Kent Water for Sustainable Growth Study

Kent County Council

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	February 2017	Draft report	01/02/2017	Sarah Kelly	Regional Director
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List of Acronyms

AMP	Asset Management Plan
BAP	Biodiversity Action Plan
BGS	British Geological Society
BOD	Biochemical Oxygen Demand
CIRIA	Construction Industry Research and Information Association
DEFRA	Department for Environment, Food and Rural Affairs
DWF	Dry Weather Flow
EA	Environment Agency
GI	Green Infrastructure
KCC	Kent County Council
l/p/d	Litres/person/day (a water consumption measurement)
LCT	Limits of Conventional Treatment
LFE	Low Flow Enterprise (low flow model)
LNR	Local Nature Reserve
LPA	Local Planning Authority
NE	Natural England
NPPF	National Planning Policy Framework
OAHN	Objectively Assessed Housing Need
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
ONS	Office for National Statistics
OR	Occupancy Rate
P	Phosphorous / phosphate
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RoC	Review of Consents (under the Habitats Directive)
RQP	River Quality Planning (tool)
S106	Section 106 (Town and Country Planning Act 1990)
SAC	Special Area for Conservation
SEW	South East Water
SESW	Sutton and East Surrey Water
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TWUL	Thames Water Utilities Limited
UKTAG	United Kingdom Technical Advisory Group (to the WFD)
UWWTD	Urban Wastewater Treatment Directive
WFD	Water Framework Directive
WfSG	Water for Sustainable Growth (Study)
WCS	Water Cycle Study
WwTW	Waste Water Treatment Work

1. Introducing the study

1.1 Study context

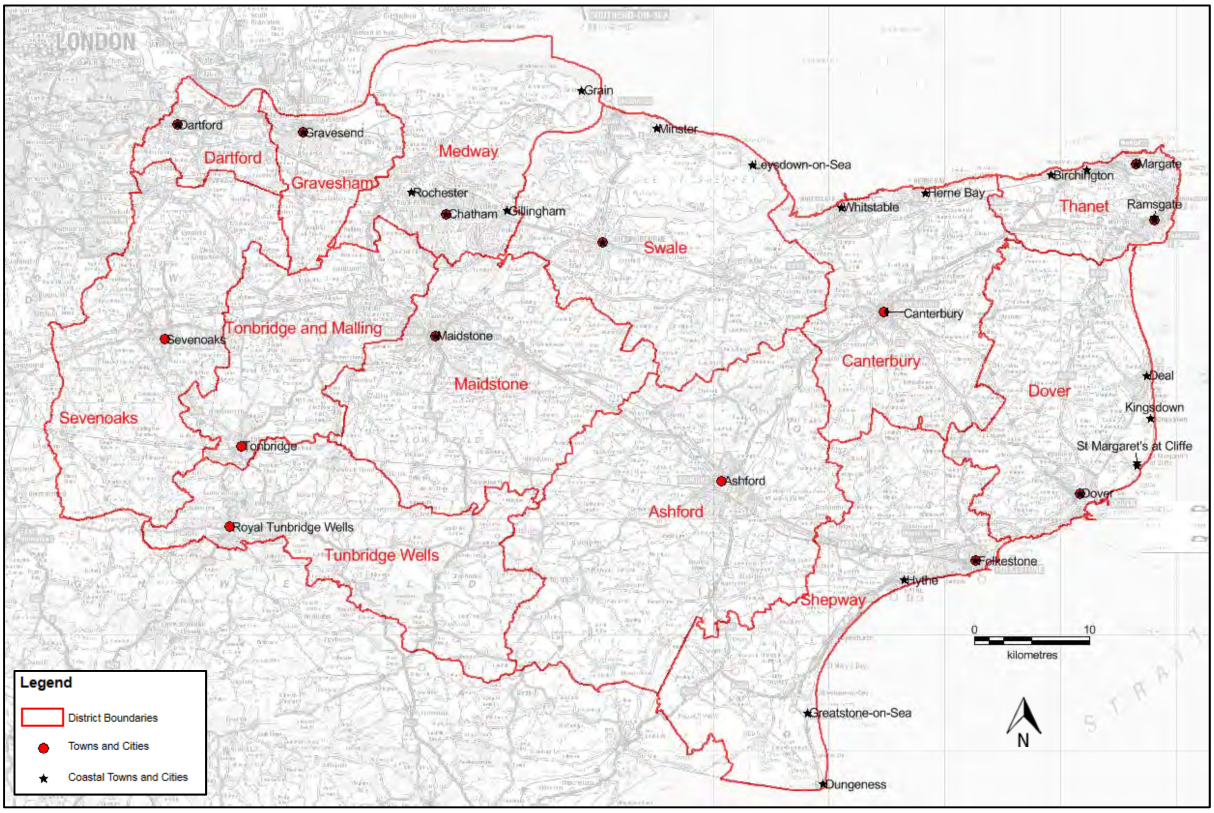
Significant population and economic growth is proposed within the county of Kent and Medway up to 2031. Each of the Local Planning Authorities (LPA) covering Kent and Medway has identified an Objectively Assessed Housing Need (OAHN) for their area as required by the National Planning Policy Framework (NPPF[1]), and each authority is preparing a Local Plan setting out how and when these targets will be delivered.

The provision of new housing, job provision and associated social infrastructure presents challenges to the water environment through the need to provide clean water supplies and to manage wastewater generated from growth. Kent County Council (KCC) therefore commissioned this Water for Sustainable Growth Study (WfSG) study to assess the impact of growth in the study area on the water environment, and to identify sustainable measures required to manage water environment impacts to 2031 and beyond. The study aims to support spatial planning decisions as well as the strategic planning of water services infrastructure by water companies in the medium to long term.

The WfSG study draws from, and supports other related strategic planning studies completed for the study area, including the Kent Spatial Risk Assessment for Water[2] (SRA) completed in 2014 and the concurrent Growth and Infrastructure Framework[3] (GIF) study (originally completed in 2015, and to be updated in 2017).

The study area (Kent County Council and Medway) is shown in Figure 1-1 alongside administrative boundaries of each LPA and the major urban centres.

Figure 1-1: The WfSG Study area



[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
[2] http://healthsustainabilityplanning.co.uk/documents/Spatial_water%20_risk_assessment%20.pdf
[3] http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/growth-and-infrastructure-framework-gif

1.1.1 Study drivers

Housing and economic growth poses specific risks to the water environment, driven by the demand created for additional water supply and need for wastewater management. Additional demand needs to be met, in part, from abstraction from existing groundwater or surface water resources, or through the development of new resources with the potential to impact on the integrity of the resources and the aquatic ecosystems which rely on them.

In addition, wastewater generated by new development needs to be treated and returned to the environment without adversely impacting on the water quality and aquatic ecosystems of water bodies receiving treated flows.

There are a number of drivers behind the WfSG study, the three key drivers being the need to manage water scarcity, the need for legislative compliance related to the water environment, and to inform strategic planning. These are summarised in the following section, and more detail on the specific water environment pressures is set out in Section 3.3.

1.1.1.1 Water availability

Some areas within Kent have been classified by the Environment Agency as at Moderate or Serious Water Stress[4], meaning either the current household demand for water is high as a proportion of the current effective rainfall available to meet that demand; or, the future household demand is likely to be a high proportion of the effective rainfall available to meet that demand. Areas of serious stress are located within the LPAs of Shepway, Dover, Thanet, Swale, Gravesham, and Sevenoaks. This classification process already requires water companies operating in areas of serious stress to evaluate the effectiveness of, and need for, compulsory metering. Growth is a key factor in influencing current and future classifications of water stress in the study area.

Additionally, the Kent SRA identified that changes in land use, and climate change as well as population growth, are likely to exacerbate water availability and increase the economic impact of water scarcity within key catchments within Kent. It also highlighted that attainment of water related legislative standards may be compromised.

1.1.1.2 Legislative compliance

Compliance with statutory environmental regulation is a key driver for the WfSG study. Abstraction needed to support demand for water supply has the potential to impact on status of water bodies which are protected under the Water Framework Directive (WFD[5]) and associated UK regulations. It also has the potential to impact on water dependent designated ecological sites under the Birds Directive[6], Habitats Directive[7] and associated UK regulations. Increased treated wastewater discharges also has the potential to impact WFD status of water bodies (including designated shellfisheries), the condition of designated sites and the Birds and Habitats Directives and the quality of bathing waters designated under the Bathing Waters Directive[8]. There is a need to ensure that water bodies and designated sites can be adequately protected.

1.1.1.3 Strategic planning

Understanding the spatial extent of pressures on the water environment, both in terms of where existing pressures are greatest and where future pressures will be most realised is a key driver for the study. It is a requirement of the NPPF that Local Plans set out strategic priorities (including policies) to deliver “The provision of infrastructure for… water supply, wastewater”[9] and the accompanying Planning Practice Guidance (PPG) provides detailed guidance on how local plan making should consider requirements related to water supply, wastewater and water quality[10]. The WfSG study provides evidence that the requirements of the NPPF and PPG have been considered in the Local Plan process. In so doing, the study will help to ensure that early steps can be made in both the spatial planning process and the process of planning water services infrastructure (wastewater treatment provision and new water resource provision) by water companies to jointly deliver sustainable water solutions.

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
[5] http://ec.europa.eu/environment/water/water-framework/index_en.html
[6] http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm
[7] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
[8] http://ec.europa.eu/environment/water/water-bathing/summary.html
[9] The National Planning Policy Framework, Paragraph 156 - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

[10] https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality

1.1.2 Study objectives

Based on the identified study drivers, the WfSG study objectives have been defined as follows:

- Achieve an understanding of the water-related environmental constraints and risks across Kent and Medway, now and up to 2031 using a scenarios approach and drawing on data from the Kent SRA;
- Present clear information regarding whether the planned development can be accommodated within these constraints and with what level of water infrastructure investment; and
- Provide a clear explanation of whether, how and where the water infrastructure costs of future development could be reduced, and / or the environmental, social and economic benefits of development increased, through long term spatial planning for development.

1.2 Study approach overview

A Water Cycle Study (WCS) approach was adopted to deliver the WfSG study. As a non-statutory instrument, WCS are often produced by planning authorities during the Local Plan making process to demonstrate that water supply, water quality and delivery of adequate water and wastewater infrastructure can be managed as required by the NPPF.

Such studies are an important part of the plan making process, however, the physical water cycle is generally influenced by spatial planning beyond limitations imposed by administrative boundaries: water bodies affected by wastewater discharges often span several authority areas and aquifers and river systems supply water to several LPA areas at a time, often through complex, interconnected water transfer and supply networks. Considering growth at a larger geographic scale (i.e. a county level) affords a more aligned catchment assessment approach to potential impacts posed by growth thereby facilitating an integrated water cycle response to be assessed and determined.

Guidance on WCS is published by the Environment Agency[11]. This guidance has been used to guide the scope of the assessments undertaken for the WfSG study, with a focus on two key topics:

- Determining the adequacy of planned water resource provision by water companies supplying the study area, and identifying appropriate measures to mitigate demand; and
- Identifying the capacity of existing wastewater treatment works (WwTW) to receive and treat wastewater flows and the water quality implications on the receiving water bodies in relation to the legislative targets which must be met.

The flood risk aspects of the WCS guidance are not necessary for the purposes of meeting the WfSG study objectives and have not been included within the study. The management of flood risk for new development is generally covered through the Strategic Flood Risk Assessment (SFRA) process, supplemented by Surface Water Management Plans (SWMPs) and Local Flood Risk Management Strategies (LFRMS) produced to support the NPPF requirements as well as flood related legislative drivers.

1.2.1 Study links and references

The Kent WfSG has been informed by preceding studies. WCS have been completed by several of the planning authorities to support previous and concurrent versions of Local Plans as set out below:

- Ashford Integrated Water Strategy[12], completed in July 2007;
- Kent Thameside Regeneration Partnership, Kent Thameside Water Cycle Study Phase One[13] (for Gravesham and Dartford), completed in March 2009;
- Dover District Council Water Cycle Study[14], completed in January 2009;
- Maidstone Borough Council, Maidstone Water Cycle Study - Outline Report[15], completed in June 2010;
- Shepway Planning Policy Team Water Cycle Report[16], completed in May 2011;
- Swale Borough Council Sustainability Appraisal, Water Infrastructure and Environmental Capacity Assessment - Outline Report[17], completed in November 2010; and

[11] http://webarchive.nationalarchives.gov.uk/20140328084622/http://cdn.environment-agency.gov.uk/geho0109bpff-e-e.pdf
[12] Ashford Integrated Water Strategy, Environment Agency, 2007
[13] Kent Thameside Regeneration Partnership, Kent Thameside Water Cycle Study Phase 1, Entec, 2009
[14] Dover District Council Water Cycle Study, 2009
[15] Maidstone Borough Council, Maidstone Water Cycle Study - Outline Report, Halcrow, 2010
[16] Shepway Planning Policy Team, Water Cycle Report, Environment Agency, 2011

- Thanet District Council Water Cycle Topic Paper[18], completed in May 2013.

The Kent SRA, which was relevant to all the authorities in Kent and Medway, was completed in February 2014. The assessment was undertaken in order to assess the potential effects from future pressure change on Kent's water systems, focusing on how the effects may vary spatially across the County in relation to receptor type and location. This has facilitated a spatially targeted assessment of potential adaptation and opportunity realisation focused on areas within the County where the impact has the potential to be the greatest.

The Kent and Medway GIF was completed in September 2015 and will be updated in early 2017 in parallel with the WfSG study. The GIF study provides a clear picture over the Local Plan period to 2031 related to housing and economic growth planned to 2031 across Kent and Medway; the fundamental infrastructure needed to support this growth; the cost of this infrastructure; the potential funding sources across the public and private sector funding during this period; and, the likely public sector funding gap and work towards solutions. The WfSG study aims to supplement the update to the GIF by providing high level costs for sustainable wastewater infrastructure solutions and potential water demand measures required to deliver the planned growth.

1.2.2 Study governance

The WfSG study has been overseen by a delivery steering group consisting of a range of interested (and affected) parties. Through the Kent and Medway Planning Policy Forum, all the LPAs were invited to take part. The following organisations were represented in the Steering Group:

- KCC;
- The Environment Agency;
- Thames Water;
- Southern Water;
- South East Water;
- Affinity Water;
- Medway Unitary Authority;
- Shepway District Council;
- Thanet District Council;
- Dover District Council;
- Ashford Borough Council; and
- Tonbridge and Malling Borough Council.

Consultation has also been undertaken during the process of completing the study with Sutton and East Surrey Water and other LPAs not represented on the Steering Group.

It is important to note that the Kent WfSG study technical study to support the Kent and Medway GIF which LPAs may also find useful to inform spatial planning and to support discussions of infrastructure provision with water and wastewater companies.

1.2.3 Study report layout

The study has been presented in separate sections as follows. Section 2 presents the growth forecasts used in the study, setting the context for the level of growth that is projected and hence subject to assessment. Section 3 then presents the baseline by providing a brief description of the water systems (both environment and infrastructure) in Kent and Medway. Section 4 presents the methodology and outputs of the assessment of water supply to meet the growth forecasts, whilst Section 5 presents the methodology and findings of the assessment of wastewater treatment and water quality. Section 6 concludes the study findings and provides further recommendations both in terms of actions for the study partners, but also, for further investigations.

Both the main detailed assessment sections for water supply and wastewater (sections 4 and 5) are presented with the study area as a whole in mind, reflecting the strategic nature of the study. Therefore, the key findings as they pertain to each LPA are presented as a 'Local Authority Digest' in Appendix E in order to give each LPA a single point of reference for the key planning related issues in their administrative area.

[17] Swale Borough Council Sustainability Appraisal, Water Infrastructure and Environmental Capacity Assessment - Outline Report, Scott Wilson, 2010
[18] Thanet District Council, Water Cycle Topic Paper, 2013

2. Growth forecasts

2.1 Growth targets

Planned growth forecasts and known development sites were provided by KCC and have been used within this study and the Kent GIF (Table 2-1 and Figure 2-1). These housing growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in August 2016 based on forecasts made in June 2016 to ensure a consistent strategic dataset across the study area[19].

The housing-led forecast is based on the assumption that a target of approximately 190,000 dwellings will be delivered between 2014 and 2031 across Kent and Medway.

Figure 2-1: Total housing growth in each LPA (2011 - 2031)

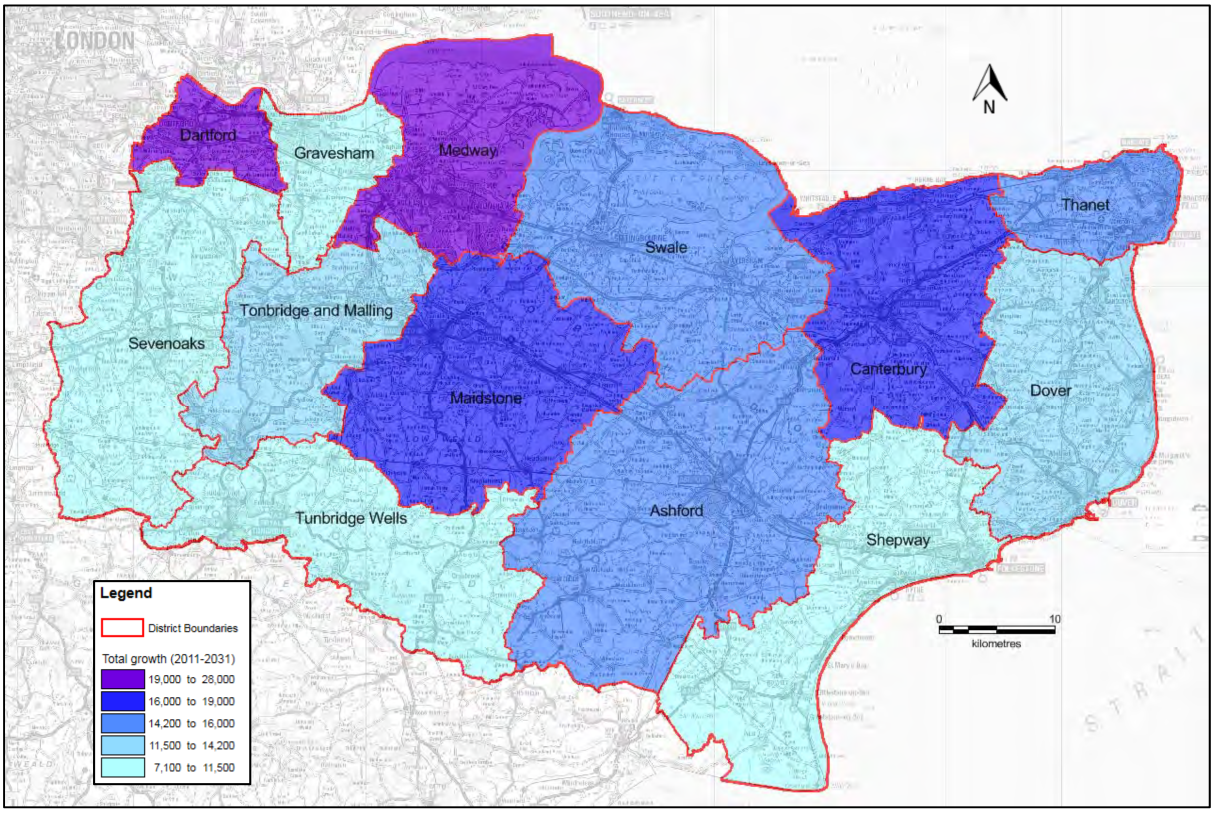


Table 2-1: Phased and total housing growth per LPA

Local Planning Authority	Phase 1 2011/12 to 2015/16	Phase 2 2016/17 to 2020/21	Phase 3 2021/22 2025/26	Phase 4 2026/27 2030/31	Target total (to 2031)
Ashford	2,857	4,736	3,475	3,475	14,543
Canterbury	2,090	5,590	4,160	4,160	16,000
Dartford	3,113	7,557	4,165	4,165	19,000
Dover	1,153	3,976	4,540	1,415	11,514
Gravesham	1,144	2,474	1,825	1,696	7,139
Maidstone	3,100	6,243	4,610	4,610	18,563
Medway	3,013	5,556	9,685	9,685	27,939

[19] It should be noted that these forecasts will change over time and represent the position as of June 2016. These forecasts have been provided to water companies in Kent to assist in the development of updated WRMPs to be published in 2019.

Local Planning Authority	Phase 1 2011/12 to 2015/16	Phase 2 2016/17 to 2020/21	Phase 3 2021/22 2025/26	Phase 4 2026/27 2030/31	Target total (to 2031)
Sevenoaks	1,056	2,396	3,860	3,860	11,172
Shepway	1,275	2,500	1,860	1,860	7,495
Swale	2,061	3,657	4,250	4,250	14,218
Thanet	1,704	2,318	5,840	5,840	15,702
Tonbridge and Malling	2,775	3,624	3,530	3,530	13,459
Tunbridge Wells	1,049	2,056	4,195	4,195	11,495
Study area total	**26,820**	**52,683**	**55,995**	**52,741**	**188,239**

2.2 Growth assessment methodology

In order to determine impact on wastewater treatment and water supply infrastructure, the specific location of proposed growth in Table 2-1 within each LPA needed to be determined so that the infrastructure capacity assessments accurately reflect the amount of growth to be served by each infrastructure element. However, the growth targets have varying degrees of spatial certainty owing to how the targets are made up as set out in Table 2-2.

Table 2-2: Housing target spatial certainty

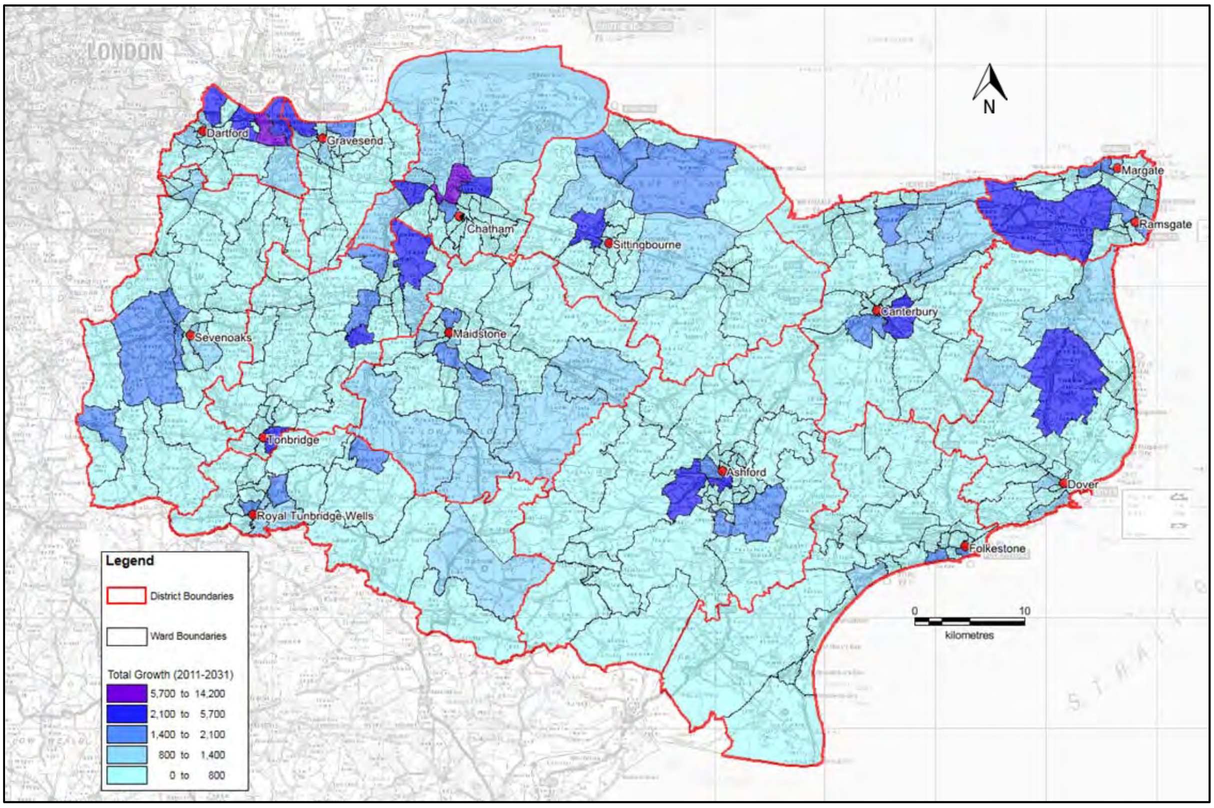
Spatially certain	Spatially uncertain
Commitments and completions. Site locations were available for sites which have been built out (completions) and those granted planning permission	Unallocated growth – the difference between the housing target for each LPA and the total which has sites identified (completed, committed and allocated)
Site allocations – sites that will be allocated by each LPA's Local Plan	

The proportion of growth target which is spatially certain was assigned to wards within each LPA using a Geographical Information System (GIS) of site layers and ward boundaries. Wards were considered to be of a sufficient geographical resolution to determine spatial impact on water infrastructure.

In agreement with KCC's Business Intelligence Research and Evaluation Team, the ratio of spatially certain growth assigned to each ward compared to the total of spatially certain growth in the LPA was then used to manually assign spatially uncertain growth totals (unallocated) for each LPA to a ward. This assumption was agreed with KCC on the basis that growth targets which are not allocated are likely to follow a similar spatial pattern of distribution around urban centres as is the case for sites both committed and allocated[20]. This method allowed a total growth target number to be developed for all wards across Kent and Medway as shown in Figure 2-2.

[20] It should be noted that spatial growth strategies in each LPA area will vary as Local Plan's develop and as such, sensitivity to these assumptions should be tested on an authority area basis as more certainty on spatial allocation is developed

Figure 2-2: Total growth targets assigned in Wards (2011-2031)[21]



2.2.1 Otterpool Garden Community

Growth targets within the study area reflect the OAHN of each LPA area; however, for Shepway District Council there has been an expression of interest[22] (EOI) for 12,000 new homes within a proposed Otterpool Garden Community, close to the town of Folkestone. The exact location of the site has not be identified and there is no masterplan or allocated plan site. The EOI has been used within this study as a guide to determine the impact of the proposed growth in addition to the OAHN for Shepway.

Shepway District Council advised as part of this study that the review of the Core Strategy Local Plan will need to determine that this is a suitable site for the Community, as well as the exact numbers of the dwellings. However, the emerging Strategic Housing Market Assessment (SHMA) suggested that there would not be more than 6,000 additional new homes by 2037 in the area. The study has therefore considered an additional assessment of 6,000 new homes in Shepway as sensitivity analysis for wastewater treatment and water supply capacity within the district of Shepway. It is acknowledged that this will include growth beyond 2031, but would give a conservative estimate of capacity on affected infrastructure. For clarity, the 6,000 homes to potentially be delivered at Otterpool, are not included within Table 2.1 (Phased and total housing growth per LPA) or Figure 2-2 above; but they have been included within the subsequent study analyses.

[21] Excluding the Otterpool Garden Community proposals
[22] http://www.shepway.gov.uk/otterpool-park

3. Water systems in Kent

This section describes the water environment and water infrastructure baseline within Kent and Medway with regards to the key components of the water cycle. This context is key to defining both existing pressures in the study area and to provide understanding of how growth is likely to affect the water environment and water infrastructure provision.

3.1 Water environment

3.1.1 Climate

Kent falls within the eastern part of the Southern England climate region as identified by the Met Office[23]. In terms of rainfall, Kent is one of the driest areas in the Southern England climate region (compared to rainfall totals of 4000 mm in the western Scottish Highlands). North Kent coast and the area around Thames Estuary normally receive less than 650mm and less than 550mm of rainfall per year, respectively. Rainfall distribution in Southern England is uneven throughout the year, with an autumn/early winter maximum that is more pronounced in counties bordering the English Channel.

3.1.2 Geology and hydrogeology

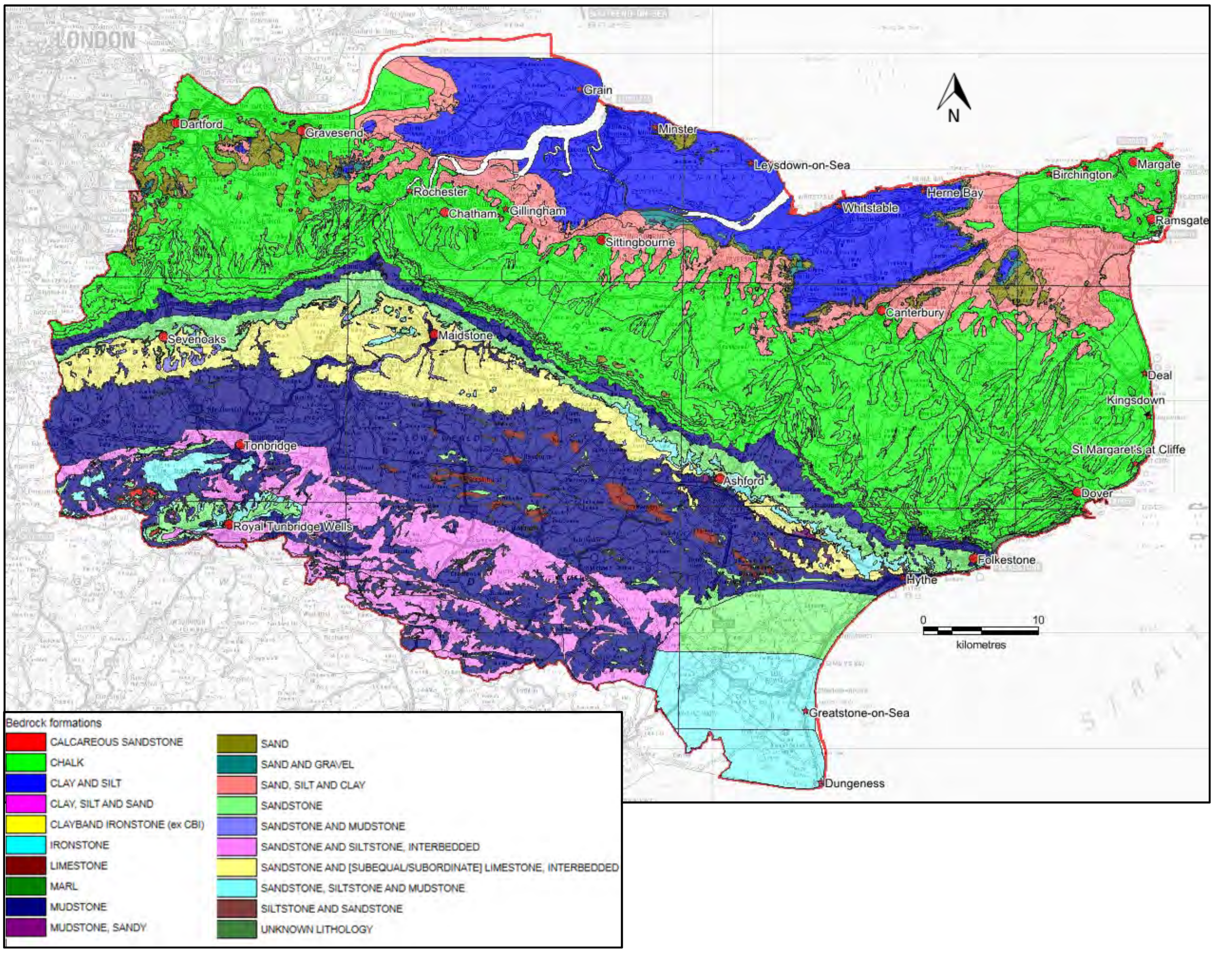
Groundwater is a key source of water resources within the County and supplies a significant proportion of water supply to the users within the study area. Five distinct regions of bedrock underlie the study area (see Figure 3-1) including:

- The Tunbridge Wells Sand Formation (Sandstone and Siltstone) and the Weald Clay Formation (Mudstone) at its southern side underlying the LPA area of Tunbridge Wells, as well as parts of Sevenoaks, Ashford and Shepway;
- The Hythe Formation (Sandstone with interbedded Limestone) at the centre of the study area;
- The Lewes Chalk Formation (Chalk) north of the Hythe Formation at the centre-centre/north of the study area underlying the LPA areas of Dartford, Gravesham, Dover, Thanet and parts of Ashford, Sevenoaks, Canterbury and Swale;
- The Thanet Sand Formation (Sand, Silt and Clay) at the northern part of the study area; and,
- The London Clay Formation (Clay and Silt) at the far north part of the area underlying parts of the LPA areas of Medway and Swale.

The Hythe Formation, the Thanet Sand Formation and the Lewes Nodular Chalk Formation are designated as Major Aquifers and the Tunbridge Wells Sand Formation is designated as a Minor Aquifer. In total, 20 groundwater bodies are designated under the WFD as important for water supply, supporting baseflow in rivers and supporting water dependent terrestrial ecosystems.

