5. Water Quality and Wastewater Treatment

This section uses all the available information to determine the environmental capacity (in terms of the receiving water quality) of the rivers draining the study area. The main UK and European legislative drivers are discussed followed by an evaluation of the existing receiving water quality. The capacity of the existing wastewater infrastructure, owned and operated by Anglian Water, is also assessed together with the influence of the proposed growth on both these assets and the receiving water quality.

5.1 Legislative Drivers

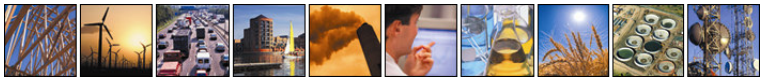
Additional protection is afforded to receiving waters and their dependant habitats which are considered particularly sensitive. Sites within or potentially influenced by activities (e.g. discharges, abstractions) within or downstream of the study area are listed in Table 5.1 along with the legislative driver under which they have been designated.

Table 5.1 Sensitive water bodies and designations

Site	Legislative Driver
Hanningfield Reservoir	UWWTD – Sensitive Area [Eutrophic] Site of Special Scientific Interest (SSSI)
Abberton Reservoir	UWWTD – Sensitive Area [Eutrophic] Habitats and Birds Directive Special Protection Area (SPA) Site of Special Scientific Interest (SSSI) and RAMSAR site
River Blackwater	UWWTD – Sensitive Area [Eutrophic] Blackwater Estuary - Habitats and Birds Directive Special Protection Area (SPA) and part of Essex Estuaries SAC
River Colne	UWWTD – Sensitive Area [Eutrophic] Colne Estuary - Habitats and Birds Directive Special Protection Area (SPA) and part of Essex Estuaries SAC
River Stour	UWWTD – Sensitive Area [Eutrophic] Stour Estuary - Site of Special Scientific Interest (SSSI)

5.1.1 Urban Wastewater Treatment Directive

The Urban Wastewater Treatment Directive (UWWTD) regulates the collection and treatment of wastewater from residential properties and industry. Under this directive receiving waters can be designated as 'Sensitive' where additional levels of treatment are required at significant contributing discharges. These can either be direct discharges or those upstream of the designated reach / water body that serves a population equivalent in excess of



10,000. One type of sensitive area is the "Sensitive Area [Eutrophic]", where elevated nutrient concentrations, mainly nitrogen or phosphorus are or present a risk to the ecological status of the receiving water. In these areas, larger sewage discharges must be treated to reduce nutrient loads.

It is important to note that if through growth the population equivalent at a WwTW discharging either directly or upstream of a designated Sensitive Area [Eutrophic] exceeds the 10,000 threshold then phosphorus stripping would be required. Within the study area there are currently five WwTW with phosphorus removal installed under the UWWTD. These are Braintree, Bocking, Haverhill, Coggeshall and Halstead.

5.1.2 Habitats and Birds Directive

There are no European sites within the Braintree District. However, Abberton Reservoir and the Colne and Blackwater Estuaries SPAs, which also form part of the Essex Estuaries SAC are all fed by rivers draining the district (see Figure 3.2).

In the recent Review of Consents under this directive none of the discharge consents within the study area have been identified as requiring a revised consent or additional treatment to protect the designated sites listed above in Table 5.1. This assessment was based on consented volumes and therefore an appropriate assessment would not be required until an element of the consent was breached. This assessment has incorporated the recently renegotiated flow limits, which reflect the change in the methodology used to derive the flow component of the discharge consent.

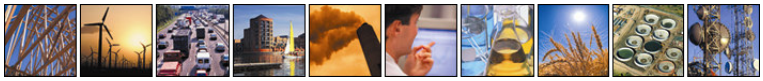
5.1.3 Sites of Special Scientific Interest

Sites of Special Scientific Interest (SSSI) are not afforded any statutory protection but, when Natural England identifies a SSSI as being in an unfavourable condition, this can drive more stringent discharge consents with investment sought through the water companies periodic review process.

5.1.4 Water Framework Directive

The WFD will be implemented through the development of River Basin Management Plans on a six yearly cycle. These plans outline the Programme of Measures required to achieve the objectives of the directive (i.e. Good Ecological Status or Good Ecological Potential in heavily modified water bodies). However, the current uncertainty surrounding the detailed requirements of these plans, which are due to be published in draft format in December 2008, necessitate that this environmental capacity assessment is revisited on publication of this document. The Environment Agency has however identified the significant issues affecting the water environment in the Anglian River Basin District. This report is available on the Environment Agency website[3]. Elevated

[3] http://www.environment-agency.gov.uk/subjects/waterquality/955573/1458449/1458613/1458926/1953846/?lang=_e



nutrients, particularly phosphorus, are highlighted as one of the significant pressures in the Anglian River Basin District.

New environmental standards and conditions for WFD are being developed by the UK Technical Advisory Group (UKTAG). These are being developed in stages and the first set of proposed standards is outlined in a recent report, "UK Environmental Standards and Conditions (Phase 1) – UKTAG 2008". The key Environmental Quality Standard (EQS) pertinent to future water quality and a potential driver for future investment in wastewater infrastructure in the study area is the annual mean standard for soluble reactive phosphorus (SRP) of 0.12mg/l. The dynamics of phosphorus speciation are complex but SRP is considered to be a robust measure of the (bioavailable) fraction available plants and algae. Treated sewage effluent is considered to be the dominant source of SRP, particularly during periods of low flow since sewage effluent is continually released to the receiving water in a readily bioavailable form. However, there is still considerable uncertainty surrounding the ecological benefits of phosphorus removal, since there is little evidence that clearly demonstrates a positive ecological response to a significant reduction in SRP concentrations in the water column. The absence or slow response of the ecology may be due to phosphorus bound in the river sediments. This raises the question of other forms of phosphorus, including sediment bound P, delivered to the water course from other diffuse and point sources. It is therefore likely that are range of measures aimed at both point and diffuse sources will be required to meet WFD objectives.

5.2 Receiving Water Environment

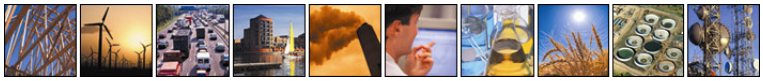
5.2.1 Environmental Capacity

The Environment Agency monitors the health of all receiving waters through the General Quality Assessment (GQA) scheme. The scheme provides a snapshot of receiving water quality based on the following aspects:

- Chemistry – water chemistry based on key the following determinands: Biological Oxygen Demand (BOD), Dissolved Oxygen (DO) and Ammonia;
- Biology – based on the biodiversity of organisms living in the river and on the river bed;
- Nitrate – Nitrate concentrations in the water column;
- Phosphate – Phosphate concentrations in the water column;

Appendix G provides both an outline of the GQA categories together with a summary of the GQA grades of river lengths in the study area.

The river water quality in the Braintree District (i.e. not including the River Stour around Haverhill and Clare) has, over the period 2002-2006, been relatively consistent. In 2006, 51.8% of the total classified river length was considered as good or above based on the water chemistry. Based on the biology 89.8% of the river length achieved the good grade or higher. However, the majority of rivers are eutrophic with high to excessively high nutrient concentrations (Phosphate - 93.4% > 0.1 mg/l, Nitrate - 78.7% > 30 mg/l). Nutrients are essential for



aquatic life, however elevated concentrations (mainly phosphorus and nitrogen) can have a significant impact of the aquatic ecology through stimulating the growth of benthic and microscopic plants. This is known as eutrophication and can result in oxygen depletion and a reduction in water clarity. Eutrophication can also have an indirect effect through changes in biodiversity / community structure and affect food of birds, fish and mammals and also a wider variety of water uses such as water supply, livestock watering, irrigation, navigation, angling, and water sports. Slow flowing lowland rivers in southern and eastern England, such as those draining the study area, are particularly susceptible to elevated nutrient concentrations and thus eutrophication.

Figure 5.1 and Figure 5.2 provide a spatial representation of the nutrient categories (nitrate and phosphate) under the 2006 GQA scheme across the study area (i.e. Braintree District and the Stour around Haverhill and Clare). This map highlights areas with elevated nutrient concentrations and therefore where growth maybe constrained due to the capacity of the receiving water. In general nutrient concentrations are lower in headwater catchments and elevated downstream. Concentrations downstream of all the locations where significant growth is proposed are already high.

However, the focus of water quality monitoring changed at the beginning of 2007 to meet WFD requirements, with more risk-based sampling focused at fewer sites. Unfortunately the GQA scheme, both sites and EQS, are not directly comparable with those being set for WFD and it is these standards that will drive future improvements to water quality and ecology of the receiving water and against which the capacity of the receiving water should be assessed.

Although it is not possible to make a direct comparison between the proposed WFD standards and those used under the GQA scheme for the purpose of this assessment we have assumed that the UKTAG standard of 0.12mg/l approximately equates to the boundary between moderate and high grade under the GQA scheme.

Based on this assumption the GQA data clearly illustrates that > 90% of the rivers in Braintree District are at risk of exceeding the WFD standard for phosphorus. For many rivers a combination of measures that tackle both diffuse and point sources will be required to meet these standards. Due to insufficient knowledge / understanding of the link between concentration and ecological status, together with the uncertainty surrounding the interdependencies with other pollutants, particularly phosphorus, UKTAG has not yet derived a WFD standard for nitrogen.

