)
Environmental Designations	Salary Brook Local Nature Reserve is located along the western edge of the TCB garden community.
Flood Risk	The majority of the CBB garden community is defined as Flood Zone 1 Low Probability of flooding from rivers. Flood zone mapping shows that Flood Zone 2 and 3 associated with the Salary Brook extends along the edge of the course of the river. There is no risk of tidal flooding. A number of surface water flow paths are located along the edge and the centre of the garden community. Flow paths of low to high surface water flood risk flow south along the edge of the course of the Salary Brook. The majority of flow paths on the garden community follow the course of the ordinary watercourses that flow through the site. There are also small areas of low to high surface water ponding located around the garden community. 0%-<25% of the garden community area is susceptible to Groundwater Flooding The west of the site along the course of the Salary Brook is at risk from Reservoir flooding.

4. Water Balance

4.1 Water demand and wastewater flow estimates

High level estimates for water demand and wastewater generation have been formulated for the Garden Communities. The aim within this Stage 1 report is to identify the water demand increases and wastewater discharge increases in order to gain an initial understanding of how these flows will be split for Stages 2 and 3 of the IWMS, but also to assess need for strategic water supply and wastewater treatment options.

For the water balance, all flows were estimated on an annual scale to consider the area–wide balance between input and output of water.

The flows have been split across the following categories:

- Potable water: High quality water supplied for uses within the home, including water used for drinking and used in the kitchen and bathroom. Within this analysis, potable water has been assumed as necessary for all household uses except toilet flushing.
- Non-Potable Water: Water which is utilised for low-contact uses including irrigation and toilet flushing. In general, this water is not required to be of the same quality as that used for potable uses. In some circumstances, water for use in the laundry may also be supplied by non-potable sources; however, this has not been included in the analysis at this stage.
- Grey Water: Wastewater generated from use in hand basins, baths and showers. Grey water generally excludes water used in toilets, the kitchen or for cleaning use, which has a greater concentration of contaminants.
- Black Water: Wastewater generated from toilets, kitchen and laundry use. This has a higher concentration of contaminants than grey water. Under the current scenario both black water and grey water are combined and disposed to the drainage system.

Flows were estimated assuming each area acts as a system boundary, with the overall volume of imported centralised water supply equivalent to the total volume discharged to the regional wastewater network.

The overall wastewater flow was estimated for each garden community, based on the anticipated residential and commercial development. The split of water across each of the above categories has been based on assumed end fittings use, as outlined in the Building Regulations Approved Document G, for 'optional' level water efficiency (Table 4-1). It should be noted that outdoor water use was not included in this proportional allowance. Annual demands were formulated assuming 365 days of residential demand and 253 days of employment demand.

Table 4-1 Percentage split used to estimate flows based on the 'optional' efficiency levels specified in the Building Regulations.

	Household	Non Household
Potable	87.84%	49.51%
Non-Potable	12.16%	50.49%
Greywater	56.71%	17.79%
Blackwater	43.29%	82.21%

The grey water/blackwater percentage split in Table 4-1 has been applied to the total estimated wastewater flow for each garden community, based on the proposed residential and commercial development, and presented in Table 4-2.

Table 4-2 Daily wastewater flow estimates for each garden community

Garden Community	Total Development			Wastewater Flows			Assumed Greywater		Assumed Blackwater	
	Homes	Employment (ha)	Equivalent no. of jobs	Additional flow (m^3/d) (houses)	Additional flow (m^3/d) (employment)	Total additional flow (m^3/d)	Residential (m^3/d)	Employment (m^3/d)	Residential (m^3/d)	Employment (m^3/d)
WoB	12350	13	326	4953	5	4958	2808.98	0.89	2144.02	4.11
CBB	24000	40	1002	9625	16	9641	5458.60	2.85	4166.40	13.15
TCB	8500	30	751	3409	12	3421	1933.34	2.14	1475.66	9.86

In considering these flow estimates, it should be noted that these been developed based on the best information available; however, they are based on numerous assumptions and should not be regarded as assured.

4.2 Results

The post-development water balance for each garden community is shown in Figure 4-1.

It should be noted that these calculations represent bulk annual flows, and therefore do not capture the spatial and temporal variation of flows across this annual time period, and the associated impact on the availability of harvestable volumes.

Figure 4-1 illustrates that the proposed development across the three Garden Communities will lead to a substantial increase in the demand for water and subsequent generation of wastewater, significantly increasing demand on the regional water supply and wastewater assets. The capacity of these systems to cope with increased demand is discussed in the following sections.

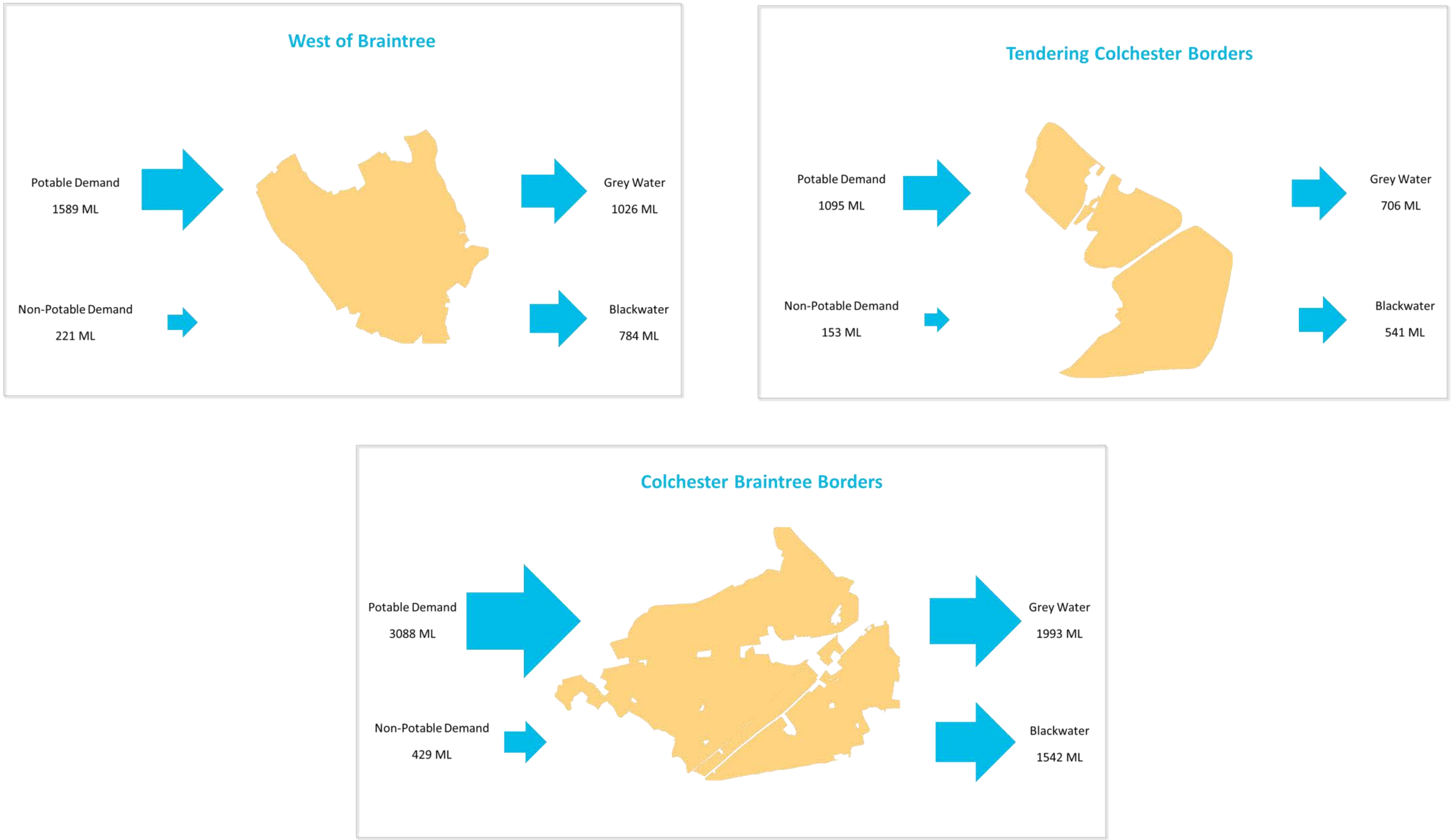

Figure 4-1 Post-development annual water balance for the WoB, CBB and TCB garden communities

5. Wastewater treatment

5.1 Wastewater in the study area

Wastewater treatment in North Essex is provided via wastewater infrastructure operated and maintained by AWS, ultimately discharging treated wastewater to a nearby waterbody. The infrastructure consists of the wastewater network (piped sewer systems and pumping stations) and treatment facilities called Water Recycling Centres (WRC). Each of the WRCs has its own drainage catchment defined by the network of wastewater pipes (the sewerage system) which collects wastewater generated by homes and businesses and transmits it to the WRC.

5.2 Garden community wastewater treatment management options

Based on the previous WCS and discussions with AWS and the Environment Agency during the development of this Stage 1 IWMS, there are four types of potential wastewater treatment options which could be pursued for each garden community:

- Option 1 - All garden community growth to be served by an existing larger WRC – to achieve economies of scale, all (or the majority) of wastewater is drained to and treated at one or more strategic sized WRC which may (or may not) need to be upgraded along with strategic new connection sewer mains and pumping stations;
- Option 2 - All garden community growth to be served by upgrading existing local WRCs; WRC local to each garden community are utilised first where treatment capacity and environmental capacity permits. Requires less strategy network infrastructure and attempts to make use of existing flow capacity where it exists;
- Option 3 - All garden community growth to be served by the construction of a new WRC for each garden community; utilise new technologies to construct and operate new dedicated WRCs for each garden community with various discharge options; and
- Option 4 - All garden community growth to be served by one new strategic WRC (AWS Strategic Option) – design and build of a new treatment facility to accommodate all garden community growth as well as replace older existing WRC assets.

In order to define what the specific options were for each garden community, meetings were held with Anglian Water (2nd May 2017) and the Environment Agency (23rd May 2017). The outcome of these discussions is summarised for each garden community in the following sections. As part of the assessment, a high level review of route options for new strategic mains has been undertaken, considering local topography and environmental designations, and is detailed for key options in the following sections.

5.2.1 Wastewater treatment Options for WoB garden community

Option 1 – All garden community growth to be served by an existing WRC

All of the growth from WoB would be directed to the existing Bocking WRC, which is located approximately 6km to the east of the proposed development. This option would require approximately 8 km of new pipeline and a new pumping station. The indicative pipeline route identified would potentially cross two rivers (Pods Brook and River Blackwater), the B1053 road and number of minor roads. Denitrification of the additional flows to Bocking WRC would need to be considered.

Option 2 – All garden community growth to be served by upgrading existing local WRCs

Rayne WRC, Braintree WRC and Felsted WRC were identified as potential options to treat the additional wastewater from the WoB garden community, due to their proximity. Following discussions with AWS and the Environment Agency, it was concluded that:

- Rayne WRC has limited land for expansion, however if it were possible to purchase adjacent farmland then there would be potential for the construction of new medium sized WRC to serve the garden community.
- Braintree WRC has no potential for expansion as the site is now encircled by development and odour management limitations would restrict further expansion.

- Felsted WRC is used to treat flow from Great Dunmow in addition to the Felsted catchment, therefore it is currently 77% overcapacity and unable to support any further growth.

From these discussions, Rayne WRC was identified as the most appropriate potential Option 2 for WoB. This option would require significant upgrades to the existing WRC, as well as approximately 3.5 km of new pipeline and a new pumping station. The indicative pipeline route identified would potentially follow minor roads and cross Pods Brook (a main river). It should be noted that the existing permit limits at Rayne WRC are tight and an increase in flows would lead to even tighter permits. The impact of this option on water quality permits are assessed in Section 5.5.1.

Option 3 – All garden community growth to be served by the construction of a new WRC for each garden community

A new WRC could be constructed close to the WoB garden community to treat the additional wastewater. This option also has the potential to divert some wastewater from Great Dunmow WRC and Felsted WRC, which would help ease the existing capacity issues at these WRCs. The treated effluent from the new WRC would potentially discharge into the River Ter or the River Brain catchments, as these watercourses are within close proximity to WoB and would require less pipeline infrastructure than discharging to the River Blackwater. Therefore, both of these options have been assessed with regards to potential discharge permits.

If the new WRC discharges into the River Ter, it is assumed that it would discharge into the upper reaches of the catchment. This option would require approximately 1.3 km of new pipeline and a new pumping station. Assuming that the discharge point would be north of the A120, the pipeline route would potentially cross the B1417.

If the new WRC discharges into the River Brain, it is assumed that it would discharge at the same location as the Rayne WRC. This option would require approximately 3.5 km of new pipeline and a new pumping station. The indicative pipeline route identified could potentially follow minor roads and cross Pods Brook (a main river).

Options 1, 2 and 3 for WoB garden community are illustrated in Figure 5-1.