[23] http://www.metoffice.gov.uk/climate/uk/regional-climates/so Accessed on 13th January 2017

Figure 3-1. Bedrock geology in Kent



3.1.3 Rivers

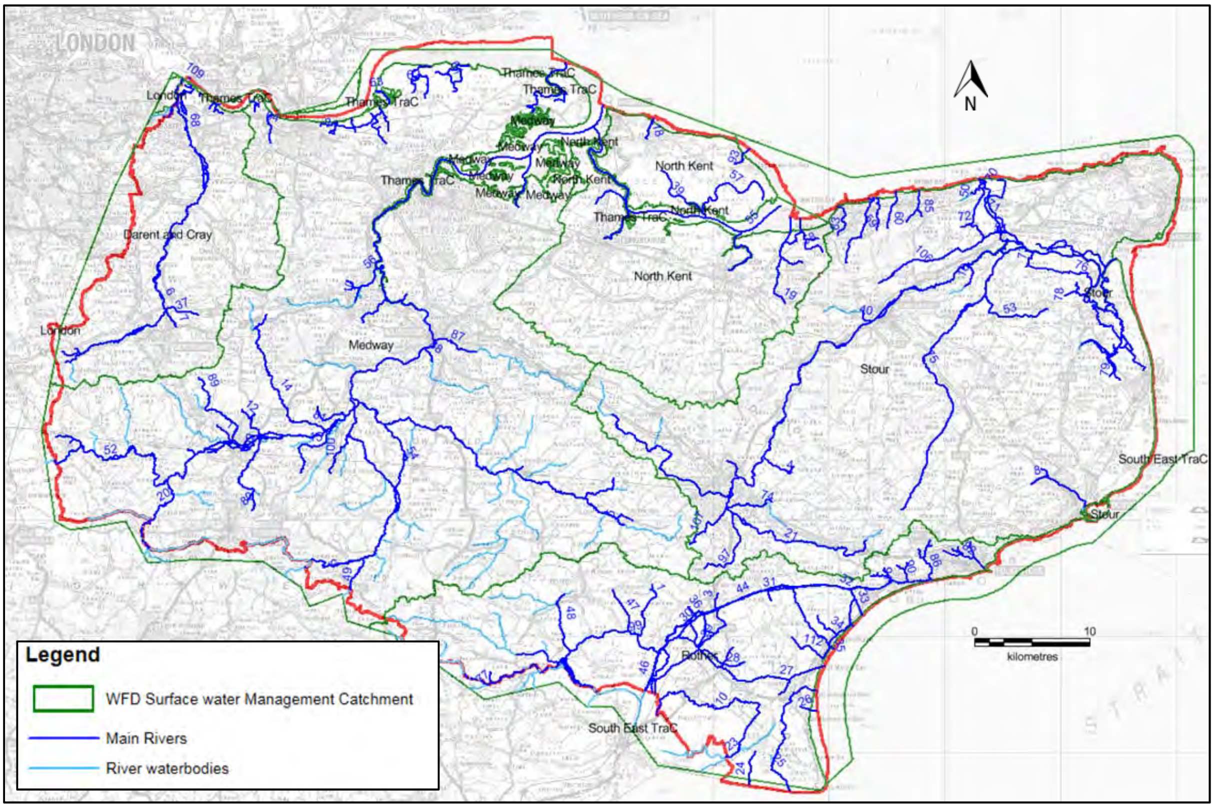
The majority of the study area is drained by three main river catchments:

- The most significant is the Medway catchment, draining the southern section of the LPA areas of Sevenoaks, Tonbridge and Malling, the northern and western section of Tunbridge Wells, the western section of Ashford, parts of Swale and the LPA areas of Maidstone, and Medway, eventually discharging to the Thames Estuary. The Medway falls into the Thames WFD River Basin District (RBD) and tributaries draining to the Medway are included within the Medway Management Catchment;
- The Great Stour, which drains most of the LPA areas of Ashford, Canterbury, parts of Dover, Shepway and Thanet to the North Sea on the eastern coast of the County. The Stour falls into the South East RBD and tributaries draining to the Stour are included within the Stour Management Catchment; and,
- The Darent, draining the majority of the LPA areas of Sevenoaks and Dartford to the Tidal Thames. The Darent falls into the Thames RBD.

Smaller catchments drain the LPA area of Swale to the Thames Estuary and North Sea (included in the Thames RBD), and parts of Dover to the English Channel (included within the South East RBD). As well as draining to the Great Stour, Romney Marsh is drained by a complex catchment of land drains to the English Channel as well as parts of the River Rother to the west; these WFD catchments fall into the Stour Management Catchment within the South East RBD.

In total, there are 114 main rivers managed for flood risk purposes by the Environment Agency, as shown in Figure 3-2; this figure also shows the main river catchments, referred to as WFD Management catchments within the RBMP. The watercourses are designated into 84 WFD water bodies (and associated WFD water body catchments) for water resources, water quality and aquatic ecology management and regulatory purposes. Appendix F provides the names for each of the numbered waterbodies shown in Figure 3-2.

Figure 3-2: Main rivers and other WFD surface water bodies in Kent



3.1.4 Status of the water environment

The WFD classifies the status of surface water bodies and groundwater bodies as published in the Environment Agency's River Basin Management Plans (RBMPs). The WFD classification is key to the WfSG study as it sets the basis for assessment of impact of growth on the water environment as a result of changes in wastewater discharges and demand for water. The impact assessment within this study is focused on the three key WFD environmental objectives which also link to other regulatory requirements:

- To prevent deterioration of the status of surface waters and groundwater;
- To achieve objectives and standards for protected areas; and
- To aim to achieve good status[24] for all water bodies.

These environmental objectives are legally binding, and all public bodies should have regard to these objectives when making decisions that could affect the quality of the water environment, including spatial planning through the Local Plan making process. As well as the RBMP documents, the Environment Agency publish the status and objectives of each water body on the Catchment Data Explorer[25], and describe the status of each water body. The status classifications for surface water bodies are detailed in Table 3-1.

The overall status of each of the surface water bodies within Kent is summarised for each WFD management catchment in Table 3-1 to Table 3-4. The tables also provide the breakdown of physico-chemical status as these elements are critical to the assessment of the impact of wastewater discharges.

The data demonstrates that only one water body in Kent meets the WFD objective of Good overall status. Reasons for this in relation to water management are discussed further in Section 3.3.

[24] Or 'Good Potential' where a water body is heavily modified or artificial
[25] http://environment.data.gov.uk/catchment-planning/

Table 3-1: WFD classifications of WFD surface water bodies in the Darent Management Catchment

Waterbody name	ID	Current status	2027 target status	Physico-chemical status 2027			
				Overall	Ammonia	DO	Phosphate
Lower Cray	GB106040024150	Poor	Good	Good	High	High	Good
Mid Darent	GB106040024222	Poor	Good	Good	High	High	High
Shuttle	GB106040024210	Poor	Good	Good	High	High	Good
Upper Cray	GB106040023990	Moderate	Good	Good	High	High	Good
Upper Darent	GB106040024221	Moderate	Good	Good	High	High	Good

Table 3-2: WFD classifications of WFD surface water bodies in the Rother Management Catchment

Waterbody name	ID	Current status	2027 target status	Physico-chemical status 2027			
				Overall	Ammonia	DO	Phosphate
Cradlebridge and Reading Sewers	GB107040019530	Moderate	Moderate	Moderate	High	Moderate	Good
Dengemarsh Sewer	GB107040013450	Moderate	Moderate	Moderate	High	Moderate	Good
Hexden Channel	GB107040019670	Poor	Good	Good	High	High	Good
Kent Ditch	GB107040013600	Poor	Moderate	Moderate	High	High	Moderate
Limden	GB107040013610	Moderate	Moderate	Moderate	High	High	Poor
New Sewer at New Romney	GB107040013480	Moderate	Good	Good	Good	Good	Good
Newmill Channel downstream of A28	GB107040013630	Moderate	Moderate	Moderate	Good	Good	Moderate
Reading Sewer (Newmill Chan to Cradlebride Sewer)	GB107040013520	Moderate	Moderate	Moderate	High	Moderate	Good
Romney Marsh between Appledore and West Hythe	GB107040019700	Moderate	Moderate	Moderate	High	Moderate	Good
Tenterden Sewer	GB107040019540	Moderate	Moderate	Moderate	High	Moderate	Good
Tributary of Newmill Channel upstream of Rolvenden	GB107040019680	Moderate	Good	Good	High	Good	Good
Upper Newmill Channel	GB107040019690	Moderate	Good	Good	High	High	Good
Walland Marsh at East Guldeford	GB107040013420	Moderate	Moderate	Moderate	High	Moderate	Good
Walland Marsh/RMC (Iden to Appledore)	GB107040013670	Moderate	Moderate	Moderate	High	Moderate	Good
White Kemp and Jury's Gut Sewer	GB107040013470	Moderate	Good	Good	Good	Good	Good

Table 3-3: WFD classifications of WFD surface water bodies in the Medway and North Kent Management Catchments

Waterbody name	ID	Current status	2027 target status	Physico-chemical status 2027			
				Overall	Ammonia	DO	Phosphate
Alder Stream and Hammer Dyke	GB106040018110	Moderate	Good	Good	High	High	Good
Allhallows Marshes	GB560504016800	Good	Good		Does not require assessment		
Barden Mill Stream	GB106040018100	Poor	Poor	Moderate	Good	High	Poor
Bartley Mill Stream	GB106040018240	Moderate	Good	Good	High	High	Good
Beult	GB106040018270	Moderate	Moderate	Moderate	High	Good	Moderate
Beult at Yalding	GB106040018140	Moderate	Moderate	Moderate	High	High	Moderate
Bewl	GB106040018500	Moderate	Good	Good	High	High	Good
Bourne (Medway)	GB106040018210	Moderate	Good	Good	High	High	Good
Ditton Stream	GB106040018200	Moderate	Good	Good	High	High	High
Eden Brook	GB106040018660	Bad	Moderate	Moderate	High	High	Poor
Eridge Stream	GB106040018390	Bad	Moderate	Moderate	Good	High	Poor
Grom	GB106040018400	Moderate	Moderate	Moderate	Moderate	Good	Moderate
Hammer Stream	GB106040018290	Moderate	Moderate	Moderate	High	High	Moderate
Hilden Brook	GB106040018170	Poor	Good	Good	High	Good	Good
Kent Water	GB106040018090	Moderate	Good	Good	High	High	Good
Len	GB106040018430	Moderate	Moderate	Moderate	High	High	Moderate
Leybourne Stream	GB106040018450	Poor	Good	Good	High	High	Good
Little Hawden Stream	GB106040018150	Moderate	Good	Good	Good	High	Good
Loose Stream	GB106040018420	Moderate	Moderate	Moderate	High	High	Moderate
Lower Eden	GB106040018160	Moderate	Moderate	Moderate	High	High	Poor
Lower Teise	GB106040018130	Moderate	Good	Good	High	High	Not assessed
Marden Mill Stream	GB106040018310	Moderate	Moderate	Moderate	High	High	Moderate
Marshes East of Gravesend							
Medway at Maidstone	GB106040018440	Moderate	Moderate	Moderate	High	High	Poor
Mereworth Stream	GB106040018190	Moderate	Good	Good	High	High	Good
Mid Medway from Eden Confluence to Yalding	GB106040018182	Moderate	Moderate	Moderate	High	High	Poor
Mid Medway from Hartfield to Eden Confluence	GB106040018181	Moderate	Moderate	Moderate	High	High	Poor
Middle Eden	GB106040018350	Moderate	Moderate	Moderate	High	High	Poor
Sherway	GB106040018320	Moderate	Moderate	Moderate	High	Moderate	Moderate
Shovelstrode Stream	GB106040018080	Moderate	Good	Good	High	High	Good
Somerhill Stream	GB106040018410	Poor	Moderate	Moderate	Good	High	Poor
Teise and Lesser Teise	GB106040018260	Moderate	Good	Good	High	High	Good
Teise at Lamberhurst	GB106040018520	Poor	Good	Good	High	High	Good
Tributary of Beult at Frittenden	GB106040018030	Moderate	Moderate	Moderate	High	Good	Moderate
Tributary of Beult at Sutton Valance	GB106040018040	Moderate	Moderate	Moderate	Good	Good	Moderate
Tributary of Eden at Four Elms	GB106040018060	Moderate	Good	Good	High	High	Good
Tributary of Teise	GB106040018510	Moderate	Good	Good	High	Good	Good
Tudeley Brook	GB106040018120	Moderate	Good	Good	High	High	Good
Ulcombe Stream	GB106040018330	Moderate	Moderate	Moderate	High	Moderate	Moderate
Upper Beult	GB106040018300	Moderate	Good	Good	High	Good	Good
Upper Beult - High Halden and Bethersden Stream	GB106040018280	Bad	Moderate	Moderate	High	Poor	Poor
Upper Teise	GB106040018250	Moderate	Good	Good	High	High	Good
White Drain	GB106040018560	Poor	Good	Good	High	Good	Good

Table 3-4: WFD classifications of WFD surface water bodies in the Stour Management Catchments

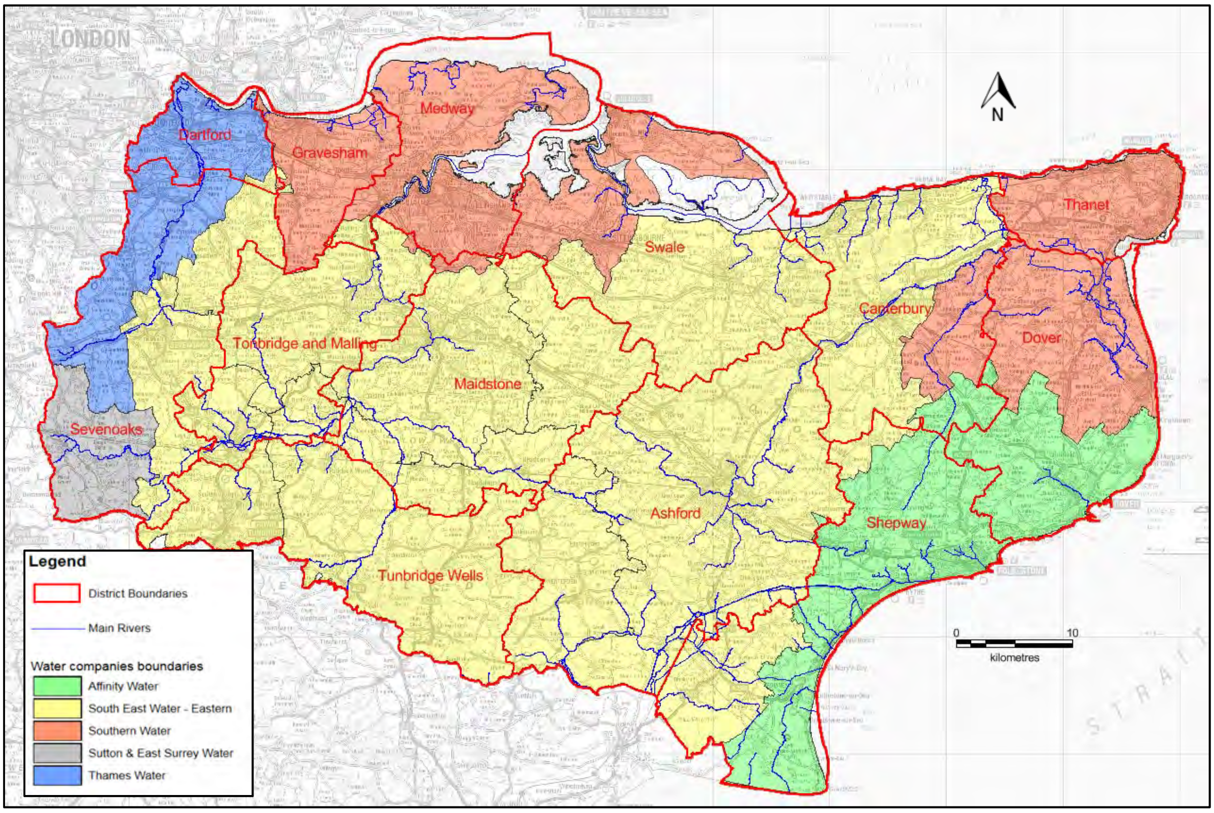
Waterbody name	ID	Current status	2027 target status	Physico-chemical status 2027			
				Overall	Ammonia	DO	Phosphate
Ash Levels	GB107040019600	Moderate	Good	Good	Good	Good	Good
Aylesford Stream	GB107040019650	Poor	Good	Good	Good	High	Good
Dour from Kearsney to Dover	GB107040073310	Poor	Moderate	Moderate	High	High	Moderate
East Stour	GB107040019640	Moderate	Good	Good	High	High	Good
Great Stour between A2 and West Stourmouth	GB107040019743	Moderate	Moderate	Moderate	High	High	Moderate
Great Stour between Ashford and Wye	GB107040019741	Moderate	Moderate	Moderate	High	High	Moderate
Great Stour between Wye and A2	GB107040019742	Moderate	Moderate	Moderate	High	High	Moderate
Hogwell Sewer and Chislet North Stream	GB107040019770	Moderate	Good	Good	High	Good	Good
Lampen Stream	GB107040019790	Poor	Good	Good	High	High	Good
Monkton and Minster Marshes	GB107040019621	Moderate	Good	Good	High	Good	Good
Nailbourne and Little Stour	GB107040019590	Poor	Good	Good	High	High	High
North and South Streams at Eastry	GB107040019730	Moderate	Good	Good	High	Good	Good
North and South Streams at Northbourne	GB107040019720	Moderate	Good	Good	High	High	High
North and South Streams in the Lydden Valley	GB107040019550	Poor	Good	Good	High	Good	High
Sarre Penn and River Wantsum	GB107040019620	Moderate	Good	Good	High	Good	Good
Swalecliffe Brook	GB107040019630	Moderate	Good	Good	Good	High	Good
Upper Dour	GB107040019490	Bad	Moderate	Moderate	High	High	Moderate
Upper Great Stour	GB107040019660	Poor	Good	Good	High	High	Good
Whitehall Dyke at Harbledown	GB107040019560	Moderate	Good	Good	Good	High	Good
Wingham and Little Stour	GB107040019570	Poor	Moderate	Moderate	Good	Moderate	Poor

3.2 Water infrastructure systems

3.2.1 Water supply

There are five water supply companies operating in Kent: Affinity Water, South East Water, Southern Water, Sutton and East Surrey Water and Thames Water. The coverage of water supply companies in Kent is illustrated in Figure 3-3.

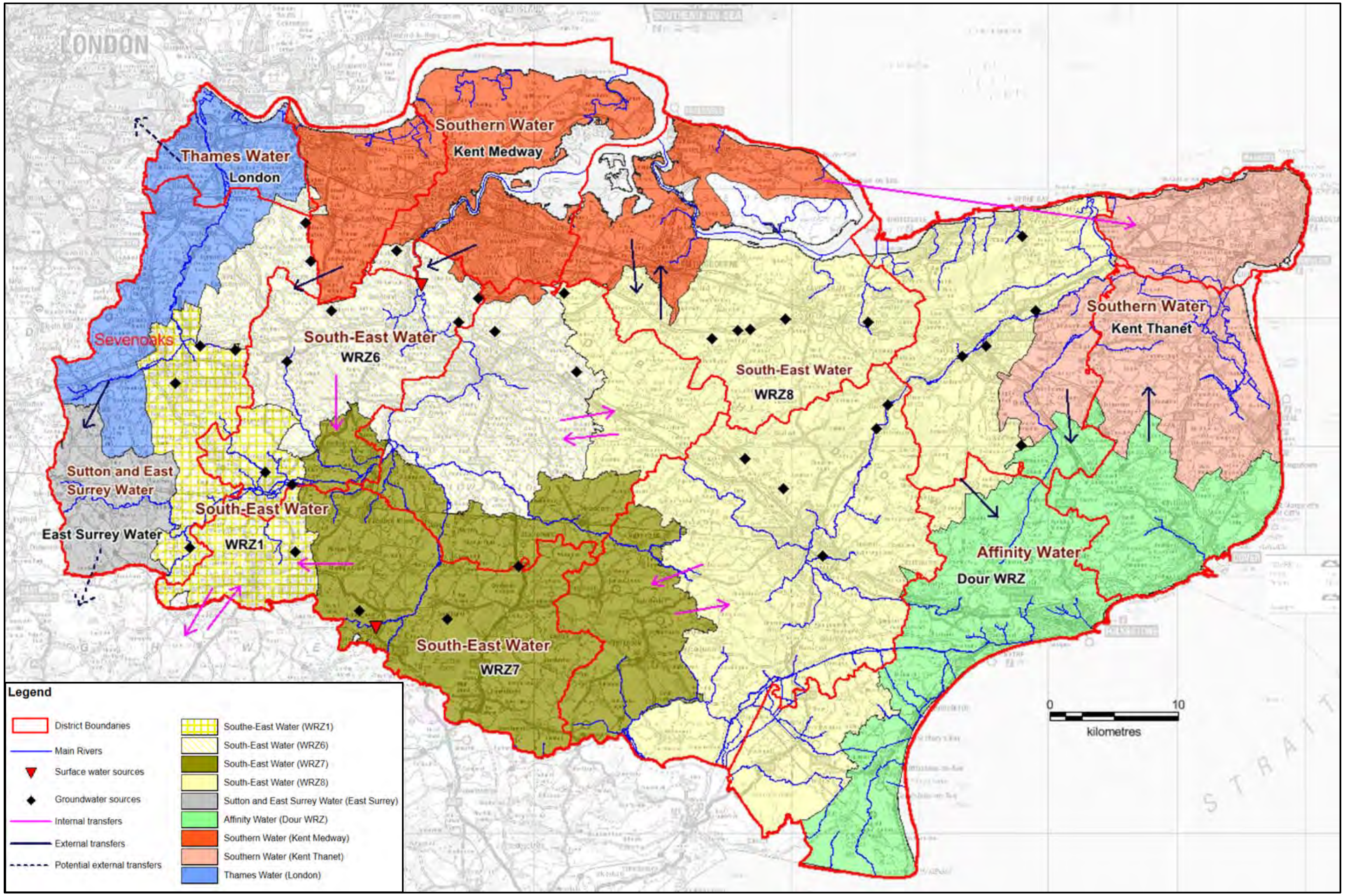
Figure 3-3: Water Supply companies in Kent



Water bodies supplying raw water resources for treatment and subsequent supply vary across the County. The various water companies operate different abstraction sources from both groundwater and surface water, and also share a complex system of resource sharing, through transfers of both raw water and treated water. Each company sets their approach to the management of water resources and demand for water within their statutory five-yearly Water Resources Management Plans (WRMP).

The WRMPs demonstrate how supply and demand over a 25 year period will be managed within discrete water supply areas called Water Resource Zones (WRZ). These WRZ are illustrated in Figure 3-4 along with how water is moved between water companies and their WRZs. A description of the main water bodies from which water is abstracted and supplied to customers within each WRZ across the study area is provided below. Groundwater is the dominant source of supply for the County.

Figure 3-4: Water Resource Zones in Kent and transfers of water within, and in/out of the study area



3.2.1.1 Dour WRZ (Affinity Water)

This WRZ covers most of Shepway, and parts of Dover and Canterbury LPA areas. The WRZ sources 90% of its water from chalk and greensand boreholes with a minor component from the Denge gravels; small amounts of water are also imported from South-East Water and Southern Water[26]. The Dour WRZ also exports water to Southern Water.

3.2.1.2 WRZ 1 (South East Water)

This WRZ covers parts of Tunbridge Wells, Tonbridge and Malling, and Sevenoaks LPA areas. 100% of water sourced in this WRZ is supplied by seven groundwater sources. South East Water operates internal transfers of water supplies to this WRZ from WRZ 7, and also moves water from and to WRZ 2.

3.2.1.3 WRZ 6 (South East Water)

This WRZ covers parts of parts of Maidstone, Tonbridge and Malling and Sevenoaks LPA areas. 78% of water sourced in this zone is supplied by nine groundwater sources. 12% is supplied by surface water sources and 10% is imported from Southern Water. Water imports and exports occur between this zone and South East Water's WRZ 8, and water is also exported to WRZ 7.

3.2.1.4 WRZ 7 (South East Water)

This WRZ covers parts of Tunbridge Wells, Tonbridge and Malling, Maidstone and Ashford LPA areas. 49% of water sourced in this zone is supplied by one surface water source shared with Southern Water and 51% of water is supplied by three groundwater sources. Inter-zonal imports and exports occur from and to South East Water's WRZ 8 and in addition, water is exported to South East Water's WRZ1 and imported from WRZ6.

3.2.1.5 WRZ 8 (South East Water)

This WRZ covers parts of Ashford, Maidstone, Swale and Canterbury LPA areas. 100% of this WRZ's supply is provided by 16 groundwater sources. There is a water import/export arrangement with Southern Water output at one groundwater source. Finally, South East water manages imports and exports from and to South East Water's WRZ6 and WRZ7.

3.2.1.6 Kent –Thanet WRZ (Southern Water)

This WRZ covers Thanet LPA area, as well as parts of Canterbury and Dover LPA areas. 77% of the WRZ's water is supplied by groundwater and only 2% is supplied by surface water. The remaining 21% is an internal transfer from the Kent-Medway WRZ. Water is also exported to Affinity Water from this WRZ.

3.2.1.7 Kent – Medway WRZ (Southern Water)

This WRZ covers most of Medway and nearly all of Gravesham, as well as part of Swale LPA area and very small parts of Tonbridge and Malling and Maidstone LPA areas. 75% of the WRZ's supply water is supplied by groundwater sources and 25% of the water supply is from rivers. Water is exported to Kent-Thanet and Sussex Hastings, both belonging to Southern Water. Also, water exports occur to South-East Water.

3.2.1.8 East Surrey WRZ (Sutton and East Surrey Water)

This WRZ covers parts Sevenoaks LPA area. 85% of the whole Company's water supply is source from four aquifer resource units; North Downs Chalk, Confined Chalk, Mole Valley Chalk and Lower Greensand. The remaining 15% of water supply is provided by a surface water reservoir storage located at East Surrey WRZ and from imports from Thames Water. Exports also occur from the East-Surrey WRZ to Southern Water.

3.2.1.9 London WRZ (Thames Water)

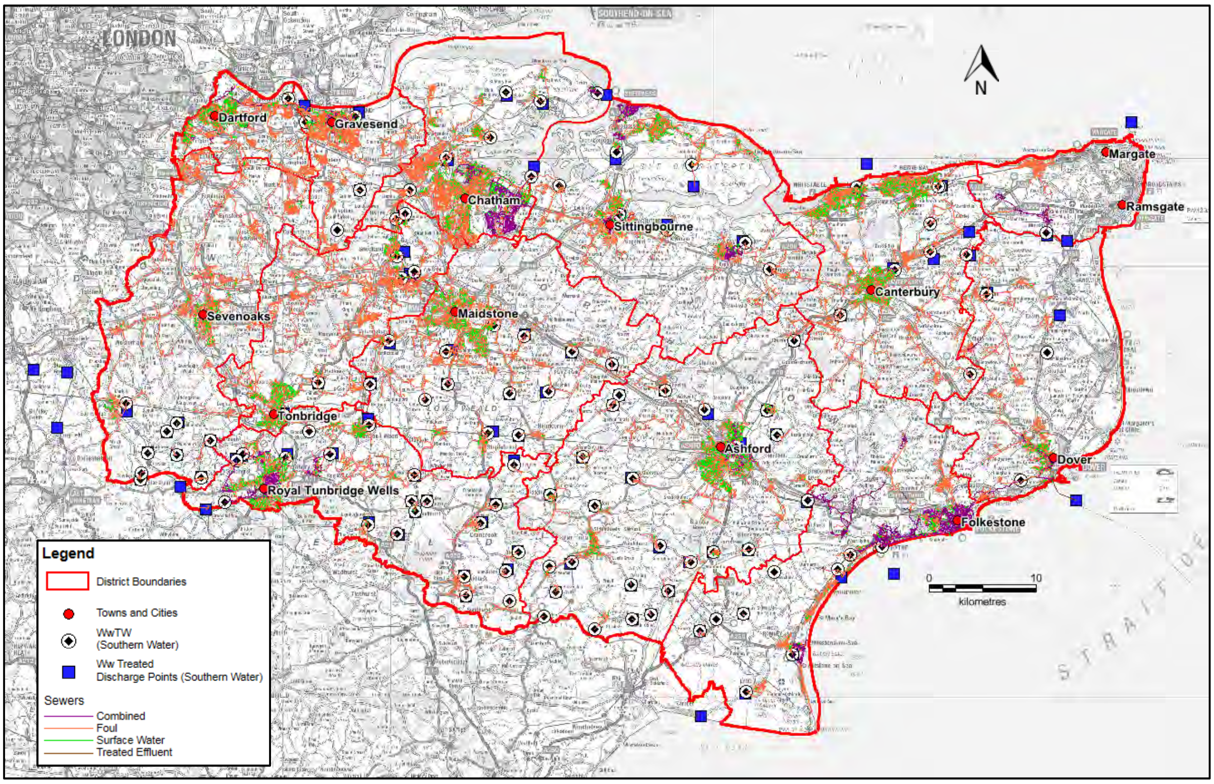
This WRZ covers Dartford LPA area and part of Sevenoaks LPA. In addition to supplying these parts of Kent, the London WRZ covers most of greater London and hence supply to Dartford and Sevenoaks LPA areas makes up a small proportion of the population and geographic area covered by this WRZ. Whilst the London WRZ is supplied by a large number and array of operational sources, groundwater abstractions from the Chalk aquifer within the Darent and Cray catchments are a key operational source supplying the Kent area of the WRZ.

[26] https://stakeholder.affinitywater.co.uk/docs/FINAL-WRMP-Jun-2014.pdf

3.2.2 Wastewater services

Southern Water is the wastewater provider for the majority of LPAs within Kent with the exception of most of Dartford and Sevenoaks which is covered by Thames Water. Figure 3-5 illustrates the locations of the WwTW, their discharge points, as well as the network of sewers: combined, foul and surface water sewers.

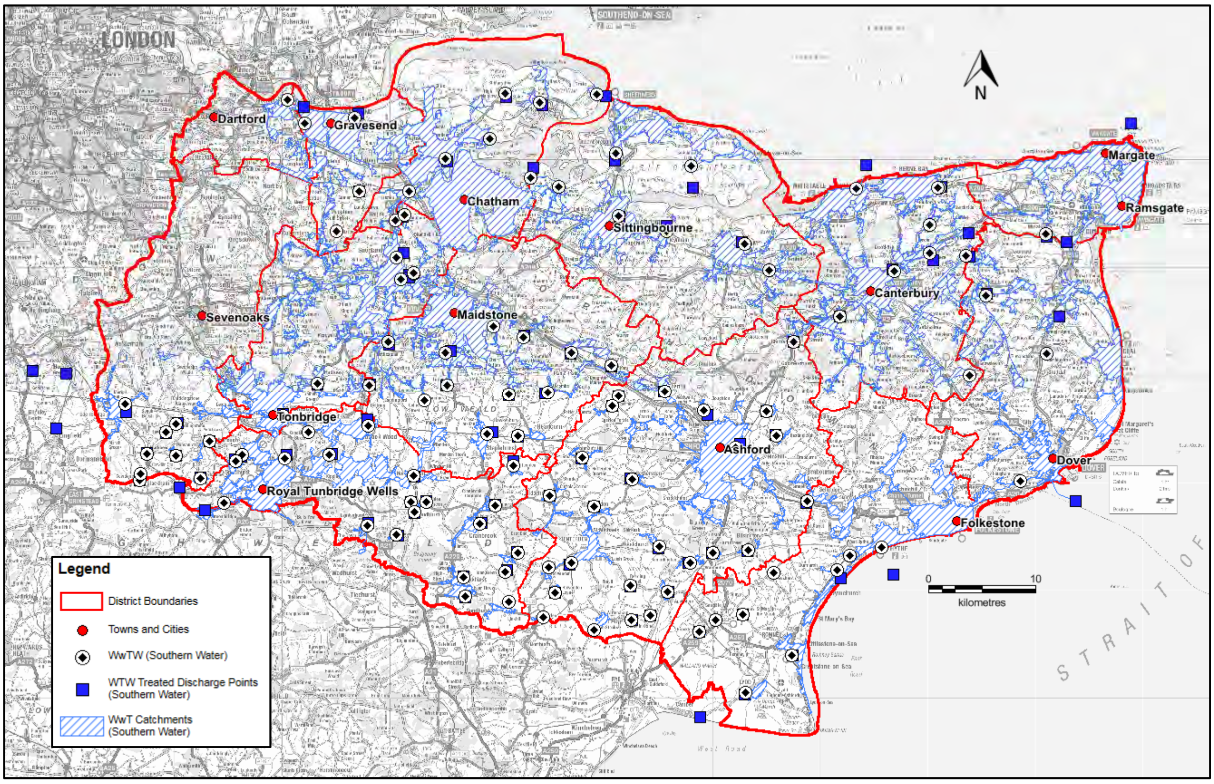
Figure 3-5: WwTW, discharge points and wastewater network layout in Kent



Each WwTW has a defined catchment area, determined by the coverage of sewer network which drains foul water from property (and surface water where the network is combined) to the treatment facility prior to treatment and discharge. This area is defined in this study as the 'WwTW catchment' and the coverage of these catchments relative to the LPA boundaries and urban centres is illustrated in Figure 3-6[27].