Currently compliance in the receiving water is assessed against the River Ecosystem (RE) scheme. This scheme provides a nationally consistent basis for setting water quality targets or River Quality Objectives (RQOs) for rivers and is used by the Environment Agency for planning improvements to, or protection of existing river water quality. They give a defined level of protection and help to sustain the use of river for recreation, fisheries and wildlife, and protect the interests of abstractors. A summary of this scheme is provided in Appendix G. There are five RE classes that reflect the chemical quality requirements of communities of plants and animals in our rivers. The standards defining these classes reflect differing degrees of pollution by organic matter and other common pollutants. Non-compliance against these objectives provides an indication of the rivers where the dilutive capacity and existing water quality may present a barrier to development. Table 5.2 summarises the compliance against the chemical GQA objectives across the study area in 2006.

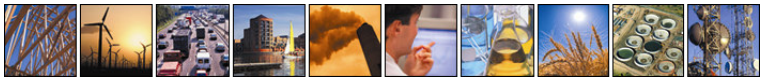
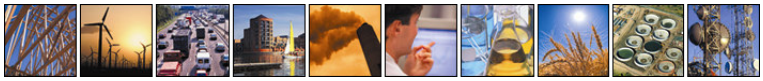
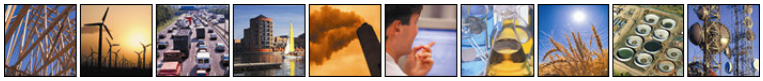


Table 5.2 Study area compliance against river quality objectives (RQO)

River	Stretch	Stretch Grid Reference		Km	Chemistry
Pant	Radwinter Bridge to Great Sampford Wastewater Treatment Works	TL6060037300	TL6320036200	4	Pass
Pant	Great Sampford Wastewater Treatment Works to Finchingfield Brook	TL6320036200	TL6830031100	10	Pass
Pant	Finchingfield Brook to Wethersfield Wastewater Treatment Works	TL6830031100	TL7000031100	4	Pass
Pant	Wethersfield Wastewater Treatment Works to Shalford Wastewater Treatment Works	TL7000031000	TL7240029400	4	Pass
Pant	Shalford Wastewater Treatment Works to Courtaulds Sluice	TL7240029400	TL7550025600	5	Pass
Blackwater	Courtaulds Sluice to Bocking Wastewater Treatment Works	TL7550025600	TL7750024300	3.5	Pass
Blackwater	Bocking Wastewater Treatment Works to Shelbourne Bridge Brook	TL7750024300	TL8020023700	4.5	Pass
Blackwater	Shelbourne Bridge Brook to Robins Brook	TL8020023700	TL8490022500	7.5	Pass
Blackwater	Robins Brook to Coggeshall Wastewater Treatment Works	TL8490022500	TL8600021400	2.5	Fail
Blackwater	Coggeshall Wastewater Treatment Works to Domsey Brook	TL8600021400	TL8670018700	4.5	Fail
Blackwater	Domsey Brook to the River Brain	TL8670018700	TL8320013650	7.5	Fail
Blackwater	River Brain to Wickham Bishops	TL8320013650	TL8230011700	2	Pass
Blackwater	Wickham Bishops to Langford	TL8230011700	TL8360009200	4	Fail
Brain	Headwater to Rayne Wastewater Treatment Works	TL6800027300	TL7330023500	7	Pass
Brain	Rayne Wastewater Treatment Works to the A120 road bridge	TL7330023500	TL7420022900	1	Pass
Brain	A120 road bridge to Notley Road	TL7420022900	TL7570022500	2	Fail
Brain	Notley Road to Braintree Wastewater Treatment Works	TL7570022500	TL7660021900	1.5	Pass
Brain	**Braintree Wastewater Treatment Works** to Bulford Mill	TL7660021900	TL7730020400	2	Fail
Brain	Bulford Mill to White Notley Wastewater Treatment Works	TL7730020400	TL7890018200	3	Fail
Brain	White Notley Wastewater Treatment Works to Chipping Hill	TL7890018200	TL8160015400	3.5	Pass
Brain	Chipping Hill to River Blackwater	TL8160015400	TL8320013650	3	Pass
Colne	Ridgewell to Poole Street	TL7400040800	TL7650037000	5	Marginal
Colne	Poole Street to the B1058 road	TL7650037000	TL7810035100	3	Pass
Colne	The B1058 road to Hedingham Wastewater Treatment Works	TL810035100	TL7930032900	3	Pass



River	Stretch	Stretch Grid Reference		Km	Chemistry
Colne	Hedingham Wastewater Treatment Works to Halstead town	TL7930032900	TL8130030600	4.5	Pass
Colne	Halstead town to Halstead Wastewater Treatment Works	TL8130030600	TL8370029600	3	Pass
Colne	**Halstead Wastewater Treatment Works** to Earls Colne Wastewater Treatment Works	TL8370029600	TL8640029200	3	Fail
Colne	Earls Colne Wastewater Treatment Works to Wakes Colne tributary	TL8640029200	TL9040027300	3	Marginal
Colne	Wakes Colne tributary to Fordstreet	TL9040027300	TL9200027100	2	Pass
Colne	Fordstreet to Lexden	TL9200027100	TL9730025600	6.5	Marginal
Colne	Lexden to East Mill	TL9730025700	TM0070025400	6	Fail
Bourne Brook	Gosfield Lake to Gosfield Wastewater Treatment Works	TL7650029700	TL7820028900	2	Pass
Bourne Brook	**Gosfield Wastewater Treatment Works** to Sparrow Pond Outlet	TL7820028900	TL7930029200	1	Pass
Bourne Brook	Sparrow Pond Outlet to the River Colne	TL7930029200	TL8460029600	8	Fail
Stour	Kirtling Brook to Thurlow	TL6560054000	TL6800050300	4.8	Fail
Stour	Thurlow to Haverhill Meat Products	TL6800050300	TL6980047700	4	Pass
Stour	Haverhill Meat Products to Kedington	TL6980047700	TL7060046500	2	Pass
Stour	Kedington to Stour Brook	TL7060046500	TL7070043800	4	Pass
Stour	Stour Brook to Stoke By Clare	TL7070043800	TL7430043100	6	Pass
Stour	Stoke By Clare to Chilton Brook	TL7430043100	TL7730045100	3	Pass
Stour	Chilton Brook to West Mill Glemsford	TL7730045100	TL8320046400	7	Pass
Barnardiston Brook	Highpoint Prison to the River Stour	TL7160051600	TL6995047700	5	Pass
Stour Brook	Wethersfield to Haverhill Wastewater Treatment Works	TL6520047800	TL6800044800	4	Marginal
Stour Brook	Haverhill Wastewater Treatment Works to Stour	TL6800044800	TL7070043800	3	Pass
Bumpstead Brook	Steeple Bumpstead to Steeple Bumpstead Wastewater Treatment Works	TL6770041100	TL6830041600	0.5	Pass
Bumpstead Brook	**Steeple Bumpstead Wastewater Treatment Works** to the River Stour	TL6830041600	TL7080043000	3	Fail



N

HAVERHILL STW
CLARE STW
LONG MELFORD STW
STOKE BY CLARE STW
STEPPLE BUMPSTEAD ST
RIDGEWELL STW
STAMBOURNE STW
GREAT CORNARD STW
TOPPESFIELD STW
SIBLE HEDINGHAM STW
PEBMARSH STW
PETCHES WTW TO THE R
WETHERSFIELD STW
HALSTEAD(LANGLEY) ST
SHALFORD STW
GOSFIELD STW
EARLS COLNE STW
GREENSTEAD GREEN STW
BOCKING STW
STISTED STW
RAYNE STW
BRAINTREE STW
COGGESHALL STW
WHITE NOTLEY STW
RIVENHALL END STW

565000 570000 575000 580000 585000 590000 595000

250000 245000 240000 235000 230000 225000 220000 215000 210000

Key:

- Braintree Study Area
- Sewage Treatment Works
- Rivers

Nitrate

- Very Low
- Low
- Moderately Low
- Moderate
- High
- Very High

2 1 0 2 km

Scale: 1:130,000 @ A3

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Braintree District Council
Water Cycle Strategy