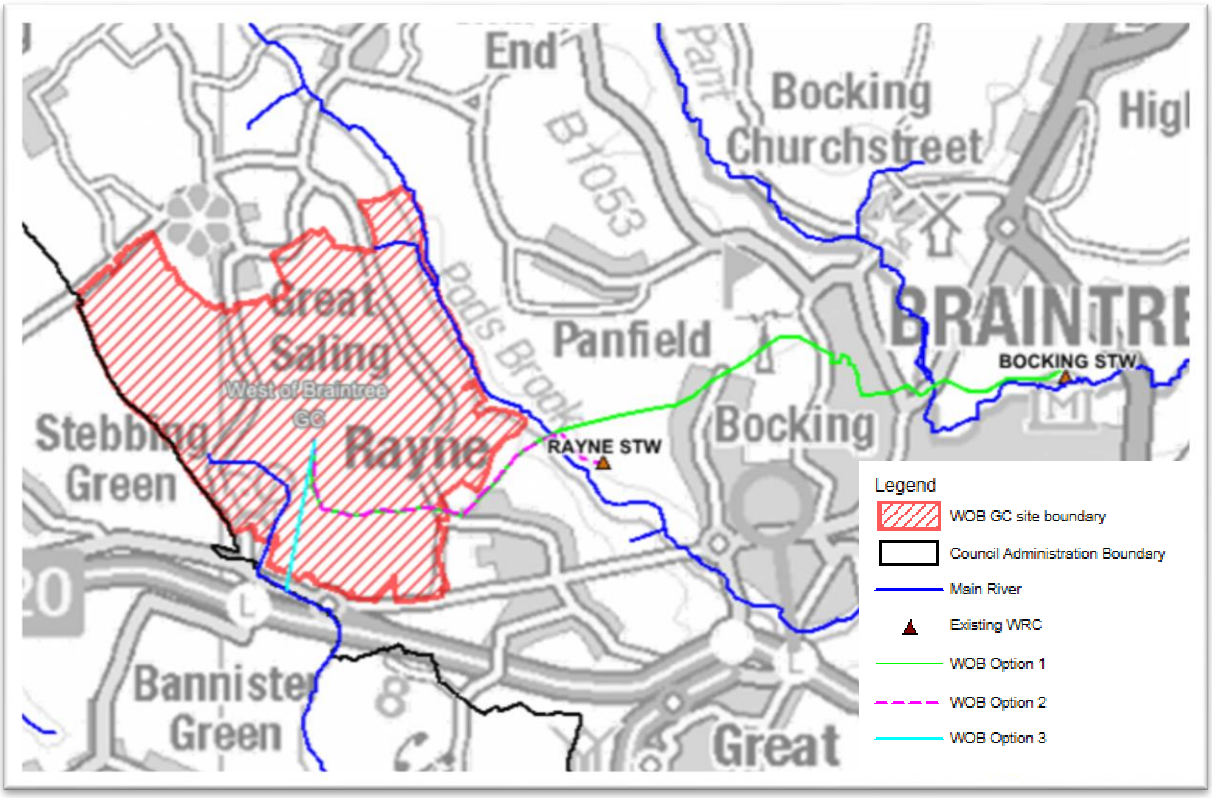

Figure 5-1 – Wastewater Treatment Options for WOB
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5.2.2 Wastewater Treatment Options for CBB garden community:

Option 1 – All garden community growth to be served by an existing WRC

The growth from both CBB would be directed to the existing Colchester WRC; it should be noted that this is also the preferred option 1 for TCB and hence a cumulative assessment has been undertaken for this option.

CBB is located approximately 11km to the west of Colchester WRC. A high level review of the local topography and environment designations was undertaken to identify a potential pipeline route and suitability for new pumping infrastructure. This option would require approximately 13 km of new pipeline and a new pumping station. The pipeline route would need to cross the Roman River and a major dual carriage road (the A120), as well as the B1022, the B1025, the B1026 and a number of minor roads.

Option 2 – All garden community growth to be served by upgrading existing local WRCs

Coggeshall WRC, Great Tey WRC, Copford WRC and Birch WRC were identified as potential options to treat the additional wastewater from the CBB garden community, due to their proximity. Following discussions with AWS and the Environment Agency, it was concluded that:

- Coggeshall WRC currently has limited capacity; however there is potential land available for expansion. Significant upgrades to the WRC would be required.
- Great Tey WRC would require complete rebuilding of the works and there would be significant opposition due to nearby roman archaeological sites. The Great Tey WRC discharges into the Roman River, which is a small river and regularly dries up in the summer months, hence capacity for significant additional discharge is limited due to environmental capacity.
- Copford WRC has no land available to expand as it is surrounded by designated sites.
- Birch WRC is currently operating at approximately 70% capacity.

From these discussions, Coggeshall WRC was identified as the most appropriate potential Option 2 for CBB garden community. This option would require significant upgrades to the existing WRC, as well as approximately 4.8 km of new pipeline and a new pumping station. The indicative pipeline route identified would potentially cross a number of rural fields and a small number of minor roads, therefore there would be minimal disruption to public access. Denitrification of the additional flows to Coggeshall WRC would need to be considered.

Option 3 – All garden community growth to be served by the construction of a new WRC for each garden community

The construction of a new package WRC within CBB garden community is an alternative option to directing the wastewater to an existing WRC. This option also has the potential to divert some wastewater from Coggeshall WRC in order to free up some capacity. The treated effluent from the new WRC could potentially discharge into the River Blackwater at the same location as the existing discharge from Coggeshall WRC.

There is potential to split the treated effluent so that a proportion of it discharges to the River Blackwater and a proportion discharges to the Roman River (at the Great Tey WRC discharge). However, this would also require a pipeline route and pumping station to the Roman River. The pipeline route would potentially cross the major A120 dual carriage road (depending on the outcome of the proposed A120 upgrade) and cross the Roman River.

Another watercourse within the local area of the CBB garden community is the Domsey Brook. The Domsey Brook is a small catchment, therefore discharging into the waterbody is not considered a suitable option.

Options 1, 2 and 3 for CBB garden community are illustrated in Figure 5-2.

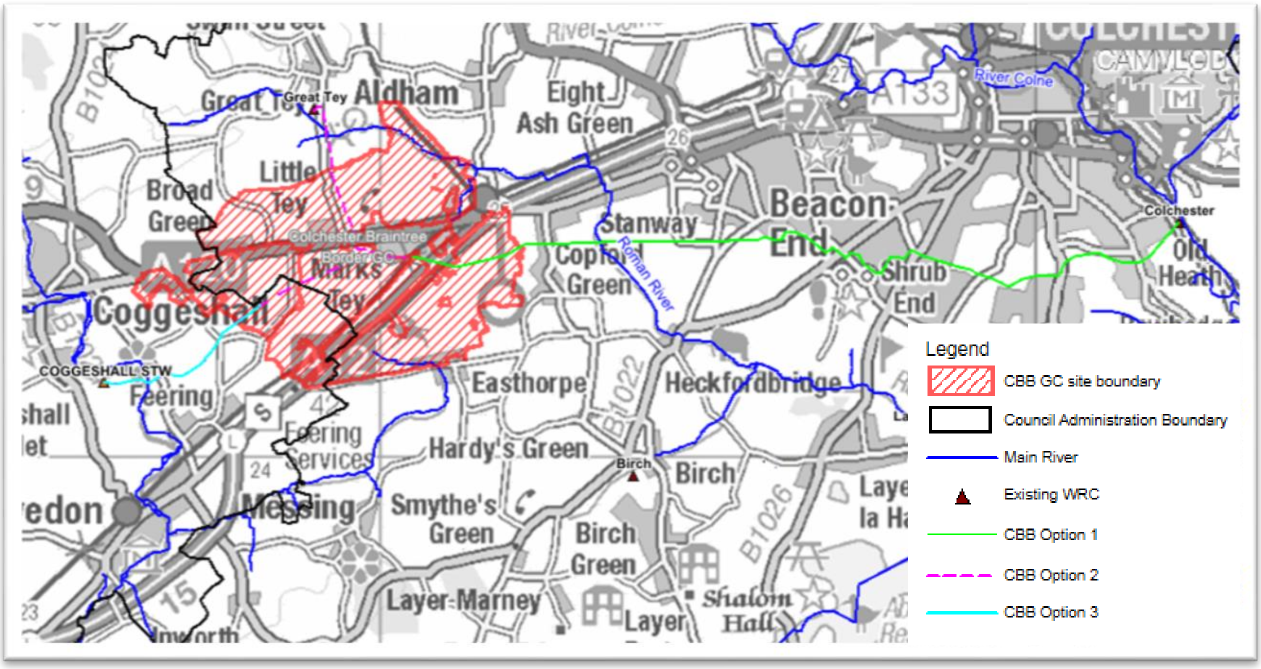

Figure 5-2 – Wastewater Treatment Options for CBB

5.2.3 Wastewater Treatment Options TCB garden community:

Option 1 – All garden community growth to be served by an existing WRC

The growth from both CBB and TCB would be directed to Colchester WRC. The most southerly point of TCB is approximately 1km north of Colchester WRC. This option would require approximately 5.2 km of new pipeline and a new pumping station. The pipeline route would need to cross the River Colne and the major A133 dual carriage road, as well as the B1028, the B1027 and a number of minor roads.

Option 2 – All garden community growth to be served by upgrading existing local WRCs

The only existing local WRC suitable for the TCB garden community is Colchester WRC. Therefore, the same network infrastructure would be required as identified for TCB Option 1.

Option 3 – All garden community growth to be served by the construction of a new WRC for each garden community

The construction of a new package WRC within TCB garden community is an alternative option to directing the wastewater to Colchester WRC and gives the opportunity to design the works using new technology. The treated effluent would be discharged into the tidal River Colne, close to (or at) the same location as the existing Colchester WRC effluent discharge. The same network infrastructure would be required as identified for TCB Option 1.

Options 1, 2 and 3 for TCB garden community are illustrated in Figure 5-3.

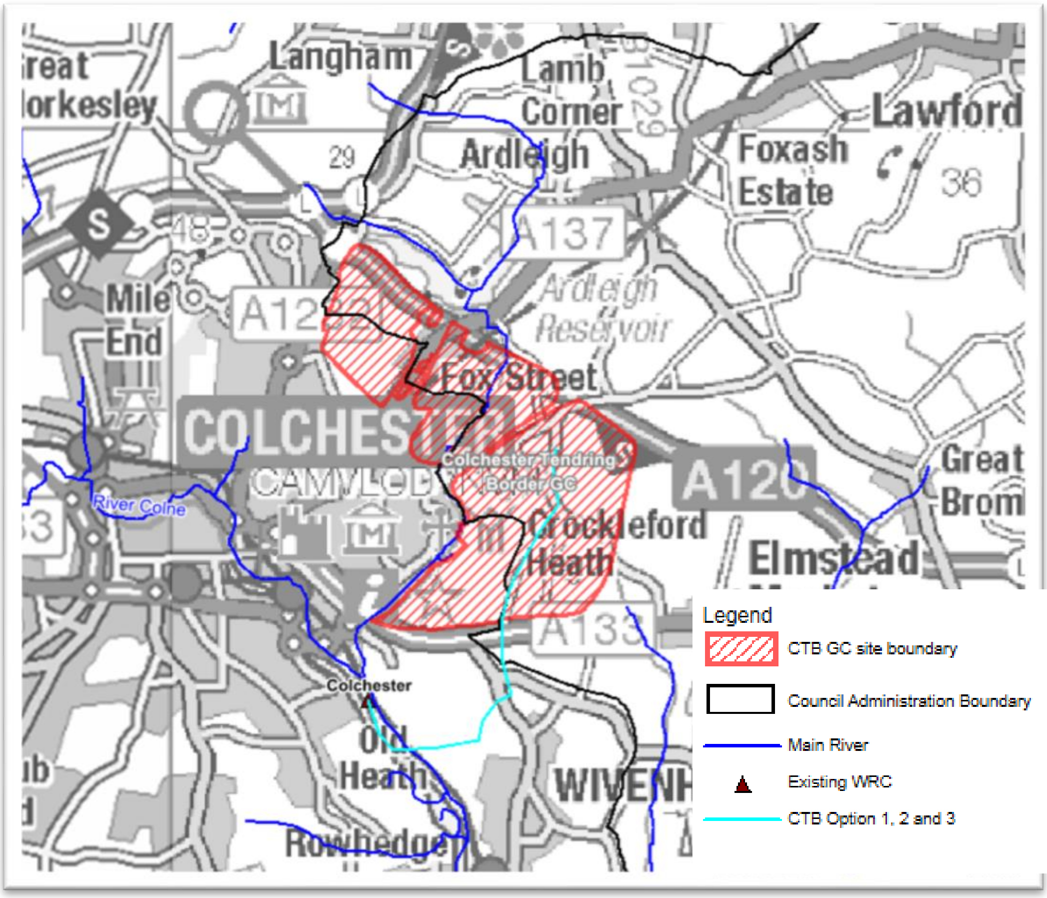

Figure 5-3 – Wastewater Treatment Options for TCB

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5.2.4 Wastewater Treatment Option 4 - All garden community growth to be served by one new strategic WRC (AWS Strategic Option)

During discussions with AWS (May 2017), an alternative wastewater treatment option was proposed to build a new strategic WRC that would serve much of the growth from all three garden communities, as well as to replace other local WRCs which are already near capacity and which would not be cost-effective to expand by bolting on new treatment processes. It is likely that this option would be used to serve growth from WoB and CBB, whist the growth for TCB would most likely be better served by Colchester WRC due to capacity and proximity of the WRC to the proposed TCB garden community boundary.

It is suggested that the new WRC would discharge somewhere into the River Blackwater with an estimated treatment capacity of 40,000 m^3; sufficient to serve all of the proposed garden community growth, replace several existing (ageing) WRCs and provide further capacity into the future. The feasibility of this option requires a review of the potential impact of removing treated flow discharged to waterbodies which may be sensitive to this loss at low flow conditions. The Environment Agency have identified that summer flows in the River Chelmer would potentially be impacted if Felsted WRC and Great Dunmow WRC were closed.

A potential additional advantage, is that this new strategic WRC would also have the potential to treat the effluent to (or close to) potable standards, which could be used to help meet the water supply demands in the local area either through a direct re-use scheme (i.e. direct supply to homes) or an indirect re-use scheme (discharge of treated effluent to a river for later abstraction), depending on certain risk factors. However, the Environment Agency have concerns that the if the treated effluent were to be discharged into the River Blackwater, the resource would flow downstream out of AWS's administration area and could be re-abstracted by Essex and Suffolk Water and hence not available for the garden communities. If AWS wish to re-abstract the effluent, it would need to be discharged into the River Stour, where AWS has an existing abstraction licence.

5.2.5 Wastewater treatment options summary

The four wastewater treatment options for each garden community are summarised in Table 5-2 including a brief description of the advantages and potential constraints of each option.

These options have been assessed from a water quality and environmental capacity perspective for each garden community to determine which options would present a strategic but feasible wastewater option, and therefore demonstrate at a strategic level that wastewater treatment can be delivered for the proposals without impacting WFD objectives. The results are presented in Section 1.3.