[27] A GIS catchment boundary for Long Reach WwTW serving most of Sevenoaks LPA and parts of Dartford LPA area was not available from Thames Water for use in this study.

Figure 3-6: WwTW Catchments in Kent



3.3 Pressures from water services

Section 3.1.4 set out the WFD status of water bodies within the study area, demonstrating that nearly all water bodies are failing to meet the WFD objective of 'Good Status'. There are a complex array of reasons why water bodies are not currently achieving this target, associated with pressures ranging from physical modification, to pollution and over-abstraction. In many cases, the RBMPs identify that the pressures are such that aiming to achieve improvement to Good Status by 2027 is unlikely to be possible in many water bodies either due to technical infeasibility or improvement measures being disproportionately costly.

Pressures related to the provision of water supply and wastewater treatment are key contributors to the current status and future status of water bodies in Kent. In combination with other pressures, abstractions for public water supply and discharges of wastewater are impacting on key WFD supporting elements in some water bodies which are critical to attaining overall Good Status; this includes impact on hydrological regime, biological quality and physico-chemical quality.

Figure 3-7 demonstrates the surface water WFD water body catchments within the study area where water industry specific activities (in addition to other pressures) are suspected (probably) or known (certain) to be contributing to a WFD status element classified as less than good and hence affecting the attainment of good status overall for the water body. This is broken down into water supply (amber) pressures or wastewater discharge pressures (green). The spatial analysis demonstrates abstraction pressures affect the Darent catchment associated with long-term groundwater abstraction from the Chalk aquifer, whilst the Medway demonstrates significant pressure from wastewater discharges affecting physico-chemical status; most significantly, Phosphate status. The Stour and Rother Management Catchments show a mixture of both abstraction and discharge pressures.

Figure 3-8 shows a similar analysis for groundwater bodies with a significant number affected for qualitative status as a result of water industry abstractions. Groundwater in Thanet is currently suspected of being impacted by wastewater discharges to ground.

Figure 3-7: WFD surface water body catchments with wastewater and water supply pressures affecting WFD objectives

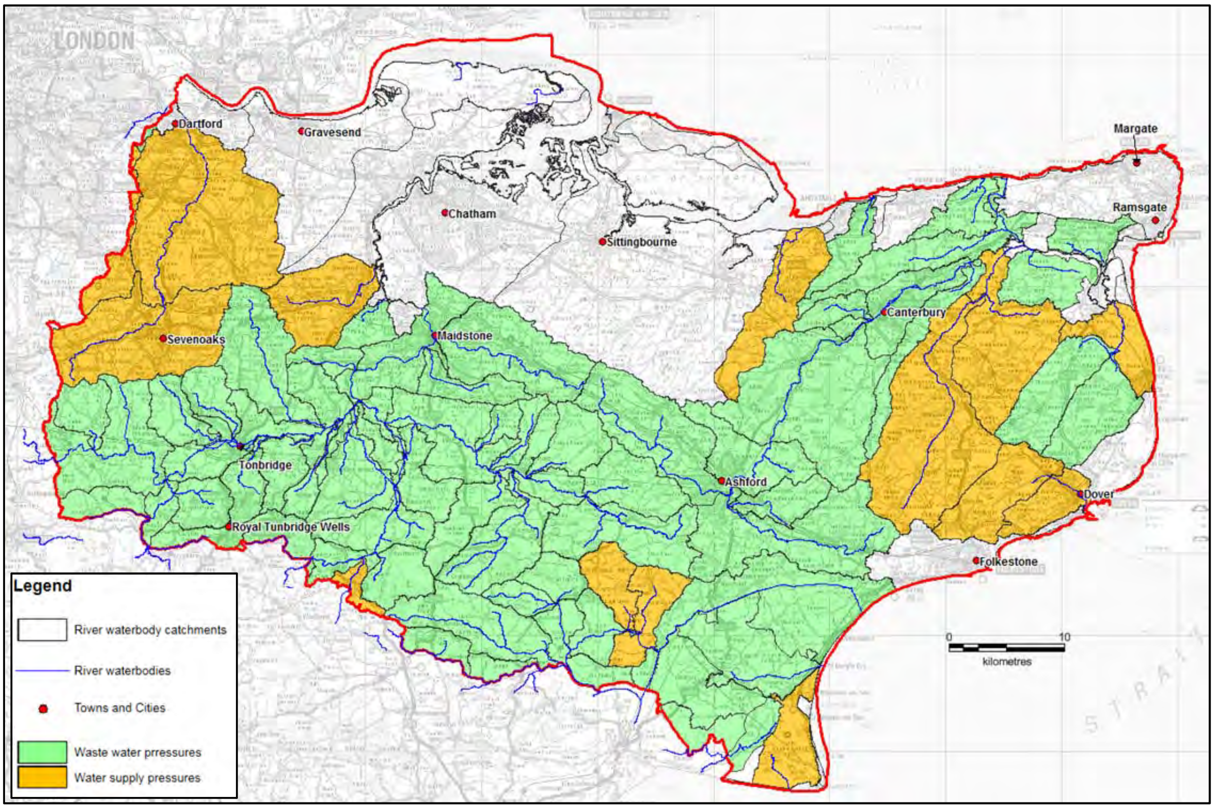
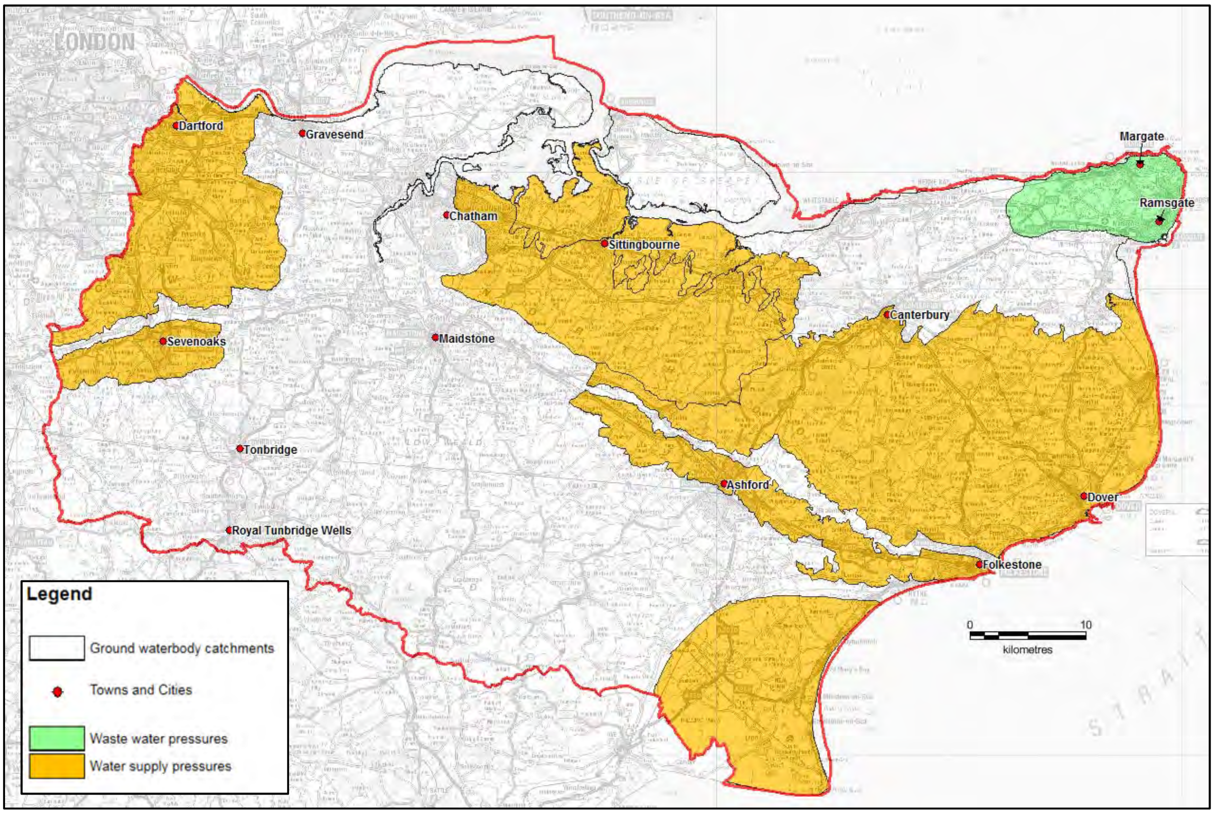


Figure 3-8: WFD groundwater body catchments with wastewater and water supply pressures affecting WFD objectives



This analysis demonstrates the significant pressure that both surface and groundwater water systems are under within Kent as a result of the need to supply water and treat wastewater for the current population. The demand for additional water and services to treat and discharge the wastewater generated by growth in the study area up to 2031 has the potential to exacerbate these pressures and limit the success of WFD mitigation measures currently being investigated and implemented to alleviate them.

4. Water supply assessment

4.1 Assessment methodology

The aim of the water supply assessment is to determine whether there are likely to be sufficient potable water supplies to meet the expected increase in demand from the housing and economic growth planned to 2031 across Kent and Medway. Where current plans for providing additional potable supply are insufficient, the study sets out alternative, sustainable options for either providing new sources or managing the additional demand.

4.1.1 Water resource planning in England

Planning for water supply by water companies is statutory process under the Water Act 2003, and requires water supply companies to produce WRMPs demonstrating how demand for water will be managed within their supply area over a 25 year planning horizon. WRMPs are completed on five yearly cycles aligned to feed into water resources investment set out in water companies' five yearly business plan and price review process. The WRMP process requires public consultation, is heavily regulated by Ofwat and the Environment Agency and each WRMP must be signed off by the Secretary of State for Environment, Food and Rural Affairs. For this reason, the production of a WRMP is a very detailed and comprehensive process which is subject to significant scrutiny prior to being accepted for publication.

WRMPs are therefore a key tool for the water supply assessment for the study and form the basis of the analysis of whether sufficient and sustainable water supply options are available to meet the planned growth to 2031. It is important to note that five yearly cycle process for WRMPs means that the published WRMPs available at any given time will not always reflect the most accurate projections for growth and demand. Therefore, the information presented within them needs to be used carefully when analysing updated planning data. How the WRMPs have been used within this study for the water supply assessment is set out in more detail in the subsequent report sub-section. The remainder of this sub-section provides some further context around the WRMP process.

WRMPs set out the difference between water available and expected demand for water and this is referred to as the 'supply and demand balance'. This supply and demand balance is calculated in a base year, and projected 25 years forward taking into account how both supply and demand will change in that time as a result of increases in population, changes in climate and changes in available water from water bodies.

Within the WRMP process, where the demand for water is projected to exceed available supply (negative supply and demand balance) the water company must demonstrate feasible and sustainable measures to balance the demand by managing (or reducing) existing and future demand and/or enhancing existing, or introducing new sources of supply. In the process, the water company must demonstrate that it has selected measures which balance the overall cost and environmental impact and must produce evidence that measures proposed do not negatively impact on environmental legislative targets such as the WFD objectives and status of designated sites under the Birds Directive and Habitats Directive.

4.1.1.1 Using WRMPs in the study

WRMPs for each water company in the supply area were approved and published in 2015. Data for predicted supply and demand balance and proposed measures for use in this study is therefore available using 2015 as the base year, and a 25 year forecast up to 2040. The available WRMPs utilised growth forecast data from 2013 to 2014 which differs to the updated 2016 growth numbers analysed within this study. In addition, water resource management measures set out in the WRMPs are programmed for delivery to 2040, beyond the plan period of 2031 considered within this study.

The key objective of this water supply assessment is therefore to compare the 2016 growth figures to the data forecasts and estimates used by the water companies within their 2015 WRMPs and determine whether there are significant differences (shortfalls) which may require new or alternative approaches to deliver the significant growth and future demand currently forecast[28]. Data within the WRMPs has been used between the base year of 2015 and forecasts of demand up to 2031. Where significant differences are evident between the 2016 growth figures and WRMPs (based on 2013-14 growth figures), the WRMPs have been used to:

28 It should be noted that each water company is currently in the process of producing their updated WRMP for publication in 2019 and hence, and hence growth data as presented in this study is being used by water companies to update the WRMP for the next cycle.

- Determine whether any of the planned measures forecast for delivery beyond 2031 (to the end of the WRMP period in 2040) could be brought forward earlier in the WRMP period to meet the difference in demand up to 2031; and
- Determine whether there are any options not taken forward into the preferred 2015 plan, which could be re-considered for delivery to meet the shortfall.

To compliment the analysis of potential supply measures, this study has also considered the role that an enhanced demand management programme could play in managing differences in growth forecasts and demand, referred to as a water neutrality assessment.

Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less) than it was before development took place[29]. If this can be achieved, the overall balance for water demand is 'neutral', and there is considered to be no net increase in demand as a result of development. In order to achieve this, new development needs to be as efficient as possible and residual increases in demand are offset by reducing the baseline demand from existing property. WRMPs already set out where baseline demand from existing sources will be tackled by the water company in the next 25 year period, and the water neutrality analysis presented in this study looks at how this can be enhanced to meet any differences in demand resulting from analysing the 2016 growth figures.

4.2 Water availability in 2031

The predicted supply and demand balances for 2030/31 are given for each water company and each WRZ in Figure 4-1. The supply and demand balances are presented as the forecast balance to 2031 before any measures are considered to balance any deficit or surplus of supply; this is referred to in this study as the unmitigated supply and demand balance. The results present the balance based on a Dry Year Annual Average (DYAA) i.e. the average annual demand in a year of low rainfall.

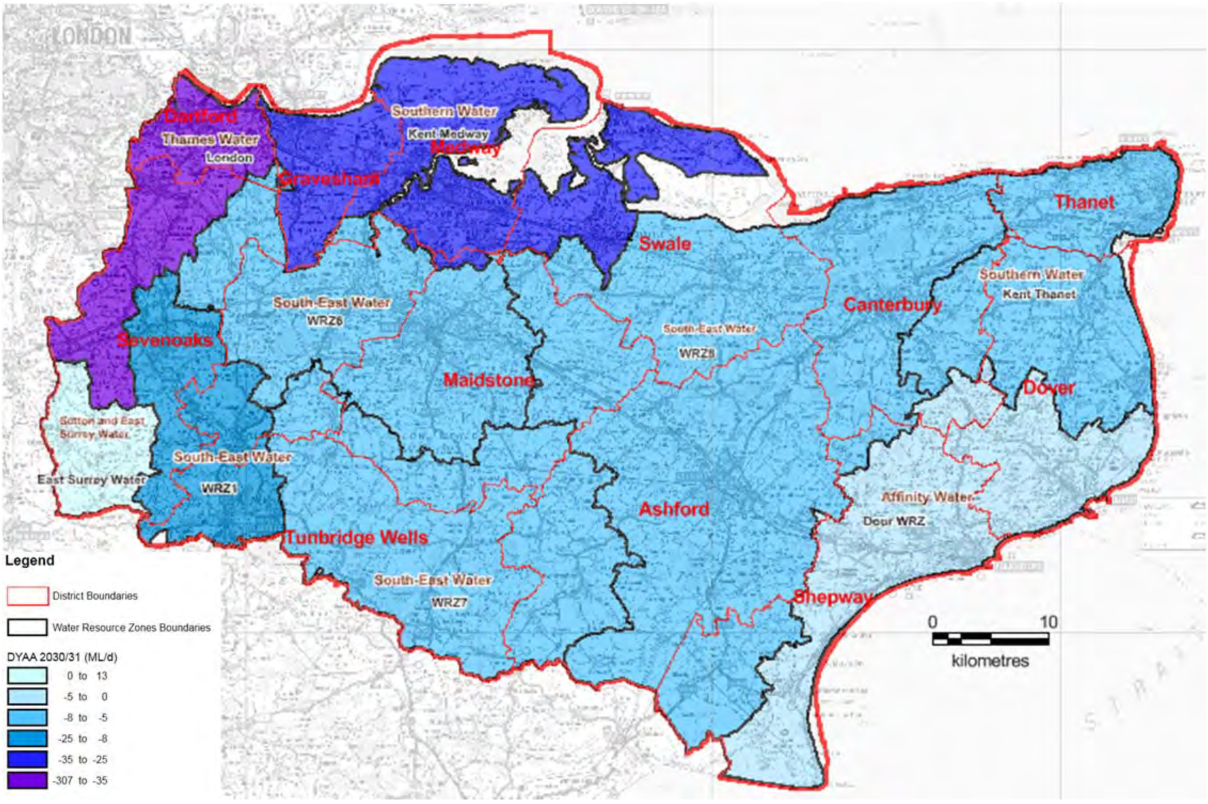
Figure 4-1 shows that by 2030/31, all except one WRZ is predicted to have a negative supply and demand balance (a deficit) largely as a result of population increase but also climate change. London WRZ exhibits the highest deficit of water supply within Kent i.e. the water demand is much higher than the supply by 306 Mega litres[30] per day (Ml/d); however, the deficit in this zone is largely attributed to the significant population growth across its supply area (Greater London) and not solely attributable to growth within Kent. The Kent-Medway WRZ also shows a significant deficit of water of 30 Ml/d. The only WRZ where the supply is higher than the demand (surplus) is East Surrey which has a surplus of by 13 Ml/d.

This analysis demonstrates the effect that population growth (as well as climate change) will have on available supply by the end of the plan period. The majority of the study area will require water companies to invest in demand management and new water resources to ensure demand can be met, whilst at the same time ensuring that the water environment and legislative targets are protected. As highlighted in Section 3.3, there are already significant abstraction pressures on the resources from which water is supplied in Kent and Medway and the need to provide further resource presents significant challenges to the water companies.

[29] Water Neutrality is defined more fully in the Environment Agency report 'Towards water neutrality in the Thames Gateway' (2007) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291668/scho1107bnmc-e-e.pdf

[30] A Mega litre is a million litres

Figure 4-1: Supply and demand Balance for the Dry Year Annual Average (2030-31) for Kent – no measures in place



4.3 Supply solutions required

4.3.1 Planned solutions

As part of their 2015 WRMP delivery, each water supply company in the study area has set out a preferred plan to balance supply and demand to the end of their plan period (2040) based on projected demands as forecast between 2013 and 2014. Each of the preferred water demand measures and water supply options for the water companies across the study is summarised in Table 4-1, showing which options were planned for delivery up to the end of 2030[31] and approximate capital costs to deliver these[32].

This analysis has not been undertaken for Sutton and East Surrey water or Thames Water. With respect to Sutton and East Surrey Water, the WRZ serving Kent remains in surplus at the end of the plan period and for Thames Water, information regarding specific options likely to serve Kent cannot be usefully determined for a strategic level study owing to the size of the overall London WRZ.

Table 4-1: Summary of planned water company demand management and supply measures to 2031 within the Kent and Medway WRZs and approximate Capital costs

Water Company planning period (AMP)	Affinity Water (WRZ 7 - Dour)	South East Water (WRZs 1,6,7 & 8)	Southern Water (Kent Thanet, and Kent Medway WRZs)
2015 – 2020 (AMP6)	• None required	• Leakage reduction • Water efficiency strategy • Groundwater (Maytham Farm)	• Alter abstraction licences (Medway) • Water efficiency Network improvements (Medway)

[31] Although the Local Plan period assessed in this study runs to the end of 2031, the WRMP cover 5 yearly (AMP) periods and it is not possible to determine whether an option would be brought forward in year 1 (i.e. 2031) of each 5 year period to cover the final year of the Local Plan period. Options have therefore been included up to the end of 2030.

[32] CAPEX costs are approximate because full break down of costs per WRZ is not always available within the published WRMPs, particularly for water efficiency and leakage measures where costs are presented as a total CAPEX across the companies' operational area which in all cases includes areas outside of Kent and Medway.

Water Company planning period (AMP)	Affinity Water (WRZ 7 - Dour)	South East Water (WRZs 1,6,7 & 8)	Southern Water (Kent Thanet, and Kent Medway WRZs)
		• Internal transfers	• Catchment management to improve water quality (Medway)
2020 – 2025 (AMP7)	• Water efficiency audits • Leakage reduction • Dover constraint removal • South East Water import continuation	• Leakage reduction • Water efficiency strategy • Three regional transfer schemes • Aylesford re-use scheme • Internal transfers	• Water re-use (Medway) • Catchment management to improve water quality (Thanet & Medway)
2025 – 2030 (AMP8)	• Network improvements (near Barham) for 2030		• Water efficiency • Licence trading • Leakage reduction
CAPEX estimate	N/A[33]	£47.1m	£57.1m (Including the Sussex Hastings WRZ outside of the Kent and Medway study area)

The options outlined would close the supply and demand deficit at 2030 based on the water companies' projections of forecast growth when developed between 2013 and 2014. At the time of producing the WRMPs, each company also proposed measures required to continue to ensure demand and supply are balanced to the end of the WRMP period in 2040.

Each water company has selected a preferred plan which provides an improvement in the mix of types of supply options available as well as connectivity of internal WRZs and connectivity between companies; these measures aid to improve resilience to both drought and climate change which is a key factor to managing supply and demand in the medium to longer term. Demand management is also a key component of each plan, through both leakage reduction and further efficiency measures in existing homes and properties.

4.3.1.1 Environmental impact

Each preferred plan has been subject to a Strategic Environmental Assessment[34] (SEA) and, where required, a Habitats Regulation Assessment[35] to test the soundness of the plan with respect to environmental impact. The SEA component includes an assessment of WFD objectives for options selected in the preferred plan. At a strategic plan level, the options proposed can therefore be concluded to be acceptable in relation to managing potential future impact on water related environmental targets such as the WFD.

However, it is important to consider how the plans have had to be developed around existing pressures from abstractions and suspected effects on WFD status and overall waterbody condition. Several of the plans have had to take into account a loss of available water as a result of sustainability reductions across the water company operating area. These reductions are proposals to change or remove abstraction licences where the operation of these licences is deemed to be having (or have the potential to have) an unacceptable impact on a water body achieving its environmental targets (such as WFD) or hydrologically linked designated ecological sites. South East Water, Southern Water and Affinity Water have not had to take account of confirmed sustainability reductions within their WRZs serving Kent and Medway; however, each has the potential to be affected by 'likely' future, or 'unknown' sustainability reductions which are either subject to ongoing investigation or have been identified for future investigation.

Each water company is undertaking sustainability reduction investigations between 2015 and 2020. Each of these investigations may lead to confirmed reductions in available water which would need to be factored into future WRMPs. Investigations within Kent and Medway which may lead to further reductions are being carried out by Affinity Water linked to the Dungeness SSSI, and by South East Water in relation to the River Stour abstraction. Additionally, Southern Water considered a 'pragmatic' sensitivity impact of up to 1.7Ml/d of sustainability reduction by 2027 in their Kent Thanet WRZ, and up to 11.2Ml/d in the Kent Medway WRZ.

[33] Affinity Water do no publish WRZ specific costs for options within its WRMP
[34] As required under the SEA Directive
[35] As required under the Habitats Directive

Taking account of the environmental pressures, a key question this study has considered is whether the growth forecasts used by the water companies to derive the preferred plan options is adequate for the level of growth forecasts used within this study up to 2031. Where there are significant forecast differences, the study then considers options available to cater for these differences.

4.3.1.2 Growth implications on planned solutions

As discussed in Section 4.1, the 2015 WRMPs published by the water companies are based on projections of population growth as estimated at some point between 2013 and 2014 and in some cases will be different to forecasts for growth that have been developed by LPAs in the last two to three years (taken from 2016). In addition, it is important to note that water companies use information from LPAs as only one of several sources of information to develop their own predictions of trends in growth, housing completions, changing demographics and demand for water. As a result of the difference in forecast years and trend analysis for housing delivery, there will be differences between the planned housing analysed in this study (from 2016) and the housing numbers used to drive demand forecasts in the WRMPs.

In order to determine the significance of any differences in growth assumptions between this study and the WRMP, the growth provided by KCC has been compared to that assumed by each water company in the 2015 WRMP to generate an estimate shortfall in planned supply within the published 2015 WRMPs. In order to do this, it was necessary to apportion the 2016 growth numbers provided by KCC into WRZ areas. This has been achieved by using the study assumptions on spatial distribution of growth within wards (see section 2.2) and comparing ward coverage to the extent of each WRZ. Estimates of growth by WRZ (using the KCC 2016 data) were then generated. Table 4-2 provides a summary of the analysis summarising the percentage of KCC growth which has been accounted for in the 2015 WRMPs and estimates of any shortfalls for each WRZ.

Table 4-2: Analysis of levels of growth included within 2015 WRMP population and demand estimates[36]

Water Company	WRZ	Forecast growth numbers to 2031 (KCC estimate as of 2016)		Water company Population projections to 2031 in WRMP (2013 as base year)	Percentage of Study area population estimates accounted for in WRMP	Potential shortfall in planned population increase included within WRMPs	Potential shortfall in water demand (Ml/d)
		Housing	Population				
South East Water	WRZ 8	34,705	***83,639***	***67,723***	80.97%	15,916	2.39
	WRZ 1	15,440	***37,210***	***14,089***	37.86%	23,121	3.47
	WRZ 6	24,941	***60,108***	***24,526***	40.80%	35,582	5.34
	WRZ 7	7,792	***18,779***	***8,207***	43.70%	10,572	1.59
Southern Water	Kent - Thanet	21,783	***52,497***	***23,740***	45.22%	28,757	4.31
	Kent - Medway	40,742	***98,188***	***83,840***	85.39%	14,348	2.15
Affinity Water	Dour WRZ	25,465[37]	***61,371***	***16,769***	27.32%	31,185	4.68
Thames Water	London WRZ	23,630	***56,948***	***55,888***	98.14%	1,060	0.16
Kent and Medway Totals			***455,324***	***294,782***		**160,542**	**24.08**

[36] For Affinity, this table includes growth of approximately 6,000 homes from the Otterpool Garden Community
[37] Includes 6,000 homes from the Otterpool Garden Community

The analysis undertaken has two key limitations:

- A significant proportion of the assessed growth within this study is spatially uncertain (unallocated growth) and assumptions have had to be made as to the spatial distribution of this growth. It is not possible to be certain whether the unallocated proportion of growth assessed in this study will fall into a particular WRZ; and,
- WRZ boundaries do not precisely match the boundary of wards used to determine assessed growth falling within a WRZ. Therefore, under or over estimates of growth are likely to occur for some WRZs where wards overlap WRZ boundaries.[38]

Despite the limitations, the analysis indicates where they may be a shortfall within the current WRMP process should the scale and spatial distribution of growth occur as set out in this study. Significant[39] shortfalls are demonstrated for:

- South East Water (WRZs 1, 6 and 7);
- Southern Water (Kent – Thanet WRZ); and
- Affinity Water (Dour WRZ).

The coverage of these WRZs in relation to LPA areas is provided in Table 4-3. This table also provides an estimate of the shortfall in demand by 2031 for each LPA area based on the difference in population accounted for and the approximate percentage of LPA which falls into each WRZ[40].

[38] The significance of this limitation is likely to be small owing the relative size of wards compared to WRZs
[39] If less than 80% of the KCC 2016 growth projections have been accounted for in the 2015 WRMP has been used to determine significance of difference – this acknowledges that uncertainties in spatial distribution of growth may have over or under estimated how the 2016 KCC growth projections would be distributed, therefore 80% of growth covered is considered to be sufficient.
[40] This is a simplistic representation based on an even geographic distribution of growth within an LPA area compared to WRZ but is produced to give an indication of how much demand is unplanned for each LPA based on older projections (from 2013) within water companies 2015 WRMPs.

Table 4-3: LPA coverage of WRZs with significant difference in growth projections

LPA	South East Water WRZ 1		South East Water WRZ 6		South East Water WRZ 7		Southern Water Kent Thanet WRZ		Affinity Water Dour WRZ (7)		Total LPA demand shortfall across all WRZs (Ml/d)
	Approximate % of LPA within zone	Estimated shortfall in demand per LPA (Ml/d)	Approximate % of LPA within zone	Estimated shortfall in demand per LPA (Ml/d)	Approximate % of LPA within zone	Estimated shortfall in demand per LPA (Ml/d)	Approximate % of LPA within zone	Estimated shortfall in demand per LPA (Ml/d)	Approximate % of LPA within zone	Estimated shortfall in demand per LPA (Ml/d)	
Tunbridge Wells	35%	1.21			60%	0.95					2.17
Sevenoaks	35%	1.21	15%	0.80							2.01
Tonbridge & Malling	30%	1.04	35%	1.87	5%	0.08					2.99
Maidstone			40%	2.13	15%	0.24					2.37
Medway			10%	0.53							0.53
Ashford					20%	0.32					0.32
Thanet							30%	1.29	5%	0.23	1.29
Canterbury							20%	0.86			1.10
Dover							50%	2.16	35%	1.64	3.79
Shepway									60%	2.81	2.81

A high level review of potential alternative options considered within the water companies WRMP has been undertaken to set out how this shortfall could be addressed and is presented in the following sub-section of this report. These alternative options consider either longer-term options proposed for delivery to 2040, or potential options not put forward into the preferred WRMP strategy.

4.3.2 Alternative WRMP measures and options

4.3.2.1 South East Water

South East Water's WRZs 1, 6 and 7 cover the LPA areas of: Tunbridge Wells, Sevenoaks, Tonbridge & Malling, Maidstone, Medway and Ashford. In total across these three WRZs, the estimated shortfall in supply up to 2031 and using 2016 forecast growth is approximately 10Ml/d.

In the current 2015 WRMP, South East Water set out a series of alternative options which could replace preferred options for each WRZ. These alternative options could be considered in addition to the preferred options to meet the shortfall. As part of a wider East Kent strategy, transfer from WRZ8 to WRZs 1 and 6 could occur with the enhancement of the Aylesford re-use scheme and or a Medway desalination scheme. These schemes could be delivered to yield new water between 2021 and 2030 potentially bringing a total of 10 Ml/d; however; the demand from WRZ8 would need to be considered as part of estimates of available yield which should also consider the development of Broad Oak Reservoir within WRZ8 to the end of 2040.

In addition, South East Water included a range of other feasible options in their modelling to develop their preferred plan as set out in Table 4-4[41], but which were not selected as part of the final plan. These options could also be considered as additional options to meet the potential shortfall.

Table 4-4: South East Water's modelled feasible options not included in the 2015 preferred plan

WRZ	Option Name	Option Type	Potential Yield
7	Transfer from Bewl Reservoir to Bewl Bridge WTW[42]	Regional Transfer	14.6Ml/d
7	Best Beech to Bewl	Internal Transfer	Not detailed
7	Kingsnorth to Bewl	Internal Transfer	Not detailed
7	Aldington to Bewl	Internal Transfer	Not detailed
6	Canterbury To Maidstone	Internal Transfer	10 to 30 Ml/d
6	River Medway abstraction at Forstal (release from Bough Beech)	Regional Transfer	5 Ml/d to 10Ml/d
1	Whitetly Hill to Blackhurst (via Horsted Keynes)	Internal Transfer	Not detailed
1	Bough Beech to Blackhurst	Regional Transfer	Not detailed
1	Bough Beech to Riverhill	Regional Transfer	Not detailed
1	Best Beech to Blackhurst	Internal Transfer	Not detailed
6 & 7	Water efficiency products pay back calculator	Demand management	Not detailed
6 & 7	Non-household on-line account and billing with specific water efficiency tips and other information	Demand management	Not detailed
6 & 7	DMA data analysis improvements	Leakage	Not detailed
6 & 7	Schools water audit and retrofit	Demand management	Not detailed
6 & 7	Free water saving devices	Demand management	Not detailed

[41] Note internal transfers between WRZs 1, 7 and 6 have not been included as they would not contribute to the potential shortfall identified in each WRZ

[42] In conjunction with expansion of the Bewl Bridge WTW

WRZ	Option Name	Option Type	Potential Yield
	offered online and in bills		
6 & 7	Hotel efficiency packs	Demand management	Not detailed
6 & 7	Integrated water and energy efficient retrofit programme delivered by third parties	Demand management	Not detailed
1, 6 & 7	Water efficiency white goods discount vouchers	Demand management	Not detailed
1, 6 & 7	Household water audits	Demand management	Not detailed
1, 6 & 7	Non-household audits and retrofit	Demand management	Not detailed
1, 6 & 7	On-line account and billing with specific water efficiency tips and other information	Demand management	Not detailed

4.3.2.2 Affinity Water (WRZ 7 – Dour)

Affinity Water's Dour WRZ (zone 7) covers the LPA areas of Shepway and Dover, and small section of Thanet. The estimated shortfall in demand up to 2031 and using 2016 forecast growth is approximately 4.7Ml//d.