Figure 5.1
Nitrate categories under GQA in Braintree

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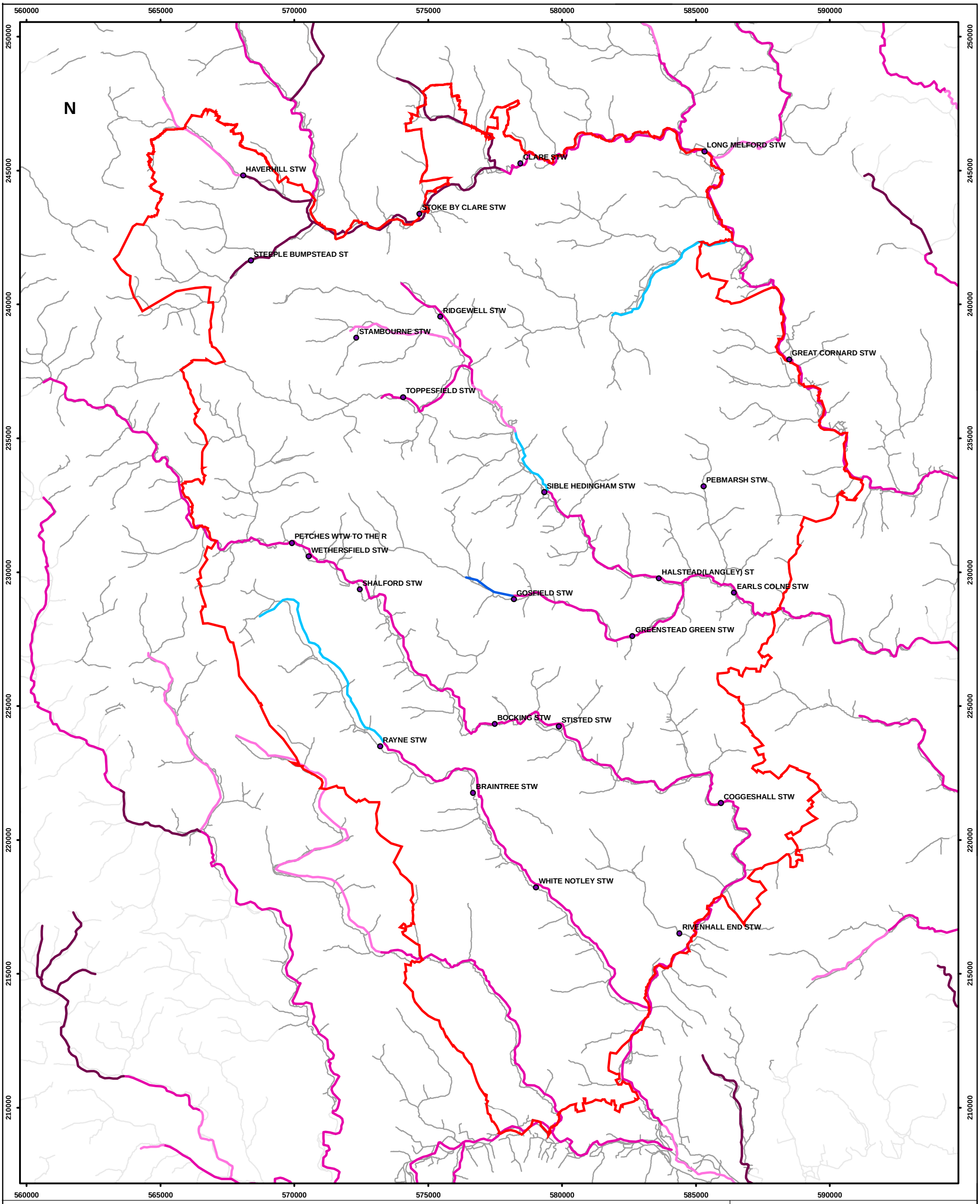


Figure 5.2 illustrates the deterioration in water quality that may be attributed to the following WwTWs:

- Braintree WwTW
- Halstead WwTW
- Gosfield WwTW
- Steeple Bumpstead WwTW

This indicates the limited environmental capacity of specific receiving waters to assimilate additional load. All the above failures are against BOD and DO standards so could be caused by sewage discharges, but it is also important to note that diffuse sources, and particularly runoff from agricultural land, will contribute (to a greater or lesser extent) to these failures.

5.3 Water Quality Interim Conclusion

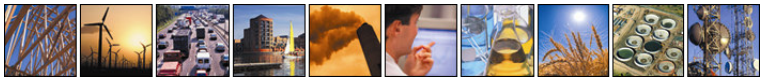
Q. Is the environmental capacity of the receiving water a constraint to growth in the Study Area?

Based on the historical chemical and biological data from the Environment Agency GQA scheme the majority of the rivers draining the study area consistently achieve or exceed good quality. However, of those river reaches that do fail, a subset are immediately downstream of key WwTW, although other influences including diffuse sources and climate driven variation can also influence GQA compliance.

Based on data available for Braintree District and the area surrounding Haverhill and Clare, the key issue across the region in terms of water quality are nutrients, and in particular phosphorus. The GQA data illustrates that elevated nutrient concentrations (Nitrates and Phosphorus) are widespread across the study area, as is the case for many rivers in the South-East. Phosphorus is a nutrient that limits plant growth in freshwaters and thus elevated concentrations are likely to adversely affect the trophic (nutrient) status and thus limit the environmental capacity of the receiving water. However, the GQA data does not provide the evidence that elevated nutrient concentrations are having a deleterious impact on the biology of the receiving water. This is supported by the recent review of consents under the Habitats Directive, which did not identify any consent conditions to be reviewed in order to protect / restore the integrity of any of the most sensitive environmental receptors, or protected sites downstream of the study area (i.e. the Blackwater and Stour Estuaries or Abberton Reservoir).

Measures Required to Comply with Water Framework Directive

Elevated concentrations also increase the risk of failing to comply with the future objectives set out in the Water Framework Directive and particularly the 0.12mg/l standard for phosphorus. The Environment Agency will set out the programme of measures required to meet this standard in the Anglian River Basin District Management Plan. This document will be published in draft in December 2008 and finalised in December 2009. It is unclear what



these measures will be but it is likely that they will seek to tackle both point and diffuse sources and therefore investigations may be required to ascertain the relative contribution in order to target the measures. As part of these investigations the link between the elevated nutrient concentrations and the ecological status should also be assessed to determine the likely environmental benefits of potential measures. These could include the tightening of discharge consents and thus potentially constrain future development. The Environment Agency is responsible for setting consent standards. The impact of the Water Framework Directive as a constraint to development is discussed further in the Integrated Conclusions section 7.1.2.

In addition to setting new standards to be met in the receiving water WFD also advocates a policy of no deterioration in the quality of the receiving water. Therefore as a minimum requirement where proposed growth will cause a breach in the current consent conditions the Environment Agency will require an overall standstill in the load to prevent deterioration in the receiving water quality. The implications are that where flow, through growth, exceeds the consented flow a pro-rata reduction in the effluent quality will be expected. Where there is scope to improve treated effluent quality this is unlikely to present a barrier to development. However, where existing consent conditions are already tight, either due to the limited capacity or sensitivity of the receiving water, further tightening the consent may be technically infeasible, disproportionately costly or have wider sustainability issues, for example increased and unsustainable use of energy, carbon or raw materials, and thus present a barrier to development. Haverhill, Rayne and Braintree WWTW already have relatively tight discharge consents conditions, due to the size and sensitivity of the receiving watercourse, Stour Brook and the River Brain. This could present a barrier to future growth in these sewerage catchments if further upgrades are not technologically or economically viable meet pro-rata reductions in effluent loads as influent loads increase, these capacity issues are explored further in the following section.

5.4 Wastewater Infrastructure Capacity

This section assesses the likely increase in capacity associated with the proposed growth scenarios and outlines the current and future planned capacity of the wastewater treatment works that are likely to be affected by this growth. The Environment Agency regulates the quality of effluent discharges to help protect water quality, the environment and human health. This is done through issuing (or refusing) discharge consents which outline the flow volumes and water quality standards that must be achieved at the point of discharge. Although for very small discharges the Environment Agency may issue a descriptive consent, these commonly serve small rural / isolated communities and are not likely to significantly influence the proposed growth developments.

There are 35 WwTWs with numeric discharge consents serving the Braintree District, together with Haverhill and Clare WwTW make a total of 37 serving the whole study area (see Table 5.3 for current consent conditions). All WwTWs are owned and operated by Anglian Water, the sewerage undertaker for the region. Smaller WwTWs with descriptive consents are not likely to be significantly affected by the proposed growth and have, therefore, been discounted from further assessment as part of this study.

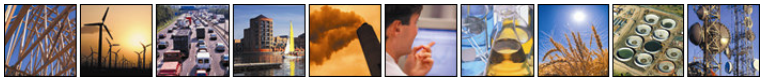
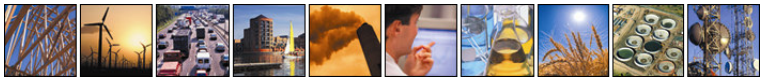


Table 5.3 Current consent conditions in the study area

Site Name	JR08 Data	Consent (mg/l)				DWF (m^3/d)		
	Total PE	TSS	BOD	AmmN	P	Measured	Calculated	Consented
Ashen WwTW	137						25	
Baythorne End WwTW	200						36	
Belchamp St. Paul WwTW	237						43	
Bocking WwTW	19526	60	20A	10	2	1558	3514	3900
Halstead Boxmill Lane WwTW	110						20	24
Braintree WwTW	22127*	16	8A	3	2	4423	3817	6859
Bulmer Tye WwTW	161						29	
Bulmer Village WwTW	181						33	
Belchamp Walter WwTW	83						15	
Clare WwTW	3317	40	20A	15		920	591	873
Coggeshall WwTW	8759	40	19A	13	2	Not available	1558	2235
Cornish Hall End WwTW	79						14	
Earls Colne WwTW	3532	40	20A	10		1036	636	934
Foxearth WwTW	189						34	
Gestingthorpe WwTW	89						16	
Great Maplestead WwTW	35						6	
Gosfield WwTW	1089	30	15A	5		Not available	196	290
Greenstead Green WwTW	222	60	40A	-			40	48
Halstead WwTW	12317	30	15A	5	2	2129	2203	2900
Haverhill WwTW	28713	20	10A	4	2	4227	4250	5700
Little Yeldham WwTW	78						14	
Pebmarsh WwTW	346	40	30A	-		130	62	53
Pentlow WwTW	44						8	
Rayne WwTW	2514	20	10A	3		480	434	650
Ridgewell WwTW	412	30	20A	-		67	74	102
Rivenhall End WwTW	130	90	70A	35		35	23	80
Steeple Bumpstead WwTW	1448	25	15A	-		Not available	261	320
Shalford WwTW	542	30	20A	20		160	98	170
Sible Hedingham – High St WwTW	66						12	