Table 5-1 A summary of the wastewater demand options for each garden community

Option	Garden community	Serving WRC	Receiving watercourse	Benefits	Drawbacks
Option 1	WoB	Bocking WRC	River Blackwater	• Lower cost due to economy of scales upgrading existing assets and treating large volume of wastewater. • Colchester WRCs coastal discharge likely to require a less stringent discharge permit.	• Infrastructure cost undermining the viability of local WRCs whose discharge is essential component to flow in local watercourses. • Loss of treated wastewater as a water resource to coastal discharge.
	CBB	Colchester WRC	River Colne		
	TCB	Colchester WRC	River Colne		
Option 2	WoB	Upgrade/replace: Rayne WRC	River Brain	• Long term sustainability, balance between cost and environmental requirements. • Maintain/improve flow conditions in local watercourses.	• High cost due to significant upgrades required to treatment processes and flow capacity at a number of local WRCs. • Fluvial discharges (Rayne and Blackwater) likely to require tight discharge permit conditions due to nature of small watercourses.
	CBB	Upgrade Coggeshall WRC	River Blackwater		
	TCB	Upgrade Colchester	River Colne		
Option 3	WoB	New WRC within WoB	River Ter or River Brain (Rayne WRC)	• Additional headroom made available at Colchester WRC and Bocking WRC. • New WRC in WoB has potential to also take some wastewater from Great Dunmow WRC and Felsted WRC, which would help with existing capacity issues at these WRCs. • New WRC in CBB has potential to also take some wastewater from Coggeshall WRC, which would help with existing capacity pressures. • Potential use of treated wastewater to contribute to local watercourse flow and replenish water resources • Reduced pumping costs and carbon footprint.	• High cost associated with construction of new WRC. • Suitable location of a new WRC requires detailed investigation.
	CBB	New WRC within CBB	River Blackwater (Coggeshall WRC) or Roman River (Great Tey)		
	TCB	New WRC within TCB	River Colne (Colchester WRC)		
Option 4	All garden community growth	New Strategic WRC	River Blackwater	• Greater economies of scale in building a new dedicated WRC • New WRC location could be selected away from urban centres solving odour concerns at replaced WRCs • Treatment processes built from new – tighter quality standards required for environmental compliance easier to achieve with new design as opposed to bolting treatment processes • Potential for combined re-use scheme	• Financial feasibility would be dependent on a degree of certainty that growth will come forward • Delays in implementation may make a scheme unviable if early phases of garden community connect and utilise existing capacity • Replacing smaller WRCs will remove potentially important baseflow of treated effluent to some watercourses • AWS would potentially need to discharge into the River Stour in order to re-abstract the resource for water demand.

5.3 Wastewater Assessment

When considering which of the options set out for each garden community is deliverable, it is essential to consider two key capacity issues:

- **Infrastructure Capacity**: defined as the ability of the wastewater infrastructure to collect, transfer and treat wastewater from homes and business. The key questions are:
  - 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 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. The key question is:
  - 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. In relation to environmental capacity it is important to define how discharges from WRC are managed as set out in the following sub-sections.

5.3.1 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 'permitted headroom', which acknowledges that allowance needs to be made for future development and the additional wastewater generated. 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 strategy, the assumption is applied that the permitted headroom is usable[1] 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[2] 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.

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

The primary legislative drivers which determine the quality conditions of any new permit to discharge are the Water Framework Directive (WFD) and the Habitats Directive (HD). Within this Stage 1 report the assessment has focused on WFD Compliance, as described in Section 6.3.2. Any impacts on Habitats Directive sites will be assessed in the Stage 2 report.

5.3.2 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 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[3]; and
- Development must not prevent a waterbody from achieving its future target status (usually at least Good status).

It is not acceptable to allow 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 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 process (assumptions and where applicable, modelling tools) is described in detail in Appendix C.

5.3.3 Limits of Conventional Treatment (LCT)

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)[4], ammonia and phosphate, and are provided in Table 5-1.

Table 5-2 Reliable limits of conventional treatment technology for wastewater

Water Quality Parameter	LCT
Ammonia	1.0 mg/l 95 percentile limit
BOD	5.0 mg/l 95 percentile limit[5]
Phosphate	0.5 mg/l annual average[6]

5.3.4 Assessment methodology

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

[3] i.e. a reduction High Status to Good Status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained
[4] 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
[5] Considered within the water industry to be the current LCT using best available techniques
[6] Environment Agency (2015) Updated River Basin Management Plans Supporting Information: Pressure Narrative: Phosphorus and freshwater eutrophication

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

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:

- **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.

5.4 Wastewater treatment headroom capacity assessment

In order to determine the deliverability of each of the options, it is necessary to assess how much flow capacity is available at each WRC within its current permit to discharge. This will identify how much additional wastewater can be accepted before a new permit will be required and potential upgrades to treatment processes being necessary.

The headroom capacity assessment has been completed in 2 stages. The first stage was to calculate the future headroom capacity for each WRC by the end of the current local plan period (2033), but excluding the early phasing of growth from the garden communities which was initially included in the Braintree and Colchester WCSs. This identifies the potential headroom capacity and equivalent additional housing capacity that would be available by 2033 to accommodate the garden community growth based on different assumptions included within the WCSs.

The second stage was then to include the additional wastewater flow that would need to be treated on top of the previous local plan growth based on the various wastewater treatment options.

The volume of wastewater, measured as Dry Weather Flow (DWF), which would be generated from the proposed housing and employment growth over the a) Local Plan period and b) Local Plan growth plus the garden community growth, within each WRC catchment has been calculated and compared to the treatment capacity at each WRC. DWF is an estimate of the flow of wastewater to a WRC which is not a direct result of rainfall.

5.4.1 Headroom Capacity Results

The results for the headroom assessment for each WRC are presented in Table 3. The headroom capacities coloured green shows WRCs that can accept the proposed growth within the current permitted flow and the yellow shows the WRCs that would require a new discharge permit and a water quality assessment to further detail how much growth can be accommodated.

Table 5-3 shows that for all the WRCs except Coggeshall, the existing permitted headroom is sufficient to accommodate the growth proposed in the Local Plans up to 2033 (excluding the garden communities). A WCS for Tendring District has been commissioned, and a review of Local Plan site allocations suggests that Colchester WRC would receive limited growth from Local Plan sites. The Braintree WCS demonstrated that based on the Braintree District Council housing trajectory for the local plan, the existing discharge permit at Coggeshall WRC will be exceeded in 2019.

Table 5-3 Headroom capacity assessment for each existing WRC

WRCs	Headroom assessment post local plan growth excluding garden communities (to 2033)			Headroom assessment post local plan growth including garden communities (beyond 2033)				WRC remaining capacity (% of permitted flow after garden community growth)
	Post Local Plan growth DWF (excl. garden communities) (m3/d)	Headroom capacity after growth (m³/d)	Housing capacity after growth (dwellings)	Maximum no. of additional houses from garden communities	Maximum Employment (m3/d)	Post garden community growth DWF (m3/d)	Headroom capacity after growth (m³/d)	
Bocking	3597	303	754	12,350	5	8,550	-4,650	-119%
Rayne	532	118	293	12,350	5	5,485	-4,835	-744%
Colchester[7]	27865	1,419	3,539	24,000 + 8,500	16+12	40,926	-11,642	-40%
Coggeshall	2741	-506	-1,262	24,000	16	12,382	-10,147	-454
Great Tey	120	22	55	24,000	16	9760	-9,618	-6773

Green - WRCs where growth can be accepted within the current permitted flow

Yellow - WRCs that require a new discharge permit and need a water quality assessment

However, once the maximum additional growth for each garden community has been applied to each WRC, none of the WRCs would have sufficient headroom to receive all of the garden community growth and 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 garden community growth would not impact on downstream environmental requirements, water quality assessment is required for each WRC to determine whether theoretically achievable quality conditions can be applied to a revised discharge permit. The results of the water quality assessment are provided in Section5.5, with detailed results from the modelling provided in Appendix D.

5.5 Water quality assessment

Bocking, Rayne, Coggeshall and Great Tey WRCs all discharge to freshwater, inland waterbodies. Therefore, statistical based water quality modelling[8] has been performed to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. Load standstill calculations have been used to determine the future permit conditions for BOD.

Colchester WRC discharges into the tidal River Colne, therefore the RQP modelling software is not suitable for this site. Instead, load standstill calculations were used to determine the future permit conditions for BOD and Ammonia.

A summary of the results for each option within each garden community are included in Tables 5-4, 5-5 and 5-6. The results show whether the increase in discharge from the garden community growth would have the potential to impact WFD objectives.

5.5.1 WoB garden community water quality assessment

Table 5-4 details the future permit quality conditions that will be required to ensure no deterioration in WFD status for the WoB garden community. Option 1, where all the additional treated effluent would be discharged into the River Blackwater at Bocking WRC[9] shows that no deterioration of WFD status is achievable within the current limits of conventional treatment by tightening the permit conditions for BOD and ammonia, and a new condition for phosphate.

[7] Note, this is a different value compared to the Colchester WCS due to different assumptions on consumption for Braintree WCS, which is a more recent assessment

[8] using Environment Agency River Quality Planning (RQP) software

[9] Option 1 with wastewater treated at the WRC, and option 3 with treatment onsite and transfer to the River Blackwater for discharge

The load standstill results for Option 2 (Rayne WRC) show that only 10% of the proposed development at WoB garden community growth (1250 houses) could be accommodated before a treatment solution beyond conventional treatment levels would be required to achieve no deterioration of WFD status in the River Brain. BOD is the restricting parameter and would drive how many houses could be connected to the works. Therefore, wastewater flow would need to be split between Rayne and Bocking WRCs depending on phasing and pumping requirements.

The water quality results for Option 3 (new WRC) show that it is unlikely that no deterioration of the WFD status can be achieved in the River Ter catchment, even with only 10% of the proposed development at WoB garden community (1250 houses). This is likely due the location of the discharge in the headwater of the River Ter, where flows are relatively small and the ammonia quality is currently at high status. There is currently no permit at this location, therefore BOD has not been assessed using the load standstill method, however it has been identified that ammonia would be the limiting factor at this location.

The future phosphorus WFD status for the River Blackwater is moderate, however the water quality results showed that moderate status cannot be achieved even without growth, therefore conventional treatment is the limiting factor (Appendix D).

Table 5-4 Required permit quality conditions to achieve no deterioration in WFD status for WoB garden community treatment options

WRC	Option	Growth Option	Consent DWF (m3/d)	BOD (mg/l 95%ile)	Ammonia (mg/l 95%ile)	Phosphate (mg/l annual average)
Bocking WRC discharging to River Blackwater		**Current Consent conditions**	**3,900**	**15**	**10**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Within consented DWF	12.1	4.08	- No permit required
	1 and 3	2033 Baseline + WoB growth	Exceeds consented DWF	6.6	2.05	4.96
Rayne WRC discharging to River Brain		**Current Quality Consent**	**650**	**10**	**3**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Within consented DWF	9.8	3	- No permit required
	2	2033 Baseline + WoB growth	Exceeds consented DWF	**0.9 Unlikely to be achievable within LCT**	1 At the LCT	2.07
	2 and 3	2033 Baseline + 10% of proposed growth for WoB	Exceeds consented DWF	5	2.49	- No permit required
New WRC discharging to River Ter		**No Current Quality Consent Available**				
		2033 Baseline (Local Plan Development excluding GARDEN COMMUNITY growth)	-	-	-	-
	3	2033 Baseline + WoB growth	-	-	**0.34 Unlikely to be achievable within LCT**	1.61
	3	2033 Baseline + 10% of proposed growth for WoB	-	-	**0.65 Unlikely to be achievable within LCT**	5.04

5.5.2 CBB garden community Water Quality Assessment

Table 5-5 shows the future permit quality conditions that will be required to ensure no deterioration in WFD status for the CBB garden community. Option 1, where all the additional treated effluent (from both CBB and TCB garden communities) would be discharged into the River Colne at Colchester WRC, shows that no deterioration of WFD status is achievable within the current limits of conventional treatment by tightening the permit conditions for BOD and ammonia. Therefore this is a workable solution for both CBB and TCB combined, and as individual garden communities.

The water quality assessment for discharging into the River Blackwater at Coggeshall WRC (Options 2 and 3) shows that only 50% of the proposed development at CBB garden community growth (12,000 houses) could be accommodated within the limits of conventional treatment to ensure no deterioration of WFD status of the receiving waterbody.

The water quality assessment for discharging into the Roman River at Great Tey WRC (Option 2) shows that it is not possible to achieve no deterioration of WFD status within the current limits of conventional treatment. The remaining 50% of the proposed housing and employment land wastewater would therefore need to be transferred to Colchester WRC for treatment, depending on phasing and pumping requirements. Colchester WRC is not considered to be a 'local' WRC within the context of the aim of Option 2, and therefore, Option 2 is not considered to be a viable option for the CBB garden community. Additionally, local treatment for discharge at Coggeshall (Option 3) is unlikely to be feasible unless new treatment process beyond conventional treatment are used or less than 50% of the treated flow is discharged at this location.

The future phosphate WFD status for the River Blackwater is moderate. The future target status results showed that moderate status is achievable for the full CBB growth to Coggeshall WRC within conventional treatment limits, with a future phosphate permit of 3.15 (Appendix D).

Table 5-5 Required permit quality conditions to achieve no deterioration in WFD status for CBB garden community treatment options

WRC	Option	Growth Option	Consent DWF (m3/d)	BOD (mg/l 95%ile)	Ammonia (mg/l 95%ile)	Phosphate (mg/l annual average)
Colchester		**Current Quality Consent**	**29,284**	**35**	**15**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Within consented DWF	29.4	12.6	-
	1	2033 Baseline + TCB growth + CBB growth[10]	Exceeds consented DWF	20	8.6	-
Coggeshall		**Current Quality Consent**	**2235**	**19**	**13**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Exceeds consented DWF	15.2	11.4	- No permit required
	2 and 3	2033 Baseline + CBB growth	Exceeds consented DWF	**3.4 Unlikely to be achievable within LCT**	3.2	6.14
	2 and 3	2033 Baseline + 50% houses for CBB growth	Exceeds consented DWF	5.5	4.66	- No permit required
Great Tey		**Current Quality Consent**	**142**	**30**	**-**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Within consented DWF	24.3	6.44	1.18

[10] CBB Option 1 includes the growth from both CBB and TCB garden communities being directed to Colchester WRC for treatment.