Affinity Water have outlined two options which would be delivered later in the WRMP period between 2031 (the end of the Local Plan period assessed in this study) and 2040. There is potential for these options to be brought forward earlier in the WRMP period to make up for the identified shortfall. The options are: Southern Water import continuation (1Ml/d), and local network improvements. These options do not necessarily require significant lead in times, and hence could be feasible for implementing earlier in the WRMP planning period. Affinity Water also identified two options in the draft plan which were not taken forward in the final plan, including continuation of an import from South East Water of up to 3 Ml/d, and dual flush retrofit for households.

In addition, Affinity Water included a range of other feasible options within the option modelling process to develop their preferred plan. Whilst not taken forward for the preferred plan in 2015, these options could be considered for delivering additional supply to meet the shortfall in future plans. Additional schemes included: two desalination options; two effluent re-use schemes; a number of potential reservoir schemes; and, improvements to network size and remove constraints. These options would need to be worked up in detail as part of the 2019 WRMP development.

4.3.2.3 Southern Water (Kent Thanet WRZ)

Southern Water's Kent Thanet WRZs covers the LPA areas of Thanet, Canterbury and Dover. The estimated shortfall in demand up to 2031 and using 2016 forecast growth is approximately 4.31Ml/d across this WRZ.

Southern Water has outlined two demand management options which would be delivered later in the WRMP period to 2040, namely: leakage reduction (0.75 Ml/d saving) and water audits and retrofitting efficiency measures in homes. These options do not necessarily require significant lead in times, and hence could be feasible for implementing earlier in the WRMP planning period; however, it is unlikely that these schemes alone would be sufficient to meet the shortfall if introduced earlier than planned. Therefore, the full list of feasible options considered for Kent Thanet WRZ has been reviewed to determine which options could meet this shortfall. The following options were assessed as feasible at option modelling stage and were included in the mix of potential options from which the preferred plan was selected:

- Stour Estuary desalination scheme – 10 to 20 Ml/d;
- Water audits for non-residential property; and
- River Stour re-use scheme – 10 to 20Ml/d.

4.3.3 Alternative options summary

A range of alternative options are likely to be available for the water companies to meet the shortfall in forecast demand, and these options are being considered alongside a mix of potential new options as well as the need for potential further sustainability reductions through the production of the 2019 WRMPs. However, the analysis undertaken in this study highlights the scale of challenge faced by the water companies in continuing to plan for and meet the demand of changing forecasts in growth, whilst balancing the needs of the environment.

It is therefore important to ensure that the need to balance demand and supply is supported by managing demand from new property which will be delivered as part of the growth forecasts. Water companies have limited influence over water use in the delivery of new property and the role that KCC and each LPA can provide in this aspect of balancing supply and demand is key to improving sustainable delivery of new options.

4.4 Managing demand

As shown in Figure 4-1 above, unless new measures are put in place by the water supply companies in Kent and Medway, water demand is forecast to be greater than water supply within nearly every WRZ within the study area. This is in part due to the scale of growth proposed in the study area up to 2031. In addition, analysis of the growth assessed within this study compared to the allowances made by the various water supply companies when calculating demand over the same period, suggests that the current 2015 WRMPs may not provide sufficient supply (if growth occurs as phased and spatially allocated). This creates a clear driver to consider a means by which the total demand of water within the planning area in 2030/31 can be minimised. Considering what is required to move to a water neutral position is one potential alternative option that could be considered across Kent and Medway.

4.4.1 How to achieve neutrality

As described in section 4.1.1.1, the term water neutrality refers to the position whereby demand for water after growth has taken place is the same as it was pre-development within a defined ‘planning area’. For this study, the ‘planning area’ has been defined as the boundary of each of the 13 LPAs within Kent and Medway and the analysis has been completed separately for each of these 13 areas.

In the context of this study, attainment of water neutrality requires a ‘twin track’ approach whereby water demand in new development is minimised as far as possible through the use of development control planning policy, whilst at the same time offsetting the residual increases in demand by taking measures to actively reduce demand from existing properties through retrofitting of water efficient devices in existing homes and business.

4.4.2 Water neutrality scenarios

When considering neutrality within an existing planning area, it is recognised by the Environment Agency[43] that achievement of total water neutrality (100%) for new development is extremely challenging, and this is because the levels of water savings required in existing properties may not be possible for the level of growth proposed. Water neutrality scenarios have therefore been developed, each with differing assumptions on minimising water demand for new development, extent of enhanced meter penetration (where this is not at or close to 100%) and percentage uptake of water efficient fixtures and fittings in existing properties. Each of these scenarios is explained in more detail below.

It is important to note that these scenarios have been developed to apply to the study area as a whole, and with the exception of assumptions on further metering, do not take account of differences across WRZs such as variable water use for existing properties or where water companies may already have embarked upon programmes of retrofit of existing properties with water efficient fixtures and fittings. This approach will result in over or under estimates of the potential savings which can be made from the measures proposed for each scenario, therefore, the outputs from the water neutrality assessment should be considered as indicative only and have a relatively low degree of confidence.

4.4.2.1 Theoretical water neutral scenario

The scenario has been developed as a context to demonstrate what is required to achieve a neutral position in each LPA area. In practice achieving 100% neutrality across the study area is unrealistic for two main reasons:

a) Developers would be required to voluntarily provide homes where water use is reduced below Building Regulation Part G Optional Requirements, through incorporation of water re-use technologies in all major development to meet non-potable demands. Local Authorities are currently limited to setting policies with specific water efficiency targets which link to existing technical standards and without a

[43] Environment Agency (2009) Water Neutrality, an improved and expanded water management definition

policy to drive higher specification homes, developers are unlikely to deliver homes with lower water use designed in; and,

b) a significant proportion of existing homes would need to be retrofitted with efficient fixtures and fittings which would require a significant funding pool and a specific project management resource to ensure the retrofitting programme is implemented. In addition, several water companies operating within Kent have already embarked on (and in some areas completed) ambitious retrofit programmes which reduces the scope for making further significant gains in demand reduction in existing property.

The key assumptions for this scenario are:

- Meter installation would be undertaken into all existing residential properties where metering is technically feasible (note, this is only assumed where the water company has not already achieved this[44] and this variability has been taken into account); and,
- All new homes would be built to deliver a water use of 78 litres per person per day, based on high specification fixtures and fittings[45], as well as rainwater harvesting and/or greywater recycling to meet non-potable demands generated by toilet flushing and washing machine use.

The two key assumptions listed above would lead to a significant reduction in water demand at the end of the plan period compared to the 'business as usual' of new homes being built to deliver water use based on Building Regulation Part G Mandatory Requirements (125 litres per person per day). However, to get to a position where water future demand does not exceed current demand at the start of the plan period, significant reductions in existing property water use is required to offset the residual increase.

The water neutrality calculations have therefore derived a percentage of existing homes which would need to be retrofitted with low flush cisterns, as well as aerated taps and shower heads based on an assumed water use reduction per existing home with these devices installed[46]. Each LPA therefore has a variable percentage of existing homes which would need to be retrofitted to reach neutrality, and hence each has a different cost associated with it.

This scenario would require a significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required. It should also be noted that the percentage of retrofit may not be technically achievable owing to the significant programme of retrofitting already undertaken (and planned to be completed) by water supply companies in the supply area, particularly in relation to Affinity Water, South East Water and Southern Water.

4.4.2.2 Mandatory requirements scenario plus retrofit

This scenario considers a more realistic scenario, and considers the savings which could be made based on a developers building houses to meet the minimum expected technical requirements for water use (Building Regulation Part G Mandatory Requirements) in addition to proposed metering programme of each relevant water company and a modest programme of additional retrofitting.

The key assumptions for this scenario are:

- All new homes would be built to deliver a water use of 125 litres per person per day[47] (Building Regulation Part G Mandatory); and
- 5% of existing homes in each LPA would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

4.4.2.3 Optional requirements scenario plus retrofit

This scenario considers the savings which could be made based on each LPA including a policy within their Local Plan to require developers build houses to meet the optional standard for water efficiency (Building Regulation Part G Optional Requirements) in addition to proposed metering programme of each relevant water company and a modest programme of additional retrofitting.

[44] Full detail on metering assumptions is provided in Appendix A
[45] Full detail on options for delivering water efficiency in new homes is provided in Appendix A
[46] Full detail on options for delivering retrofit measures in existing homes is provided in Appendix A
[47] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

The key assumptions for this scenario are:

- All new homes would be built to deliver a water use of 110 litres per person per day (Building Regulation Part G Optional); and
- 5% of existing homes in each LPA would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The scenario has primarily been developed to demonstrate (and provide an evidence based for) the added benefit of adopting policy based on Building Regulation Part G Optional as well as undertaking a joint programme of retrofit.

4.4.3 Neutrality scenario assessment results

A summary of results for the water neutrality assessment for each of the 13 LPAs is provided in Table 4-5. The table compares the three scenarios to the business as usual condition[48]. The table presents:

- the percentage of existing homes which would need to be retrofitted in the 'Theoretical water neutral' scenario, in order to reach complete water neutrality;
- the expected water use savings from delivering the mandatory requirements scenario (including metering and existing property retrofit) and the percentage this reduction represents compared to the increase in demand that would occur without the measures (business as usual[49]); and,
- the expected water use savings from delivering the optional requirements scenario (including metering and existing property retrofit) and the percentage this reduction represents compared to the increase in demand that would occur without the measures.

Full details for each LPA are provided within the Local Authority Digests provided in Appendix E.

[48] which assumes that new properties are built to deliver Building Regulation Part G Mandatory, no additional water metering is undertaken by water companies and no retrofitting is undertaken
[49] Note – the business as usual comparison includes achieving mandatory targets under the Building regulations, therefore reductions in demand for this scenario are based on planned water company metering and retrofit of existing homes with efficient fixtures and fittings.

Table 4-5: Water neutrality scenario assessment results

Local Planning Authority	Mandatory requirements plus 5% retrofit		Optional requirements plus 5% retrofit		Theoretical water neutral scenario		
	Savings compared to business as usual demand (Ml/d)	Percentage additional demand met	Savings compared to business as usual demand (Ml/d)	Percentage of additional demand met	Savings compared to business as usual demand (Ml/d)	Percentage additional demand met	Percentage of existing housing stock requiring retrofit to reach neutrality
Ashford	0.36	8%	0.85	19%	4.58	100%	34%
Canterbury	0.42	9%	0.93	19%	4.79	100%	31%
Dartford	0.25	4%	0.89	15%	5.95	100%	38%
Dover	0.26	8%	0.61	19%	3.89	100%	35%
Gravesham	0.24	11%	0.48	21%	2.23	100%	24%
Maidstone	0.48	9%	1.07	19%	5.55	100%	32%
Medway	0.64	7%	1.59	18%	8.89	100%	37%
Sevenoaks	0.34	9%	0.72	20%	3.59	100%	24%
Shepway	0.25	6%	0.66	17%	3.85	100%	43%
Swale	0.38	9%	0.84	19%	4.32	100%	31%
Thanet	0.36	8%	0.85	19%	4.62	100%	34%
Tonbridge and Malling	0.37	9%	0.80	20%	4.03	100%	30%
Tunbridge Wells	0.34	9%	0.73	20%	3.67	100%	29%

4.4.3.1 Scenario costs

A high level cost of delivering the scenarios for each LPA is provided within the Local Authority Digests (Appendix E), including a breakdown of costs by developer and other stakeholders. Full details of how the costs have been derived are set out in Appendix A. A summary of total costs for the study area is provided in Table 4-6.

Table 4-6: Water neutrality scenario costs per LPA (developer costs and third party costs)

	Water neutrality scenarios (costs in £)		
Local Planning Authority	**Very High**	**Mandatory requirements plus retrofit**	**Optional requirements plus retrofit**
Ashford	58,425,000	539,000	685,000
Canterbury	62,644,000	677,000	803,000
Dartford	82,960,000	455,000	609,000
Dover	48,204,000	538,000	633,000
Gravesham	29,002,000	451,000	508,000
Maidstone	72,171,000	721,000	867,000
Medway	115,923,000	1,196,000	1,425,000
Sevenoaks	49,613,000	524,000	617,000
Shepway	56,790,000	531,000	645,000
Swale	57,299,000	625,000	740,000
Thanet	65,141,000	664,000	792,000
Tonbridge and Malling	51,837,000	546,000	651,000
Tunbridge Wells	48,725,000	521,000	620,000
Kent and Medway totals	**798,734,000**	**7,988,000**	**9,595,000**

4.4.3.2 Using a neutrality approach to meet water resource planning shortfalls

The potential for the two water neutrality scenarios to meet the potential WRMP shortfall in demand for affected LPAs has been considered and the results set out in Table 4-7. For each LPA where there has been assessed to be a potential shortfall in supply based on the 2015 WRMPs, the percentage of this shortfall which could be met by the implementing either the mandatory requirements or the optional requirements scenario has been calculated.

Table 4-7: Analysis of water neutrality scenarios in meeting the demand shortfall

LPA	**Total LPA demand shortfall (Ml/d)**	**Mandatory requirements plus 5% retrofit**		**Optional requirements plus 5% retrofit**	
		Saving (Ml/d)	**% of shortfall met**	**Saving (Ml/d)**	**% of shortfall met)**
Tunbridge Wells	2.17	0.34	16%	0.73	34%
Sevenoaks	2.01	0.34	17%	0.72	36%
Tonbridge & Malling	2.99	0.37	12%	0.80	27%
Maidstone	2.37	0.48	20%	1.07	45%
Medway	0.53	0.64	100%+	1.59	100%+
Ashford	0.32	0.36	100%+	0.85	100%+
Thanet	1.29	0.36	28%	0.85	66%
Canterbury	1.10	0.42	38%	0.93	85%

LPA	Total LPA demand shortfall (Ml/d)	Mandatory requirements plus 5% retrofit		Optional requirements plus 5% retrofit	
		Saving (Ml/d)	% of shortfall met	Saving (Ml/d)	% of shortfall met)
Dover	3.79	0.26	7%	0.61	17%
Shepway	2.81	0.25	9%	0.66	23%

The results show that adopting the optional approach could remove any potential shortfall for Medway and Ashford, and make a significant improvement on the shortfall for Canterbury and Thanet. The following section sets out how the elements of the each scenario could be delivered along with identification of a responsible authority.

4.4.4 Potential delivery pathway

In order to set out a feasible route for how the proposed scenarios could be delivered, this study has considered delivery requirements for the 'optional requirement plus retrofit scenario'. This has been undertaken to allow each LPA to consider the potential costs and benefits of developing a water use policy to require developers to build new homes to meet the Building Regulation Part G Optional water standards, and to consider working with water companies to develop further options for retrofitting existing properties with efficiency fixtures and fittings.

Table 4-8 summarises the delivery requirement and includes a high level assessment of the likely ease with which each element could be perused and delivered, along with recommendations on the likely responsible organisation that could take each option forward.

Table 4-8: Water efficiency and retrofit measures and recommended responsible organisations

Delivery requirements	Ease of adoption and delivery	Responsible stakeholder
Ensure planning applications for Major Development are compliant with the recommended policies on water use requirements	High Some officer training may be required, but policing of policy compliance would be a reasonably straightforward procedure. Examples for water efficiency policy guidance are available[50]	LPAs (planning team)
Fitting water efficient devices in accordance with policy	High A significant library of information base is available on available water efficiency measures to meet a range of standards including online water calculators.	Developers and LPA (Building Control)
Provide guidance on the installation of water efficient devices through the planning application process	High Pre-application advice could be provided specific to water efficiency options and specific information made available on each LPA's website or on KCC's website	KCC and LPAs
Ensure continuing increases in the level of water meter penetration where the maximum possible is not already achieved	High This initiative should reflect commitments in current and future WRMPs	TWUL, SESW, Southern Water
• Retrofit devices within council owned housing stock; and, • Retrofit devices within privately owned housing stock	Low to Medium A significant funding pool and staff resource requirement would need to be identified to deliver feasibility studies and retrofit implementation. Water companies are embarking on retrofit as part of their response to meeting OFWAT's mandatory water efficiency targets. These programmes are funded out of operational expenditure. If a company has, or is forecasting, a supply-demand deficit over the planning period, water efficiency programmes can form part of a preferred option(s) set to overcome the deficit. These options are identified as part of the companies'	Water companies in partnership with LPAs – Water companies would need to fund this, but LPAs and KCC could consider providng a programme lead to identify suitable properties and manage the programme delivery

[50] https://www.eastcambs.gov.uk/sites/default/files/FD.EVR23%20-%20Final.pdf

Delivery requirements	Ease of adoption and delivery	Responsible stakeholder
	WRMPs and will have to undergo a cost-benefit analysis but further analysis subsequent to this study could inform a greater investment in retrofitting measures as a means to offset demand from new property, particularly where funding could be supplemented through developer contributions (although this is considered unlikely)	
Promote water audits and set targets for the number of businesses that have water audits carried out.	Medium Allocate a specific individual or team within each of the local authorities to be responsible for promoting and undertaking water audits (a relatively low cost option) and ensuring the targets are met. The same team or individual could also act as a community liaison for households (council and privately owned) and businesses where water efficient devices are to be retrofitted, to ensure the occupants of the affected properties understand the need and mechanisms for water efficiency.	KCC and LPAs
Educate and raise awareness of water efficiency[51]	High All stakeholders could use existing tools such as website information, pre-development application responses and public events to increase awareness and education regards the importance of water efficiency in Kent	All stakeholders

4.4.4.1 Non-domestic retail competition

The Water Act 2014 provides the legislative framework for non-household water retail competition to be introduced in England in April 2017. LPAs will have the opportunity to tender for a new retail service provider across their estates and this offers significant opportunity to seek added value from their supplier for additional services such as water audits, improved water use monitoring, and programmes of retrofit of water efficient fixtures and fittings across the estates. This could provide a cost efficient means by which council owned property could reduce overall water consumption as part of broader drive to minimise demand down from existing property stock.

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

5. Wastewater treatment assessment

Unlike water resource planning, strategic planning for wastewater does not currently have a statutory driver which requires a formal plan making process. Water and sewerage companies do undertake strategic wastewater planning at different spatial levels and to varying levels of detail for operational as well as investment planning purposes. Some produce drainage plans and others use guidance from 2013 by the Environment Agency and Ofwat for the production of strategic drainage strategies; however, there is no singular consistent approach to the management of wastewater, and in particular wastewater treatment, discharge and the planning of environmental capacity within the water environment. For this reason, the Kent WfSG study required a bespoke approach to the assessment of capacity in wastewater treatment and environmental capacity in the receiving water environment.

The assessment of the impact of growth on wastewater treatment and the water environment has considered the capacity of the WwTW serving each of the LPAs, primarily in relation whether there is environmental capacity within the receiving water bodies. The assessment has focused on whether the WwTWs can service (or be improved to service) the proposed growth within the environmental limitations dictated by the WFD, the Birds Directive and the Habitats Directive within the receiving environment. This approach has been taken to reflect that, in the majority of cases, wastewater treatment infrastructure can be upgraded to ensure that wastewater from proposed growth can be physically treated, but environmental capacity (or lack of) has the potential to limit the type and volume of discharge that can realistically be achieved without requiring treatment processes that are disproportionately expensive and potentially unsustainable in the long-term.

This assessment has determined where infrastructure investment may be required in order to sufficiently protect the environment and how much this investment may cost. For one WFD Management Catchment, it has also considered other options available to treat wastewater to higher standards within existing facilities.

5.1 Assessment methodology

5.1.1 Methodology overview

The wastewater assessment has been undertaken using the following steps which are explained in further detail in the following sub-sections:

- Determine which WwTWs would receive wastewater from the proposed growth and at what point over the plan period.
- Determine the available capacity within each WwTW to accept and treat this additional wastewater flow.
- Where capacity would likely need to be increased, use modelling techniques to determine the water quality impact (environmental capacity) on the receiving water body; as well as WFD assessment, this includes identification of downstream designated sites under the Birds and Habitats Directive.
- Where there is an unacceptable environmental impact, determine the treatment upgrades that would be required to accommodate the additional flow and assess whether these are achievable within the limits of conventional treatment.
- Where treatment upgrades are required which are not technically feasible, consider alternative solutions which could be delivered as opposed to relying on non-conventional (and potentially less sustainable) treatment processes.
- Provide high level cost estimates of providing additional, sustainable treatment infrastructure where this is required.

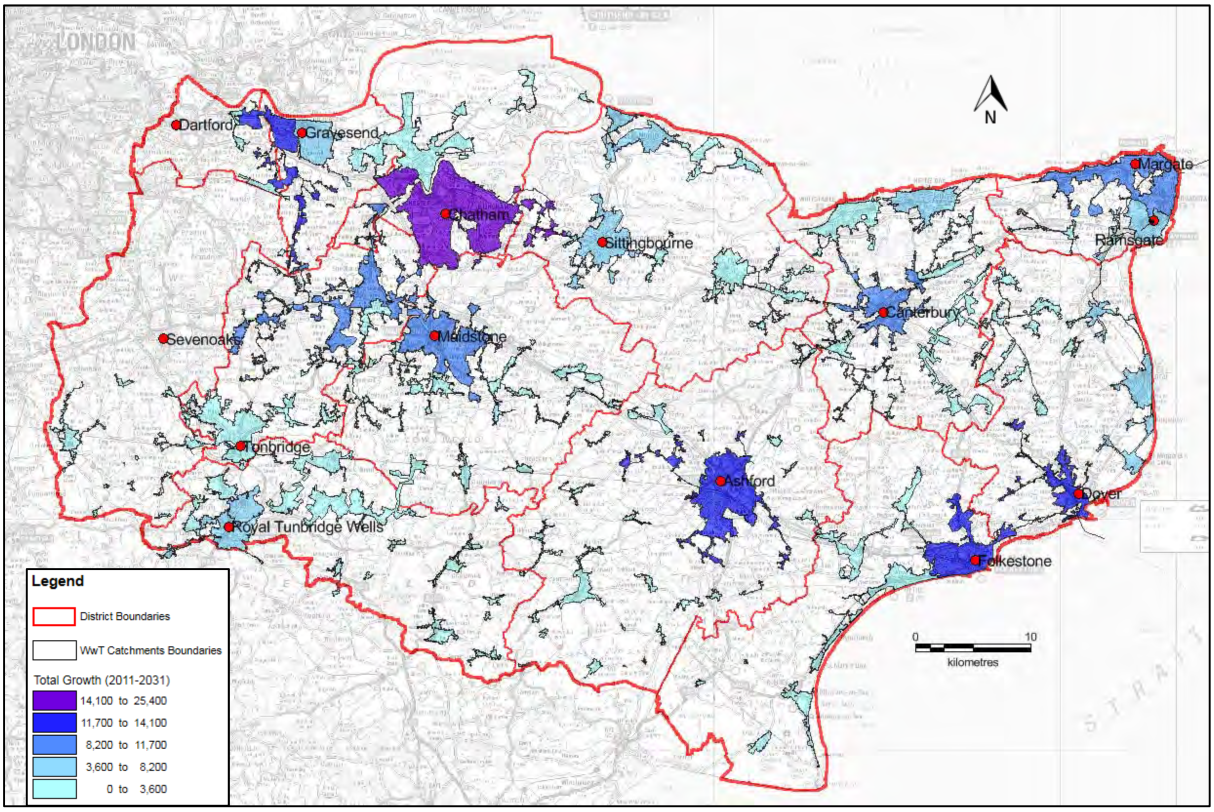
5.1.2 Assigning growth to WwTW catchments

As discussed in Section 2.2, the housing growth targets assessed in the study had a variable degree of spatial certainty. Therefore, only a proportion of the growth target could be easily assigned to the WwTW most likely to receive and treat the wastewater flow, and assumptions had to be made for the remaining growth target which had no spatial information (unallocated).

Firstly, the spatially certain growth with known sites was assigned to the nearest WwTW by using the catchment boundaries compared to the site locations. The percentage of each LPA's spatially certain growth going to each WwTW was then used to assign the remaining non-spatially certain growth to a WwTW using the same ratio.

This method allowed an LPA's entire growth total to be assigned to a WwTW catchment even where a significant proportion of this growth is unallocated. This outcome is demonstrated spatially in Figure 5-1 for each WwTW catchment.

Figure 5-1: Housing growth totals (to 2031) assigned to WwTW catchments



5.1.3 Treatment headroom assessment

The next step was to determine the available headroom at each WwTW.

All WwTWs 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 water body. They also dictate how much wastewater each WwTW can accept, as well as the type of treatment processes and technology required at the WwTWs to achieve the quality permit limits. The amount of wastewater that a WwTW can discharge is termed its "permitted discharge volume".

A key assumption of the methodology is that, where a WwTW has capacity to receive future wastewater flows without exceeding its permitted discharge volumes, no environmental assessment is required. It is acknowledged that this is a simplified assumption as some impact may occur from utilising this available headroom, but for the purposes of this strategic level study, it was agreed with the steering group that this assumption would be suitable.

5.1.3.1 Determining treatment headroom

The flow element of the discharge permit determines an approximation of the maximum number of properties that can be connected to a WwTW catchment. When discharge permits are issued, they are generally set with flow 'headroom', which acknowledges that allowance needs to be made for future development and the additional wastewater generated. This allowance is referred to as 'permitted headroom'. The quality conditions applied to the discharge permit are derived to ensure that the water quality of the receiving water body is not adversely affected, up to the maximum permitted flow of the discharge permit.

For the purposes of this study, the assumption is applied that the permitted headroom is usable[52] and would not affect downstream water quality. This headroom therefore determines how many additional properties can be connected to the WwTW catchment before Southern Water or Thames Water 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).

5.1.3.2 Calculating headroom

A spreadsheet was developed for all WwTWs within the study area. Estimates of the current measured flow were provided by Thames Water and Southern Water for each WwTW and this was compared to the flow condition on each of the WwTW's permits to discharge. This defined available treatment headroom at each WwTW.

To calculate if the headroom for each WwTW was sufficient to service all the proposed growth in its catchment, housing numbers were converted to an estimate of phased wastewater flow increases to 2031 by making assumptions on future water use (and hence wastewater generation) per person, as well as assumptions on the average number of people living in each new house proposed as listed below:

- As a simplification, it was assumed that all new properties would be designed and fitted with water fixtures and fittings to meet the Building Regulations requirements on water use of 125 litres per person per day (l/p/d)[53]; and
- an assumption of 2.35 people per household was used based on KCC's published housing led forecast (June 2016)[54].

Using these assumptions, the volume of wastewater, measured as Dry Weather Flow (DWF)[55], which would be generated from the proposed housing and employment growth over the plan period within each WwTW catchment was therefore generated.

5.1.4 Environmental impact and capacity

When treatment headroom is exceeded by growth and 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 WwTW would result in an increase in the pollutant load[56] of some substances being discharged to the receiving water body. 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 WwTW, which may also require improvements or upgrades to be made to the WwTW to allow the new conditions to be met. In some cases, it may be the case that the quality conditions required to protect water quality and ecology are not achievable with conventional treatment processes and as a result, this study assumes that a new solution would be required in this situation to allow growth to proceed.

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

5.1.4.1 WFD Compliance

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

- Development must not cause a deterioration in WFD status of a water body[57]; and
- Development must not prevent a water body from achieving its future target status (usually at least Good status).

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[52] In some cases, there is a hydraulic restriction on flow within a WwTW which would limit full use of the maximum permitted headroom.
[53] http://planningguidance.communities.gov.uk/blog/guidance/housing-optional-technical-standards/water-efficiency-standards/
[54] http://www.kent.gov.uk/__data/assets/pdf_file/0010/59806/KCC-Housing-Led-forecas-June-2016-Summary.pdf
[55] DWF is a measure of the flow of foul water only to a WwTW (excludes additional flow as a result of excessive rainfall or groundwater infiltration entering the sewer network).
[56] 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.
[57] 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

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 water body'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 water body is already less than Good.

Where permitted headroom at a WwTW would be exceeded by proposed growth, a water quality modelling assessment (or equivalent calculation) 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.

5.1.4.2 Water quality assessment overview

For discharges to freshwater water bodies, statistical based water quality modelling[58] has been performed to check for compliance with the key WFD objectives in terms of permit conditions for ammonia and phosphate. Load standstill calculations[59] have been used to determine the future permit conditions for BOD. For estuarine water bodies load standstill calculations have been used to determine future permit conditions for BOD and ammonia (where existing permit condition is present).

The calculated permit conditions required to meet the WFD objectives has then been compared to what is achievable within the currently accepted Limits of Conventional Treatment (LCT)[60]. If the calculated permit conditions required are within LCT, then the study concludes that a treatment upgrade or new solution is technically feasible and a sustainable solution to meeting WFD objectives is achievable. Where the required permit conditions are less than what can be achieved within LCT, then a technical solution is deemed not possible at the WwTW at the present time and an alternative solution is required. The exception relates to where modelling demonstrates that a WwTWs is already likely to be treating to beyond LCT. In these cases, the level of growth is compared to current discharge volumes to determine whether the high level of treatment could continue once growth is included.

It is important to note at this point that technologies considered to be LCT have (and will continue to) change over time and the resultant standards of treatment have improved and will continue to improve as advancements in technology are made. Where the study concludes that LCT would currently prevent a water body quality standard being met, future technologies may change this analysis and this is especially relevant where new quality conditions are only likely to be required later in the plan period once available permitted headroom is utilised as the full growth target is realised. In particular, national trials have been undertaken by several water companies with the co-operation of the Environment Agency on alternative phosphate treatment and the outcomes are due to report in 2017; it is expected that the trial outcomes will demonstrate technologies which can reliably, and cost-effectively treat phosphate below 0.5 mg/l (current LCT) to at least 0.3mg/l. As reflected in the number of waterbodies considered unable to meet future Good Status, this has implications for where the study concludes that it is LCT which prevents future WFD status targets being achieved (i.e. improvement to good status) and not the impact of growth. As treatment technology improves, the potential for reaching good status also improves, and hence the effect of growth needs to be continually assessed to ensure it will not subsequently be the limiting factor.

However, the study can only determine what is achievable at the point in time at which the study was completed, and therefore re-assessment against what is considered LCT at that future point would be required when new permits are applied for and LCT levels are accepted as changed.

5.1.4.3 Habitats Directive and Birds Directive

The Habitats Directive, Birds Directive and the associated UK Regulations have led to the designation of some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been on-going since the translation of the Habitats and Birds Directive into the UK Regulations called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the abstraction licences and discharge permit it has previously issued on sites which became protected (and hence designated) under the Regulations.

If the RoC process identifies that an existing licence or permit cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the licence or permit. As a

[58] The Environment Agency's River Quality Planning (RQP) tool has been used for statistical water quality modelling purposes
[59] Load Standstill calculations determine the concentration required o discharge volumes to ensure load does not increase even where the flow volumes into the waterbody increase.
[60] The water industry and the Environment Agency currently consider LCT to be the following for the parameters assessed in this study: 0.5mg/l (mean) for Phosphate; 1mg/l (90 percentile) for Ammonia; and 5mg/l (90 percentile) for BOD.