Site Name	JR08 Data	Consent (mg/l)				DWF (m^3/d)		
	Total PE	TSS	BOD	AmmN	P	Measured	Calculated	Consented
Sible Hedingham WwTW	6450	25	10A	5		1392	1052	1450
Stisted WwTW	695	30	20A	20		169	125	300
Stambourne WwTW	301	40	20A	-		5	54	70
Toppesfield WwTW	322	50	30A	-		73	58	80
Wethersfield WwTW	2418	35	25A	15		400	435	955
Wickham St Paul WwTW	211						38	
Witham WwTW	35458	40	20A	10		Not available	4714	8100
White Notley WwTW	5827	30	15A	10		524	1043	660

PE – Population Equivalent. JR08 – 2008 June returns to OFWAT. TSS – Total Suspended Solids. BOD – Biological Oxygen Demand. AmmN – Ammonia. P – Phosphorus. DWF – Dry Weather Flow.
* the JR08 PE for Braintree WwTW has been queried by the works operators and is currently under investigation and may therefore increase

5.4.1 Capacity Assessment

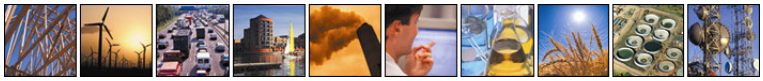
The hydraulic capacity of wastewater infrastructure is a function of the physical / hydraulic capacity of assets (both the sewer network and wastewater treatment processes) to receive additional flows. A fundamental factor describing capacity is a sewage treatment work's 'Dry Weather Flow' (DWF). This is a measure of the flow influx to a WwTW derived from human activity (both domestic and trade), but excluding any storm-induced flows. The mechanism for deriving DWFs has evolved over recent years. All WwTWs should now have certified flow monitoring equipment that enables effluent flows to be accurately monitored. The DWF is calculated based on the 20th percentile flow on the basis of 12 months daily data (i.e. the flow that is exceeded 80% of the time). The design capacity of WwTW is generally governed by DWF.

For water quality planning and design purposes, dry weather flow can also be estimated based on the following equation:

Box 5.1 Estimating Dry Weather Flow

DWF = PG + I + E
where:

P = Population served
G = Water consumption per head per day
I = Infiltration allowance
E = Trade Effluent flow to sewer as applicable



A similar equation 'Formula A' is commonly used to describe the flow passed forward for full treatment (i.e. not spilling from the drainage network via a Combined Sewer Overflows following heavy rainfall):

Formula A = (PG+I+E) + 1360P

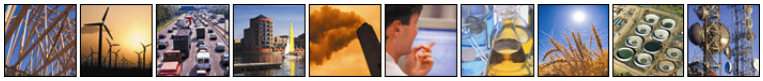
The capacity of a WwTW is commonly defined by 3 x DWF. This is considered a robust representation of the peak demand and should ensure spills are avoided during dry weather conditions. Storage (i.e. storm tanks) should accommodate the remaining flow (i.e. the difference between Formula A and 3 x DWF). Formula A approximately equates to 6 times DWF.

Since growth scenarios for this WCS have been provided for general locations, which in some cases cannot be mapped to an individual WwTW future capacity has initially been assessed on a town / village basis based on the calculated DWF. Where significant growth can be identified in a specific location and the drainage area identified this assessment could be extended in subsequent phases of this WCS to undertake a detailed review of the capacity of other key assets in the sewerage network (i.e. pumping stations and CSOs) using Formula A. The costs and disruption of relaying sewers to connect new developments with the nearest WwTW with sufficient existing capacity or with the potential to upgrade is important and should also be considered when identifying the preferred development locations. For example sites located within or in close proximity to the sewer network of a WwTW with sufficient or potential capacity to accommodate additional flows will provide a more sustainable option compared to those located on the opposing side of an urban area. Connections to an existing sewerage networks upstream of CSOs will also require urban pollution management studies to ensure any increase in spill frequencies do not have a deleterious impact on the quality of the receiving water. Where this is the case significant improvement works may be required to increase the capacity and storage of the sewerage network (i.e. increase pipe capacity or offline storage).

For the purpose of this study future growth estimates were derived based on the following data / assumptions:

The dwelling completions provided by the Local Authorities (see Table 2.1);

- The household occupancy rates used by the water company operating the Wastewater Treatment Works (provided in draft Water Resource Management Plans);
- A wastewater consumption rate of 165 l/day waste discharge per person (termed "consents manual" in the following plots), has been assumed to be representative of the whole Braintree District and agreed to be a representative figure with both Anglian Water and the Environment Agency. Although higher than Anglian Waters official figure (146.1 l/day averaged across metered and unmetered households) this figure presents a worst case scenario and provides a basis against which the benefit of metering and water efficiency measures can be quantified;



- A fixed infiltration rate of 25% of consumption (i.e. PG) has been assumed representative in all WwTW catchments;
- The water efficiency scenarios based on the water supply demand balance appraisal presented in section 5.5 and assuming 100% of the water supply is returned to the sewer. Code of sustainable homes level 5/6 have not been used since wastewater flows would be likely to exceed water supply due to the adoption of water efficiency measures such as rainwater harvesting and grey-water recycling, that utilise different water sources;
- Non household is not included in the location based assessment but has been estimated separately;
- No allowance has been made for an increase in trade effluent.

The assessment forecasts a net reduction in wastewater flows at many locations, due to the possible reductions in demand on public water supply as a result of demand management measures and reduced occupancy rates. Overall demand on wastewater services will decline as demand for public water supply decreases due to water efficiency measures and increased household metering.

However, in areas where significant growth is proposed, increased wastewater flows are possible, particularly under the 500 house per annum scenario. The future increase in waste water generated at these locations is illustrated in the following graphs (see Figure 5.3 to Figure 5.6).

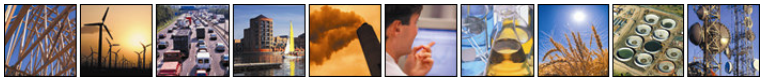


Figure 5.3 Forecast waste water flows to Braintree, Bocking and White Notley

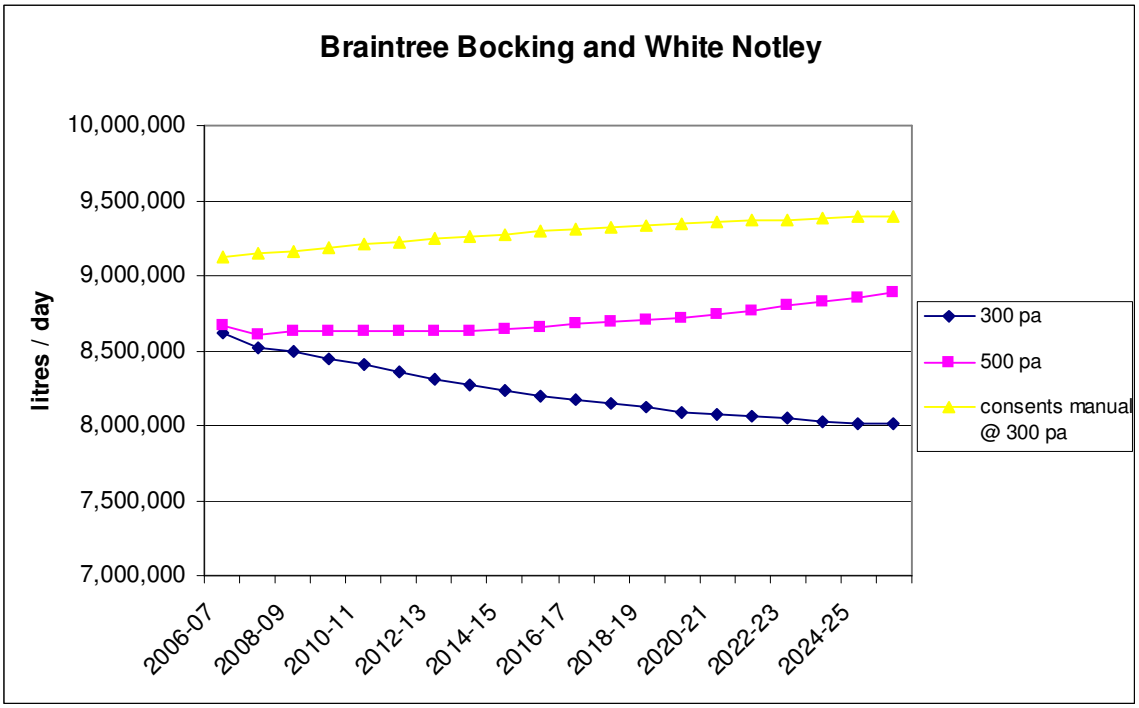
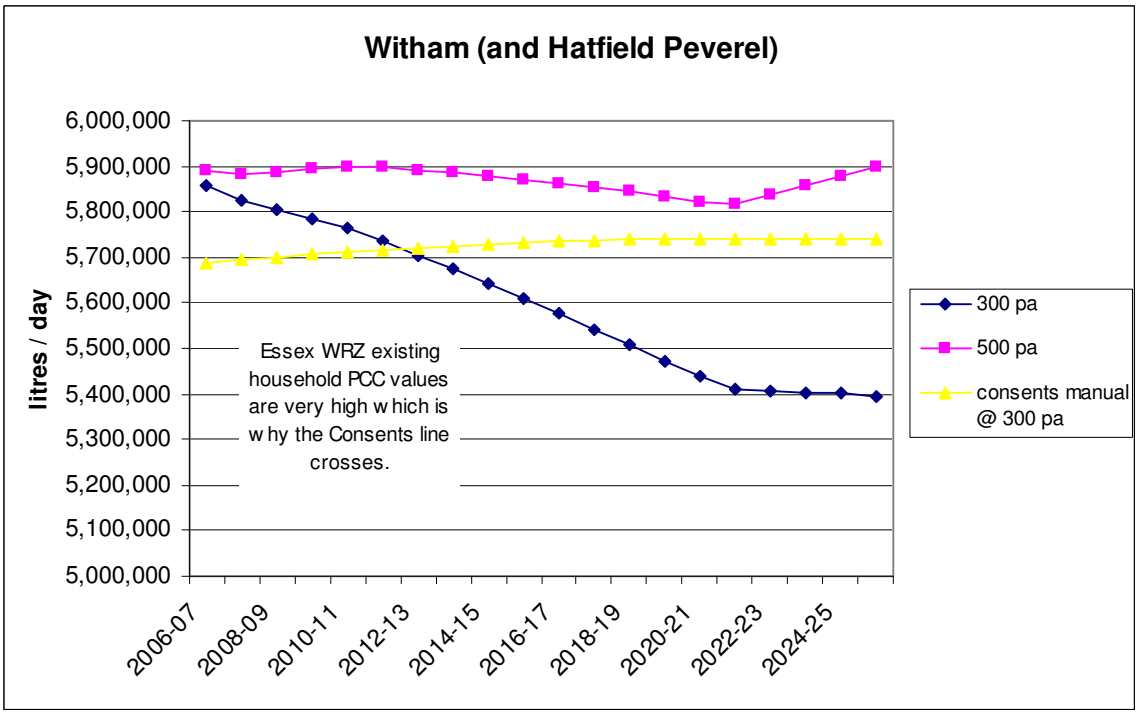