	2	2033 Baseline + CBB growth	Exceeds consented DWF	**0.4 Unlikely to be achievable within LCT**	**1.11**	**0.27 Unlikely to be achievable within LCT**
	2 and 3	2033 Baseline + 50% houses for CBB growth	Exceeds consented DWF	**0.7 Unlikely to be achievable within LCT**	**1.21**	**0.28 Unlikely to be achievable within LCT**

5.5.3 TCB garden community water quality assessment

Table 5-6 shows the future permit quality conditions that will be required to ensure no deterioration in WFD status for the TCB garden community. All three options for TCB require discharging the full additional treated effluent into the River Colne at Colchester WRC. The results show that no deterioration of WFD status is achievable within the current limits of conventional treatment by tightening the permit conditions for BOD and ammonia.

Table 5-6 Required permit quality conditions to achieve no deterioration in WFD status for TCB garden community treatment options

WRC	Option	Growth Option	Consent DWF (m3/d)	BOD (mg/l 95%ile)	Ammonia (mg/l 95%ile)	Phosphate (mg/l annual average)
Colchester	1,2,3	**Current Quality Consent**	**29,284**	**35**	**15**	**-**
		2033 Baseline (Local Plan Development excluding garden community growth)	Within consented DWF	29.4	12.6	-
		2033 Baseline + TCB growth[11]	Exceeds consented DWF	26.2	11.2	-

5.6 Wastewater and water quality assessment summary

The headroom capacity assessments and water quality assessments have shown that there are workable wastewater options within the limits of conventional treatment for each of the three garden communities in North Essex which would not impact on the WFD status of receiving waterbodies. These options have been summarised in Table 5-7.

Table 5-7 Preferred Wastewater options for each garden community

Garden community	Option	Description
WoB	1	100% WoB growth to be treated at Bocking WRC
WoB	3	New WRC with the treated effluent split 10/90 between River Brain at Rayne WRC and River Blackwater at Bocking WRC
CBB	1	Directing all growth to Colchester WRC
TCB	1,2	Directing all growth to Colchester WRC

The options will be reviewed and developed in more detail in the Stage 2 IWMS which will also identify local measures to reduce the overall wastewater generation, such as re-use and recycling of greywater on site. Reducing the overall generation volume through innovative, integrated and localised measures could make other combinations of strategic options more viable, and this will be considered as part of the Stage 2 study.

[11] TCB Options 1,2,3 only includes growth for TCB garden community to be treated at Colchester WRC

6. Water Supply

6.1 Introduction

Water resources within Essex are currently subject to significant levels of stress and will continue to be in the future. The locations of the garden communities are within areas of moderate to serious water stress as defined by the Environment Agency[12]. This arises from several pressures including, high demands, effects of climate change on raw resources, leakage, environmental protection and finite capacity within raw resources.

6.1.1 Public Water Supply

There are two water companies that cover the north Essex garden communities development: water supply for the WoB and CBB garden communities would be provided by Anglian Water Services (AWS), whereas the TCB garden community straddles the water supply boundary between AWS and Affinity Water (Central). Water companies manage water supply by 'Water Resource Zones' (WRZ) or 'resource zones' (RZ); that is, all customers in a WRZ or RZ share the same water resources and hence share the balance of supply and demand. WoB is located within AWS South Essex RZ, CBB is partially within AWS South Essex RZ and AWS Central WRZ, and TCB is partially within AWS' South Essex RZ and partially in Affinity Water's WRZ8.

The AWS Water Resource Management Plan 2015[13] (WRMP) and Affinity Water 2014 WRMP[14] have been used to determine the available water resource in the local area and whether it can accommodate the demand from the proposed garden communities. The water companies' WRMP's are currently in the process of being updated and due for publication in 2019.

6.1.2 Local Water Resource Availability

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 are shown in Table 6-1. The classification is based on an assessment of a river system's ecological sensitivity to abstraction-related flow reduction. This classification can then be used to assess the potential for additional water resource abstractions.

Table 6-1 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

[12] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
[13] Anglian Water Limited Final Water Resources Management Plan (2015) http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf
[14] https://stakeholder.affinitywater.co.uk/docs/FINAL-WRMP-Jun-2014.pdf

	support Good Ecological Status (as required by the Water Framework Directive (Note: we are currently investigating water bodies that are not supporting GES / GEP). 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 local Water Resource Management Units (WRMU) in the updated Environment Agency Essex Catchment Abstraction Management Strategy (CAMS)[15], published in February 2013,has been summarised for surface waterbodies in Table 6-2.

Table 6-2 Resource availability classification

River – WRMU	Surface Water (flow exceedance scenarios)			
	Q30	Q50	Q70	Q95
AP8 River Colne/Bourn Brook				
AP9 River Colne				
AP11 Roman River/Layer Brook				
AP15 River Brain at confluence with Blackwater				
AP17 River Ter at confluence with Chelmer				
AP18 River Chelmer				

All rivers are defined as having no water available for licencing during periods of low flow (Q95). The River Brain catchment has no water available for licensing, even during periods of high flows. The River Colne catchment has water available for licensing during flows above Q50, which could provide opportunities for localised abstraction and storage and this will be considered as part of the Stage 2 IWMS. All other local catchments to the garden communities have restricted water available for licensing during periods of high flow (Q30).

At the time of publication of the IWMS, the Environment Agency is in the process of updating the Essex CAMs. The 2013 Essex CAMS identified the following key components and issues with regards to water resources in this area:

- The Ely-Ouse to Essex Transfer Scheme (EOETS) is a key component within the catchment, which transfers water from the Great Ouse to the headwaters of the Rivers Stour and Pant, providing resources for public water supply, a small amount of agricultural abstraction, and environmental support in Essex;
- The Abberton Scheme – extension of the existing public water supply reservoir to meet demand, and the effect this has on reservoir control curves and the operation of the EOETS;
- Small recharge to the main confined Chalk aquifer and unsustainable groundwater abstraction;
- Drying up of the Roman River in summer months;
- Ongoing development and the need to meet increasing demand for water. Significant population growth of existing urban areas in Essex is expected over the next 6-10 years;
- Existing groundwater monitoring is inadequate to determine the groundwater resource availability within the CAMS area, however, CAMS has identified on a broad scale that the Essex Chalk aquifer is over-committed;
- The low flow in many rivers is dominated by Sewage Treatment Works (STW) discharges. These act as a baseline lower limit for flow.

[15] Essex Abstraction Licensing Strategy, February 2013. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289840/LIT_7740_6e1970.pdf

This analysis indicates that there is limited potential for local abstraction to support major site development at a local level and therefore, reliance on strategic water resource management and movement of water into the area is required to sustain growth and demand for potable water..

6.2 Water resource planning

The AWS Water Resource Management Plan 2015[16] (WRMP) and Affinity Water 2014 WRMP[17] have been used to determine the available strategic water resource availability in the local area. As identified in section 6-1, there are two WRZs that cover the proposed garden communities: AWS South Essex RZ and Affinity Water WRZ8.

6.2.1 AWS South Essex RZ

The South Essex RZ extends inland from Colchester and is based on the supply systems for Colchester and Braintree (Appendix B, figure B5). Supplies in the RZ are obtained from a combination of sources that include groundwater abstracted from the Chalk and surface water pumped from the River Colne into storage at Ardleigh reservoir. The Ardleigh reservoir resource is currently shared with Affinity Water on a 70/30 arrangement.

Accounting for growth in the Local Plan period, under the current assessment of water resource availability for the next 25 years[16], the supply demand balance in the AWS South Essex RZ is predicted to decrease to a deficit of 1.02Ml/d by 2040 under dry year annual average conditions.

AWS has developed a number of new water supply feasibility options to increase the water available for use in order to address the forecast deficit in the South Essex RZ. These include

- SE1 Colchester water reuse - Effluent from the Colchester Water Recycling Centre would be treated to an extremely high standard and discharged to the River Colne to supplement river flows and permit increased abstraction.
- SE2 East Suffolk RZ transfer (12Ml/d) - The transfer of 12 Ml/d of water from Ipswich in the East Suffolk RZ to Colchester via a new 22km long pipeline.
- SE4 Amendment to Ardleigh agreement – Increase the AWS share of the available resource from Ardleigh reservoir To an 80/20 split.
- SE6 South Essex RZ groundwater development - Utilising an existing licenced borehole in the Colchester area.
- SE7 Ardleigh reservoir extension - An extension to the existing Ardleigh reservoir utilising disused mineral abstraction pits to provide additional storage.
- SE8 East Suffolk RZ transfer (2Ml/d) - Transfer 2Ml/d from the East Suffolk WRZ

Lowering demand through metering, water efficiency programmes and leakage reduction is a priority within AWS's preferred plan. AWS anticipate approximately 4,000 customers in the South Essex RZ will opt to metering and they aim to complete approximately 9000 water efficiency audits.

Within their WRMP, AWS has identified adequate feasible options to meet future demand in South Essex RZ within the current planning period; however, in the context of the garden communities, the demand forecast used in the WRMPs does not allow for the demand from the garden communities.

6.2.2 AWS Central Essex RZ

The Central Essex RZ is adjacent to the northern boundary of the South Essex RZ, and covers the supply system for Halstead (Appendix B, figure B5). Supplies in the RZ are dependent on groundwater abstracted from the Chalk aquifer and shared resources from other RZs.

Accounting for growth in the Local Plan period, under the current assessment of water resource availability for the next 25 years[16], the supply demand balance in the AWS Central RZ is predicted to decrease to a deficit of 0.86 Ml/d by 2040 under dry year annual average conditions.

[16] Anglian Water Limited Final Water Resources Management Plan (2015) http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf
[17] https://stakeholder.affinitywater.co.uk/docs/FINAL-WRMP-Jun-2014.pdf

AWS has developed two water supply feasibility options to increase the water available to address the forecast deficit in the Central RZ:

- CE1 South Essex RZ transfer - This option provides a transfer from South Essex RZ to Central Essex RZ requiring 12km of new pipeline with 2 new pumping stations, and
- CE2 - West Suffolk RZ transfer - A transfer from West Suffolk RZ to Central Essex RZ via a new 34km long pipeline and 3 new pumping stations.

However, both of these options are supplied by RZs in deficit by the end of the forecast, therefore a new resource will be required in the donor RZs. The most likely options for the location of the CBB garden community are those developed for the South Essex RZ (described in section 6.2.1).

Lowering demand through metering, water efficiency programmes and leakage reduction is a priority within AWS's preferred plan. AWS anticipate approximately 2,000 customers in the Central RZ will opt in to metering and they aim to complete approximately 1,500 water efficiency audits.

Within their WRMP, AWS has identified adequate feasible options to meet future demand in Central RZ within the current planning period, by utilising options developed for the South Essex RZ; however, in the context of the garden communities, the demand forecast used in the WRMPs does not allow for the demand from the garden communities.

6.2.3 Affinity Water WRZ8

The Affinity Water WRZ8 (East) covers north east Essex, including the towns of Harwich and Clacton on Sea, with a population of 156,000 people. The majority of the supply comes from groundwater sources, with additional supply from the Ardleigh reservoir resource, shared with AWS. 72% of households in this resource zone are metered, resulting in a low consumption in this area.

Under the current assessment of water resource availability for the next 25 years[16], the supply demand balance in the Affinity Water WRZ8 is forecast to remain in surplus, reducing from 5.54 Ml/d in 2015 to 1.51 Ml/d by 2040. Due to the surplus, there is no requirement to increase water availability or reduce consumption to maintain the supply / demand balance for planned development up to 2040, therefore Affinity Water has not undertaken an options appraisal for WRZ8. However, the demand forecast used in the WRMPs does not allow for the demand from the garden communities.

In their WRMP, Affinity Water has identified that the North of WRZ8 is projected to be a significant growth area, especially for AWS, and has agreed to explore opportunities for flexible water trading of shared resources. Affinity Water has agreed to sell more of their share of the Ardleigh reservoir resource to AWS from 2031, from the current 30/70 agreement to a 20/80 split. This would reduce Affinity Water's available resource to 5.4Ml/d at both average and peak, however this can be accommodated due to the surplus in the supply/demand balance.

6.3 Water demand from garden communities

Estimates for water demand for each garden community has been calculated through the water balance in Section 4. The daily estimates for potable and non-potable water are shown in Table 6-3. In considering these water demand estimates, it should be noted that these been developed based on the best information available; however, they are based on numerous assumptions and should not be regarded as assured.

Table 6-3 Daily estimates for potable and non-potable water demand for each garden communities

	Total development			Water demand	
Garden community	**Homes**	**Employment (ha)**	**Equivalent no. of jobs**	**Total potable demand (Ml/d)**	**Total non-potable demand (Ml/d)**
WoB	12,350	13	326	4.35	0.61
CBB	24,000	40	1,002	8.46	1.18
TCB	8,500	30	751	3.00	0.42
Totals	44,850	83	2,079	15.81	2.21

6.3.1 Water supply for the garden communities

Although the majority of the CBB garden community is located within the AWS Central Essex RZ, the options to meet the deficit in the RZ are dependent on the options developed for the South Essex RZ, therefore the water supply analysis for this Stage 1 IWMS has concentrated on the South Essex RZ.

The AWS WRMP forecasts a supply/demand deficit of 1.02 Ml/d by 2040 under the current planning period for the South Essex RZ. The total water demand (potable and non-potable) for the combined garden communities is an additional 18.02 Ml/d. AWS would be required to supply water to WoB and CBB, and as it is on the supply boundary, they could also likely supply TCB. This would increase their deficit to a total of 19.04 Ml/d.