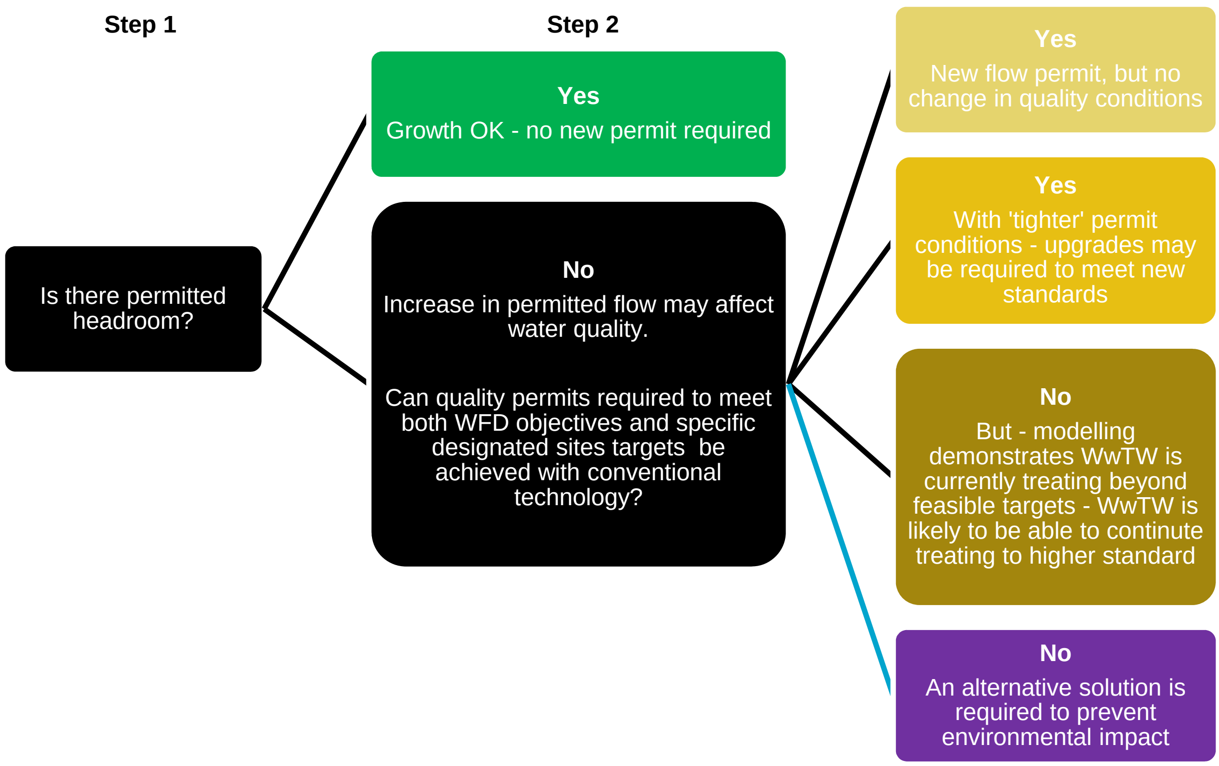
result of this process, restrictions on some discharge permits have been introduced to ensure that any identified impact on downstream sites is mitigated. Although the Regulations do not directly stipulate conditions on discharge, the Regulations can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions) from water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

Where permitted headroom at a WwTW would be exceeded by proposed levels of growth, high level regulations assessment exercise has been undertaken in this study to identify whether protected sites which are hydrologically linked with wastewater flows from growth would be adversely affected.

5.1.5 Presenting results

Figure 5-2 graphically demonstrates the process described in sections 5.1.2 to 5.1.4. A colour coding has been developed and used to present results spatially across Kent, giving an indication of the scale and magnitude of the impact assessment.

Figure 5-2: Assessment process diagram for wastewater treatment capacity



5.2 Assessment results – permitted headroom

In total, 65 WwTWs were identified as likely to receive future wastewater flows from the assumed spatial distribution of growth. 64 of these WwTWs are operated by Southern Water, with one (Long Reach WwTW) operated by Thames Water.

Ten of these WwTWs did not have any flow condition within the permit, either because they operate a descriptive only consent[61], or discharge via long sea outfalls and do not have a flow condition on the permit[62]. These WwTWs have not been assessed as it was agreed with Southern Water that these WwTW would need to be considered using a different methodology beyond the scope of this study. The long sea outfall WwTWs are unlikely to present a significant barrier to growth as capacity for both flow and treatment is greater at these facilities, although future assessment of process technologies required to maintain Bathing Water standards, Shellfish Water Standards as well as WFD standards will be required as growth comes forward. For smaller

[61] A descriptive consent does not have numerical limits on discharge volumes or quality and hence no numerical analysis is possible.
[62] In addition, Gravesend WwTW did not have any water quality permit data – further discussion on headroom and capacity at this WwTW is provided in the Local Authority Digest for Gravesham (Appendix E)

WwTW with descriptive consents, Southern Water would need to consider whether transfer of flow to larger WwTW is more feasible than investment is smaller WwTW where the cost benefit ratio can be limiting.

The results of the headroom assessment for the 55 WwTW with flow permits and receiving some level of growth is summarised in the following sections.

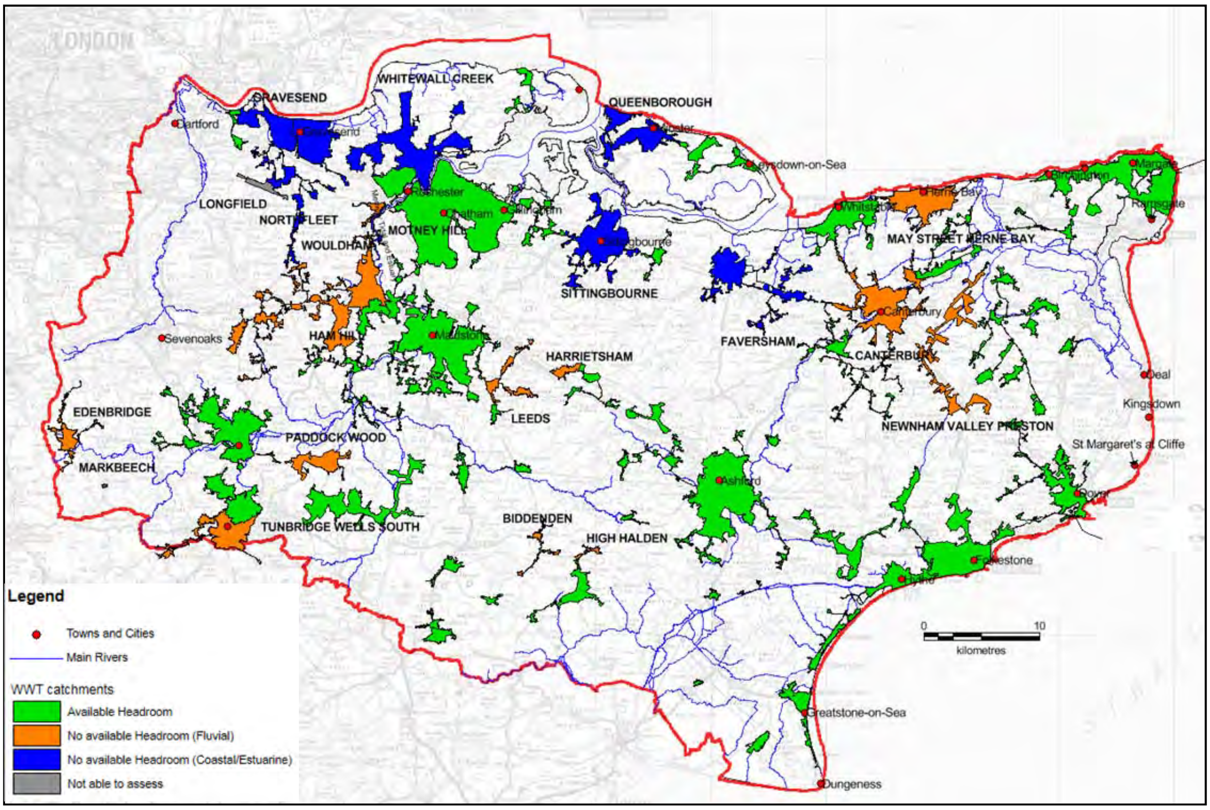
5.2.1 WwTW with permitted headroom

The headroom analysis identified that the majority (73%) of the 55 WwTWs assessed have sufficient flow headroom within the existing permit to accept the additional wastewater flow from forecast housing growth. In total, 15 WwTWs would likely exceed their current flow permit and require revision of the permit conditions in relation to protection of water quality.

Figure 5-3 demonstrates the location of WwTWs with flow headroom capacity (shown in green) and those without headroom capacity (blue where discharge is tidal or coastal and orange where the discharge is to a fluvial watercourse). Table 5-1 provides further detail of the WwTW where existing permitted headroom is sufficient to accommodate all of the proposed growth and also provides an approximation of the number of additional dwellings that could be connected before the flow condition of the discharge permit would be exceeded.

For the WwTW identified as having sufficient flow headroom, the study has assumed that no wastewater treatment infrastructure upgrades are required to deliver the proposed growth in these locations and meet WFD requirements and therefore no further assessment has been undertaken for these WwTWs as part of this study.

Figure 5-3: WwTW permitted flow headroom capacity assessment results



An estimate of 16,828 homes has been assigned to Thames Water's Long Reach WwTW catchment from Dartford Borough and parts of Sevenoaks. Long Reach WwTW has a large catchment serving the London Boroughs of Bromley, Bexley and parts of Croydon in addition to Dartford and Sevenoaks LPA areas in Kent (see Figure 5-4).

The analysis of available headroom at Long Reach WwTW identifies clear headroom capacity to serve the proposed growth within the study area; however, capacity at this WwTW needs to be considered for its catchment as a whole including significant growth proposed within the three London Boroughs. Thames Water has recently completed significant upgrade works to Long Reach WwTW to both increase treatment flow capacity for anticipated population changes and to improve quality of discharge to the Thames Tideway (as part of the Thames Tideway Water Quality Improvements programme). Therefore, Thames Water has advised that the proposed growth within Kent is likely to be accommodated at Long Reach WwTW within the plan period without the need for a revised discharge permit.

Figure 5-4: London WwTW catchments including Long Reach WwTW

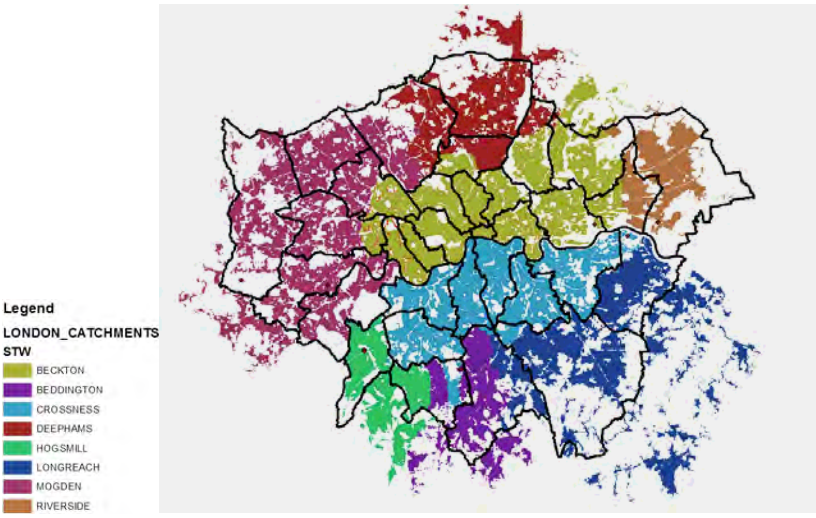


Table 5-1: WwTW with permitted flow headroom capacity[63]

WwTW	Local Authority	Headroom Assessment pre-growth (2016)	Quantity of additional dwellings to 2031	Headroom Assessment post-Growth (2031)		WwTW Remaining Capacity as a percentage of permitted flow after growth to 2031[64]
		Headroom Capacity (m^3/day)		Headroom Capacity (m^3/day)	Approx. Residual Housing Capacity	
Ashford	Ashford	4,583	13,314	672	2,300	3%
Aylesford	Maidstone & Tonbridge and Malling	5,838	11,675	2409	8,200	10%
Benenden	Tunbridge Wells	95	101	65	200	26%
Bethersden	Ashford	83	86	58	200	24%
Bidborough	Tunbridge Wells	410	269	331	1100	15%
Bilsington	Ashford	28	37	17	<100	25%
Brookland	Shepway	74	14	70	200	61%
Broomfield Bank	Dover and Shepway	8,351	11,799	4885	17,000	11%
Charing	Ashford	46	99	16	<100	3%
Chartham	Canterbury	250	96	222	800	13%
Coxheath	Maidstone	538	1,747	25	<100	1%
Cranbrook	Tunbridge Wells	338	1,013	41	100	3%
Dambridge Wingham	Dover	1,506	1,625	1029	3,500	29%
Ditton	Tonbridge and Malling	947	192	890	3,000	43%
Dymchurch	Shepway	543	91	516	1,800	31%
Eastchurch	Swale	1,751	312	1659	5,700	37%
Eastry	Dover	298	191	242	800	49%
Hamstreet	Ashford	125	99	96	326	26%

[63] Long Reach WwTW is not included in this table (see section 5.2.1)
[64] 10% capacity or less is likely to need further assessment for water quality if spatial growth patterns vary to those assessed within this study

WwTW	Local Authority	Headroom Assessment pre-growth (2016)	Quantity of additional dwellings to 2031	Headroom Assessment post-Growth (2031)		WwTW Remaining Capacity as a percentage of permitted flow after growth to 2031[64]
		Headroom Capacity (m^3/day)		Headroom Capacity (m^3/day)	Approx. Residual Housing Capacity	
Hawkhurst North	Tunbridge Wells	112	134	72	200	12%
Hawkhurst South	Tunbridge Wells	62	208	1	<100	0%
Headcorn	Maidstone	513	829	270	900	24%
Horsmonden	Maidstone	1,188	812	949	3,200	44%
Hythe	Shepway	1,020	1641	538	1,800	53%
Lenham	Maidstone	202	438	73	200	11%
Minster Lot	Thanet	75	62	57	200	6%
Motney Hill	Medway and Swale	9,493	25,312	2058	700	5%
New Romney	Shepway	1,495	638	1308	4,500	48%
Sellindge	Shepway	718	317	625	2,100	39%
Staplehurst	Maidstone	432	1,075	116	400	9%
Sutton Valence	Maidstone	203	58	186	600	48%
Swalecliffe	Canterbury	895	1,237	532	1,800	7%
Tenterden	Ashford	910	648	719	2,400	31%
Teynham	Swale	323	698	118	400	14%
Tonbridge	Sevenoaks and Tonbridge & Malling	3,444	3,032	2553	8,700	22%
Tunbridge Wells North	Tunbridge Wells	2,399	3,627	1333	4,500	15%
Wateringbury	Maidstone	243	590	70	237	3%
Weatherlees Hill A	Dover and Thanet	8,948	7,672	6695	22,800	31%
Westbere	Canterbury	657	1,003	363	1,200	21%
Wye	Ashford	342	99	313	1,000	43%

5.2.2 WwTW without permitted headroom

The calculations of flow headroom capacity demonstrate that eleven WwTWs discharging to fluvial watercourses and four WwTWs discharging to coastal/estuarine water bodies are unlikely to have sufficient headroom once all the growth within the WwTW catchment is accounted for; these are detailed in Table 5-3 and Table 5-4. In undertaking this assessment and using the findings, it should be noted that DWF calculations for existinf WwTW flows are based on measurement of flow arriving at the treatment works, this will be influenced by rainfall events, it is therefore possible that reported DWF values used to determine headroom will vary from one year to the next and in years of high rainfall may underestimate how much headroom is actually available.

These WwTWs are likely to exceed their maximum permitted DWF under their existing discharge permits. Additional headroom can be made available through an application by the relevant water company for a new or revised discharge permit from the Environment Agency. However, to ensure that the increase in permitted DWF required would not impact on downstream WFD objectives, a water quality assessment using modelling or equivalent calculations[58] has been undertaken for these WwTWs to determine whether theoretically achievable quality conditions can be applied to a revised discharge permit. This process is reported separately for each WwTW in 5.3 (Appendix B provides the detail of the modelling and calculation results for each WwTW) and a study wide summary is provided in Section 5.3. Additionally, an ecological appraisal of potential designated sites is presented in Section 5.4.

5.2.3 Otterpool Garden Community

As described in Section 2.2.1, Shepway District Council are currently in consultation on the proposed Otterpool Garden Community (OGC) which will deliver up to 12,000 new homes and associated services including schools and community facilities. The Council recommended that an additional 6,000 homes by 2037 is likely to meet housing needs of the region. As this study considers growth until 2031, assuming a linear housing completion rate, 4090 homes can be expected to be completed by 2031 and this growth has been considered for wastewater treatment implications,

In consultation with Southern Water, due to the extensive growth associated with the proposed OGC, it is unlikely that all flows could be treated by the (Sellindge WwTW) without compromising the water quality of the receiving water body (East Kent Stour). A more likely scenario would be for flows to be piped (to be funded by the development) to the Hythe WwTW where expansion would be more cost effective and less likely to disrupt the ecology of the East Kent Stour.

Without growth at Otterpool, Hythe WwTW would not exceed its flow capacity. Therefore, a calculation of flow headroom for the Hythe catchment including growth allocated in the existing study and growth from the OGC has been performed to assess the impact of the expansion on the WwTW. For Hythe WwTW, no current DWF information was available; hence the consented maximum flow discharge of 1020 m^3/d was used in the calculation (see Table 5-2).

Table 5-2: Hythe WwTW without permitted flow headroom capacity for the Otterpool Park Garden Community

WwTW	Local Authority	Quantity of Dwellings to 2031	Future 2031 DWF after Growth (m^3/d)	Headroom Assessment (2031) including OPGV		WwTW Capacity After Growth (%)
				Headroom Capacity (m^3/day)	Approx. Residual Housing Capacity	
Hythe	Shepway	5731	2,703	-1,683	-5,731	-165%

The result of the Hythe WwTW headroom assessment demonstrated that growth associated with OGC would cause the WwTW to exceed its current headroom capacity.

Hythe WwTW discharges to the final part of the Reading, Cradlebridge and Royal Military Canal which is proximal to the ‘Romney Marsh between Appledore and West Hythe’ water body. The ‘Romney Marsh between Appledore and West Hythe’ water body currently has an overall water body status of ‘Moderate’, with the alternative objective to maintain ‘Moderate’ status by 2021. Its current overall status is limited to ‘Moderate’ due to the status of DO (poor), phosphate (poor) and surface water mitigation measures (Moderate or less). The current status for ammonia is ‘High’. However, the main flows from Hythe WwTW discharge directly into the channelised sections of the lower Reading, Cradlebridge and Royal Military Canal and are separated from the marsh elements of ‘Romney Marsh between Appledore and West Hythe’ water body, and so Hythe WwTW can be considered as a coastal discharge.

There are no permits set by the Environment Agency for ammonia, BOD or phosphate for the current discharge. Conventional nitrate or DO permits often attributed to coastal water bodies have also not been set, likely due to direct discharge to the English Channel, rather than a transitional or estuarine water body. However, phasing assessment has demonstrated that the upgrades would likely be needed early in AMP 7 owing to the scale of proposed development, and Southern Water would need to plan for these works in their current draft business plan. Expansion of Hythe WwTW to cope with the OGC would require the Environment Agency to reassess the need for new flow and quality consent permits to be set, following detailed coastal modelling.

Table 5-3: WwTW without permitted flow headroom capacity for fluvial water bodies

WwTW	Local Authority	Headroom Assessment pre-Growth (2016)	Quantity of Dwellings 2031	Future 2031 DWF after Growth (m^3/d)	Headroom Assessment post-Growth (2031)	WwTW Capacity After Growth to 2031 (%)
		Headroom Capacity (m^3/day)			Headroom Capacity (m^3/day)	
Biddenden	Ashford	Limited	111	688	-83	-14%
Canterbury	Canterbury	Limited	9,172	23434	-3,258	-16%
Edenbridge	Sevenoaks	446	1,580	2258	-18	-1%
Ham Hill	Tonbridge and Malling	647	8,235	13972	-1,772	-15%
Harrietsham	Maidstone	167	652	440	-24	-6%
High Halden	Ashford	31	123	231	-5	-2%
Leeds	Maidstone	Limited	1,273	1393	-373	-37%
May Street Herne Bay (Stour Outflow)	Canterbury	818	4,376	6371	-468	-8%
Newnham Valley Preston	Canterbury	Limited	117	3492	-1,121	-47%
Paddock Wood	Tunbridge Wells	171	1,790	2574	-355	-16%
Tunbridge Wells South	Tunbridge Wells	750	4,281	9,358	-508	-6%

Table 5-4: WwTW without permitted flow headroom capacity for estuarine/coastal water bodies

WwTW	Local Authority	Headroom Assessment pre-Growth (2016)	Quantity of Dwellings to 2031	Future 2031 DWF after Growth (m^3/d)	Headroom Assessment post-Growth (2031)	WwTW Capacity After Growth to 2031 (%)
		Headroom Capacity (m^3/day)			Headroom Capacity (m^3/day)	
Faversham	Swale	Limited	1,634	7,620	- 620	-9%
Queenborough	Swale	1,068	4,234	11,401	- 176	-2%
Whitewall Creek	Gravesham and Medway	Limited	2,081	5,625	- 625	-12%
Wouldham	Tonbridge and Malling	187	2,397	853	- 517	-154%

5.3 Assessment results - water quality assessment

5.3.1 Presentation of results

The water quality assessment results are presented within this section. A summary of results across the study area is presented initially, followed by further detail for each WwTW. The WwTW results are summarised in relation to the target quality conditions which need to be met and the infrastructure upgrades required at each WwTW in order meet WFD objectives. Further detail on WwTW headroom capacity and current WFD condition of the receiving water body are provided in Appendix C.

5.3.2 Study wide summary

The water quality analysis undertaken for each WwTW requiring new permits has demonstrated that there are no locations where new treatment solutions beyond LCT are likely to be required to meet WFD objectives. Despite this, the scale of upgrades required to meet WFD targets will require significant investment at several locations within Southern Water's wastewater operational area and these will need to be adequately planned for as certainty on development comes forward.

In particular, there are four locations where WwTW are already treating to levels considered beyond LCT (three for phosphate and one for ammonia) and additional growth will increase pressure on these facilities to continue to treat to a high standard which may have significant investment implications. Further discussion related to this is provided in 5.3.3 (assessment uncertainty).

Study wide maps have been produced to demonstrate spatially where investment is more likely to be required (or phasing of growth may be impacted whilst solutions are implemented) in meeting the consent conditions defined in this study for the three parameters of BOD, ammonia and phosphate. This is set out in Figures 5-5 to 5-7.

The results demonstrate potential investment and phasing concerns focused within the Medway catchment at Paddock Wood, Leeds, Tunbridge Wells and Edenbridge WwTW in relation to achieving Phosphate and to a lesser extent, ammonia. As a result, a high level review of potential catchment approaches to managing phosphate has been provided in this report (see section 5.6) for the Medway catchment.

Further details on the infrastructure upgrades required for each WwTW to meet WFD requirements for future growth are provided in subsection 5.3.3 below as well as detail in Appendix B (modelling results) and Appendix C (detailed WwTW discussion).

In relation to investment, Section 5.5 provides estimates of costs associated with providing the required solutions at the locations shown in Figure 5-5 to 5-7.

Figure 5-5: No deterioration test results BOD

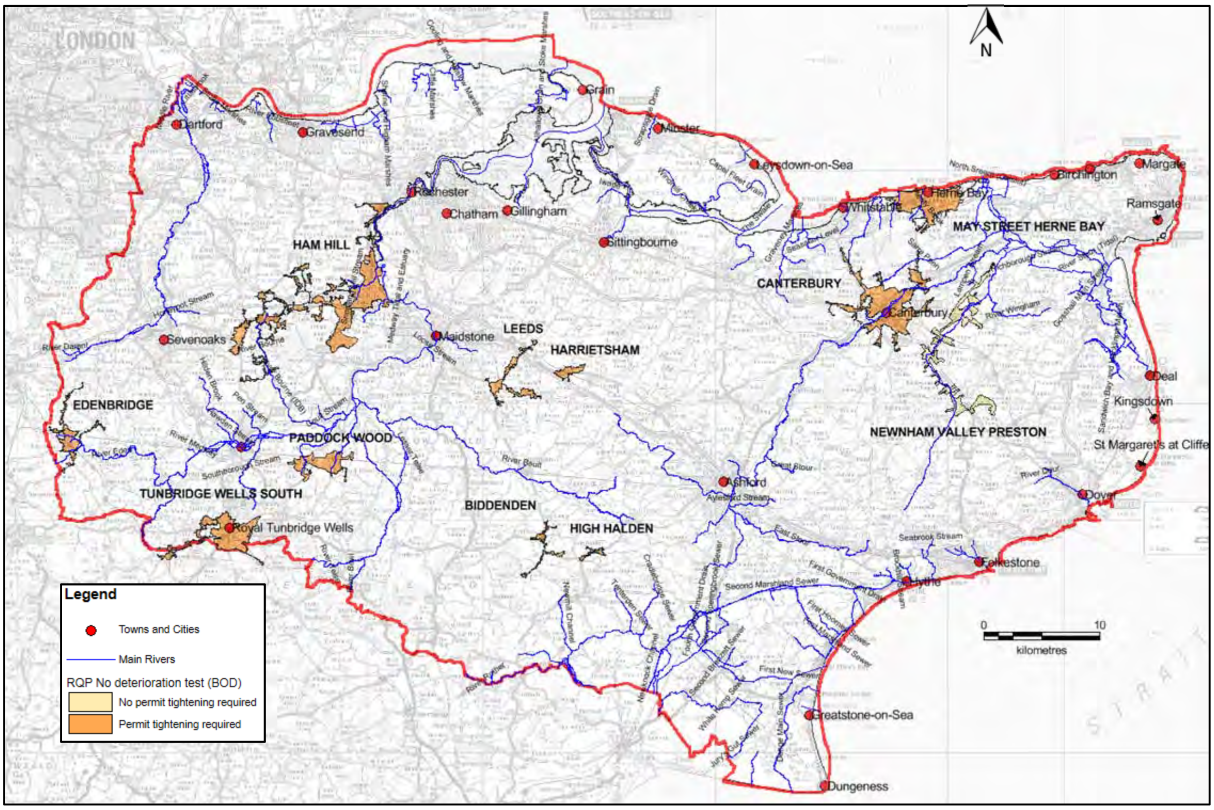


Figure 5-6: No deterioration test results ammonia

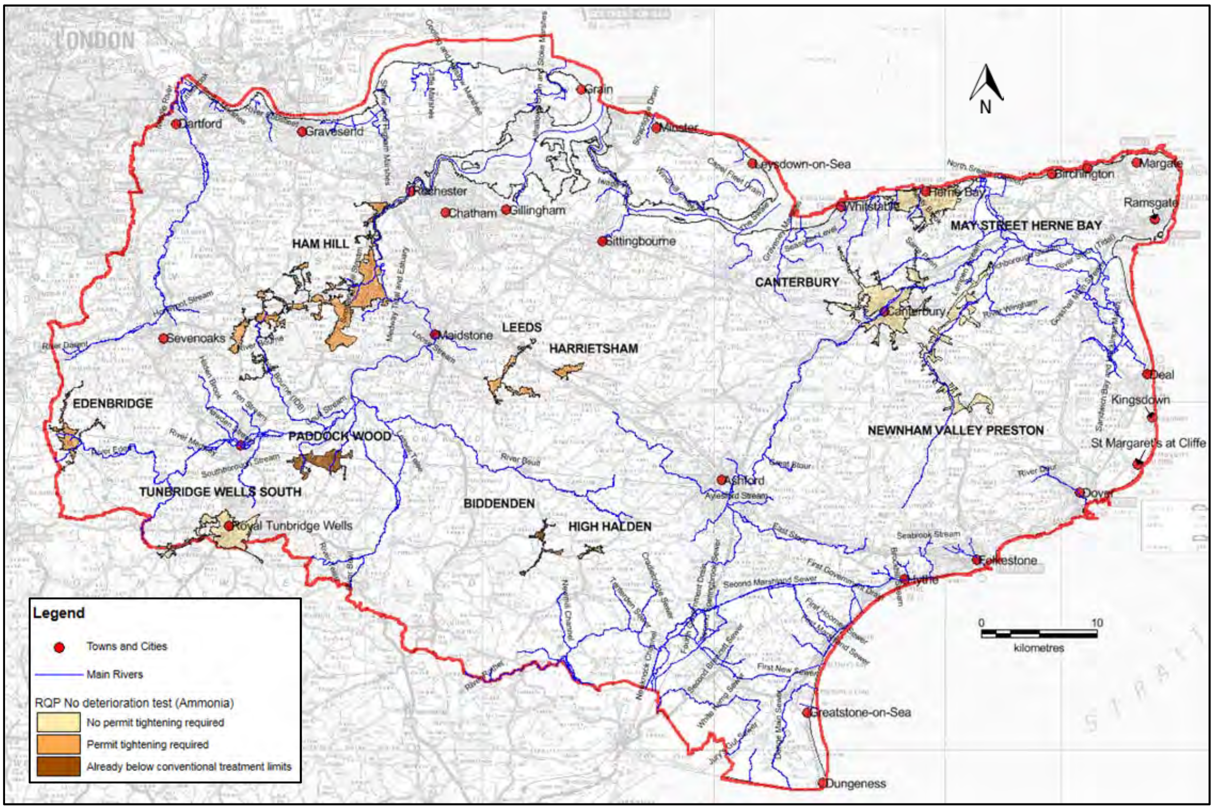
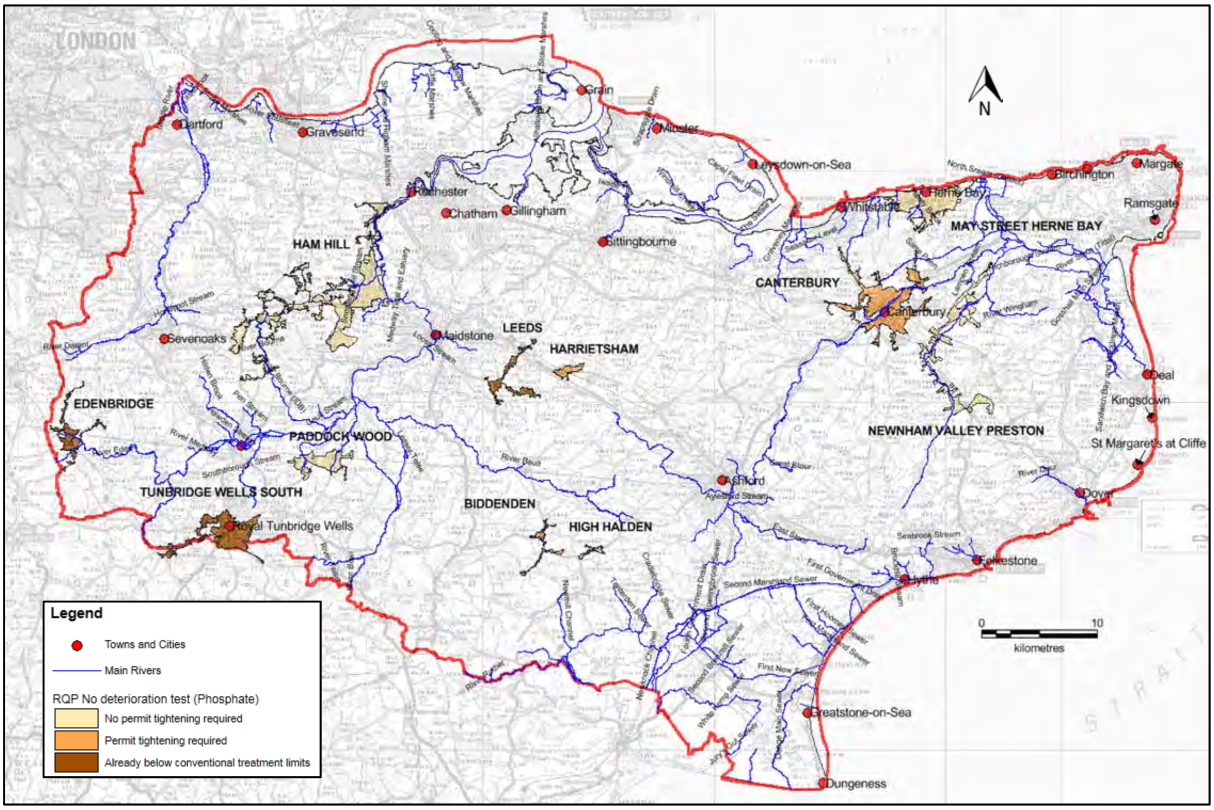


Figure 5-7: No deterioration test results phosphate



5.3.3 Assessment uncertainty

The bespoke approach developed for the wastewater assessment is founded on several key assumptions that result in a degree of risk in relation to the study wide conclusions made. Further commentary is provided on these uncertainties within this section.

5.3.3.1 Spatial uncertainty of growth

The requirement to make broad assumptions on the likely location of target growth which currently does not have site allocations has a significant bearing on the conclusions drawn, particularly because the study has not identified any significant barrier within the limits of current conventional treatment .

The study has assumed that unallocated growth will follow the same spatial pattern as currently complete, committed or allocated site data, and hence growth to some WwTW is likely to have been over or under estimated. Given that the study has not identified any insurmountable wastewater infrastructure or environmental capacity barriers to the levels of growth assessed, over-estimation of growth is not a significant risk. Under-estimation is a bigger risk, where the study assumes there is sufficient headroom where there may not be with a different spatial assumption. The study has therefore presented residual permitted headroom for each WwTW (Table 5-1) with a numerical consent, to allow study partners to make some level of judgement on the initial effect in the event of a different spatial pattern emerging for the currently unallocated targets. Information in Table 5-1 is supplemented by a visual representation of headroom capacity and water quality assessment for each WwTW by LPA area in the Local Authority Digests (Appendix E), allowing an initial assessment of permitted headroom capacity to be made on varying spatial patterns of growth.

It is recommended that where Local Plan making is still in progress, LPAs consider testing different spatial options for delivering unallocated housing targets on wastewater treatment and environmental water quality through additional supporting studies, and that opportunities to work collaboratively with partnering authorities in the same waterbody catchments are sought.