Figure 5.4 Forecast waste water flows to Witham



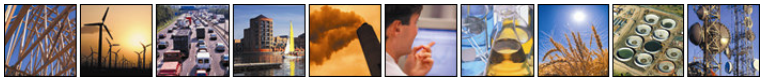


Figure 5.5 Forecast waste water flows to Haverhill

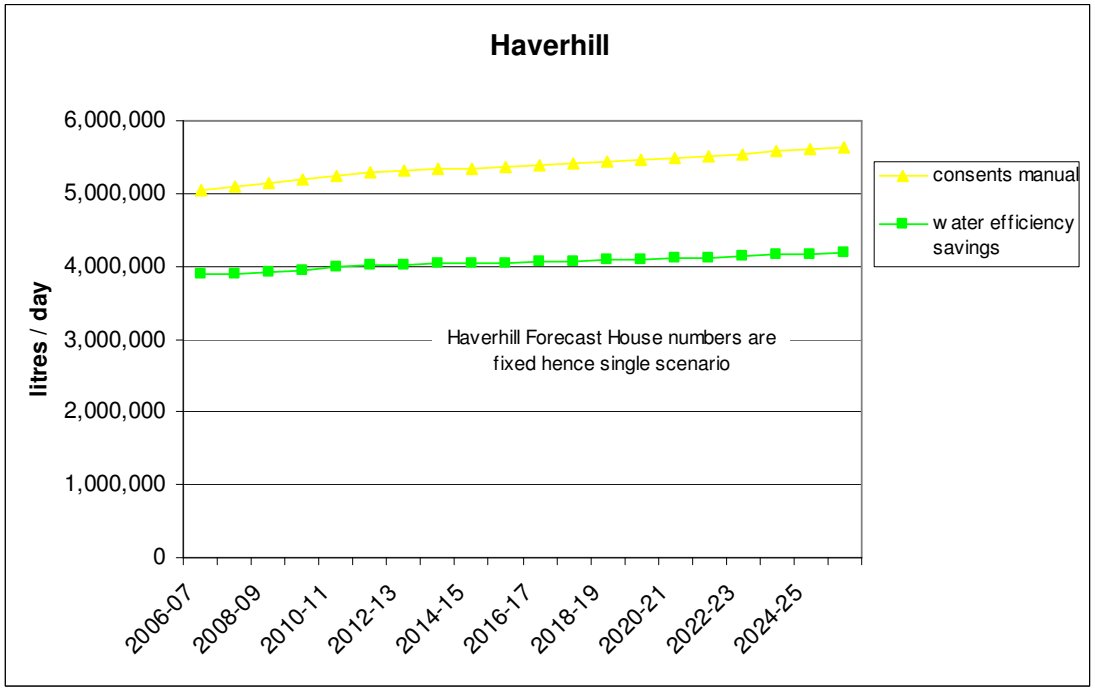
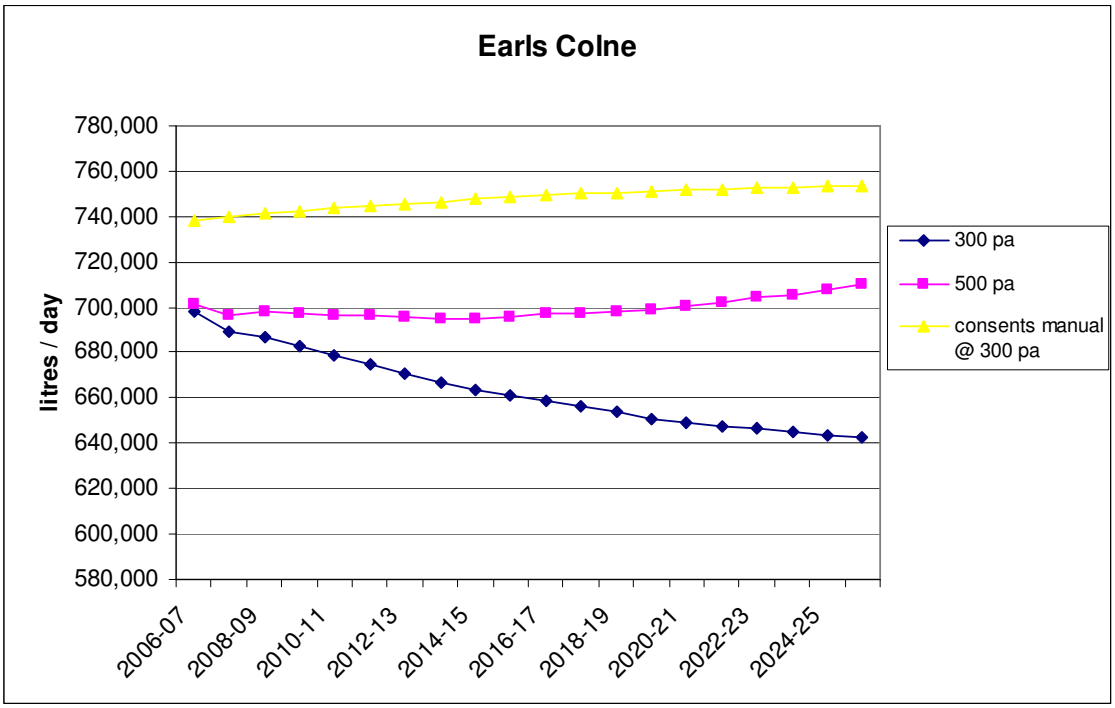
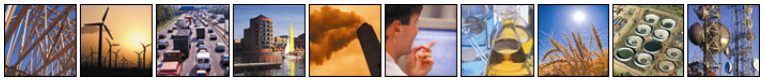


Figure 5.6 Forecast waste water flows to Earls Colne





With the exception of Braintree (Figure 5.3) these location specific growth estimates can be used as an indication of the scale of the potential increase in flow at a specific works. However, there are four WwTWs that have the potential to serve Braintree Town and the surrounding area:

- Braintree – central and southern Braintree
- Bocking – northern Braintree and the surrounding area to the North-East
- Rayne – the surrounding area to the north – east of Braintree
- White Notley – the surrounding area to the south of Braintree

Non-household demand of wastewater infrastructure capacity

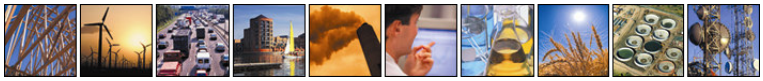
The water resources demand assessment indicates a potential increase in non-household demand of between 1 to 2.5 Ml/d (the existing non-household demand is 8.586 Ml/d) across the study area (see section 4.4.2). A significant proportion of this increased demand will be returned to foul sewer. However, it is difficult to identify the relative capacity requirements associated with non-household use at specific WwTWs.

Braintree District Council has indicated any significant commercial development will be located in the larger towns of Braintree, Witham and Halstead. Although there are numerous options regarding the potential size and location of this type of development one is raised in the recent draft Core Strategy preferred options for consultation with stakeholders; the proposed development of a new Innovation and Enterprise Business Park, with the favoured location in the vicinity of the A120 at Braintree and a likely size of 25 hectares. Based on a 40% conversion rate to estimate the floor space and its associated population from the total 25 hectare development footprint the "theoretical" non household demand associated with this development is 0.73Ml/d.