The range of new water supply feasibility options for the South Essex RZ identified in the AWS WRMP (Section 6.3.1) would deliver more than the planned deficit of 1.02Ml/d. Option SE2 would involve a 12Ml/d internal transfer from the East Suffolk RZ. Option SE4 means AWS would be able to access 80% of the Ardleigh reservoir resource. These options, in combination with potential Ardleigh reservoir extension, Colchester water reuse and groundwater development are likely to be able to supply all three garden communities, especially when considered alongside demand reduction and water efficiency measures. Although not all options were included in the preferred plan for the 2015 WRMP, they were considered feasible and deliverable options and could be accelerated for consideration in the 2019 WRMP update based on the garden community proposals.

In addition to feasible options already identified in the 2015 WRMP, high level discussions with AWS as part of this Stage 1 IWMS also suggested that alternative potential future options could include a bulk transfer to the region from the River Trent and the possibility of sharing resource from Essex and Suffolk Water's Abberton raw water reservoir, however this would need agreement with Essex and Suffolk Water. These potential options are very high level and have not been assessed in any detail in terms of feasibility; however, assessment could be progressed in the future if required.

If Affinity Water were to supply water for TCB, this would bring their current forecast surplus into a deficit of 1.91 Ml/d. At this stage, Affinity Water has not undertaken an options appraisal for WRZ8 in their WRMP, therefore alternative and additional supply options are not available for discussion. However, they have identified that by reducing their share of the Ardleigh reservoir resource, they are helping AWS to supply significant growth in the North of WRZ8.

In summary, from reviewing the AWS 2015 WRMP and Affinity Water 2024 WRMP, and through liaison with AWS, it has been established that the additional water demand from the growth proposed within the three garden communities can potentially be accommodated for through a combination of the additional supply options identified in the AWS WRMP, demand reduction and water efficiency measures. The optimal means of supplying the garden communities (including how demand can be reduced through local measures), will be included in the Stage 2 IWMS.

7. Summary of Options

The wastewater treatment headroom capacity assessments and water quality assessments have shown that there are workable wastewater options within the limits of conventional treatment for each of the three garden communities in North Essex which would not impact on the WFD status of receiving waterbodies. These options have been summarised in Table 5-7.

Table 7-1 Preferred Wastewater options for each garden community

Garden community	Option	Description
WoB	1	100% WoB growth to be treated at Bocking WRC
WoB	3	New WRC with the treated effluent split 10/90 between River Brain at Rayne WRC and River Blackwater at Bocking WRC
CBB	1	Directing all growth to Colchester WRC
TCB	1,2	Directing all growth to Colchester WRC

From reviewing the AWS 2015 WRMP and Affinity Water 2024 WRMP, and through liaison with AWS, it has been established that the additional water demand from the growth proposed within the three garden communities can potentially be accommodated for through a combination of the additional supply options identified in the AWS WRMP, demand reduction and water efficiency measures. The AWS South Essex RZ new water supply feasibility options include:

- SE1 Colchester water reuse - Effluent from the Colchester Water Recycling Centre would be treated to an extremely high standard and discharged to the River Colne to supplement river flows and permit increased abstraction;
- SE2 East Suffolk RZ transfer (12Ml/d) - The transfer of 12 Ml/d of water from Ipswich in the East Suffolk RZ to Colchester via a new 22km long pipeline;
- SE4 Amendment to Ardleigh agreement – Increase the AWS share of the available resource from Ardleigh reservoir to a 80/20 split;
- SE6 South Essex RZ groundwater development - Utilising an existing licenced borehole in the Colchester area;
- SE7 Ardleigh reservoir extension - An extension to the existing Ardleigh reservoir utilising disused mineral abstraction pits to provide additional storage;
- SE8 East Suffolk RZ transfer (2Ml/d) - Transfer 2Ml/d from the East Suffolk WRZ.

7.1 Next Steps

The solutions identified in Stage 1 will be taken into the Stage 2 Outline IWMS which will develop a range of delivery option strategies for each garden community based on a series of potential wastewater, water supply surface water management and flood risk measures.

The delivery option strategies will be developed from the measures considering an integrated approach to managing water demand, wastewater generation and flood risk to support developing masterplans for each garden community.

A key aspect of the next stage study will be identifying reasonable and deliverable local measures to reduce demand and wastewater generation from the options identified in this Stage 1 report. Whilst the strategic options identified have shown to be deliverable, they will require considerable investment and would require significant amounts of new infrastructure as well as energy to operate effectively. It is therefore important that the Stage 2 IWMS identifies how reliance on strategic options identified can be minimised. The use of localised integrated water management measures may reduce potable demand and wastewater generation to a point that makes other combinations of strategic options preferable and this will be considered through the Stage 2 IWMS scope. All preferred measures will be identified and agreed in liaison with the partner authorities, the Environment Agency and the relevant infrastructure providers.

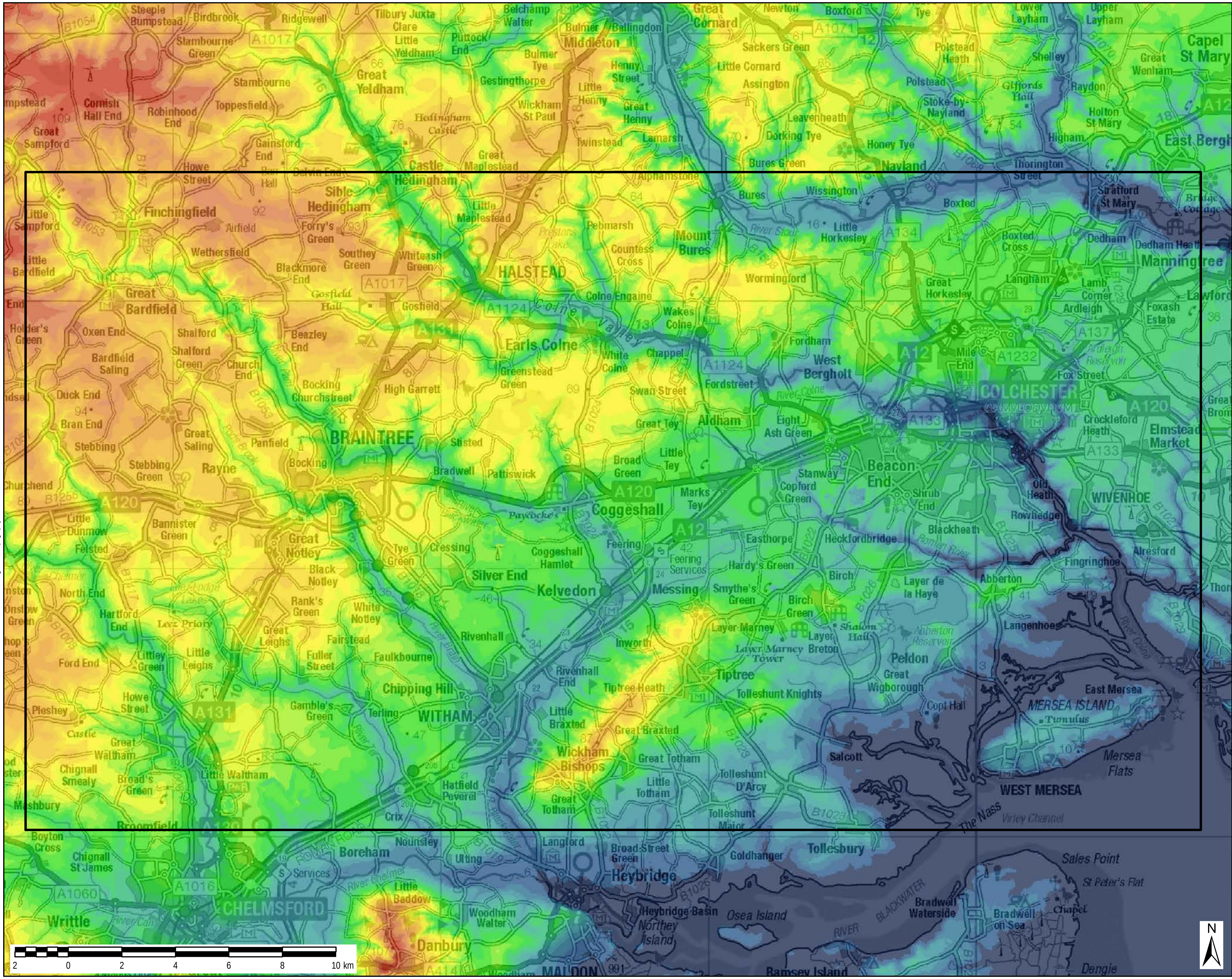
Appendix A Policy and Legislative Drivers

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[18], 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[19]. Standards, and water body classifications are published via River Basin 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.

[18] 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.
[19] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B Figures



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LEGEND

Study Area

Elevation (m)

- 0 to 5m
- >5 to 10m
- >10 to 15m
- >15 to 20m
- >20 to 25m
- >25 to 30m
- >30 to 35m
- >35 to 40m
- >40 to 45m
- >45 to 50m
- >50 to 55m
- >55 to 60m
- >60 to 65m
- >65 to 70m
- >70 to 75m
- >75 to 80m
- >80 to 85m
- >85 to 90m
- >90 to 95m
- >95 to 100m
- >100 to 105m
- >105m

Purpose of Issue

FINAL

Client

Tendring District Council

Braintree District Council

Colchester

Project Title

NORTH ESSEX GARDEN COMMUNITIES IWMS

Drawing Title

TOPOGRAPHY WITHIN THE STUDY AREA

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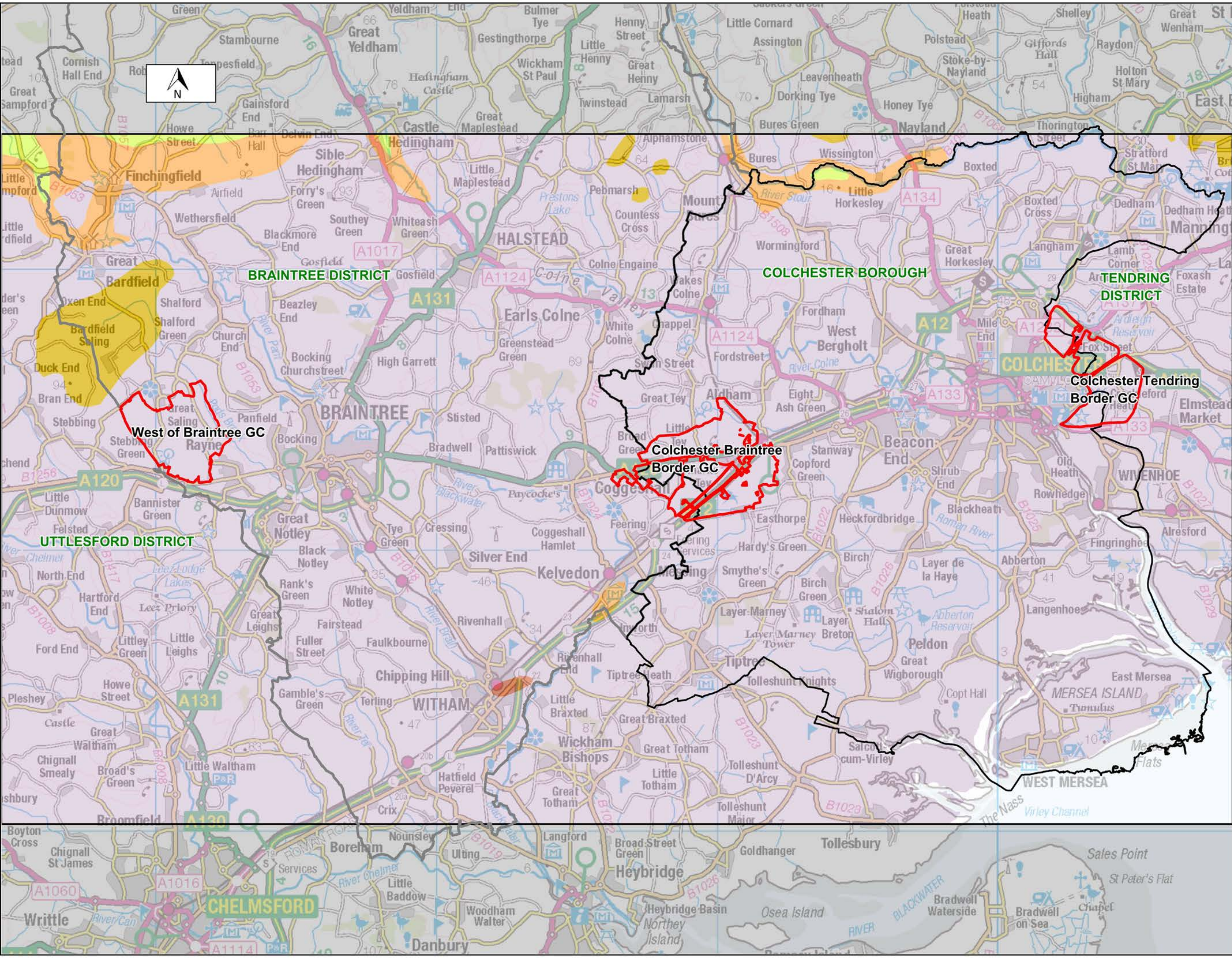
FIGURE B1	02

File Name:\\BA-WP-00344700 - Water\Water New\4 - PROJECTS\60541670 - North Essex Garden Communities IWMS\20 WIP\02 GIS\MXDs\Figure B1 Topography.mxd



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Colchester Borough Boundary

Braintree District Boundary

Garden Community Boundary

Bedrock Geology

- Thanet Sand Formation
- White Chalk subgroup
- Lamberth Group
- Thames Group
- Neogene to Quaternary Rocks (undifferentiated)