5.3.3.2 Use of available permitted headroom

The high level assumption that available flow headroom is usable without affecting water quality in the receiving water bodies needs to be tested on a case by case basis by the Environment Agency, Thames Water and Southern Water as certainty around spatial growth distribution increases through the Local Plan period.

In some cases, the existing permit may not be adequately protective of the WFD and related standards and as such, further investment may be required to maintain quality targets. In particular, WwTWs where there is significant flow headroom and a large number of new homes are proposed (relative to existing population) within a WwTW catchment may be the most sensitive to use of available headroom. To identify WwTWs that fall within this risk category, an additional calculation has been undertaken to highlight WwTW that could benefit from future wastewater modelling.

Of the WwTWs with sufficient headroom, WwTWs with 10% (or greater) additional flow versus current measured DWF were identified as well as WwTWs with 50% or greater percentage of current DWF capacity versus the current DWF permit. Four WwTWs, as identified in Table 5-5, were found to meet both of these risk parameters. These WwTWs could be considered as a priority for further investigation by Southern Water into the effect of headroom utilisation on current and future WFD status.

Table 5-5: WwTWs which are close to or at risk from exceeding flow headroom with additional growth in excess of planned levels

Local Planning Authority	WwTW	Additional flow from growth/3 year DWF 20%ile	Current DWF capacity/Current DWF consent
Shepway	Brookland	10%	64%
Dover	Eastry	28%	60%
Maidstone	Horsmonden	24%	55%
Shepway	New Romney	15%	54%

5.3.3.3 WwTW at Limits of Conventional Treatment

With regards to WwTW that have been identified within the assessment as being ‘already below conventional treatment limits’; this definition provides for a level of uncertainty. This category means that the WwTW is already potentially treating at a standard that is (in theory) beyond conventional treatment levels.

This category could have been identified due to a number of factors:

- Distance between the discharge point and the monitoring point i.e. where the monitoring point used to determine the current status is so far downstream that significant dilution occurs for pollutants which means the WwTW could be discharging worse quality than the model says it needs to, but the quality is improved by the time it is monitored further downstream;
- The WwTW is “over-performing” i.e. it has been designed to take a much larger flow/pollutant load and can much more efficiently remove pollutants from a smaller flow such that its treated quality is of a better standard than would be expected with current technology. However, in all cases where this happens for the WfSG study, it has been shown that future growth does not make a material difference to what the current discharge quality needs to be.

However, to enable the provision of water quality improvements it is recommended that further assessment is undertaken to determine a more accurate result for WwTW that are identified as being ‘already below conventional treatment limits’. Ideally, this would include a SIMCAT catchment modelling approach which also includes the increased loading effects from WwTWs which remain within their current permit.

5.3.4 WwTW discussion

A discussion on future permits for each WwTW modelled is set out in the following sub-sections. Quality conditions required on the permit to meet water quality targets are provided alongside a commentary of the WwTW infrastructure upgrade requirements in relation to conventional treatment. Within each table of permit quality condition detail, a green colouring indicates the condition can be met without any infrastructure upgrades; amber indicates the condition is achievable within conventional treatment, but new infrastructure is likely to be required, and red indicates a solution whereby current standards which are currently considered beyond conventional treatment must be continued at the WwTW.

5.3.4.1 Biddenden WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 (2020 – 2025) and AMP 8 (2025-2030) asset planning periods, in line with revised quality conditions for ammonia, phosphate and BOD.

At some point in the plan period, the future permit quality conditions detailed in Table 5-6 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient for BOD and phosphate (i.e. the quality conditions are within the limits of conventional treatment). This demonstrates that a technical solution is feasible for BOD and phosphate. However, ammonia is currently being treated to a level below LCT (0.83 mg/l), with the revised permit also below LCT (0.82 mg/l). Southern Water would need to ensure Biddenden WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

Table 5-6: Required permit quality conditions for Biddenden WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	N/A	**8.80**	**N/A**
Ammonia (mg/l 95%ile)	4	**0.82 ***	**N/A**
Phosphate (mg/l annual average)	2	**1.33**	Not achievable for current flows within LCT

***modelling current flows (pre growth) requires a standard of 0.83 mg/l 95 percentile which is also below LCT*

5.3.4.2 Canterbury WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031. The exact technical specification and timing of the upgrades required should be determined by Southern Water for the AMP7 and AMP 8 (asset planning periods, in line with revised quality conditions for ammonia and phosphate and new quality conditions for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-7 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible.

Table 5-7: Required permit quality conditions for Canterbury WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	15	**13.3**	**N/A**
Ammonia (mg/l 95%ile)	4	**Retain - 4**	**N/A**
Phosphate (mg/l annual average)	N/A	**9.08**	Not achievable for current flows within LCT

5.3.4.3 Edenbridge WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP8 asset planning period, in line with revised quality conditions for phosphate and new quality conditions for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-8 will be required to ensure no deterioration in status. To achieve the new phosphate permit quality condition, current conventional treatment technologies would be sufficient for BOD and ammonia (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution for BOD and ammonia is feasible. However, phosphate is currently being treated to a level below LCT (0.30 mg/l), with the revised permit also below LCT (0.26 mg/l). Southern Water need to ensure Edenbridge WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

Table 5-8: Required permit quality conditions for Edenbridge WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	10	7.90	**N/A**
Ammonia (mg/l 95%ile)	5	3.29	**N/A**
Phosphate (mg/l annual average)	N/A	**0.37***	Not achievable for current flows within LCT

*****_modelling current flows (pre growth) requires a standard of 0.22 mg/l annual average which is also below LCT_

5.3.4.4 Ham Hill WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 and AMP 8 asset planning periods, in line with revised quality conditions for phosphate and new quality conditions for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-9 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient for BOD, and ammonia and phosphate (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible for ammonia, BOD and phosphate.

Table 5-9: Required permit quality conditions for Ham Hill WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	25	20.70	**N/A**
Ammonia (mg/l 95%ile)	25	14.78	**N/A**
Phosphate (mg/l annual average)	N/A	33.59	0.73

5.3.4.5 Harrietsham WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 and AMP 8 asset planning periods, in line with revised quality conditions for ammonia and phosphate and new quality conditions for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-10 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within LCT) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible.

Table 5-10: Required permit quality conditions for Harrietsham WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	15	5.70	**N/A**
Ammonia (mg/l 95%ile)	5	3.42	**N/A**
Phosphate (mg/l annual average)	1	0.69	Not achievable for current flows within LCT

5.3.4.6 High Halden WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for ammonia and BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-11 will be required to ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within LCT) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible.

Table 5-11: Required permit quality conditions for High Halden WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	10	8.4	**N/A**
Ammonia (mg/l 95%ile)	4	2.37	**N/A**
Phosphate (mg/l annual average)	1	**Retain - 1**	Not achievable for current flows within LCT

5.3.4.7 Leeds WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required in the near future when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period, in line with revised quality conditions for phosphate, ammonia and new quality condition for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-12 will be required to ensure no deterioration in status. To achieve the new permit quality conditions, current conventional treatment technologies would be sufficient for BOD and ammonia (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution for BOD and ammonia is feasible. However, phosphate is currently being treated to a level below LCT (0.22 mg/l), with the revised permit also below LCT (0.21 mg/l). Southern Water need to ensure Leeds WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

Table 5-12: Required permit quality conditions for Leeds WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	15	11	**N/A**
Ammonia (mg/l 95%ile)	3	1.76	**N/A**
Phosphate (mg/l annual average)	N/A	**0.21***	Not achievable for current flows within LCT

modelling current flows (pre growth) requires a standard of 0.22 mg/l annual average which is also below LCT

5.3.4.8 May Street Herne Bay (Stour Outflow) WwTW

It is unlikely that significant process upgrades will be required at the WwTW based on growth projections and the water quality assessment undertaken. Some upgrades may be required in relation to hydraulic capacity in relation to headroom exceedance and for improvements to BOD concentrations; however, the exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period.

By the end of the plan period, the future permit quality conditions detailed in Table 5-13 will be required to ensure no deterioration in status. To achieve the new permit quality condition, current conventional treatment technologies would be sufficient; this demonstrates that a technical solution is feasible.

Table 5-13: Required permit quality conditions for May Street Herne Bay WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	10	8	**N/A**
Ammonia (mg/l 95%ile)	3	**Retain - 3**	**N/A**
Phosphate (mg/l annual average)	N/A	**26.43**	0.65

5.3.4.9 Newnham Valley Preston WwTW

It is unlikely that significant process upgrades will be required at the WwTW based on growth projections and the water quality assessment undertaken. Some upgrades may be required in relation to hydraulic capacity in relation to headroom exceedance; however, the exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period. This demonstrates that a technical solution is feasible.

Table 5-14: Required permit quality conditions for Newnham Valley Preston WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	30	**Retain 30**	**N/A**
Ammonia (mg/l 95%ile)	10	**Retain 10**	**N/A**
Phosphate (mg/l annual average)	N/A	**23**	**0.69**

5.3.4.10 Paddock Wood WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 and AMP 8 asset planning periods, in line with revised quality conditions for ammonia and BOD. However, ammonia is currently being treated to a level below LCT (0.67 mg/l), with the revised permit also below LCT (0.63 mg/l). Southern Water need to ensure the WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

By the end of the plan period, the future permit quality conditions detailed in Table 5-15 will be required to ensure no deterioration in status. To achieve the new phosphate permit quality condition, current conventional treatment technologies would be sufficient for BOD (i.e. the quality conditions are within LCT) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible.

Table 5-15: Required permit quality conditions for Paddock Wood WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	10	**8**	**N/A**
Ammonia (mg/l 95%ile)	3	**0.63***	**N/A**
Phosphate (mg/l annual average)	N/A	**1.19**	Not achievable for current flows within LCT

*****_modelling current flows (pre growth) requires a standard of 0.67 mg/l 95 percentile which is also below LCT_

5.3.4.11 Tunbridge Wells South WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 and AMP 8 asset planning periods, in line with revised quality conditions for phosphate and new quality conditions for BOD.

By the end of the plan period, the future permit quality conditions detailed in Table 5-16 will be required to ensure no deterioration in status. To achieve the new phosphate permit quality condition, current conventional treatment technologies would be sufficient for BOD and ammonia (i.e. the quality conditions are within LCT) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution for BOD and ammonia is feasible. However, phosphate is currently being treated to a level below LCT (0.31 mg/l), with the revised permit also below LCT (0.29 mg/l). Southern Water need to ensure Tunbridge Wells WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

Table 5-16: Required permit quality conditions for Tunbridge Wells South WwTW by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…	
		Ensure no deterioration in status	Achieve future target status
BOD (mg/l 95%ile)	12	**10.4**	**N/A**
Ammonia (mg/l 95%ile)	4	**Retain 4**	**3.79**
Phosphate (mg/l annual average)	N/A	**0.29***	Not achievable for current flows within LCT

***modelling current flows (pre growth) requires a standard of 0.31mg/l annual average which is also below LCT*

5.3.4.12 Faversham WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period, for the revised quality conditions for BOD. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within LCT) but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible for the WwTW.

5.3.4.13 Queenborough WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW may be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP8 asset planning period. Current conventional treatment technologies would be sufficient for BOD. This demonstrates that a technical solution is feasible for BOD.

5.3.4.14 Whitewall Creek WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period, for the revised quality conditions for BOD and ammonia required. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient. This demonstrates that a technical solution is feasible for BOD and ammonia.

5.3.4.15 Wouldham WwTW

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WwTW are likely to be required before 2031 when based on growth projections, permitted headroom would be exceeded. Significant improvements may be required to deliver the tighter BOD consent. The exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning periods, revised quality condition for BOD. To achieve the tighter permit condition, current conventional treatment technologies would be sufficient but would need to be implemented by Southern Water at some point in the future. This demonstrates that a technical solution is feasible for BOD.

5.4 Wastewater ecological appraisal

5.4.1 Appraisal approach

To undertake the ecological appraisal, those WwTWs that would exceed current discharge consents to accommodate the planned future development were considered[65]. Each water body receiving treated discharge

[65] WwTW that do not need to change their current discharge permits are not included in the appraisal. This is on the basis that the ecological impacts of those permits will have already been considered as part of the Environment Agency's RoC process.

from these WwTWs were traced downstream from the discharge point. Where a receiving watercourse enters, or passes adjacent to, an internationally important wildlife site that has potential to be vulnerable to changes in water quality (based on the information available such as citations), these are identified and potential impacts considered. For the purposes of this assessment, only sites designated under the Ramsar convention, Habitats Directive and Birds Directive[66] have been considered.

Where available, reasons for designation of the wildlife sites have been gathered primarily from the following sources:

- Joint Nature Conservation Committee www.jncc.defra.gov.u ; and
- Natural England www.naturalengland.org.uk.

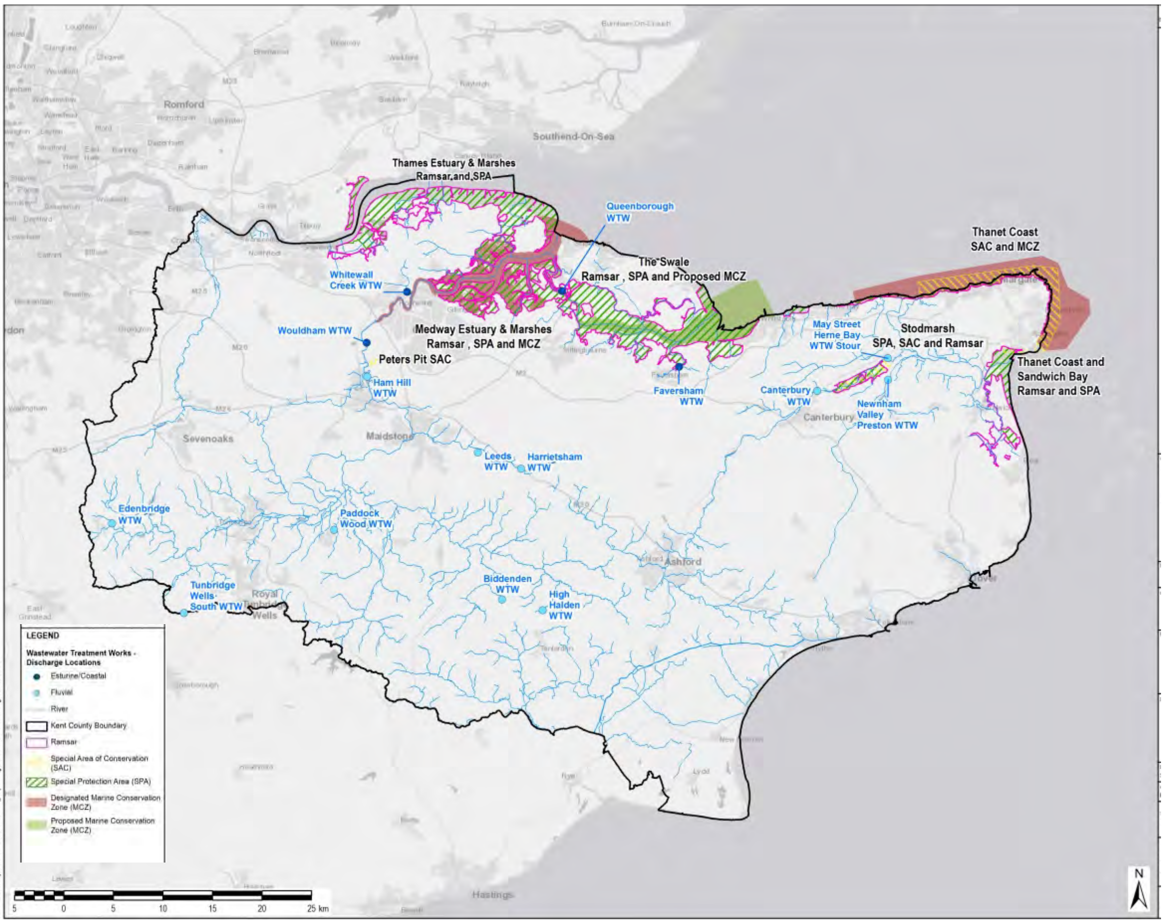
Following the process described above, sixteen internationally important statutory designated sites have been identified as being hydrologically connected to WwTWs that are unable to meet expected development needs during the Plan period without a change to their discharge permits. These WwTWs are identified in Table 5-3 and Table 5-4 (section 5.2). The designated sites connected to these WwTW, even where they are just located adjacent to the watercourse but not confirmed to be hydrologically dependent upon it are listed (alphabetically):

- Medway Estuary Marine Conservation Zone (MCZ);
- Medway Estuary & Marshes Ramsar site;
- Medway Estuary & Marshes Special Protection Area (SPA);
- Sandwich Bay Special Area of Conservation (SAC);
- Stodmarsh Ramsar Site;
- Stodmarsh SAC;
- Stodmarsh SPA;
- Thames Estuary and Marshes Ramsar site;
- Thames Estuary & Marshes SPA;
- Thanet Coast MCZ;
- Thanet Coast & Sandwich Bay Ramsar;
- Thanet Coast SAC ;
- Thanet Coast & Sandwich Bay SPA;
- The Swale Estuary MCZ;
- The Swale Ramsar site; and
- The Swale SPA.

The locations of these sites are illustrated on Figure 5-8. Appendix D lists designated sites that have potential to interact with each WwTW and details the distances between the sites and the relevant WwTW discharge point.

[66] It should be noted that lesser designated sites such as Site of Special Scientific Interest (SSSI), Local Nature Reserve (LNR), National Nature Reserve (NNR), and County Wildlife Site (CWS), and ecology outside of designated wildlife sites have potential to interact with the discharged effluent. However, these are not considered within this study as they were outside the scope of the agreed commission.

Figure 5-8: Designated ecological sites with hydrological links to WwTWs potentially exceeding their flow permit



The ecological background to the statutory designated ecological sites, including the details of the interest features and relevant condition assessments (where available), is provided in Appendix D.

5.4.2 Sites affected by discharges to coastal waters

Four WwTWs discharge directly into coastal environments. The vulnerabilities of these marine sites are summarised below. This is followed by a discussion relating to the individual WwTWs.

Unlike some other estuaries (such as Chichester & Langstone Harbours SPA on the Solent coast), the international interest features which are known to be very susceptible to increased nutrient levels, the North Kent designated sites (Swale Estuary proposed MCZ, The Swale Ramsar and SPA, Medway Estuary & Marshes SPA, Ramsar site and MCZ) are more resilient. Whilst the grazing marsh components of these sites are sensitive to deteriorations in water quality, the grazing marshes and their ditches are not subject to the presence of treated sewage effluent, which due to the point of discharge flows through the creek channels into the marine/estuarine portions of the designated sites.

In estuarine conditions, increases in nutrients such as ammonia and phosphates promote the growth of macro-algae (such as members of the sea lettuce genus *Ulva*). Where these are able to grow uncontrolled by other climatic conditions or environmental processes (such as in the Solent) they can develop thick persistent mats over mudflats, saltmarsh and other intertidal habitats. This can result in a significant reduction in oxygen within the sediment which can in turn reduce invertebrate biomass, thereby reducing its value as foraging habitat. The mats can also prove a simple physical barrier for birds trying to forage within the underlying sediment. The principal issue controlling oxygen depletion in the underlying sediments appears to relate less to the weight and coverage of algae but to the quick growth and over-winter persistence of the mats.

In some estuaries smothering macro-algae have been a historic problem due to the warmer water temperatures, low sediment loading and limited wave action, which result in a combination of rapid algal growth during the summer and low algal mortality during the winter and thus the accumulation of large dense persistent mats. In these estuaries nutrient inputs to the water have been a major contributor to the further growth of these algae (since there are few environmental factors to otherwise inhibit growth) and have necessitated controls on nitrogen loading of discharged effluent as well as other sources (such as agricultural runoff). However, in estuaries like The Swale and Medway along the North Kent coast where the sediment loading is higher (reducing light penetration and thus restricting rates of growth), in addition to temperatures being cooler and wave action stronger (leading to winter break up of mats and considerable annual variation in algal cover), the sediments are able to remain well oxidised despite high nutrient loadings and hence the benthic invertebrate community is unaffected by macro-algal mats. If the benthic invertebrate community is unaffected then the site would continue to maintain its prey productivity for birds and its designated features would not be subject to adverse effects.

For previous projects, the Environment Agency has confirmed that while nutrient levels are high within the various estuaries around the greater Thames Estuary (including those along the North Kent coast), this does not result in the smothering macro-algal growth that has been having an adverse effect upon other European marine sites (such as The Solent). The prevailing expert opinion is that the dominant control on phytoplankton growth in these estuaries is not nutrient availability but light availability which is controlled by the high loading of suspended sediment, and as such nutrient levels in the water column are not considered to pose a risk to the north Kent European designated sites.

Due to the estuarine conditions and tidal processes within the North Kent estuarine designated sites, water conditions are essentially cold and relatively turbid with high levels of water movement and wave action. Inflows into the estuarine sites are constantly changing and water is flushed away from the area dispersing any waste water and associated sedimentation and nutrients and thus reducing BOD.

The Medway Estuary MCZ is partially designated for its populations of tentacled lagoon-worm (*Alkmaria romijni*). However, evidence[67] suggests that these are not vulnerable to changes in water quality, but are affected more by salinity.

Having presented the relative vulnerability and resilience of these designated sites, the implications of each relevant WwTW are discussed below.

5.4.2.1 Faversham WwTW

This WwTW discharges directly into the coastal environment at Faversham Creek on The Swale, which is part of the Swale Estuary proposed MCZ, The Swale Ramsar and SPA.

The only pollutant that has been modelled at this WwTW is BOD as there is no other biochemical limit imposed on this permit. Increased BOD can result in lower dissolved oxygen concentrations in watercourses, which in turn can result in death of plants and animals. BOD treatment at this WwTW is already within conventional treatment limits. To ensure that the planned level of development does not increase BOD load the consented discharge permit will however require tightening. As this tightening is within the LCT there should be no impact on designated sites.

5.4.2.2 Queenborough WwTW

This WwTW discharges directly into the coastal environment on The Swale which is part of The Swale Estuary proposed MCZ, and Medway Estuary & Marshes SPA and Ramsar site. 0.5 km downstream from the discharge point the discharged water enters The Swale SPA and Ramsar site. 5 km downstream of the discharge point, the discharged water enters the Medway Estuary MCZ. Beyond this, after 8 km the water enters the Thames Estuary and Marshes SPA and Ramsar site. Due to the estuarine conditions and tidal processes within these designated sites, water conditions are essentially cold and relatively turbid with high levels of water movement and wave action. As such, inflows into the estuarine sites are constantly changing and water is flushed away from the area dispersing any wastewater and associated sedimentation and nutrients, reducing BOD. Increased BOD from discharges can however result in lower dissolved oxygen concentrations in watercourses, which in turn can result in death of plants and animals.

[67] JNCC http://jncc.defra.gov.uk/page-5677 [accessed 25/01/2017]
Natural England. The Medway Estuary Marine Conservation Zone DRAFT supplementary advice on conserving and restoring site features
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485002/medway-estuary-mzc-supplementary-advice.pdf [accessed 25/01/2017]

Similarly to Faversham WwTW, the only pollutant that has been modelled at this WwTW is BOD as there is no other biochemical limit imposed on this permit. BOD at this WwTW is already treated within conventional treatment limits. To ensure that the planned level of development does not increase BOD loads, the consented discharge permit will however require tightening. As this tightening is within the LCT there should be no impact on designated sites.

5.4.2.3 Whitewall Creek WwTW

This WwTW discharges directly into the coastal environments of the River Medway which at this point is part of the Medway Estuary MCZ. 3 km downstream from the discharge point the discharged water enters the Medway Estuary and Marshes SPA and Ramsar site. Approximately 20 km downstream from the discharge point the water enters the Thames Estuary & Marshes SPA and Ramsar site.

BOD and ammonia at this WwTW are already treated within conventional treatment limits. To ensure that the planned level of development does not increase the ammonia or BOD load, the consented discharge permit will require tightening. As this tightening is within the LCT there should be no impact on designated sites related to BOD or ammonia.

5.4.2.4 Wouldham WwTW

This WwTW discharges into coastal environments at the River Medway. The River Medway Enters the Medway Estuary MCZ 3 km downstream. After 12.5 km (from the discharge point) the discharged water enters the Medway Estuary & Marshes SPA and Ramsar site. Almost 30 km downstream from the discharge point the discharged water enters the Thames Estuary & Marshes SPA.

Due to the dynamic nature of the estuarine environments within these designated sites (including cold water intrusions, high turbidity and water movement) and the more than 3km distance separating the nearest designated site from the point of discharge, effluent will be considerably diluted. Coupled with the relatively high resilience of these designated sites to nutrient input there is considered unlikely to be any impact upon the designated features. The only pollutant that has been modelled at this WwTW is BOD as there is no other biochemical limit imposed on this permit. BOD treatment at this WwTW is already within conventional treatment limits. To ensure that the planned level of development does not increase BOD loading to the receiving water bodies, the consented discharge permit will however require tightening. As this tightening is within the LCT there should be no impact on designated sites related to BOD.

5.4.3 Sites affected by discharges to fluvial water bodies

5.4.3.1 Screened out WwTW

Seven WwTWs likely to exceed their current permit are located 27 km from the Medway Estuary MCZ, 36 km Medway Estuary and Marshes SPA and Ramsar sites and 52.5 km from the Thames Estuary and Marshes SPA and Ramsar sites at their closest. Given the distances involved, there is no likelihood of discharges from the WwTW affecting any of these internationally important sites, even in combination, due to the very substantial dilution that will occur. No freshwater or terrestrial internationally important wildlife sites were identified to interact with discharged water from the following WwTW and as such they have been screened out for impact assessment:

- Biddenden WwTW;
- Harrietsham WwTW;
- High Halden WwTW;
- Paddock Wood WwTW;
- Tunbridge Wells South WwTW;
- Edenbridge WwTW; and
- Leeds WwTW.

5.4.3.2 Ham Hill WwTW

This WwTW discharges directly into the River Medway. Effluent then enters the Medway Estuary MCZ 7.5 km downstream of the discharge point. A total of 17 km downstream of the discharge point the effluent reaches the Medway Estuary and Marshes SPA and Ramsar site, and approximately 33 km downstream the waters enter the Thames Estuary and Marshes SPA and Ramsar site.

To ensure that future growth will not prevent the WFD objective of 'No Deterioration' for BOD and ammonia from being attained, the 'No Deterioration Assessment' identified that permit tightening for BOD and ammonia will be required. Whilst the effluent from this WwTW is hydrologically connected to the Medway Estuary & Marshes and Thames Estuary & Marshes there will be substantial dilution and mixing. Moreover, as already discussed, these internationally important sites are relatively resilient to nutrient inputs. Provided that the permit tightening is achieved before the associated housing is delivered within its catchment, there should be no impact on designated sites.

The phosphate consent would also require tightening to enable the WFD 'Good Status' target to be achieved. It is not anticipated that the planned future development will prevent this WwTW target being achieved. Provided that this tightening is achieved before the associated housing is delivered within its catchment, there should be no impact on designated sites.

5.4.3.3 Newnham Valley Preston WwTW

This WwTW discharged directly into the Little Stour. The effluent enters Sandwich Bay SAC and subsequently Thanet Coast and Sandwich Bay SPA and Ramsar site 17 km downstream. After 29 km, this reaches Thanet Coast SAC and MCZ.

Appendix D identifies that Sandwich Bay SAC is designated for its extensive dune systems and would not be affected by nutrient inputs from this WwTW. However the flora, invertebrates and botanical species for which the Ramsar site and SPA are designated have potential to be vulnerable to changes in nutrient inputs from WwTW.

In theory, due to the dynamic nature of the coastal and estuarine environments adjoining these designated sites (including cold water intrusions, high turbidity and water movement), pollutants will be quickly diluted and dispersed, thus not impacting upon the designated features and sites. English Nature (2000)[68] states that '*The reefs [and sea caves] at Thanet are close to a number of sewage outfalls. However effects are localised because dispersion from outfalls is quite high'.*

English Nature detailed that under the Urban Waste Water treatment Directive (UWWTD) all coastal discharges above a certain size must have secondary treatment installed by 2000, thus significantly reducing organic loading and to a lesser extent reducing concentrations of dissolved nutrients. English Nature also suggested that '*cleaner sewage discharges may cause a redistribution of feeding birds, or they may have a much greater effect causing a reduction in the overall capacity of a coastal area to support bird population'.* English Nature acknowledged that the effect of the reduced organic and nutrient inputs on the SPA will be '*difficult to predict'.* English Nature identified that feeding grounds of little tern and other migratory species were becoming locally exposed to organic material in proximity to sewage discharge points. However, for little tern and other migratory species, this was at the time not considered to be an issue as increased nutrients can also result in increased food provision for this species.

The current Site Improvement Plan (SIP) for Thanet Coast & Sandwich Bay SPA[69] suggests that designated turnstone populations are potentially suffering from reduced food availability due to nutrient enrichment in proximity to feeding grounds. The nutrient rich waters promote algal growth and potentially smother food sources for turnstone, with these bays being less subject to wave action and having less sediment in the water column than the North Kent estuaries meaning that macroalgae can potentially grow more quickly and persist over winter. Equally,

The SIP acknowledges that these designated sites have a historic problem with water quality and that changes have been made to improve water quality. However, at the time of writing this assessment, monitoring results, and thus evidence of the effectiveness of these improvement interventions is not known. The SIP states: '*Water quality in water courses has suffered from insufficiently treated Sewage Treatment Works discharges… Work to improve quality of water (phosphate stripping) was carried out in 2006 but we are unclear what further monitoring has been carried out.'*

As a precaution, it is therefore assumed that the international interest features of the Thanet Coast are vulnerable to increased nutrient inputs. The water quality modelling and calculation analysis identifies that to ensure that

[68] English Nature (2000) North East Kent European marine sites comprising: Thanet Coast candidate Special Area of Conservation (cSAC), Thanet Coast and Sandwich Bay Special Protection Area (SPA), Sandwich Bay candidate Special Area of Conservation (cSAC) English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 http://publications.naturalengland.org.uk/file/3229392 [accessed 24/01/2017]
[69] Natural England (2014) http://publications.naturalengland.org.uk/file/6055004372729856 [accessed 24/01/2017]

future growth will not prevent the WFD objective of ‘No Deterioration’ for BOD, phosphates and ammonia from being obtained, no permit tightening for BOD, ammonia and phosphate will be required. Therefore, coupled with the 17km minimum separation between the outfall and the SPA/Ramsar site, it is considered that no adverse effect will arise.

It should be noted that the reef habitats of the Thanet coast have historically been identified to be vulnerable to toxic contamination from heavy metals within sewage discharges[70]. Whilst this is noted, no water quality detail relating to heavy metals are available as part of this analysis, and so are not investigated further. It is recommended that consultation with the Environment Agency and Natural England are undertaken to determine if heavy metal presence is still a current concern for the reef habitats; if it is further investigation is likely to be required.

5.4.3.4 May Street Herne Bay WwTW Stour

This WwTW discharges directly into the River Stour, approximately 18 km upstream of Sandwich Bay SAC, and the Thanet Coast and Sandwich Bay SPA and Ramsar site. After approximately 30 km from the discharge point the water enters the Thanet Coast SAC and MCZ.

The analysis as presented for Newnham Valley Preston WwTW (section 5.4.3.3) is relevant to the assessment of nutrient inputs relevant to these designated sites for May Street Herne Bay WwTW.

The water quality modelling and calculation analysis identifies that to ensure that future growth will not prevent the WFD objective of ‘No Deterioration’ for BOD from being obtained, permit tightening for BOD will be required. The modelling also identifies no permit tightening for ammonia and phosphate will be required to maintain current WFD Status. The BOD permit is well within the LCT and hence a feasible treatment solution is possible to also ensure no impact on the designated sites.

As previously noted, reef habitats of the Thanet coast have historically been identified to be vulnerable to toxic contamination from heavy metals within sewage discharges. Whilst this is noted, no water quality detail relating to heavy metals are available as part of this analysis, and so are not investigated further. It is recommended that consultation with the Environment Agency and Natural England are undertaken to determine if heavy metal presence is still a current concern for the reef habitats; if it is further investigation is likely to be required.

5.4.3.5 Canterbury WwTW

This WwTW discharges directly into the Great Stour, which flows past the Stodmarsh SPA, SAC and Ramsar site 1.5 km downstream of the discharge point. The river drains into Sandwich Bay SAC and Thanet Coast and Sandwich Bay SPA and Ramsar site 27 km downstream of the discharge point. Approximately 39 km downstream of the discharge point is the Thanet Coast SAC and MCZ.