5.4.2 Headroom

Headroom in the sewerage network and the WwTWs can be defined as the capacity to accommodate additional sewage effluent load without exceeding the capacity of the sewer network (resulting in sewer flooding or unsatisfactory intermittent discharges) or breaching the consent conditions. As the connected population increases, there is generally a proportional increase in the amount of raw sewage. WwTW discharge consents are set to a certain design horizon and as a result there is commonly a population and flow headroom allowance available in the effluent consent. As the population increases this headroom is eroded and the risk of non-compliance, and thus risk of failing to meet the water quality objectives in the receiving water, increases. As a result headroom is not an absolute value but is defined as the difference between the assessed probability of failure (of a particular asset or level of service) and the maximum acceptable probability or risk of failure.

As flows approach or exceed the consented flow the water company will be required to renegotiate consent conditions with the Environment Agency. The Environment Agency national permitting centre has stated (*Personal Communication.,* June 2008) that any exceedance in the flow consent is likely to lead to tighter water



quality standards to ensure no overall increase in the consented effluent load. This approach is adopted to ensure there is no deterioration in the receiving water quality. However, the tightening of effluent quality standards should not exceed those considered achievable using the Best Available Techniques (BAT). A cost benefit analysis is also required to ensure any change in consent conditions is sustainable in terms of both cost and wider environmental impacts such as increased use of raw materials, energy and carbon costs.

The Pollution Prevention and Control Regulations 2000 introduced the concept of BAT. Associated with this is the Best Available Technique Not Entailing Excessive Costs (BATNEEC). There is no widely adopted agreement between the water companies and the Environment Agency regarding what constitutes either BAT or BATNEEC. However, they do mark a threshold at which it is important to consider both the cost and wider environmental and sustainability issues of meeting tighter effluent standards.

The BAT standards agreed through the UK Water Industry Research Group (UKWIR) as part of an ongoing Catchment Based Consenting project are as follows:

- BOD – BAT Limit of 5 mg/l (95%ile)
- Ammonia – BAT Limit of 1 mg/l (95%ile)
- Total P – BAT Limit of 1 mg/l (Mean)
- Total N – BAT Limit of 10 mg/l (Mean)

BATNEEC standards will be specific to an individual WWTW and the specific treatment processes they employ.

Anglian Water has recently negotiated revised consent conditions at the WwTWs listed below for flow non-compliance (i.e. where the DWF based on certified flow monitoring already exceeds or is at risk of exceeding consent conditions), attributed to historic growth in the catchment:

- Bocking – current 3900m^3/d, revised 4518 m^3/d
- White Notley – current 660 m^3/d, revised 1225 m^3/d
- Coggeshall - current 2235 m^3/d, revised 3025 m^3/d
- Clare - current 873 m^3/d, revised 1206 m^3/d
- Earls Colne - current 934 m^3/d, revised 1267 m^3/d
- Sible Hedingham – current 1450 m^3/d, revised 2145 m^3/d

Despite the revised flow conditions, effluent quality limits will not be altered. These revised consent flow conditions reflect the more robust flow data against which compliance can now be assessed. These revised figures include a headroom provision and alone are not indication of insufficient capacity at these WwTWs.

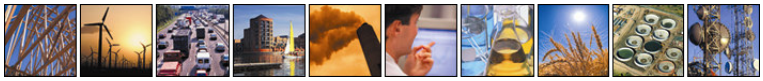
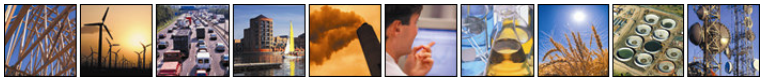


Table 5.4 presents the growth figures used by Anglian Water to assess the future capacity requirements to 2021, together with a comparison with the dwelling completion figures provided by Braintree and St Edmundsbury Councils. In all cases the figures used by Anglian Water are within or exceed those based on the two scenarios (i.e. 300 or 500 house p.a.), and thus provide confidence in the basis of both assessments. As part of their assessment Anglian Water have identified the WwTWs that they project will exceed the DWF 2021 due to the projected increase in wastewater flows. This analysis is based on either measured or calculated DWF and takes account of the recent renegotiated consent conditions at the WwTWs listed above. The analysis undertaken in this assessment also indicates that the reduced occupancy rates and per capita consumption may offset much of the increase demand associated with growth.

Table 5.4 Population equivalent growth predictions to waste water treatment works across the study area

Asset Name	JR08 Total PE	AWS* Assumed PE Growth	Population Growth to 2021 (300 scenario)	Population Growth to 2021 (500 scenario)	Potential Headroom Issues and Basis of AWS Analysis
Witham WwTW	35458	4302	2696	4503	
Bocking WwTW	19526	2766	2590	4321	Calculated DWF
Braintree WwTW	22127**	2687	2470	4121	
Halstead WwTW	12317	1679	612	964	
Coggeshall WwTW	8759	1289	235	436	Measured DWF
Sible Hedingham WwTW	6450	823	165	264	Measured and Calculated DWF
White Notley WwTW	5827	751	406	677	Measured and Calculated DWF
Earls Colne WwTW	3532	543	355	570	Measured DWF
Wethersfield WwTW	2418	388		64	
Rayne WwTW	2514	366	34	67	
Steeple Bumpstead WwTW	1448	224	67	134	
Gosfield WwTW	1089	168			
Stisted WwTW	695	112	34	34	
Shalford WwTW	542	92	34	34	
Ridgewell WwTW	412	62			
Pebmarsh WwTW	346	52	34	34	
Toppesfield WwTW	322	51			
Stambourne WwTW	301	44			
Greenstead Green WwTW	222	42			



Asset Name	JR08 Total PE	AWS* Assumed PE Growth	Population Growth to 2021 (300 scenario)	Population Growth to 2021 (500 scenario)	Potential Headroom Issues and Basis of AWS Analysis
Baythorne End WwTW	200	35			
Belchamp St. Paul WwTW	237	32	34	34	
Wickham St. Paul WwTW	211	31			
Rivenhall End WwTW	130	26	12	20	
Bulmer Village WwTW	181	25	18	18	
Bulmer Tye WwTW	161	22	16	16	
Ashen WwTW	137	20			
Foxearth WwTW	189	19			
Gestingthorpe WwTW	89	16			
Halstead – Boxmill Lane WwTW	110	15			
Cornish Hall End WwTW	79	15		3	
Belchamp Walter WwTW	83	13			
Little Yeldham WwTW	78	13			
Sible Hedingham – High St WwTW	66	9	3	4	
Pentlow WwTW	44	9			
Great Maplestead WwTW	35	7			
Clare WwTW	3317	477	135		Measured DWF
Haverhill WwTW	28713	4172	3976		

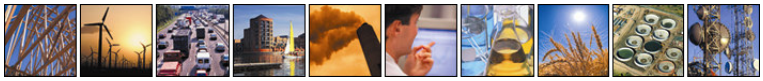
* AWS assumed growth profile currently under review for the final draft business plan. Final figures are more likely to reflect 300 houses per annum scenario. The revised figures should form the basis on any capacity assessment in the detailed study.

**JR08 figure for Braintree is currently under investigation

Population forecasts per waste water treatment works is based on property and occupancy rate data provided by Braintree District Council. The occupancy rate in existing households is forecast to decline over the planning period. Population figures are dynamic and are likely to vary particularly in the current economic climate. It is therefore important that the figures in the above table are reviewed prior to commencing the detailed study.

5.4.3 Wastewater Asset Growth Summaries

Anglian Water has undertaken an analysis of the future capacity requirements for specific wastewater assets (both the wastewater treatment works and the sewerage network) as part of the business planning process for PR09. This assessment has been based on figures taken from the Regional Spatial Strategy to estimate any increase in population and thus demand to 2021 and a summary of this analysis of provided below. Where Anglian Water has



identified a need for significant capital investment in the wastewater infrastructure asset plans have been developed which outline the specific upgrade requirements during AMP5. Anglian Water has not prepared asset plans for WwTWs with potential headroom issues if they envisage no significant capital investment will be required during the AMP 5 period (i.e. 2010 - 2015). The WwTWs in this category are listed below:

- Haverhill
- Earls Colne
- Sible Hedingham
- Coggeshall
- Clare

Some increase in capacity at these sites can be met through minor works and / or optimization of the treatment processes. Where this is insufficient an interim application for further funding to meet this demand could be made to OFWAT outside the AMP process. If there is sufficient existing capacity or significant growth is unlikely to be delivered during this period Anglian Water may seek approval for addition investment to upgrade these and other sites in AMP6 (i.e. post 2016). A summary of the proposed Anglian Waters upgrades to specific WwTWs and sewerage networks during AMP5 is provided in Appendix H. These outline the capital investment in the wastewater infrastructure to meet the increased demand in the main towns (Braintree and Witham). Anglian Water does not project that the increase demand, due to growth around Haverhill, will exceed the existing capacity of Haverhill WwTW prior to AMP6 (2016).

5.5 Wastewater infrastructure assessment and potential development locations

Thus far this assessment has focused on the increase in capacity required on a parish basis, in some cases this can be mapped to a specific WwTW. Upgrades to wastewater infrastructure to accommodate the proposed growth at specific locations will require an assessment of the hydraulic or treatment capacity at each WwTW and an assessment of the capacity of the existing sewerage network. This is required to identify potential constraints associated with an increase of wastewater flows to sewer. The detailed study should include further analysis of the sewerage network to ensure there is sufficient capacity to convey any increase in wastewater flows to a WwTW with sufficient hydraulic and treatment capacity. Figures 5.7 and 5.8 illustrate the preferred locations for development around Braintree and Witham respectively. St. Edmundsbury Council has not identified preferred sites for development and so this assessment does not include Haverhill or Clare. The potential constraints and implications of development at these sites are discussed in Section 8, Integrated Conclusions. Other potential development locations are also indicated on these maps. These sites represent those that developers have shown an interest or (pre) planning applications have been received. They are not the locations being promoted by Braintree Council.