Purpose of Issue

Final

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Drawing Title

BEDROCK GEOLOGY

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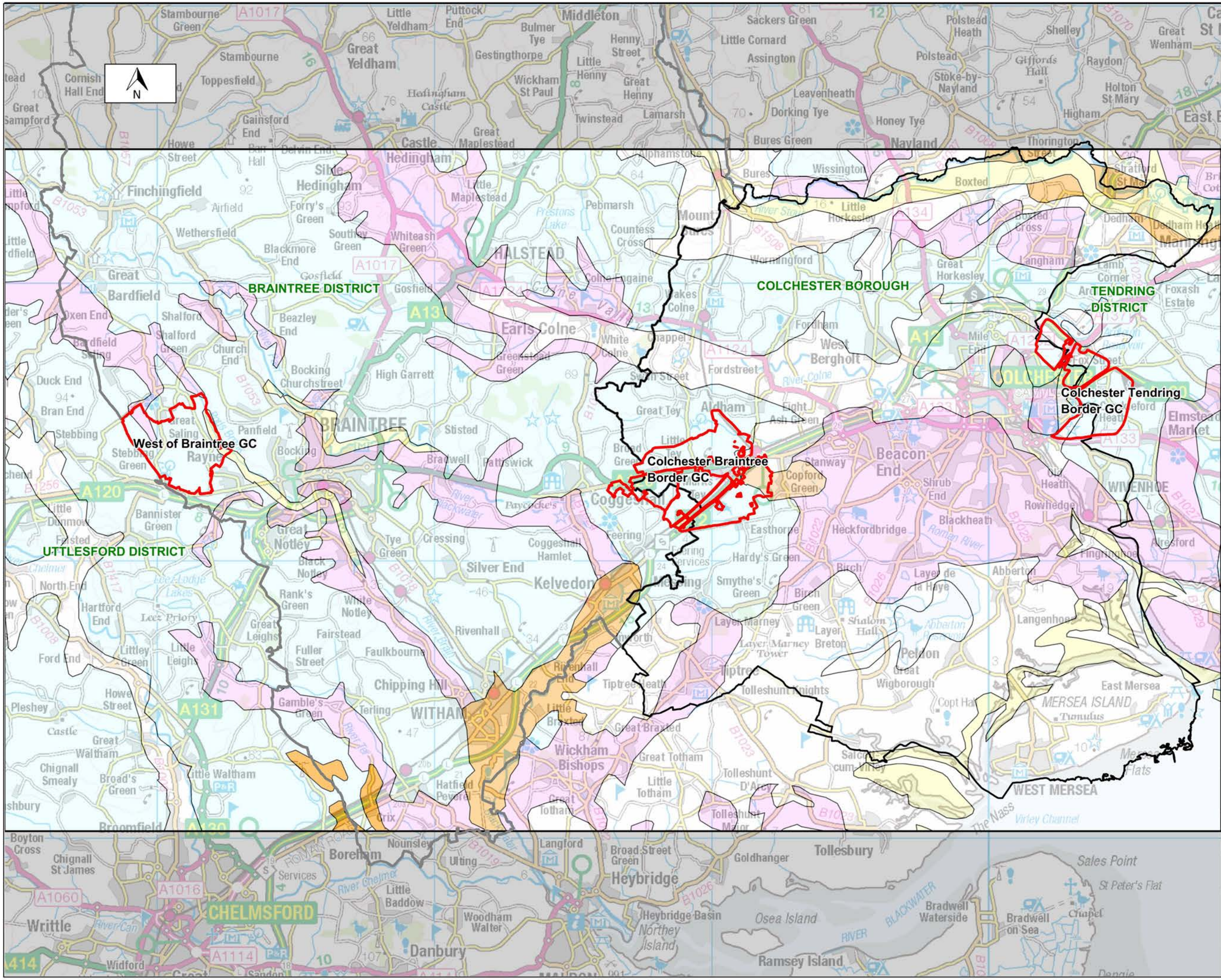

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Colchester Borough Boundary

Braintree District Boundary

Garden Community Boundary

Superficial Geology

- Alluvium
- River Terrace deposits
- Till
- Glacial Sand and Gravel
- Brickearth
- Lacustrine deposits (undifferentiated)

Purpose of Issue
Final

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Drawing Title
SUPERFICIAL GEOLOGY

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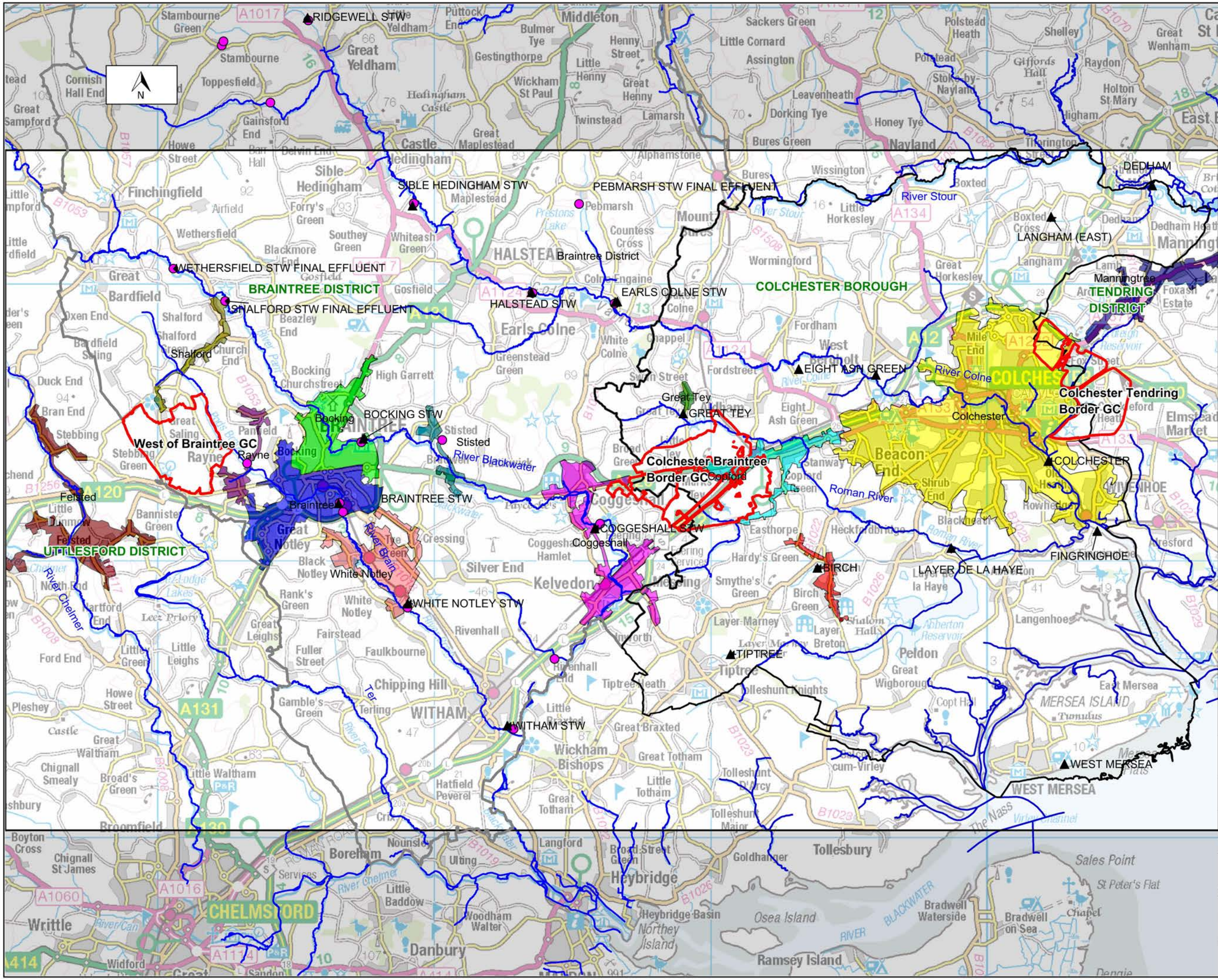
FIGURE B3	02



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Colchester Borough Boundary
Braintree District Boundary
Garden Community Boundary
Main Rivers
Water Recycling Centres
Sewage Treat. Works discharge locations

Sewer catchments
Birch
Bocking
Braintree
Coggeshall
Colchester
Copford
Felsted
Great Tey
Manningtree
Rayne
Shalford
Stisted
White Notley

Purpose of Issue
FINAL

Braintree District Council
Tendring District Council
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Drawing Title
WASTEWATER

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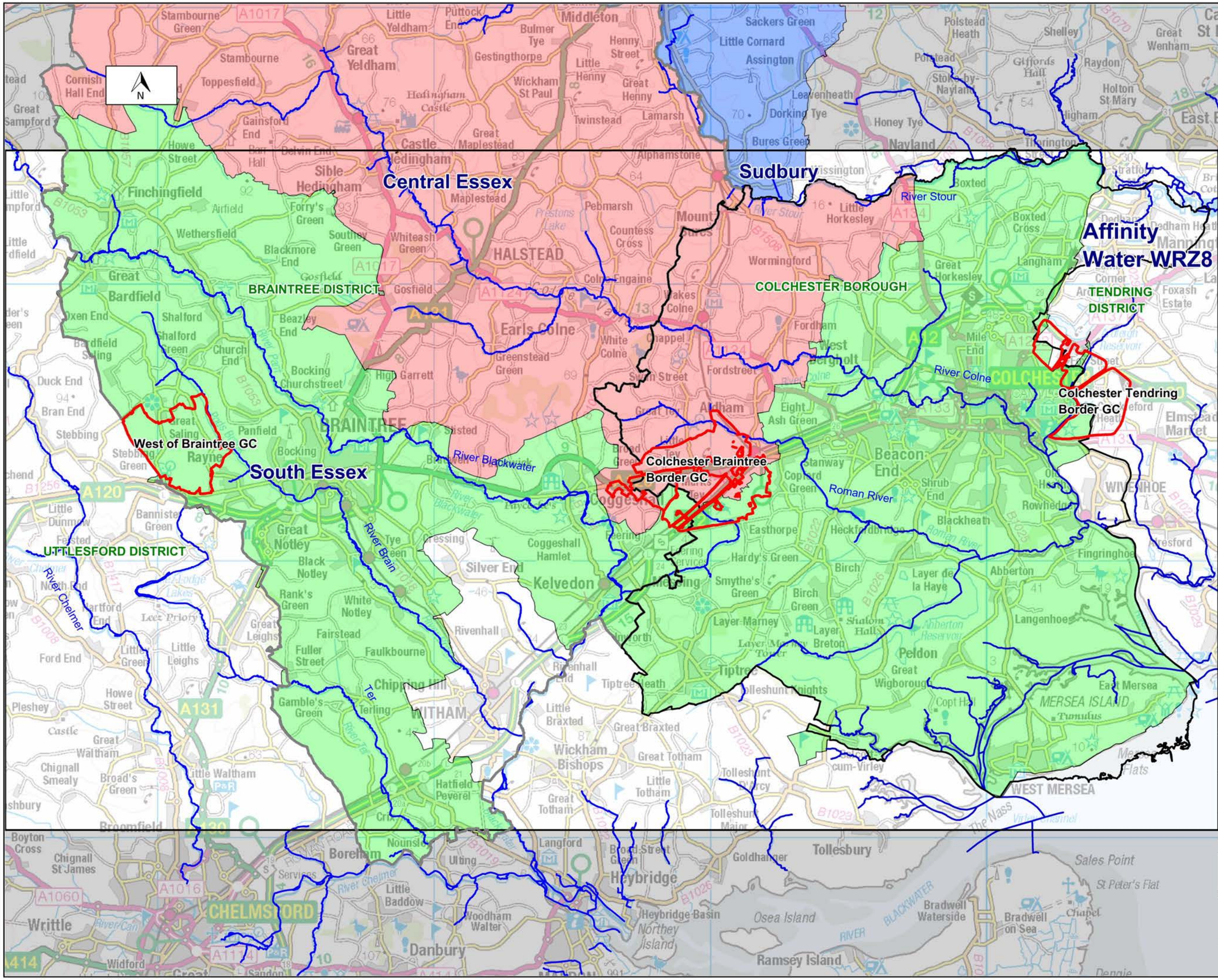