The Stodmarsh internationally important wildlife sites are designated for wetlands habitats, including reed beds and open water which support rare wetland birds, invertebrates, including Desmoulin’s whorl snail; and botanical species associated with woodland, reedbed, grazing marsh and tidal river and adjacent lake habitats (i.e. both terrestrial and aquatic). Habitats associated with the site receive water from the Great Stour are vulnerable to changes in levels in BOD, phosphate and nitrogen (from nitrified ammonia) carried within floodwaters. The 2009 River Basin Management Plan[71] indicates that the Great Stour has historically high levels of phosphates and organic pollutants. It identifies that the Canterbury WwTW (and other WwTW within the Great Stour catchment) would at the time be required to reduce discharges for nutrients such as phosphate, and organic pollutants. It is assumed this took place as part of permit changes imposed in the Environment Agency’s RoC process.

For the terrestrial environments such as those associated with this site, phosphate is a principal growth-limiting nutrient, along with nitrogen. In freshwater systems, phosphates are the primary limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. Increased levels of BOD can result in lower oxygen levels in watercourses which in turn can result in death of plants and animals. Even relatively low levels of ammonia can be toxic to plants and animals and can result in deaths. Nitrification of ammonia can result in increased levels of nitrogen, similar to phosphates;

[70] English Nature (2000) North East Kent European marine sites comprising: Thanet Coast candidate Special Area of Conservation (cSAC), Thanet Coast and Sandwich Bay Special Protection Area (SPA), Sandwich Bay candidate Special Area of Conservation (cSAC) English Nature’s advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 http://publications.naturalengland.org.uk/file/3229392 [accessed 24/01/2017]
[71] Environment Agency (2009). Water for Life and Livelihoods. River Basin Management Plan South East River Basin District https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295841/geso0910bsta-e-e.pdf [accessed 25/01/2017]

this is a limiting nutrient within terrestrial habitats that can lead to increased growth of more competitive plant species and changes in plant communities (and structure of a habitat).

The SIP for the site[72] identifies that bird features (bittern, and gadwall) are vulnerable to water pollution. The SIP states '*Poor water quality has been recorded in the NNR lake (Unit 10) and associated reedbeds. The Lampen stream and Great Stour which feeds into the lake have fairly high nitrogen levels, and orthophosphate levels regularly over 100ug/L, especially since 2009. This leads to a reduction in fish stocks and macrophytes, which impacts on food availability for SPA birds (bittern, gadwall)'.* It is believed that Desmoulin's whorl snail graze on fungi, micro-algae and possibly bacteria growing on marsh plants and decaying higher plants[73]. These food sources are likely to result in increased growth from elevated nutrient inputs, thus providing an increased food supply for the snail. However, Killeen (2003)[74] also identifies that '*Desmoulin's whorl snail populations are potentially or actually at risk from water quality issues, particularly elevated phosphate and nitrate levels, and organic pollution. The snails may be directly vulnerable to organic pollution, particularly during periods of high flows when they can be immersed or transported. They are also vulnerable to poor water quality if it affects their habitat. The habitat on which Desmoulin's whorl snail depends can be impacted by pollution if it results in changes to the plant community. Elevated levels of nutrients, particularly phosphates and nitrates, are likely to be detrimental if changes result in the vegetation community. This is particularly relevant to snail habitat in river margins and drains*[75]*, if the vegetation is likely to become rank.'* However, in reality it is currently unknown what impact water quality may have on Desmoulin's whorl snail populations.

Natural England's SIP recommends that actions are taken to de-silt the main NNR lake to reduce the phosphate store in the site, which leads to algal blooms that can kill fish. However, this appears not to be linked to treated sewage effluent discharge. The SIP also identifies the need for investigations and monitoring of nutrients as they enter the lake in water and sediments, to determine requirements to improve water quality.

With respect to the Sandwich Bay and Thanet Coast sites, it is acknowledged (see discussion in relation to Newnham Valley Preston WwTW, section 5.4.3.3) that because of the distance from the discharge point to the these wildlife sites, water discharge will have been sufficiently diluted to not impact upon the designated features of these wildlife sites.

The water quality modelling and calculation analysis identifies that to ensure that future growth will not prevent the WFD objective of 'No Deterioration' for BOD and phosphate from being obtained permit tightening for BOD and phosphate will be required. Provided that this tightening is achieved before the associated housing is delivered within its catchment, there should be no deterioration or adverse effect on Stodmarsh, assuming that Canterbury WwTWs permit has already been subject to any relevant sustainability reductions to protect the site. The analysis also identifies that to ensure that future growth will not prevent the WFD objective of 'No Deterioration' for ammonia from being obtained, no permit tightening for ammonia will be required therefore, ammonia discharges should not impacted on designated sites.

5.4.4 Ecological appraisal summary

The ecological appraisal has identified that, as long as solutions to improved treatment can be delivered (as identified within the LCT), there should be no significant impact on designated sites as a result of growth increasing wastewater discharge volumes. This conclusion is contingent upon solutions being identified and implement in line with the advancement of growth.

5.5 Wastewater assessment - cost estimates

Estimates of total costs[76] for meeting the tighter permits required to meet WFD and other environmental targets have been defined using published cost research by Ofwat and Defra. Ofwat have undertaken research into the total cost of meeting tighter discharge permits required to meet WFD for Phosphate (2005)[77], and ammonia and BOD[78] (2006).

[72] Natural England (2014) http://publications.naturalengland.org.uk/file/5579385566396416 [accessed 25/01/2017]
[73] Killeen IJ (2003). Ecology of Desmoulin's Whorl Snail. Conserving Natura 2000 Rivers Ecology Series No. 6. English Nature, Peterborough.
[74] Ibid
[75] as is the case at Stodmarsh
[76] CAPEX and OPEX
[77] Arup/Oxera (2005) Water Framework Directive – Economic Analysis of Water Industry Costs, Nov 2005
[78] Oxera (2006) What is the cost of reducing ammonia, nitrates and BOD in sewage treatment works effluent?, Nov 2006

The research provides estimates of unit costs for different sized WwTWs to meet different permit conditions for the three determinands (BOD, ammonia and phosphate) assessed within this study. These unit costs are estimated per year as a total cost to provide and operate new infrastructure and are provided as a cost per kilogram of load removed.

The research aimed to give a high level estimate of costs based on ranges of treatment technologies to feed into WFD RBMPs for assessing the cost-benefit of improving WwTW discharges. Whilst high level, the research provides a useful means by which to estimate the cost over the plan period to deliver improved consent conditions via process upgrades and increased operational management. Costs are provided in Table 5-17.

Table 5-17: Total cost estimates for delivering permit improvements during the plan period (to 2031)

WwTW	Ammonia permit costs	BOD permit costs	Phosphate permit costs	Total permit costs
Harrietsham	£92,000	£182,000	£56,000	£329,000
Biddenden	£399,000	£12,000	£178,000	£589,000
Canterbury	-	£29,000	£89,000	£118,000
Edenbridge	£148,000	£31,000	£35,000	£214,000
Ham Hill	£3,544,000	£280,000	£2,181,000	£6,005,000
Newnham Valley Preston	-	£0.00	£69,000	£69,000
Paddock Wood	£320,000	£46,000	£10,000	£377,000
Tunbridge Wells South	-	£53,000	£26,000	£79,000
High Halden	£140,000	£22,000	-	£162,000
Leeds	£297,000	£78,000	£7,000	£383,000
May Street Herne Bay	-	£115,000	£2,244,000	£2,359,000
Whitewall Creek	£447,000	£152,000	-	£599,000
Faversham	£0.00	£94,000	-	£94,000
Queenborough	£0.00	£82,000	-	£82,000
Wouldham	£0.00	£2,526,000	-	£2,526,000
TOTAL	**£5,387,000**	**£3,702,000**	**£4,895,000**	**£13,985,000**

The totals will under-estimate the full cost associated with providing the required upgrades across Kent for the following reasons:

- They include estimates of capital costs related to treatment processes only, and do not include costs for planning, land purchase, sludge treatment, odour treatment and other infrastructure upgrades required to deliver WwTW upgrades;
- They do not include capital costs to increase hydraulic capacity at each WwTWs;
- They do not include network and pumping station upgrades required to transmit flow to the WwTWs;
- They do not include costs associated with WwTWs that do not exceed their headroom; and,
- Costs have only been provided in relation to the plan period, and will not represent the full facility capital costs which will vary with design life.

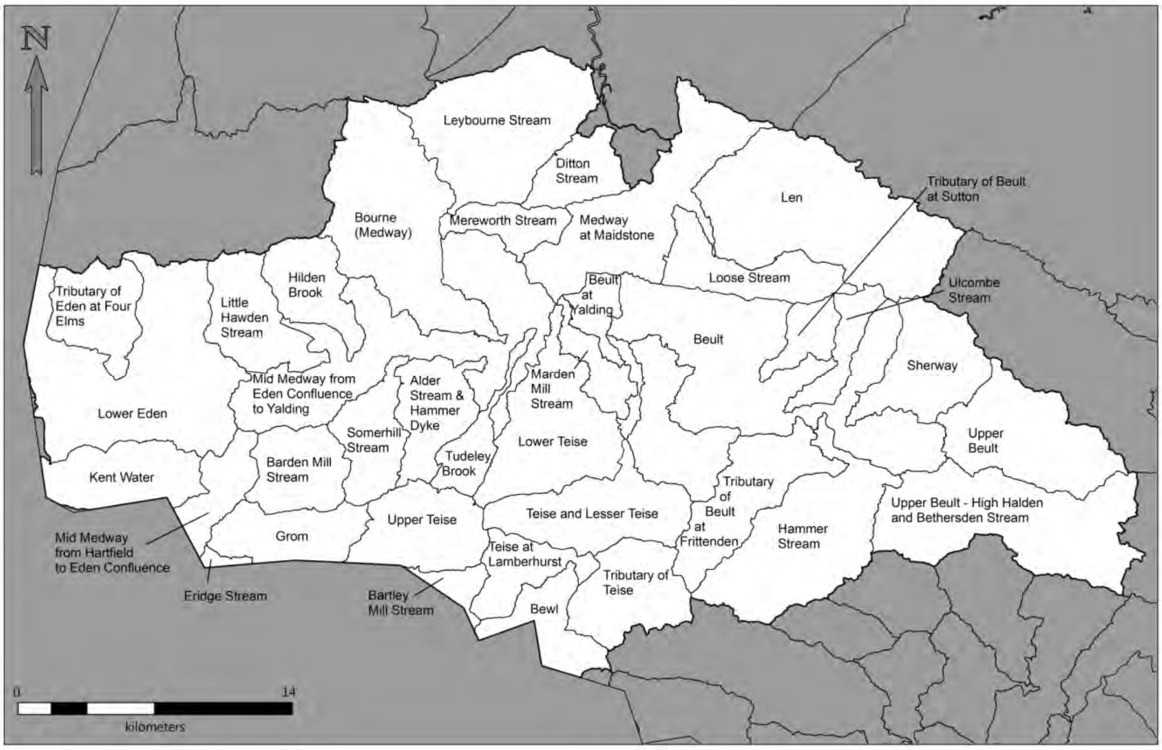
5.6 Catchment approach – Medway

This section presents the current status of the Medway catchment for phosphate and ammonia, exploring the reasons for not achieving good status (RNAGs) in more detail, where relevant in comparison to WwTW discharges and other catchment pressures. It highlights whether there are potential catchment solutions as an alternative option to further investment in existing facilities and treatment technologies where this could offer a more cost-beneficial or sustainable solution.

5.6.1 Phosphate current status for Medway water bodies

Figure 5-9 presents WFD water body names and extent of each water body catchment within the Medway management catchment. Figure 5-10 provides information on the current status of each water body for phosphate ('High' to 'Bad').

Figure 5-9: Outline map of the Medway catchment indicating the relevant water body names



For phosphate, 'Poor' status dominates the waterbodies making up the Eden, Medway and Beult river systems, with 'Moderate' status present in more isolated rural water bodies. Only the Bewl and Leybourne Stream water bodies have 'Good' status, with 'High' status present only for the independent Ditton stream catchment. These three catchments with the highest water quality do not receive any water from any WwTWs. Both Tudeley Brook and the Somerhill Stream water bodies have 'Bad' status indicating very high phosphate concentrations.

Figure 5-10: Map of the Medway catchment indicating WFD water body phosphate current (2015) status

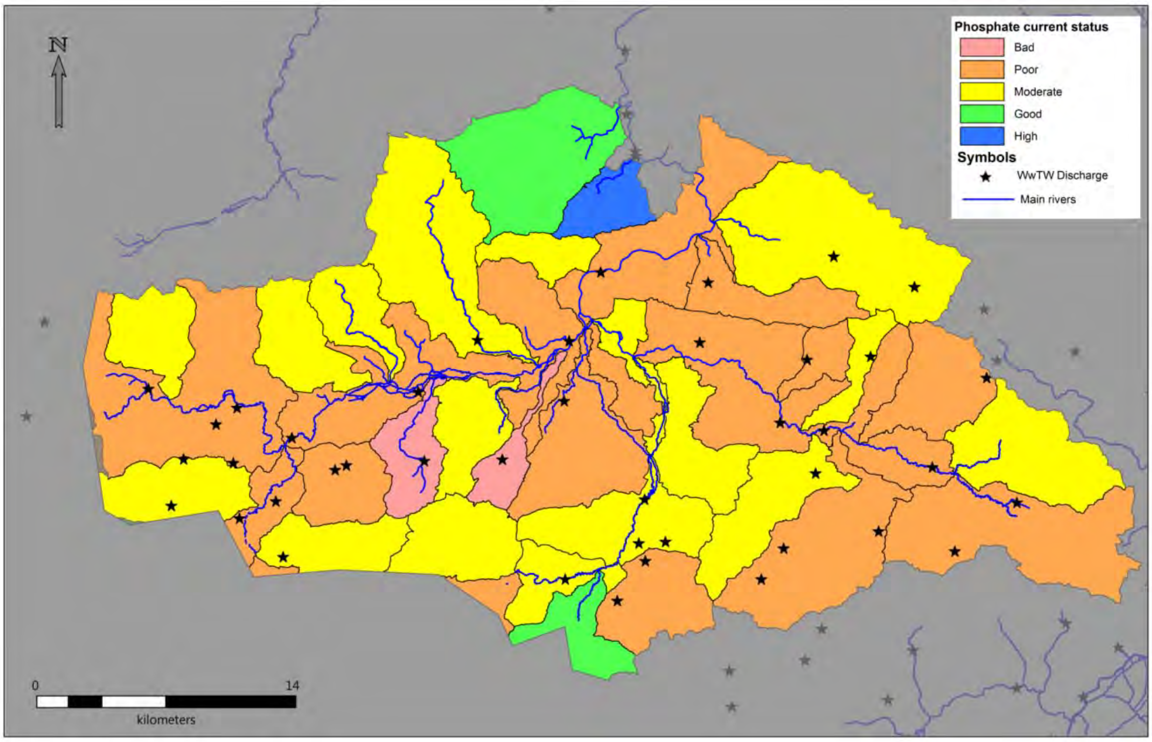
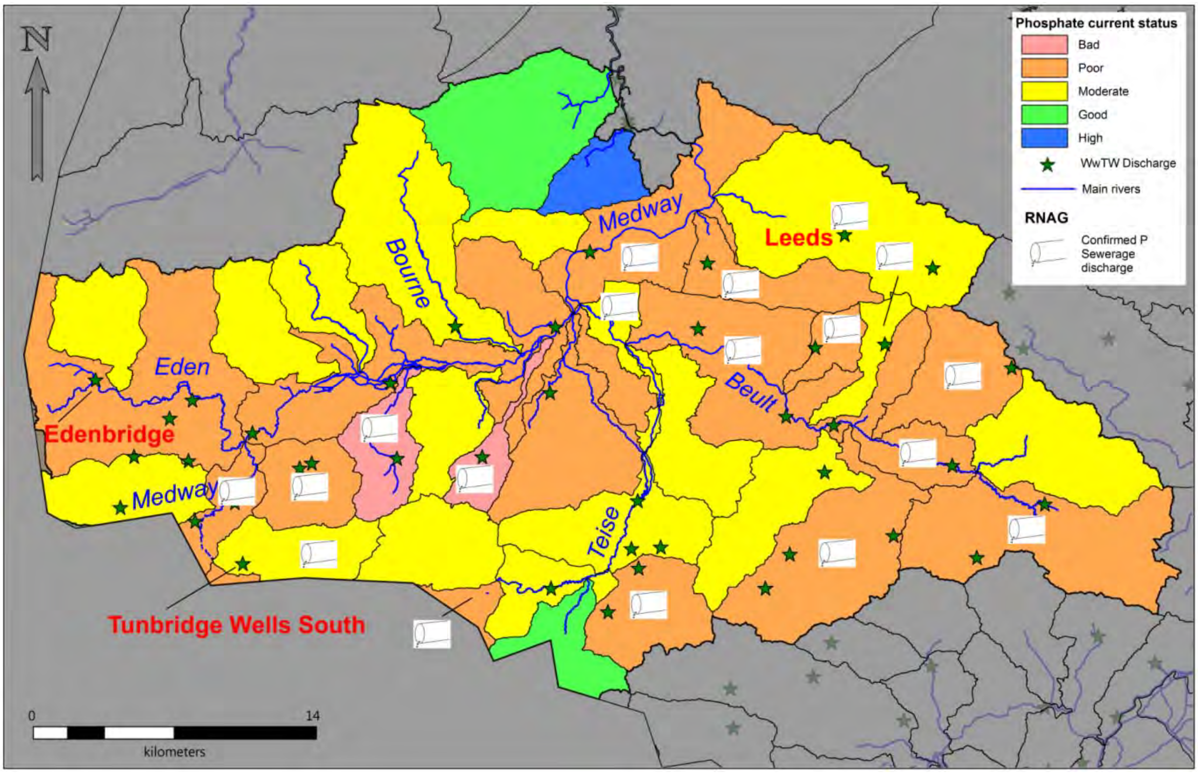


Figure 5-11 presents the reasons for not achieving good status for phosphate current status together with the location of water bodies with confirmed wastewater discharges. In some cases, this figure indicates where a water body RNAG is due to (in part or full) confirmed phosphate wastewater discharge (indicated by pipe outflow).

Where WwTWs are currently treating phosphate to below LCT the name of the WwTW is indicated in red as these WwTWs are likely to require the most significant investment. 18 water bodies are reported as receiving wastewater discharge from WwTWs, which are confirmed by the EA to be linked to phosphate failing to achieve 'Good' status.

Figure 5-11: Map of the Medway catchment indicating RNAG phosphate for each water body

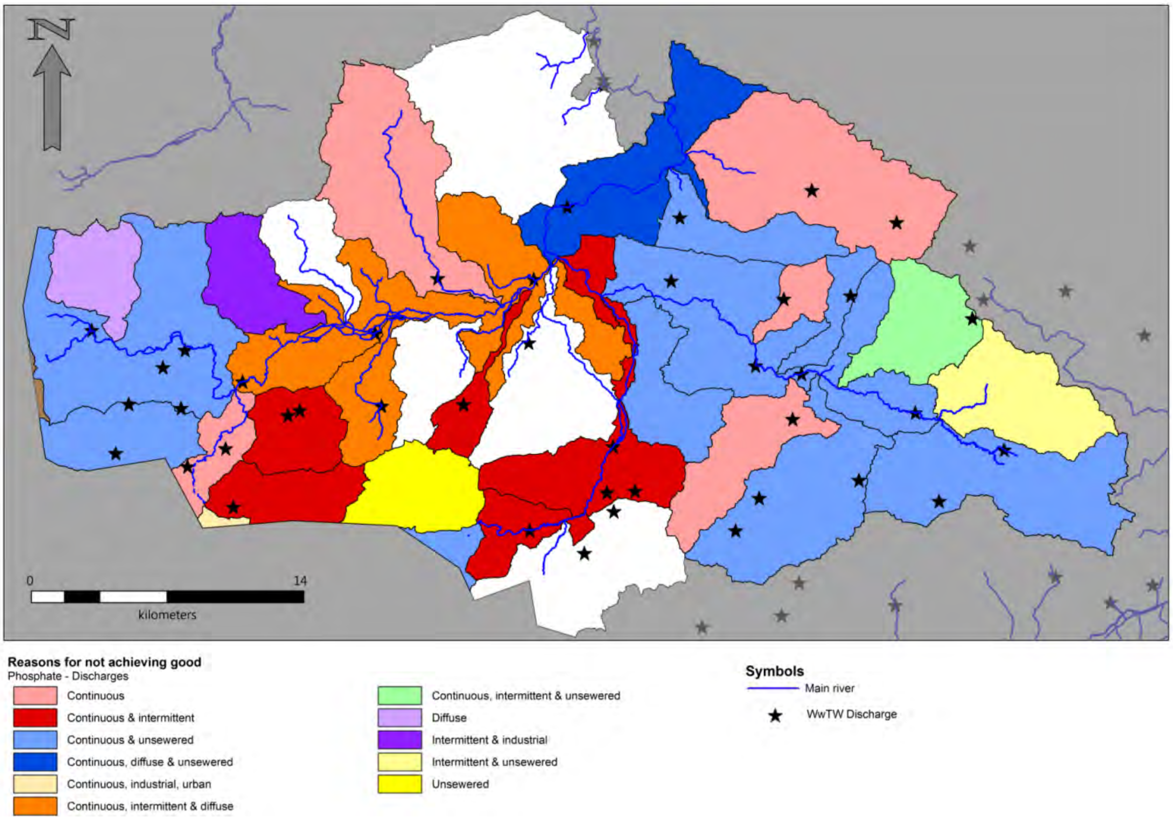


5.6.2 Wastewater discharge pressures

Figure 5-12 gives further information on where individual water bodies are affected by discharges at all levels of activity certainty (confirmed, suspected and probable) in relation to Phosphate Status.

This analysis shows catchments lower down the course of the Medway (e.g. Medway at Maidstone) were found to be affected by a diversity of discharges including continuous, diffuse and unsewered discharges at all levels of activity certainty (confirmed, suspected & probable). However, some more remote catchments such as the Upper Teise were found to only be affected by unsewered discharges, highlighting the rural nature of the catchment and use of septic tanks. Continuous wastewater discharge was the most frequent RNAG for phosphate due to the presence of WwTW outfalls in most catchments.

Figure 5-12: Detailed wastewater discharge reasons for not achieving good status (RNAG) for phosphate

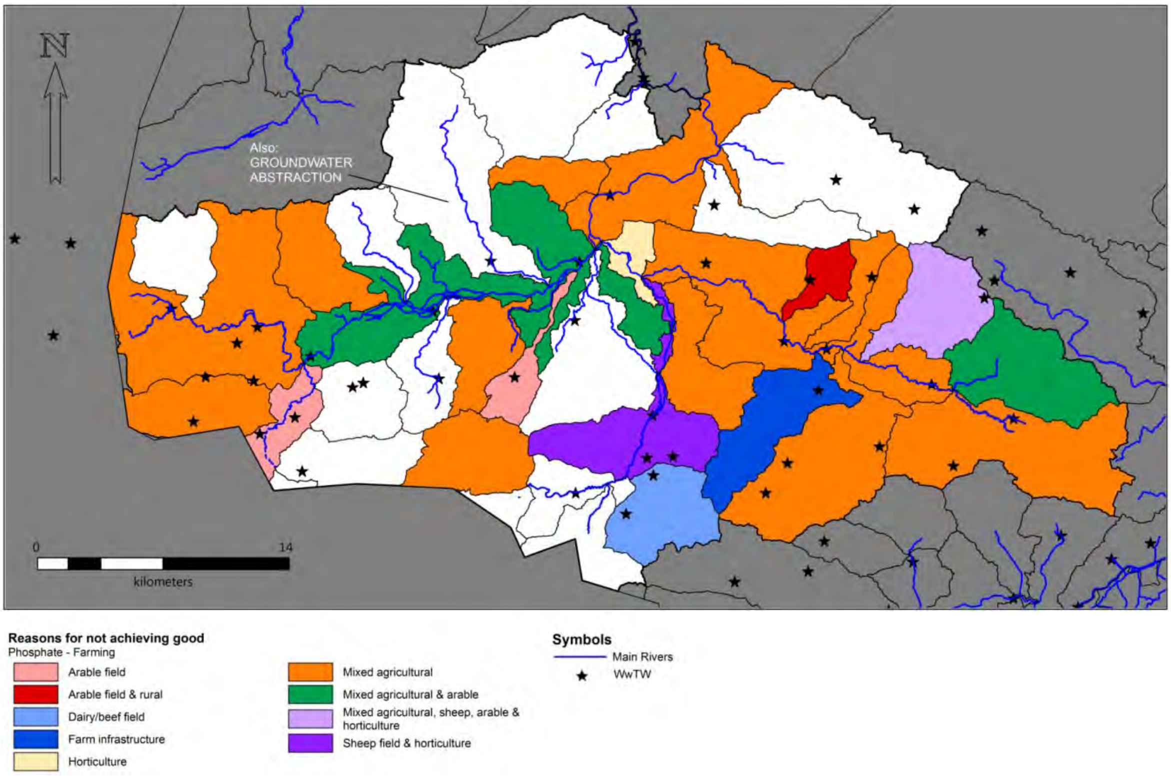


5.6.3 Agriculture and abstraction catchment pressures

Figure 5-13 shows the detailed agricultural and groundwater abstraction RNAG for phosphate at suspected and probable levels of activity certainty for individual water bodies.

The map highlights that mixed agriculture is the most frequent RNAG, but that a mixture of separate arable and livestock RNAG are focused on some catchments. For example, in the Tudeley Brook and Mid Medway (from Hartfield to Eden Confluence) arable sources were the main RNAG for phosphate, in the Teise and Lesser Teise sheep farming and horticulture were the main RNAG and in the Tributary of the Teise water body, dairy and beef were the main RNAG for phosphate. Groundwater abstraction is an additional RNAG for phosphate in the Bourne (Medway) catchment.

Figure 5-13: Detailed agricultural reasons for not achieving good status (RNAG) for phosphate



5.6.4 Alterative discharge options

Currently three WwTWs in the Medway catchment are treating phosphate to below LCT including Leeds WwTW (discharge to River Len), Tunbridge Wells WwTW (discharge to River Grom) and Edenbridge WwTW (discharge to Lower Eden). Paddock Wood WwTW (discharge to Lower Teise) currently treats ammonia to below LCT. All of these WwTWs are at the highest position (compared with other WwTWs) in the catchment and so there is no opportunity for permit tightening to be offset at an upstream WwTW with more environmental capacity. Further, whilst improvements to diffuse sources of Phosphate load may be possible downstream, the analysis has shown that the water body catchments receiving the discharges are significantly affected by the WwTW continuous discharges such that is unlikely that alternative means of reducing Phosphate discharge would significantly offset the need for further investment in the WwTWs within these upstream sections of water body.

If development is to progress according to the plan period schedule and current estimate of spatial distribution, then in each case improvements in current process infrastructure are still likely to be required to upgrade the WwTWs to ensure treatment continues to maintain quality to below LCT.

6. Summary and next steps

This section summarises the key study conclusions, limitations and recommendations emerging from the study. There are several recommendations from the study which after a brief set of conclusions, are presented as:

- Recommendations for stakeholder partner authorities actions in relation to the conclusions drawn; and
- Recommendations for further work (particularly where uncertainty in the methods applied for this strategic level assessment has been highlighted).

6.1 Conclusions

6.1.1 Baseline condition

The WfSG study has demonstrated that the status of water bodies in Kent is adversely affected by a range of pressures on the environmental quality of the water bodies. As of 2015, only one surface waterbody in Kent met overall Good Status as required under the WFD. In combination with other confirmed pressures such as channel modification, agricultural pollution and barriers to fish migration, pressures from abstraction for water supply and wastewater treatment are suspected by the Environment Agency of playing a significant role in the current status classification and failure to meet Good Status.

Whilst several measures are proposed to improve the status of many water bodies to Good Status as required by the WFD, the scale of growth proposed across Kent and Medway has the potential to significantly increase the scale and number of pressures on both the natural and infrastructure based water systems in Kent unless sustainable options to mitigate those pressures can be identified.

6.1.2 Water supply assessment

The statutory WRMP process has formed the basis of the water supply assessment for the study. Based on water company forecasts for growth from 2013, a deficit of available water to meet demand is forecast by water companies for nearly all of the Kent and Medway area by 2031. WRMPs were produced in 2015 to set out how this forecast deficit will be managed and each company developed a range of preferred new supply and demand management measures with a focus on increasing resilience through increasing the mix of available supply options. With the preferred plans in place, each water company is able to show that sufficient supply would be made available to meet the increasing demand to the end of the Local Plan period assessed in this study (2031).

However, analysis undertaken in this study has demonstrated that there is a significant difference in growth forecast by water companies in 2013 (and used in their current published plan) compared to the forecast growth from 2016 used within this study. This has the potential to lead to a shortfall of available supply across the study area of approximately 24 Ml/d by 2031; specifically, this would relate to growth in: Tunbridge Wells, Sevenoaks, Tonbridge & Malling, Maidstone, Medway, Ashford, Thanet, Canterbury, Dover and Shepway. The study has set out that a range of options are available to Southern Water, South East Water and Affinity Water to cater for this additional forecast growth within these Districts. Some of these options include bringing forward options currently planned for later delivery in the WRMP period (to 2040), whilst for others, it would require options which were removed from the final WRMP to be reinstated or alternative options not included in the preferred 2015 plan being instigated in addition. All of these options were considered 'feasible' options as defined by the WRMP guidelines, and hence had a degree of scrutiny regards likely compliance with the SEA directive and Habitats Directive, but would need more detailed scrutiny (including costing) as part of the current WRMP updates due to be released in 2019. The water companies will need to consider the latest 2016 growth forecasts across Kent and Medway (and how this may have subsequently changed) in their current supply and demand forecasts being used to generate preferred options in their 2019 plans.

The planning of additional options needs to be considered against the requirements for all water companies in the Kent and Medway area to look into the impact of current abstractions on water body and/or designated site condition, particularly in relation to the current WFD pressures highlighted in this study. All water companies in the study area are undertaking investigations and studies between 2015 and 2020 which may lead to future reductions in licences volumes which in addition to the effect of growth, would require further options to be considered. It is therefore apparent that measures are required to minimise the impact of further growth through management of future demand.

As an alternative to new supply options, this study has considered the potential benefit and costs of implementing steps towards water neutrality. Achieving total neutrality at the end of 2031 is unrealistic for several key reasons; most notably the limitations on what development control policy can be implemented to minimise future demand from new property, as well as the significant extent and scale of demand management proposals already being delivered by water companies in the Kent and Medway area for existing homes. Nevertheless, this study has set out the potential benefits that could be gained from implementing a policy to require developers to meet the optional standard for water efficiency under the Building Regulations part G, as well as potential additional measures to work with water companies to deliver further retrofit of existing properties to offset some of the additional demand. In some cases, potential shortfalls in planned water supply provision could be significantly reduced through these measures before the identified alternative supply and demand options would need to be considered.

6.1.3 Wastewater treatment

In the absence of a statutory wastewater planning requirement, the wastewater assessment for this study has required a bespoke approach to assessing medium to longer term effects of growth on wastewater treatment infrastructure and water quality impacts on the receiving environment. Simplified and high level modelling has been undertaken to determine whether existing treatment infrastructure has sufficient permitted headroom to treat additional wastewater, and where capacity is limited, what conditions are likely to need to be applied to future discharge permits in order to maintain environmental quality in the receiving waterbodies. The key test the assessment has considered is whether treatment upgrades are likely to be required which are currently beyond the levels of conventional treatment (LCT) and hence not considered sustainable or deliverable without impacting on water quality targets.

The study has demonstrated that whilst there are no locations where new treatment solutions beyond LCT are likely to be required to meet WFD objectives or requirements under the Habitats Directive, the scale of upgrades required to meet water body standards will require significant investment at several locations within Southern Water's wastewater operational area and these will need to be adequately planned for as certainty on development comes forward. In particular, there are four locations where WwTW are already treating to levels considered beyond LCT (three for phosphate and one for ammonia) and additional growth will increase pressure on these facilities to continue to treat to a high standard which may have significant investment implications. The results demonstrate potential investment and phasing concerns focused within the Medway catchment at Paddock Wood WwTW, Tunbridge Wells WwTW (both in Tunbridge Wells LPA area), Leeds WwTW (in Maidstone LPA area), Edenbridge WwTW (in Sevenoaks LPA area), and Biddenden WwTW (in Ashford LPA area) in relation to achieving Phosphate and to a lesser extent, ammonia. A high level summary of costs associated with providing the required solutions at these locations has been provided.

However, a key conclusion from the study is that, whilst maintaining current WFD status is theoretically possible, attaining Future Good Status is not possible for many watercourses and the study concludes that it is the limits related to current conventional treatment that prevents this and not the growth in isolation. This reflects the baseline assessment that several water bodies are already limited from attaining Good Status as a result of existing discharges. When considering this conclusion, it is therefore important to consider that technologies considered to be LCT have changed (and will continue to change) over time. Where the study concludes that LCT would currently prevent a water body quality standard being met, future technologies may change this conclusion and the impact of growth could be more of a concern where additional wastewater flow could become the limiting factor. As a result, the effect of growth needs to be continually assessed as Local Plan development continues to ensure growth does not exacerbate the existing WFD limitations. This is reflected in recommendations for further work set out below.