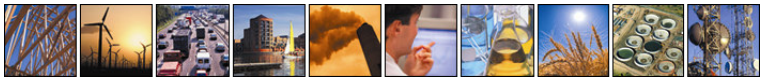


Table 5.4 (above) provides an analysis of the potential constraints at those WwTWs in close proximity to the main towns and thus most likely to be influenced by the development of the preferred and / other development locations.

Waste water treatment and water quality are the principal constraints within the Study Area. Table 5.5 (below) illustrates the dominance that these issues have on the feasibility of development locations.

The subjective assessment used above highlights the potential issues surrounding the treatment and discharge of additional wastewater loads at specific WwTWs and into the receiving water, respectively. A traffic light system is used to illustrate the relative significance of these elements of the water cycle on development in the study area:

Key:

Little or no capacity issue

Issues that can be overcome but may present phasing issues

Issues that will be more difficult, but not impossible, to overcome

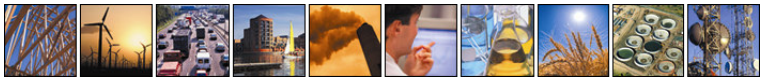
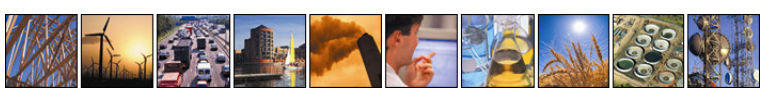
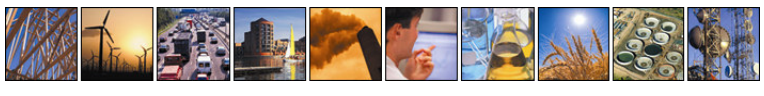
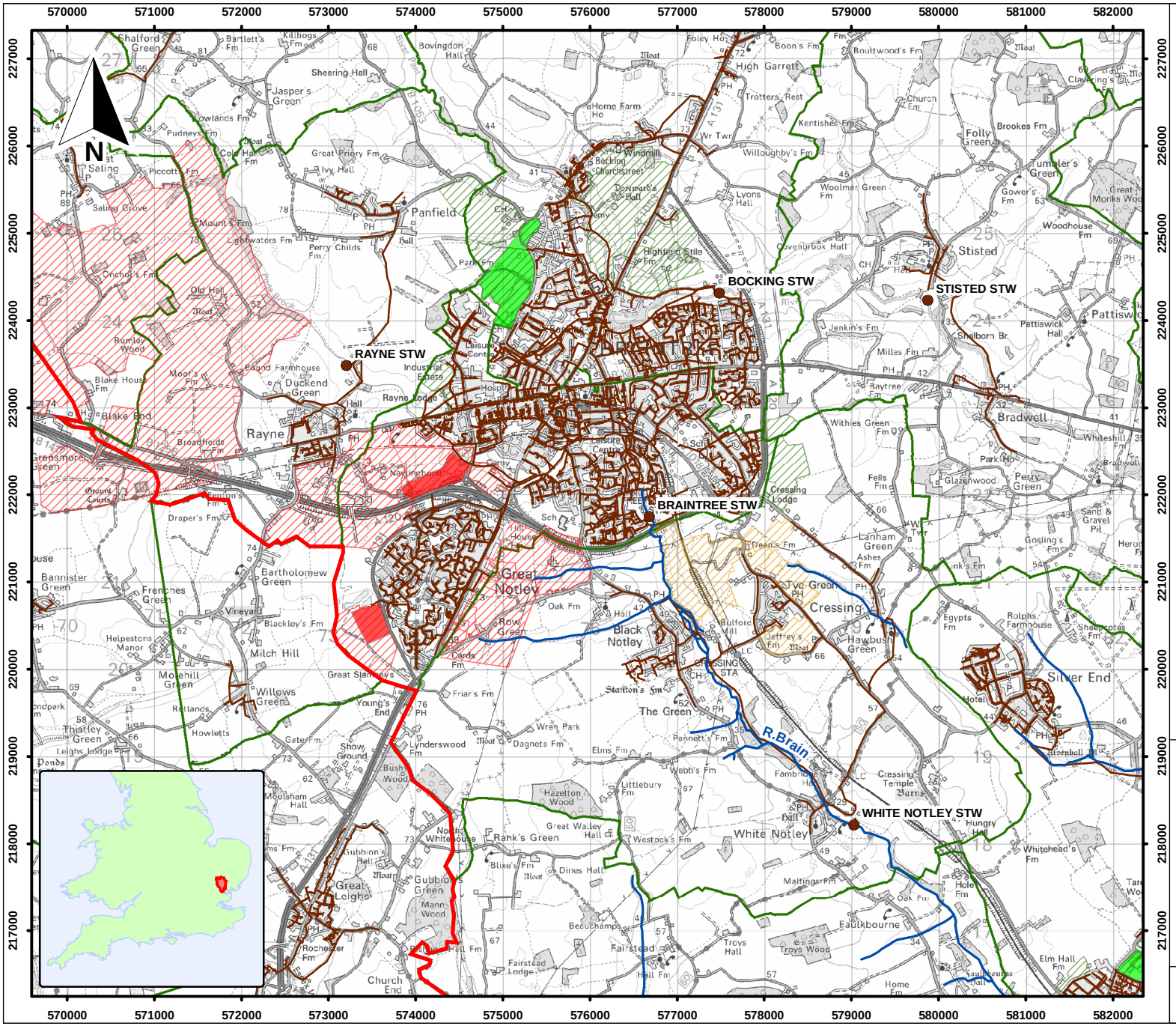


Table 5.5 Potential constraints at sites within the study area

STW name	Consented DWF (m3/d)	Hydraulic headroom in terms of PE (based on existing consent conditions)		Comments	Treatment capacity	Receiving Water Capacity	Planned investment	Overall score post investment and main limiting factor
		2021 measured DWF headroom m3/d (PE)	2021 calculated DWF headroom m3/d (PE)					
Haverhill	5700	1473 (7365)	964 (4820)	Calculated DWF expected to near consent conditions by 2021 due to growth.	Relatively tight consent conditions including Phosphate removal. Some existing odour issues due to proximity to residential area. Limited capacity within existing footprint to extend. As discharge consent is exceeded may need to consider or the provision of a second WWTW the potential location of which should be considered when identifying areas preferred for development.	Minimal dilution provided by Stour Brook. An increase in flow that exceeds the consent conditions will necessitate an increase in the hydraulic capacity of the receiving water	No plan to increase capacity in AMP5 (2010 - 2015). Proposed growth may required future upgrade in AMP6 (2015 - 2020)	Receiving water capacity. Limited capacity for upgrades if current capacity is exceeded. No investment planned for AMP5.
Witham	8100	2783 (13915)	1149 (5745)	Growth prior to 2021 not projected to exceed the consented DWF	No existing compliance issues sufficient treatment capacity to accommodate proposed growth and scope to further tighten consent as flows increase. However, little or no scope to expand works footprint to accommodate additional treatment processes and capacity of inlet pumping station restricts flow to full treatment	Discharges to Blackwater Estuary via outfall owned by Essex and Suffolk Water. The capacity of this outfall is to treat 4xDWF. Current consent conditions remain unchanged following recent review for the Habitats Directive.	Minimal investment the existing treatment assets could be configured to economically accommodate increased flows, upgrades likely in AMP5.	Treatment capacity and WwTW footprint
Bocking	3900	2342 (11710)	389 (1945)	Current DWF expected to be exceeded soon after 2011. Already renegotiated DWF (4518 m3/d) would increase calculated headroom to 453 m3/d.	Ample headroom within treatment processes, although there are potential issues with capacity within the inlet works and storm separation tanks which are currently under review (the existing inlet cannot take the specified flows to full treatment)	Discharges to the River Blackwater and thus receives more dilution than WWTW discharging to the R. Brain	Investigations planned for AMP5 to transfer flows from Braintree to Bocking WwTW	Hydraulic capacity should be address in AMP5
Braintree	6859	2436 (12180)	3340 (16700)	Current DWF at or near consent and under review	Existing compliance issues due to tight consent conditions. Upgrade to treatment processes will be required to meet growth but limited space to accommodate significant upgrades and located within residential / industrial area. Therefore limited scope to further tighten consent.	Discharges to a small watercourse the River Brain and thus receives little dilution, upstream reach already fails river quality objective. Diverting flows to Bocking WwTW could present issues regarding increase spill frequencies and lower dilution ratio in the receiving water potentially	Investigations planned for AMP5 to assess potential options for the long term provision of sustainable wastewater treatment for Braintree and the surrounding area, including diverting flows associated with additional growth beyond AMP5 to Bocking WwTW. Funding for capitial solution would be bid for in AMP6 (i.e. post 2016)	Receiving water and treatment capacity (under current consent conditions)
Rayne	480	170 (850)	173 (865)	Consent DWF sufficient to meet planned growth in catchment (366 to 2021). Although growth figures could be substantially higher if Rayne WwTW receives foul flows from the locations highlighted to the west of Braintree.	Existing compliance issues no treatment headroom. Upgrade to secondary treatment required to meet any growth. Limited scope to further tighten consent if wastewater flows increase as already at BATNEEC.	As above discharges to the River Brain and thus receives little dilution.	Investigations planned for AMP5 to assess potential options for the long term provision of sustainable wastewater treatment for Braintree and the surrounding area, including Rayne. Funding for capitial solution would be bid for in AMP6 (i.e. post 2016)	Receiving water and treatment capacity (under current consent conditions)
White Notley	660	136 (680)	-319 (-1595)	Existing flow compliance issues are at current consent limits therefore a renegiation of flow consent is required. An application to increase flows from 660 to 1225 m3/d has been made but has yet to be approved.	Some compliance issues due to historic and recent growth. Capacity of inlet works, storm tanks and secondary treatment processes would require upgrade to meet significant growth. Also existing network issues. Scope to tighten quality consent limits if flow consent is renegoiated.	River quality objectives exceeded upstream but not downstream of the outfall. Although nutrient (both N and P) concentrations remain very high.	No investment planned for AMP5 if no significant change to flow. Development of periphery sites to the South of Braintree could greatly exceed growth planned for by Anglian Water.	Receiving water and treatment capacity