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Colchester Borough Boundary

Braintree District Boundary

Garden Community Boundary

Main Rivers

Water Resources Zones

Central Essex

South Essex

Sudbury

West Suffolk

Purpose of Issue

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Braintree District Council

Tendring District Council

Colchester

Drawing Title

WATER RESOURCES ZONES

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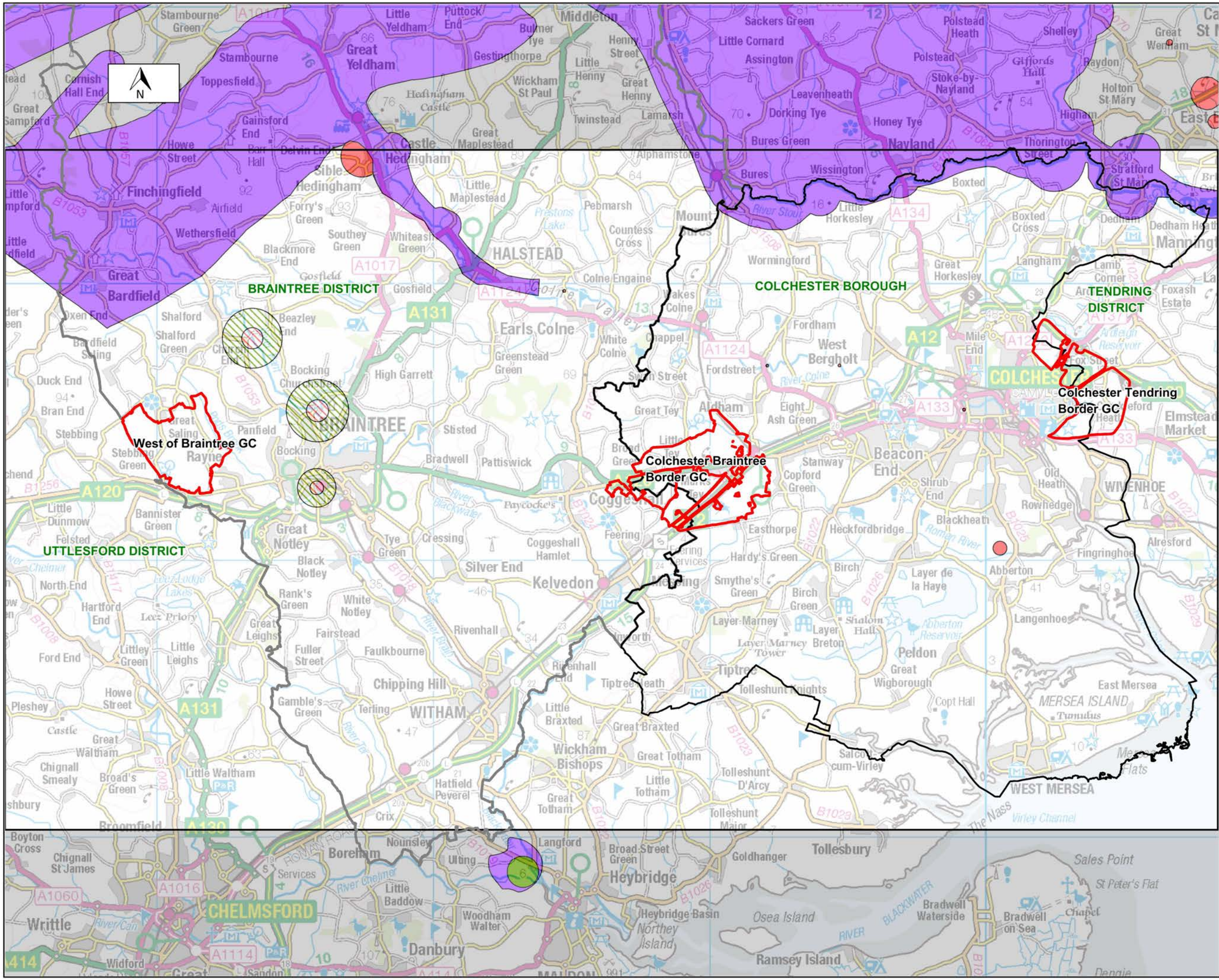
FIGURE B5	02



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Colchester Borough Boundary

Braintree District Boundary

Garden Community Boundary

Source Protection Zones

- 1
- 1c
- 2
- 2c
- 3
- 3c
- 4

Purpose of Issue

FINAL

Braintree District Council | Colchester | Tendring District Council

Drawing Title

SOURCE PROTECTION ZONES

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FIGURE B6	02

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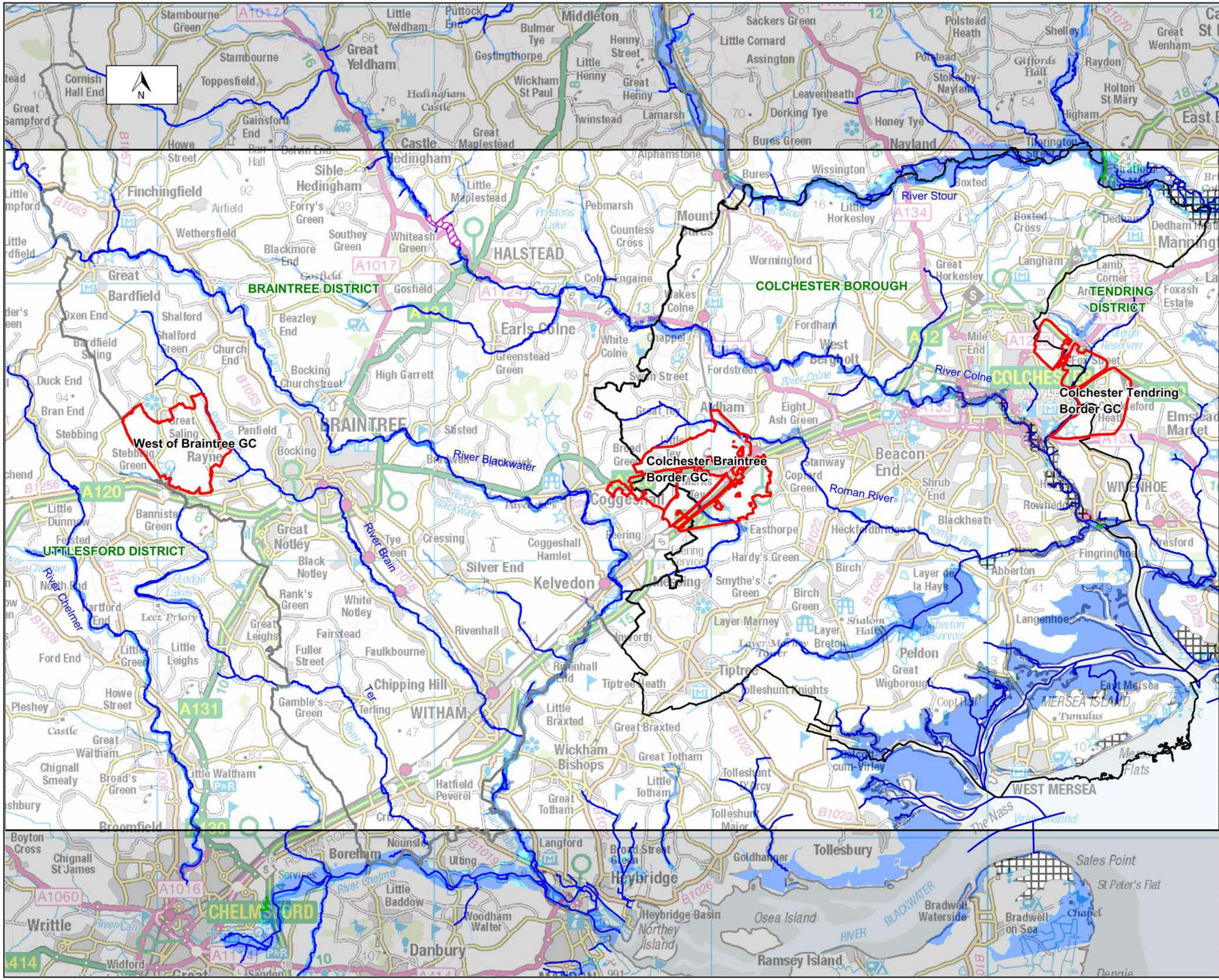

- Colchester Borough Boundary
- Braintree Borough Boundary
- Garden Community Boundary
- Main Rivers
- Flood Zone 2
- Flood Zone 3
- Flood Storage Areas
- Defences
- Areas Benefiting from Defences

Purpose of Issue
FINAL

Braintree District Council | Colchester | Tendring District Council

Drawing Title
FLUVIAL FLOOD ZONES

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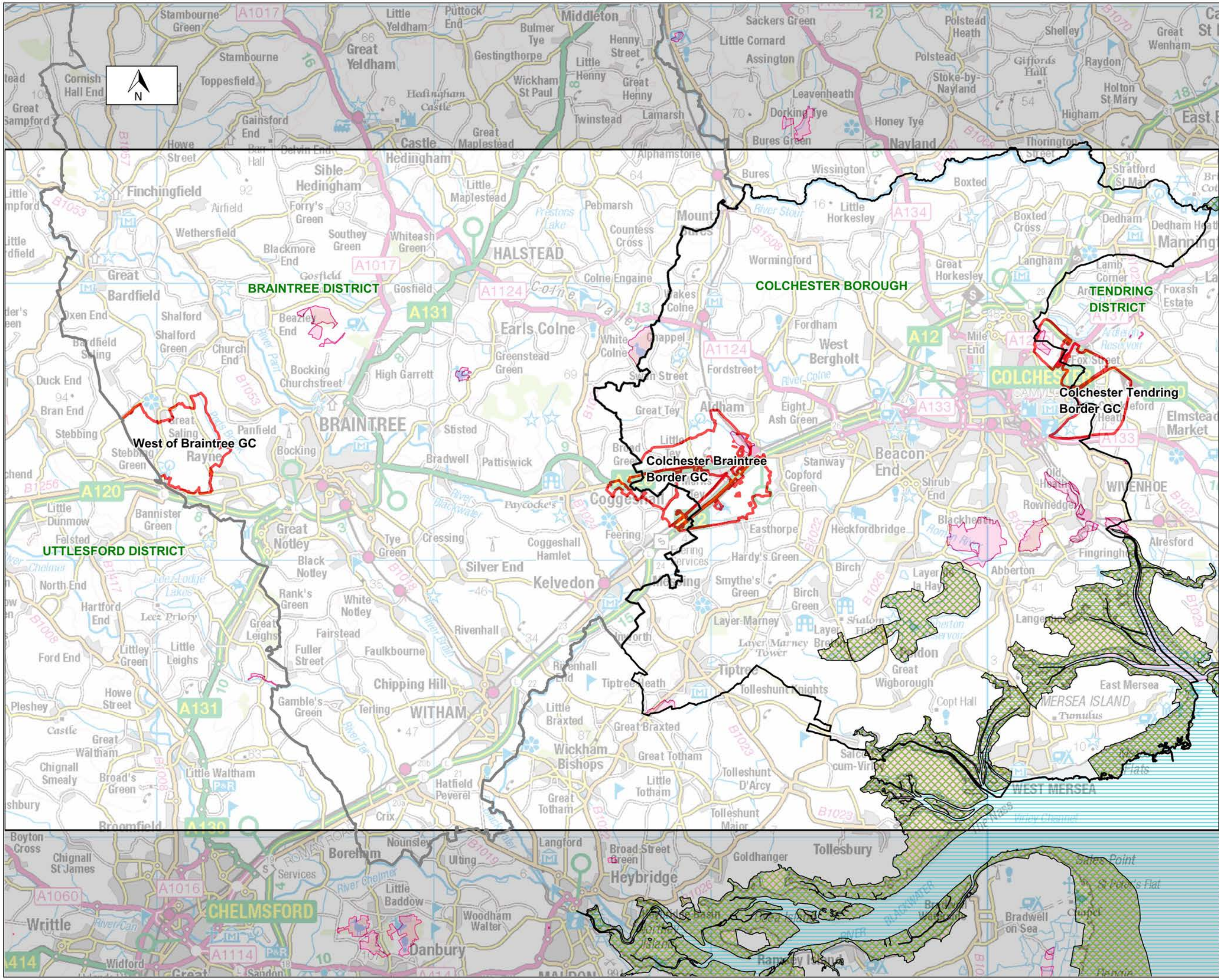
Drawing Number
FIGURE B7

Rev
02



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- Colchester Borough Boundary
- Braintree District Boundary
- Garden Community Boundary
- Special Protection Areas
- Sites of Special Scientific Interest
- Special Areas of Conservation

Purpose of Issue
FINAL

Braintree District Council
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FIGURE B8	02

Appendix C WRC headroom capacity and water quality assessment methodology

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 an assumed Occupancy Rate of 2.28 people per house and an average consumption of 176 l/h/d (as set out in the Braintree WCS, 2017);
- WRC current flows were taken as the current measured dry weather flow (DWF) (Q80) as provided by AWS for the Braintree WCS (2017) and Colchester WCS (2016). Future 2033 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.28, a consumption value of 131l/h/d and an additional allowance of 45l/h/d for an increase in infiltration) 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 outputs from LowFlows Enterprise software – data was provided as mean flow and Q95 ,
- Raw water quality data for modelling was provided by Environment Agency water quality planners for the Braintree and Colchester WCSs. 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 2015 WFD status has been used from the Environment Agency's Catchment Explorer website http://environment.data.gov.uk/catchment-planning/

C.2 Assessment Techniques

Modelling of the water quality permits 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. 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 Local plan growth (excluding the garden communities) within a WRC catchment to determine the additional flow expected at each WRC;
2. Calculate the additional wastewater flow generated at each WRC from local plan growth;
3. Calculate the remaining permitted flow headroom at each WRC;
4. Determine the quantity of garden communities growth within a WRC catchment to determine a second stage of additional flow expected at each WRC;
5. Calculate the additional wastewater flow generated at each WRC from garden communities growth;
6. Calculate the remaining permitted flow headroom at each WRC;
7. Determine whether the growth can be accommodated within existing headroom.

C.4 Water Quality Assessment

For those WRCs where the headroom is exceeded, modelling has been undertaken to determine the new quality conditions required for each WRC discharge permit to ensure:

- No deterioration from the current WFD status of the receiving waterbody, and
- The future target WFD status is not compromised by growth.

Table C-1 provides detail on each of the calculation steps and the sequence in which these are performed.

Step 1 – 'No Deterioration'

Calculations were undertaken to first determine if the receiving watercourse can maintain no deterioration downstream from the current WFD status with the proposed growth within limits of conventional treatment technology, and what permit limits would be required.

Table C-1. Step 1 – 'No Deterioration'

Step	Calculation Name	Calculation Detail	Reason for Calculation
1	No deterioration (Local Plan 2033)	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
2	No deterioration (post Local Plan, including garden communities)	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
3	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.

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, a calculation was undertaken to determine if the receiving watercourse could achieve future 'Good Status', with the proposed growth within limits of conventional treatment technology and what permit limits would be required to achieve this.

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

If 'Good' could be achieved with growth with permits achievable within the limits of conventional treatment, then a proposed discharge permit standard which may be needed in the future has been given.

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

Table C-3. Step 2 – Meeting Future 'Good' Status

Step	Calculation Name	Calculation Detail	Reason for Calculation
4	Achieve Good status (Current)	Achieving good ecological status with current effluent flow	To test what effluent quality would be needed to achieve good status with the current flow permit
5	Achieve Good status (Future)	Achieving good ecological status with future effluent flow	To assess whether the future quality permit limits needed to achieve good status will be significantly more onerous and difficult to achieve than those currently needed (calculation 4)

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

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

If the watercourse could not meet 'Good Status' without growth (assuming the treatment standard were improved to the limits of conventional treatment technology), then it is not the growth that would be preventing future 'Good Status' being achieved and the 'No Deterioration' permit standard given in Table B1. (Step 1) above would be sufficient to allow the proposed growth to proceed.