Key:

- Braintree Study Area
- Sewage Treatment Works
- Rivers
- Sewer Mains
- Sewage Catchments

CS Preferred Locations

- No/Little Issue to development
- Potentially significant barrier for development

CS Other Development Locations

- No/Little Issue to development
- Development issue, but potential to overcome.
- Potentially significant barrier for development

0 1 2 km

Scale: 1:65,000 @ A4

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Braintree District Council
Water Cycle Strategy

Figure 5.7
Preferred and Other Development Locations around Braintree with Wastewater Infrastructure Capacity Assessment

October 2008
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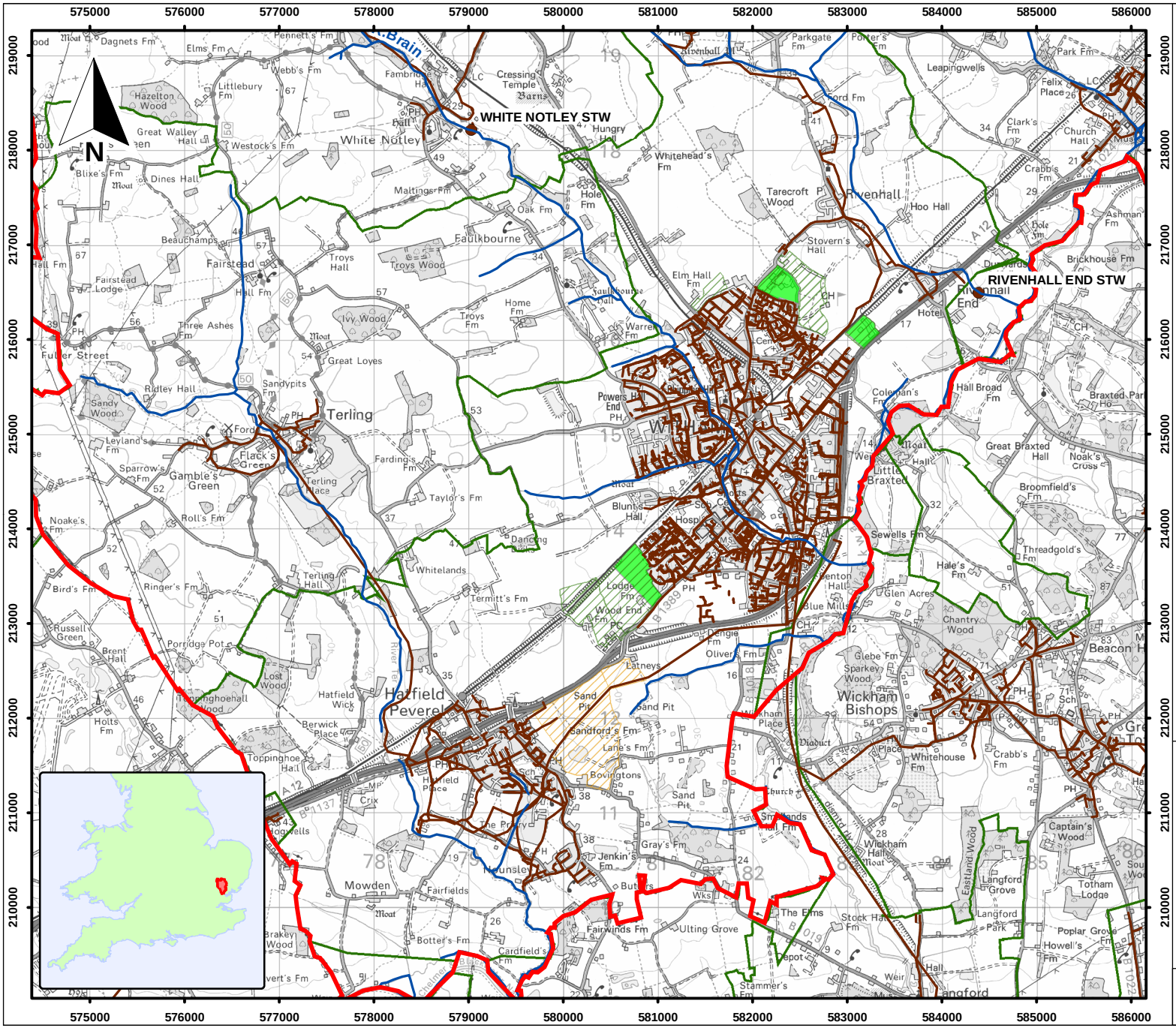

Key:

- Braintree Study Area
- Sewage Treatment Works
- Rivers
- Sewer Mains
- Sewage Catchments

CS Preferred Locations

- No/Little Issue to development
- Potentially significant barrier for development

CS Other Development Locations

- No/Little Issue to development
- Development issue, but potential to overcome.
- Potentially significant barrier for development

0 1 2 km

Scale: 1:65,000 @ A4

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Braintree District Council
Water Cycle Strategy

Figure 5.8
Preferred and Other Development Locations around Witham with Wastewater Infrastructure Capacity Assessment

October 2008
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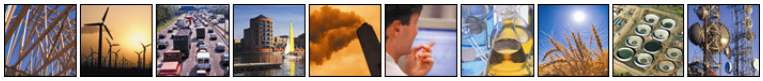
This analysis is based on the upgrades that are likely to be required to accommodate the proposed growth, whilst meeting current statutory objectives in the receiving water and the Water Frameworks Directive's no-deterioration policy. No attempt has been made to pre-empt potential changes to achieve future receiving water targets (e.g. Water Framework Directive objectives). However, the Environment Agency has confirmed that it is not promoting any additional phosphorus removal schemes in the study area, despite the fact that the GQA data highlights phosphorus as the key determinand likely to result in non-compliance against WFD standards (see section 6.3). Environment Agency staff in Anglian Region have indicated that a pragmatic approach, which considers the wider sustainability (e.g. energy and carbon costs) implications of meeting tighter standards in the receiving water, is likely to be adopted.

5.6 Wastewater Treatment Interim Conclusion

Q. Is Wastewater Treatment a constraint to growth in the Study Area?

Despite the proposed development, little or no net increase in wastewater flows is forecast across much of the study area. This is based on the occupancy rates provided by Braintree and St. Edmundsbury Councils, and per capita consumption figures provided by the water companies. However, individual WwTWs serving the main towns earmarked for significant growth may see a marginal increase in flows to the foul sewer. The increase in flow projected from the non-household demand also has the potential to further increase future capacity requirements on an individual WwTW basis and should be considered in choosing the location of the proposed Innovation and Enterprise Business Park or similar scale development. Additional capacity requirements associated with a significant non-household / business park development could exceed any increase in capacity associated with residential growth within an individual sewerage catchment.

Anglian Water, the sole sewerage undertaker in the study area, has adopted a proactive approach to growth planning and the management of their assets and has undertaken a robust assessment that is consistent with the population growth projections that form the basis of this assessment. Based on this assessment they have projected which WwTW are likely to exceed the consented flow by 2021 and the specific investment requirements to meet this demand at key WwTW. Based on this evidence it is clear that wastewater infrastructure serving the study area has or will have sufficient capacity to meet the proposed growth. However, the dilutive capacity and existing water quality issues in the receiving water at specific locations, particularly on the River Brain around Braintree and Stour Brook around Haverhill may necessitate the further tightening of already tight discharge consents to meet any additional demand. This is particularly the case for Rayne, Braintree and in addition Haverhill WwTW. Although there is some headroom at these WwTWs, and in some cases space is available if treatment plants need to be extended to meet the proposed growth, the capacity of the receiving water to dilute the additional discharge whilst maintaining water quality, presents a finite capacity to accommodate additional growth, particularly beyond AMP5. Bocking and Witham WwTW present a more sustainable solution since there is existing headroom at most stages of treatment and in the case of Bocking even redundant processes could be bought online to further increase capacity. There is also more scope to further tighten quality elements of these discharges beyond the current consent conditions as flow increases due to growth.



Continued proactive engagement is therefore recommended with Anglian Water once preferred sites for development have been identified to determine the capacity of the sewerage network and the most sustainable options for conveying and treating any increase in wastewater flow during the Phase 2 study. This is case for any significant residential and non-residential developments.