If the watercourse could meet 'Good Status' without growth, then it is the growth that would be preventing future 'Good Status' being achieved. Therefore consideration needs to be given to whether there are alternative treatment options that would prevent the future failure to attain 'Good Status'. The methodology is designed to look at the impact of proposed growth alone, and whether the achievement of 'Good Status' will be compromised. It is important that AWS have an understanding of what permits may be necessary in the future. The RBMP and Periodic Review planning processes will deal with all other issues of disproportionate costs.

Appendix D WRC water quality assessment results

'NO DETERIORATION' ASSESSMENT

	Bocking WRC			
	2033 Baseline (Local Plan Development excluding garden community growth)		**2033 Baseline + WoB growth**	
	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Current permit quality condition (95%ile or AA)	10	None	10	None
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5
Receiving waterbody	**River Blackwater**			
Upstream sample point	BL0675			
Downstream sample point	AN-BL06	BL04	AN-BL06	BL04
Effect of the Current Discharge				
Current DWF mean (m^3/day)	2869.00			
Baseline river quality at mixing point	0.16	0.32	0.16	0.32
Threshold at which status deterioration would occur	0.30	1.103	0.30	1.103
Is the current discharge already causing a status deterioration at the mixing point?	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*
Effect of the Future Discharge				
Future DWF mean (m^3/day)	3592		8550	
Future river quality at mixing point	0.67	0.34	1.35	0.44
Level of deterioration caused by future growth	319%	6%	744%	38%
Permit quality condition required to ensure no deterioration in status (95%ile or AA)	**4.1**	**No permit required - discharge quality equivalent to 1.3**	**2.05**	**4.96**
Future Target Status				
Current status at d/s sampling point	**High**	**Poor**	**High**	**Poor**
WFD waterbody future target status	**Good**	**Moderate**	**Good**	**Moderate**
River quality target (90%ile or AA)	Future target status already being achieved	0.217	Future target status already being achieved	0.217
Permit quality condition required today (95%ile or AA)		The river quality target is not achievable without improving river quality upstream of the discharge.		The river quality target is not achievable without improving river quality upstream of the discharge.
Permit quality condition required in the future (post 2033) (95%ile or AA)				
Will growth prevent the future target status from being achieved?	*N/A*	*No - quality conditions today cannot be achieved with current conventional technology.*	*N/A*	*No - quality conditions today cannot be achieved with current conventional technology.*
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)			
No Deterioration target	**High**			
River quality target (90%ile)	**4.0**			
Limit of Conventional Treatment (LCT) (95%ile)	**5**			
Current DWF Permit				
Current DWF Permit (m3/day)	**3900**			
Current permit quality condition (95%ile)	15			
Discharge Permit Required				
Current DWF (m3/day)	**2869**			
Current permit quality condition required (95%ile)	**15**			
Future DWF (m3/day)	**3592**		**8550**	
Future permit quality condition required (95%ile)	**12.1**		**6.6**	

Key to 'Effluent Quality Required'

Green Value – no change to current permit required

Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes

Red Value – not achievable within limits of conventionally applied treatment processes

'NO DETERIORATION' ASSESSMENT

	Rayne WRC					
	2033 Baseline (Local Plan Development excluding garden community growth)		2033 Baseline + 100% WoB growth		2033 Baseline + 10% WoB growth	
	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Current permit quality condition (95%ile or AA)	3	None	3	None	3	None
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5	1	0.5
Receiving waterbody	**River Brain**					
Upstream sample point	AN-BR0316					
Downstream sample point	BL0150					
Effect of the Current Discharge						
Current DWF mean (m^3/day)	517.00					
Baseline river quality at mixing point	0.06	0.64	0.06	0.64	0.06	0.64
Threshold at which status deterioration would occur	0.30	1.105	0.30	1.105	0.30	1.105
Is the current discharge already causing a status deterioration at the mixing point?	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*
Effect of the Future Discharge						
Future DWF mean (m^3/day)	527		5485		1028	
Future river quality at mixing point	0.22	0.65	0.96	2.45	0.37	0.98
Level of deterioration caused by future growth	267%	2%	1500%	283%	517%	53%
Permit quality condition required to ensure no deterioration in status (95%ile or AA)	**3.0**	**No permit required - discharge quality equivalent to 4.79**	**0.95**	**2.07**	**2.49**	**No permit required - discharge quality equivalent to 4.79**
Future Target Status						
Current status at d/s sampling point	**High**	**Poor**	**High**	**Poor**	**High**	**Poor**
WFD waterbody future target status	**Good**	**Poor**	**Good**	**Poor**	**Good**	**Poor**
River quality target (90%ile or AA)	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved
Permit quality condition required today (95%ile or AA)						
Permit quality condition required in the future (post 2033) (95%ile or AA)						
Will growth prevent the future target status from being achieved?	*N/A*		*N/A*		*N/A*	
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)					
No Deterioration target	**High**					
River quality target (90%ile)	**4.0**					
Limit of Conventional Treatment (LCT) (95%ile)	5					
Current DWF Permit						
Current DWF Permit (m3/day)	**650**					
Current permit quality condition (95%ile)	10					
Discharge Permit Required						
Current DWF (m3/day)	**517**					
Current permit quality condition required (95%ile)	**10**					
Future DWF (m3/day)	**527**		**5485**		**1028**	
Future permit quality condition required (95%ile)	**9.8**		**0.9**		**5**	

Key to 'Effluent Quality Required'
Green Value – no change to current permit required
Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes
Red Value – not achievable within limits of conventionally applied treatment processes

'NO DETERIORATION' ASSESSMENT

	River Ter					
	2033 Baseline (Local Plan Development excluding garden community growth)		**2033 Baseline + 100% WoB growth**		**2033 Baseline + 10% WoB growth**	
	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Current permit quality condition (95%ile or AA)	None	None	None	None	None	None
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5	1	0.5
Receiving waterbody	**River Ter**					
Upstream sample point	No sampling point upstream					
Downstream sample point	AN-TE0155					
Effect of the Current Discharge						
Current DWF mean (m^3/day)	No exisiting DWF					
Baseline river quality at mixing point	0.09	0.18	0.09	0.18	0.09	0.18
Threshold at which status deterioration would occur	0.30	1.105	0.30	1.105	0.30	1.105
Is the current discharge already causing a status deterioration at the mixing point?	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Effect of the Future Discharge						
Future DWF mean (m^3/day)	N/A		4958		500	
Future river quality at mixing point	-	-	0.86	0.39	0.41	0.25
Level of deterioration caused by future growth	N/A	N/A	856%	117%	356%	39%
Permit quality condition required to ensure no deterioration in status (95%ile or AA)	N/A	N/A	**0.3**	**1.6**	**0.7**	**5.0**
Future Target Status						
Current status at d/s sampling point	**High**	**Poor**	**High**	**Poor**	**High**	**Poor**
WFD waterbody future target status	**Good**	**Poor**	**Good**	**Poor**	**Good**	**Poor**
River quality target (90%ile or AA)	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved
Permit quality condition required today (95%ile or AA)						
Permit quality condition required in the future (post 2033) (95%ile or AA)						
Will growth prevent the future target status from being achieved?	*N/A*		*N/A*		*N/A*	
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)					
No Deterioration target	**High**					
River quality target (90%ile)	**4.0**					
Limit of Conventional Treatment (LCT) (95%ile)	5					
Current DWF Permit						
Current DWF Permit (m3/day)	No exisiting DWF					
Current permit quality condition (95%ile)	N/A					
Discharge Permit Required						
Current DWF (m3/day)	-					
Current permit quality condition required (95%ile)	-					
Future DWF (m3/day)	**N/A**		**4958**		**500**	
Future permit quality condition required (95%ile)	**-**		**-**		**-**	

Key to 'Effluent Quality Required'

Green Value – no change to current permit required

Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes

Red Value – not achievable within limits of conventionally applied treatment processes

FINAL

'NO DETERIORATION' ASSESSMENT

	Coggeshall WRC					
	2033 Baseline (Local Plan Development excluding garden community growth)		**2033 Baseline + 100% CBB growth**		**2033 Baseline + 50% CBB growth**	
	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Current permit quality condition (95%ile or AA)	13	None	13	None	13	None
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5	1	0.5
Receiving waterbody	**River Blackwater**					
Upstream sample point	BL05					
Downstream sample point	BL04					
Effect of the Current Discharge						
Current DWF mean (m^3/day)	2195.00					
Baseline river quality at mixing point	0.38	0.13	0.38	0.13	0.38	0.13
Threshold at which status deterioration would occur	0.60	1.103	0.60	1.103	0.60	1.103
Is the current discharge already causing a status deterioration at the mixing point?	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*	*No - no deterioration in status*
Effect of the Future Discharge						
Future DWF mean (m^3/day)	2741		12382		7569	
Future river quality at mixing point	0.68	0.14	2.25	0.30	1.54	0.22
Level of deterioration caused by future growth	79%	8%	492%	131%	305%	69%
Permit quality condition required to ensure no deterioration in status (95%ile or AA)	11.40	No permit required - discharge quality equivalent to 1.36	3.2	6.14	4.66	No permit required - discharge quality equivalent to 1.36
Future Target Status						
Current status at d/s sampling point	**Good**	**Poor**	**Good**	**Poor**	**Good**	**Poor**
WFD waterbody future target status	**Good**	**Moderate**	**Good**	**Moderate**	**Good**	**Moderate**
River quality target (90%ile or AA)	Future target status already being achieved	0.217	Future target status already being achieved	0.217	Future target status already being achieved	0.217
Permit quality condition required today (95%ile or AA)		3.87		3.87		3.87
Permit quality condition required in the future (post 2033) (95%ile or AA)		3.15		0.89		1.3
Will growth prevent the future target status from being achieved?	*N/A*	*No - quality conditions can be achieved with current conventional technology.*	*N/A*	*No - quality conditions can be achieved with current conventional technology.*	*N/A*	*No - quality conditions can be achieved with current conventional technology.*
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)					
No Deterioration target	**High**					
River quality target (90%ile)	**4.0**					
Limit of Conventional Treatment (LCT) (95%ile)	5					
Current DWF Permit						
Current DWF Permit (m3/day)	**2235**					
Current permit quality condition (95%ile)	19					
Discharge Permit Required						
Current DWF (m3/day)	**2195**					
Current permit quality condition required (95%ile)	19					
Future DWF (m3/day)	**2741**		**12382**		**7561**	
Future permit quality condition required (95%ile)	15.2		3.4		5	

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'NO DETERIORATION' ASSESSMENT

	Great Tey WRC					
	2033 Baseline (Local Plan Development excluding garden community growth)		**2033 Baseline + 100% CBB growth**		**2033 Baseline + 50% CBB growth**	
	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Current permit quality condition (95%ile or AA)	-	-	-	-	-	-
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5	1	0.5
Receiving waterbody	**Roman River**					
Upstream sample point	No sampling point upstream					
Downstream sample point	AN-RR01					
Effect of the Current Discharge						
Current DWF mean (m^3/day)	97.00					
Baseline river quality at mixing point	0.81	0.25	0.81	0.25	0.81	0.25
Threshold at which status deterioration would occur	0.30	0.20	0.30	0.20	0.30	0.20
Is the current discharge already causing a status deterioration at the mixing point?	*Yes - maintain current discharge quality*	*Yes - maintain current discharge quality*	*Yes - maintain current discharge quality*	*Yes - maintain current discharge quality*	*Yes - maintain current discharge quality*	*Yes - maintain current disharge quality*
Effect of the Future Discharge						
Future DWF mean (m^3/day)	120		9760		4948	
Future river quality at mixing point	0.94	0.27	5.50	1.17	5.04	1.05
Level of deterioration caused by future growth	16%	8%	579%	368%	522%	320%
Permit quality condition required to ensure no deterioration in status (95%ile or AA)	**6.44**	**1.18**	**1.11**	**0.27**	**1.21**	**0.28**
Future Target Status						
Current status at d/s sampling point	**High**	**Moderate**	**High**	**Moderate**	**High**	**Moderate**
WFD waterbody future target status	**Good**	**Moderate**	**Good**	**Moderate**	**Good**	**Moderate**
River quality target (90%ile or AA)	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved	Future target status already being achieved
Permit quality condition required today (95%ile or AA)						
Permit quality condition required in the future (post 2033) (95%ile or AA)						
Will growth prevent the future target status from being achieved?	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)					
No Deterioration target	**High**					
River quality target (90%ile)	**4.0**					
Limit of Conventional Treatment (LCT) (95%ile)	5					
Current DWF Permit						
Current DWF Permit (m3/day)	**142**					
Current permit quality condition (95%ile)	30					
Discharge Permit Required						
Current DWF (m3/day)	**97**					
Current permit quality condition required (95%ile)	**30**					
Future DWF (m3/day)	**120**		**9760**		**4948**	
Future permit quality condition required (95%ile)	**24.3**		**0.4**		**0.7**	

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Red Value – not achievable within limits of conventionally applied treatment processes

FINAL

NO DETERIORATION' ASSESSMENT

	Colchester WRC								
	2033 Baseline (Local Plan Development excluding garden community growth)			2033 Baseline + CTB growth			2033 Baseline + CTB growth + CBB growth		
LOAD STANDSTILL ASSESSMENT	BOD 95%ile (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	BOD 95%ile (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)	BOD 95%ile (mg/l)	Ammonia 95%ile (mg/l)	Phosphate mean (mg/l)
Receiving waterbody	Tidal River Colne								
Limit of Conventional Treatment (LCT) (95%ile)	5	1	0.5	5	1	0.5	5	1	0.5
Current DWF Permit									
Current DWF Permit (m3/day)	29284								
Current permit quality condition (95%ile)	35	15	-	35	15	-	35	15	-
Discharge Permit Required									
Current DWF (m3/day)	23378								
Current permit quality condition required (95%ile)	35	15	-	35	15	-	35	15	-
Future DWF (m3/day)	27865			31285			40926		
Future permit quality condition required (95%ile)	29.4	12.6	-	26.2	11.2	-	20.0	8.6	-

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