By necessity, the analysis has been undertaken using several key assumptions which present considerable limitations on the confidence of findings presented. Whilst the study outlines that, with significant investment, there should be no fundamental concerns to maintaining WFD status, this conclusion is based on an assumed distribution of growth across Kent and Medway, a large percentage of which is currently spatially uncertain at this point in time. As allocation of development sites advances, the analysis of available headroom and subsequent modelling assumptions could significantly change. Additionally, the study has assumed that use of available treatment headroom at WwTW would not significantly affect water quality targets in receiving waterbodies which is not likely to be the case in every situation without further investment and changes to existing permits. Recommendations for further analysis to improve confidence in these conclusions is set out below.

6.2 Recommendations

6.2.1 Stakeholder recommendations

The following recommendations are made for each stakeholder partner as a result of assessments made in this study.

In relation to the water supply assessment:

- Affinity Water, Thames Water, Southern Water and South East Water should ensure the full range of growth set out in this study is taken into account within the 2019 WRMP updates to ensure that adequate options are planned for the proposed growth levels.
- All LPAs should consider adopting the Building Regulations optional standard for water use (110 l/p/d) as the preferred policy target for new development with respect to water efficiency. Each LPA could consider developing specific guidance on how developers can achieve this standard, and how to consider going further with the introduction of water recycling technologies.
- Water supply companies should consider the option of enhanced programmes for retrofit of existing properties with water efficient fixtures and fittings within the 2019 WRMP updates. At a strategic level, the study has shown that, alongside adoption of policy for more stringent water efficient targets for new build, retrofitting of existing properties offers a means to (in part) address the current shortfalls in planned water supply to the end of the Local Plan period (2031). LPAs could consider supporting this as a joint initiative through facilitating adoption of measures within each Council's estate as well as providing programme management and resource to such an initiative.

In relation to the wastewater assessment:

- Once further spatial certainty is attained regards the full quantum of growth in each LPA area, Southern Water should consider early phasing of WwTW improvements where this study has highlighted limited available headroom capacity, or capacity being utilised within the next 10 years. The Price Review (PR) 2019 process (PR19) should consider the investment required over the next 5-year water company planning cycle AMP 7 (2020 to 2025).
- Due to the potentially significant upgrade works required at key WwTWs to maintain already high discharge standards, consideration to limiting early phasing of growth and or different spatial distribution of growth should be considered within the LPA areas of Tunbridge Wells (relating to Paddock Wood and Tunbridge Wells South WwTW catchments), Maidstone (relating the Leeds WwTW catchment), Sevenoaks (relating to Edenbridge WwTW), and in Ashford (relating to Biddenden WwTW).

6.2.2 Further investigation recommendations

6.2.2.1 Site specific infrastructure

This study has been completed at a strategic scale. As well as wastewater treatment and water resource capacity concerns, site specific analysis of infrastructure constraints should be considered as part of the Local Plan process in relation to sewerage and water supply networks. Whilst such infrastructure issues would be unlikely to limit development options, strategic level upgrades may be necessary in some locations where growth sites are numerous and total growth forecast is significant. As a result, there may be phasing limitations and developer contribution considerations for some growth locations.

6.2.2.2 Spatial uncertainty

The requirement for the study to make broad assumptions on the likely location of target growth which currently does not have site allocations has a significant bearing on the confidence of the conclusions drawn, particularly because the study has not identified any significant barrier within the limits of current conventional treatment in relation to wastewater treatment.

The study has therefore presented residual permitted headroom for each WwTW which have a numerical consent (Table 5-1 and Appendix E), to allow study partners to make some level of judgement on the initial effect in the event of a different spatial pattern emerging for the currently unallocated targets. It is recommended that where Local Plan making is still in progress, LPAs consider testing different spatial options for delivering unallocated housing targets on wastewater treatment and environmental water quality through additional supporting studies, and that opportunities to work collaboratively with partnering authorities in the same waterbody catchments are sought.

6.2.2.3 Use of available headroom

The high level assumption that available flow headroom is usable without affecting water quality in the receiving water bodies needs to be tested on a case by case basis. This is because the existing permit may not be adequately protective of the WFD and related standards.

This study highlighted that Brookland, Eastry, Horsmonden and New Romney WwTWs have sufficient permitted headroom for the growth forecast likely to drain to them, but were most likely to be at risk of causing some level of deterioration in their receiving water bodies if this headroom is utilised. This conclusion was drawn based on the large proportion of headroom available at each WwTW and the significant volume of wastewater that could drain to each WwTW by 2031. It is recommended that further analysis on the effect of using headroom on water quality is undertaken by Southern Water and the Environment Agency in collaboration with LPAs via the Local Plan process to improve confidence in the study conclusions.

6.2.2.4 WwTW at Limits of Conventional Treatment

With regards to WwTW that have been identified within the assessment as being ‘already below conventional treatment limits’; this definition provides for a level of uncertainty. It is recommended that further, detailed modelling is undertaken to determine a more accurate result for WwTW that are identified as being ‘already below conventional treatment limits’. Ideally, this would include a SIMCAT catchment modelling approach which also includes the increased loading effects from WwTWs which remain within their current permit.

6.2.2.5 WwTW costings

The costings derived for wastewater treatment works improvements identified in this study are likely to significantly under-estimate the total costs, in particular the capital costs required to meet more stringent discharge targets. The specific process design would need to be considered for each facility on a case by case basis to accurately determine full capital costs as oppose to using high level unit costs. It is recommended that a separate analysis of costs is undertaken.

6.2.2.6 Ecological considerations

No significant effects are predicted on the international, and European designated sites; however, lesser designated sites not appraised in this study such as SSSI, LNR, NNR, and CWS, and ecology outside of designated wildlife sites have potential to interact with the discharged waters. It is recommended that the impacts of the WwTW that will require a new discharge permit are investigated for these lower priority sites and ecological features.

In relation to the Thanet Coastal Designated Sites: As identified, reef habitats of the Thanet coast have historically been vulnerable to toxic contamination from heavy metals within sewage discharges. Whilst this is noted, no water quality detail relating to heavy metals are available as part of this study, and so are not investigated further. It is recommended that the Environment Agency and Natural England determine if there still a current concern for the reef habitats; if it is, further investigation is likely to be required.

6.2.2.7 Other water quality considerations

The study has focused on compliance with WFD and Habitats Directive requirements. It is recommended that once greater spatial certainty on the full quantum of growth is known, that water companies and the Environment Agency consider Bathing Water and Shellfish waters in more detail where revisions to permits to discharge are required.

Appendix A – Water neutrality assumptions and detail

A.1 Improving efficiency in existing development

A.1.1 Metering

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 50l per household per day, assuming an occupancy rate of 2.3 for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker Review). The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table A1).

A1. Change in typical metered and unmetered household bills

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

A.1.2 Low or variable flush toilets

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

A.1.3 Cistern displacement devices

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

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

A.1.4 Low flow taps and showers

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

A.1.5 Pressure control

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

A.1.6 Variable tariffs

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

The Walker review assessed variable tariffs for water, including:

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

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

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

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

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

A.1.7 Water efficient appliances

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

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

A.1.8 Non-domestic properties

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

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

- better soil drainage between the tunnels,
- improved humidity levels inside them; and,

- an improvement in plant health through the use of harvested water.

A.2 Water efficiency in new development

A.2.1 Fixtures and fittings

The use of efficient fixtures and fittings as described in above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions that use of efficient fixtures and fitting has in new builds is to consider what is required in terms of installation of the fixtures and fittings at different ranges of specification to ensure attainment of code levels under the CSH water use requirements. The Cambridge WCS gave a summary of water use savings that can be achieved by the use of efficient fixtures and fittings, as shown below in Table A2.

Table A2. Summary of water savings borne by water efficiency fixtures and fittings

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

[a] Combines kitchen sink and wash hand basin

[b] 6/3 litre dual-flush toilet (f) recycled water

[c] 160 litre bath filled to 40% capacity, frequency of use 0.4/day

[d] 4.5/3 litre dual flush toilet

[e] 120 litre bath

[f] rainwater/greywater harvesting

[g] Assumed garden use

Table A2 highlights that in order to be achieve a for water use of 80 l/p/d water re-use technology (rainwater harvesting and/or greywater recycling) needs to be incorporated into the development.

In using the BRE Water Demand Calculator, the experience of URS BREEAM/CHS assessors is that it is theoretically possible to get close to 80l/p/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that Code Level 5 and 6 can be reached without some form of water recycling.

A.2.2 Rainwater harvesting

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

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure A1 below gives a diagrammatic representation of a typical domestic system.

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

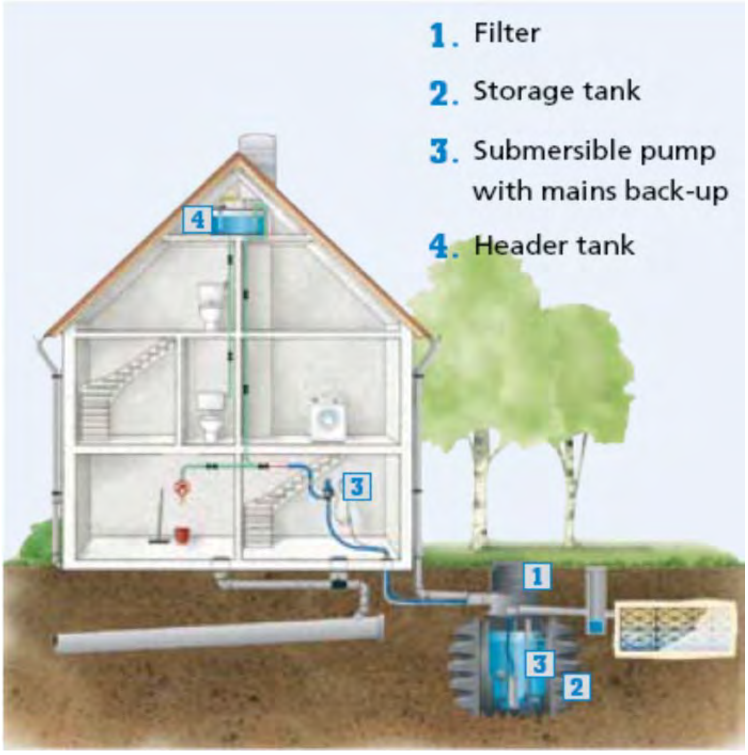


Figure A1: A typical domestic rainwater harvesting system

A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe, approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table A3.

Table A3: Rainwater Harvesting Systems Sizing

Number of occupants	Total water consumption	Roof area (m^2)	Required storage tank (m^3)	Potable water saving per head (l/d)	Water consumption with RWH (l/p/d)
1	110	13	0.44	15.4	94.6
1	110	10	0.44	12.1	97.9
1	110	25	0.88	30.8	79.2
1	110	50	1.32	57.2	52.8
2	220	25	0.88	15.4	94.6
2	220	50	1.76	30.8	79.2
3	330	25	1.32	9.9	100.1
3	330	50	1.32	19.8	90.2
4	440	25	1.76	7.7	102.3
4	440	50	1.76	15.4	94.6

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

A.2.3 Greywater recycling

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

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. A2 below gives a diagrammatic representation of a typical domestic system.

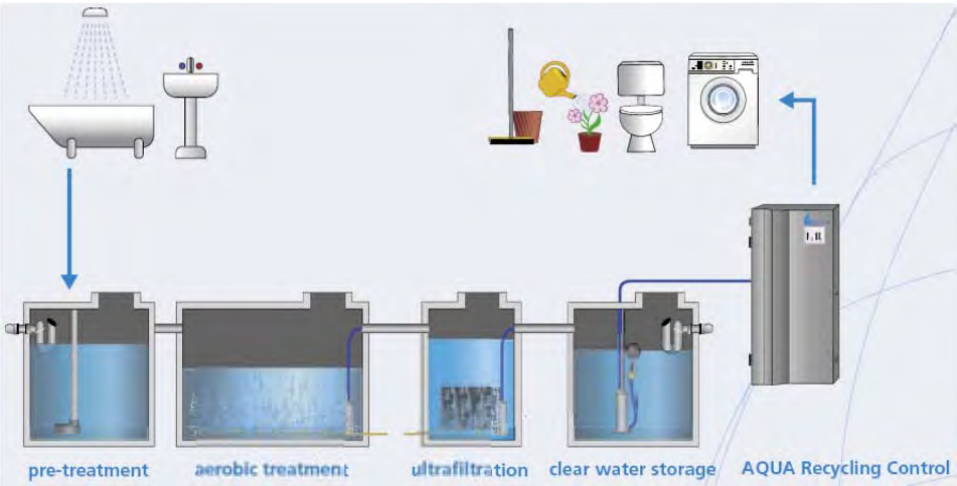


Figure A2: A typical domestic greywater recycling system

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

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

Table A4 demonstrates the water savings that can be achieved by GWR. If the toilet and washing machine are connected to the GWR system a saving of 37 litres per person per day can be achieved.

Table A4: Potential water savings from greywater recycling

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

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

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

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

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

A.3 Financial Cost Considerations for Water Neutrality scenarios

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

A.3.1 New Build Costs

Costs for water efficiency in new property have been provided based on homes achieving different code levels under the CSH based on the cost analysis undertaken by CLG and as set out in Table A6.

Table A6: CSH Specification and costs

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

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

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

A.3.2 Water Recycling

Research into the financial costs of installing and operating GWR systems gives a range of values, as show in Table D7

Table D7: Costs of greywater recycling systems

Cost	Cost	Comments
Installation cost	£1,750	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[79]
	£2,000	For a single dwelling[80]
	£800	Cost per house for a communal system[81]
	£2,650	Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[82]
Operation of GWR	£30 per annum[83]	
Replacement costs	£3,000 to	It is assumed a replacement system will be required every 25

[79] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[80] http://www.water-efficient-buildings.org.uk/?page_id=1056 (link no longer valid)
[81] http://www.water-efficient-buildings.org.uk/?page_id=1056 (link no longer valid)
[82] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[83] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

replace[84]	years

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

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

A.3.3 Installing a Meter

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

A.3.4 Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England , costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table A8.

Table A8: Water saving methods

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

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

A.4 Metering assumptions across Kent

The existing level of metering within each Water Company in the supply area, as well as the 2030/31 metering target, is shown in Table A1 below.

Table A7: Percentages of properties metered currently and in 2030/31

Water Company	Percentage of properties currently metered	Current Savings from meters installations (L/household/day)	Percentage of properties metered in 2030/31
Southern Water -Kent Medway	80%	35.82	95%
Southern Water - Kent Thanet	63%	16.46	92%
South East Water	49%	20.60	97.5%
Affinity Water	93%	N/A	97.5%

[84] LOST LINK – IDENTIFY & REPLACE

Water Company	Percentage of properties currently metered	Current Savings from meters installations (L/household/day)	Percentage of properties metered in 2030/31
Thames Water	32%	75.02	52%
Sutton and East Surrey	38%	17.00	95%

The percentages of the metered properties in 2030/31 shown in Table A1 above are either extrapolated or assumed values, which are derived from the 2015 WRMPs of each of the Water Companies

The Southern Water WRMP for Medway states that by the end of AMP5, 92% of the properties in the area should be metered. Recent updates have shown that 80% of the properties are metered in 2015. Similarly, the Southern Water WRMP for Thanet stated that by the end of AMP5, 92% of the properties would be metered; however recent updates illustrated that only 63% was metered by 2015.

South-East Water WRMP indicated that by 2020 almost 90% of the properties will metered, and, therefore, it is assumed that by 2030, 97.5% of meter penetration would be feasible.

The proportion of metered properties within Affinity Water is based on the current meter penetration.

Thames Water WRMP identified that by 2029/30, approximately 51.4% of the properties would have a meter installed.

Finally, the South-East Water WRMP stated in its Business Plan that by 2020, a 60% meter penetration would be achieved, so it is assumed that by 2030/31, 95% of the properties would be metered.

Appendix B – Detailed water quality assessment outputs

Water for Sustainable Growth Study Kent County Council - WFD Assessments

LOAD STANDSTILL ASSESSMENT - Nov 2016

	Faversham WwTW	Queenborough WwTW	Whitewall Creek WwTW		Wouldham WwTW
	BOD	BOD	BOD	Ammonia	BOD
Downstream of Discharge	The Swale	West Swale	River Meadway		River Meadway
No Deterioration target	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Esturine/coastal quality target (90-percentile)	¾	¾	¾	¾	¾
LCT	5	5	5	5	5
Current DWF Permit					
Current DWF (m^3/day)	**7140**	**10157**	**5013**		**149**
Permit limits (95%ile)	40	40	25	20	70
Permit exceeded?	Yes - current permit 7000 m^3/day	No	No		No
(C6) Discharge Permit Required					
Future DWF (m^3/day)	**7620**	**11401**	**5625**		**853**
Quality permit required (95%ile)	**37.5**	**35.6**	**22.3**	**17.8**	**12.3**
2 - No. already within conventional treatment limits & Permit needs tightening.	**2**	**2**	**2**	**2**	**2**
Result - Will Growth prevent WFD No deterioration Status from being achieved?	No. Permit needs tightening	No. Permit needs tightening	No. Permit needs tightening	No. Permit needs tightening	No. Permit needs tightening

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

Water for Sustainable Growth Study Kent County Council - WFD Assessments

'NO DETERIORATION' ASSESSMENT - 18/11/16

	Biddenden WwTW			Canterbury WwTW			Harrietsham WwTW		
	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate
River Downstream of Discharge	Hammer Stream (Beult Catchment, drains to Medway)			Great Stour (between A2 and West Stourmouth) (Drains to Stour)			River Len (Middle Medway catchment, drains into Medway)		
No Deterioration target	No Designation	High	Poor	No Designation	High	Poor	No Designation	High	Moderate
Designated Salmonid Fishery ?									
River quality target (90-percentile or AA)	n/a	0.30	1.00	n/a	0.30	1.00	n/a	0.30	0.17
LCT	5	1	0.5	5	1	0.5	5	1	0.5
Current Permit									
Current DWF (m^3/day)	655			20740			249		
Permit limits (95%ile or AA)	10	4	2	15	4	no permit	15	5	1
Current effluent quality required (95%ile or AA)	**n/a**	**0.83**	**1.35**	**n/a**	**6.97 - retain 4**	**10.11**	**n/a**	**5.63**	**1.07**
DWF Permit already exceeded?	YES - Permit 605 m^3/day			YES - Permit 20176 m^3/day			NO		
Discharge Quality Required									
Future DWF (m^3/day)	688			23434			440		
Effluent quality required (95%ile or AA)	**8.80**	**0.82**	**1.33**	**13.30**	**6.26 - retain 4**	**9.08**	**5.7**	**3.42**	**0.69**
1 - No. No tightening required; **2 -** No. Tightening required; **3 -** No. already below conventional treatment limits	2	3	2	2	1	2	2	2	2
Will Growth prevent WFD objective of 'No Deterioration' from being achieved ? (worst case descriptor)	**No - tightening required for BOD, ammonia already below LCT. Check if WwTW can treat ammonia further below LCT. Set new permit for phosphate.**			**No - tightening required for BOD, retain existing permit for ammonia & set new permit for phosphate.**			**NO - tighten all permits for BOD, ammonia and phosphate.**		

'IMPROVEMENT TO GOOD STATUS' ASSESSMENT - 18/11/16

	Biddenden WwTW			Canterbury WwTW			Harrietsham WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge									
WFD Status target	High	High	Good	No Designation	High	Good	No Designation	High	Good
River quality target (90-percentile or AA)			0.069			0.069			0.069
Discharge Quality Required - Current									
Current DWF (m^3/day)	655			20740			249		
Effluent quality required (95%ile or AA)			**0.08**			**0.24**			**0.36**
Discharge Quality Required - Future									
Future DWF (m^3/day)	688			23434			440		
Effluent quality required (95%ile or AA)			**0.08**			**0.22**			**0.24**
2 - No. already within conventional treatment limits & needs tightening. **3 - No.** already below conventional treatment limits			3			3			3
Will Growth prevent WFD Good Status from being achieved ?	**No - Phosphate already below LCT**			**No - Phosphate already below LCT**			**No - Phosphate already below LCT**		

Water for Sustainable Growth Study Kent County Council - WFD Assessments

'NO DETERIORATION' ASSESSMENT - 18/11/16

	High Halden WwTW			Newnham Valley Preston WwTW			Paddock Wood WwTW		
	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate
River Downstream of Discharge	Upper Beult - High Halden and Bethersden Stream (Beult drains Medway Catchment)			Little Stour (Wingham and Little Stour) (drains into Stour catchment)			Lower Teise (drains into Medway catchment)		
No Deterioration target	No Designation	High	Poor	No Designation	Good	Poor	No Designation	High	Poor
Designated Salmonid Fishery ?									
River quality target (90-percentile or AA)	n/a	0.30	1.00	n/a	0.60	1.00	n/a	0.30	1.00
LCT	5	1	0.5	5	1	0.5	5	1	0.5
Current Permit									
Current DWF (m^3/day)	195			3457			2048		
Permit limits (95%ile or AA)	10	4	1	30	10	no permit	10	3	no permit
Current effluent quality required (95%ile or AA)	**n/a**	**2.64**	**2.63 - retain 1**	**n/a**	**62.78 - retain 10**	**23.22**	**n/a**	**0.67**	**1.23**
DWF Permit already exceeded?	NO			YES Permit 2371 m^3/day			NO		
Discharge Quality Required									
Future DWF (m^3/day)	231			3492			2574		
Effluent quality required (95%ile or AA)	**8.4**	**2.37**	**2.4 - retain 1**	**29.7 - retain 30**	**62.18 - retain 10**	**23**	**8**	**0.63**	**1.19**
1 - No. No tightening required; **2 -** No. Tightening required; **3 -** No. already below conventional treatment limits	2	2	1	1	1	1	2	3	1
Will Growth prevent WFD objective of 'No Deterioration' from being achieved ? (worst case descriptor)	**No - BOD & ammonia needs tightening, retain existing phosphate permit.**			**No - retain existing permit for BOD and ammonia. Set new permit for phosphate.**			**No - BOD permit needs tightening, ammonia already below LCT. Check if WwTW can treat ammonia further below LCT. Set new permit for phosphate.**		

'IMPROVEMENT TO GOOD STATUS' ASSESSMENT - 18/11/16

	High Halden WwTW			Newnham Valley Preston WwTW			Paddock Wood WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge									
WFD Status target	No Designation	High	Good	No Designation	Good	Good	No Designation	High	Good
River quality target (90-percentile or AA)			0.069			0.069			0.069
Discharge Quality Required - Current									
Current DWF (m^3/day)	195			3457			2048		
Effluent quality required (95%ile or AA)			**0.13**			**0.70**			**0.08**
Discharge Quality Required - Future									
Future DWF (m^3/day)	231			3492			2574		
Effluent quality required (95%ile or AA)			**0.12**			**0.69**			**0.08**
2 - No. already within conventional treatment limits & needs tightening. **3 - No.** already below conventional treatment limits			3			2			3
Will Growth prevent WFD Good Status from being achieved ?	**No - Phosphate already below LCT**			**No - Phosphate within LCT & needs tightening**			**No - Phosphate already below LCT**		

Water for Sustainable Growth Study Kent County Council - WFD Assessments

'NO DETERIORATION' ASSESSMENT - 18/11/16

	Tunbridge Wells South WwTW			Edenbridge WwTW			Leeds WwTW		
	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate
River Downstream of Discharge	River Grom (Upper Medway part of the Medway catchment)			Lower Eden waterbody - River Eden (part of the Medway catchment)			River Len (drains to Middle Medway, Medway catchment)		
No Deterioration target	No Designation	Moderate	Moderate	Moderate	High	Poor	No Designation	High	Moderate
Designated Salmonid Fishery ?									
River quality target (90-percentile or AA)	n/a	1.10	0.17	6.5	0.30	1.00	n/a	0.30	0.17
LCT	5	1	0.5	5	1	0.5	5	1	0.5
Current Permit									
Current DWF (m^3/day)	8100			1794			1019		
Permit limits (95%ile or AA)	12	4	no permit	10	5	no permit	15	3	no permit
Current effluent quality required (95%ile or AA)	n/a	7.45 - retain 4	0.31	n/a	3.94	0.22	n/a	1.97	0.22
DWF Permit already exceeded?	NO			NO			NO		
Discharge Quality Required									
Future DWF (m^3/day)	9358			2258			1393		
Effluent quality required (95%ile or AA)	10.4	6.96 - retain 4	0.29	7.9	3.29	0.37	11	1.76	0.21
1 - No. No tightening required; **2 -** No. Tightening required; **3 -** No. already below conventional treatment limits	2	1	3	2	2	3	2	2	3
Will Growth prevent WFD objective of 'No Deterioration' from being achieved ? (worst case descriptor)	**No - BOD permit needs tightening, ammonia permit can be retained, phosphate already below LCT. Check if WwTW can treat phosphate further below LCT.**			**No - BOD & ammonia permit needs tightening, phosphate already below LCT. Check if WwTW can treat phosphate further below LCT.**			**No - BOD & ammonia permit needs tightening, phosphate already below LCT. Check if WwTW can treat phosphate further below LCT.**		

'IMPROVEMENT TO GOOD STATUS' ASSESSMENT - 18/11/16

	Tunbridge Wells South WwTW			Edenbridge WwTW			Leeds WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge									
WFD Status target	No Designation	Good	Good	Moderate	High	Good	No Designation	High	Good
River quality target (90-percentile or AA)		0.6	0.069			0.069			0.069
Discharge Quality Required - Current									
Current DWF (m^3/day)	8100			1794			1019		
Effluent quality required (95%ile or AA)		4.06	0.09			0.30			0.09
Discharge Quality Required - Future									
Future DWF (m^3/day)	9358			2258			1393		
Effluent quality required (95%ile or AA)		3.79	0.09			0.26			0.08
2 - No. already within conventional treatment limits & needs tightening. **3 - No.** already below conventional treatment limits		2	3			3			3
Will Growth prevent WFD Good Status from being achieved ?	**No - Ammonia within CTL & needs tightening, Phosphate already below LCT**			**NO - Phosphate already below LCT**			**No - Phosphate already below LCT**		

Water for Sustainable Growth Study Kent County Council - WFD Assessments

'NO DETERIORATION' ASSESSMENT - 18/11/16

	May Street Herne Bay WwTW Great Stour			Ham Hill WwTW		
	BOD - LS	Ammonia	Phosphate	BOD - LS	Ammonia	Phosphate
River Downstream of Discharge	(Lower Stour, Great Stour between A2 and West Stourmouth)			River Meadway		
No Deterioration target	No Designation	High	Poor	Good	High	Poor
Designated Salmonid Fishery ?						
River quality target (90-percentile or AA)	n/a	0.30	1.00	5.0	0.30	1.00
LCT	5	1	0.5	5	1	0.5
Current Permit						
Current DWF (m^3/day)	5085			11553		
Permit limits (95%ile or AA)	10	3	no permit	25	25	no permit
Current effluent quality required (95%ile or AA)	**n/a**	**41.58 - retain 3**	**32.81**	**n/a**	**17.65**	**40.3**
DWF Permit already exceeded?	NO			NO		
Discharge Quality Required						
Future DWF (m^3/day)	6371			13972		
Effluent quality required (95%ile or AA)	**8**	**33.46 - retain 3**	**26.43**	**20.7**	**14.78**	**33.59**
1 - No. No tightening required; **2 -** No. Tightening required; **3 -** No. already below conventional treatment limits	2	1	1	2	2	1
Will Growth prevent WFD objective of 'No Deterioration' from being achieved ? (worst case descriptor)	**NO - BOD permit needs tightening, retain exisitng ammonia permit, set new phosphate permit.**			**NO - Ammonia & BOD permit needs tightening. Set new phosphate permit.**		

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

'IMPROVEMENT TO GOOD STATUS' ASSESSMENT - 18/11/16

	May Street Herne Bay WwTW Great Stour			Ham Hill WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge						
WFD Status target	No Designation	High	Good	Good	High	Good
River quality target (90-percentile or AA)			0.069			0.069
Discharge Quality Required - Current						
Current DWF (m^3/day)	5085			11553		
Effluent quality required (95%ile or AA)			**0.80**			**0.87**
Discharge Quality Required - Future						
Future DWF (m^3/day)	6371			13972		
Effluent quality required (95%ile or AA)			**0.65**			**0.73**
2 - No. already within conventional treatment limits & needs tightening. **3 - No.** already below conventional treatment limits			2			2
Will Growth prevent WFD Good Status from being achieved ?	**No - Phosphate above LCT & needs tightening**			**No - Phosphate within LCT & needs tightening**		

Appendix C – WwTW water quality assessment detail

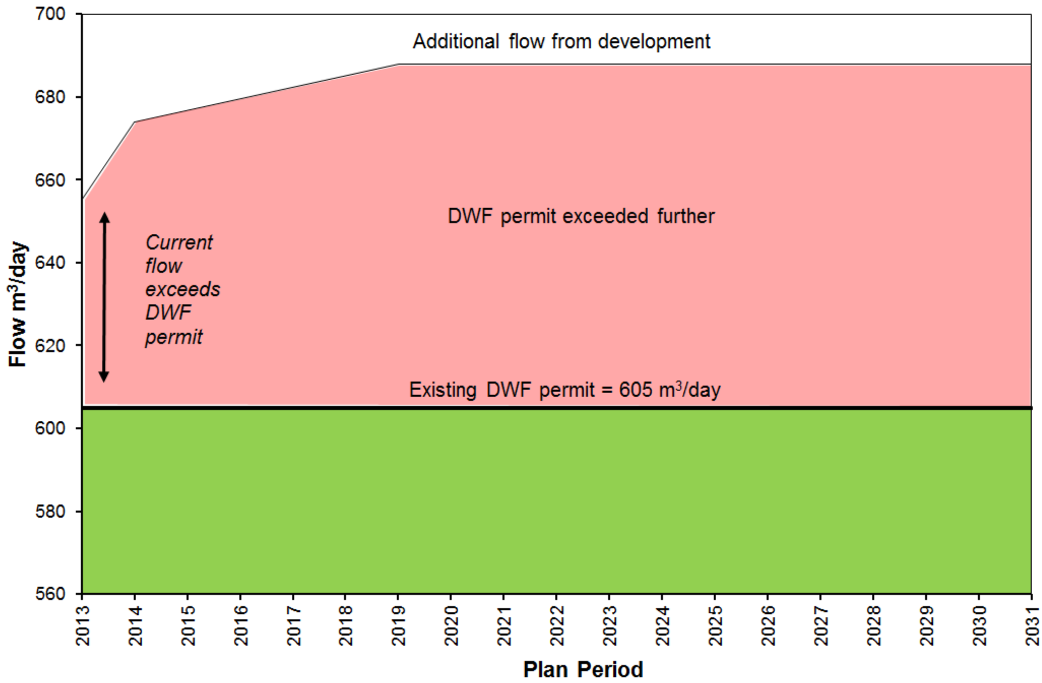
C.1 Biddenden WwTW

Headroom phasing

The headroom assessment has demonstrated that Biddenden WwTW does not currently have sufficient flow headroom in its discharge permit to accept development. In addition, according to data provided by Southern Water, the WwTW is already exceeding its existing DWF permit as shown in Figure C1.

Therefore, until additional flow headroom can be made available at the WwTW, any development connecting to the WwTW would result in the existing DWF permit being exceeded further, and by a total volume of 83 m^3/d (equivalent to approximately 283 dwellings) by the end of the plan period.

Figure C1 Biddenden WwTW DWF across plan period and DWF permit exceedance



Environmental Baseline

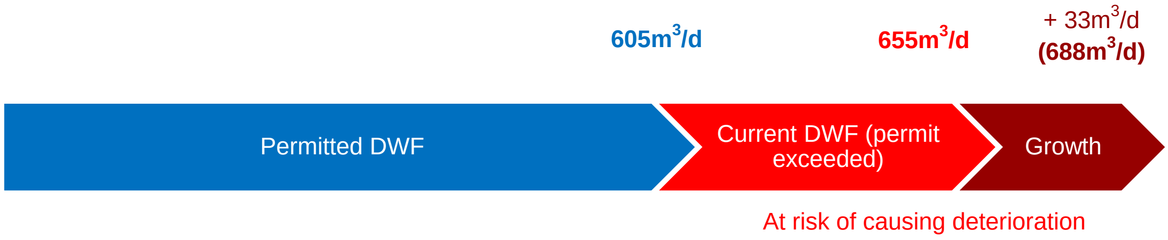
Biddenden WwTW discharges to the Hammer Stream, part of the Beult Catchment which drains into the Medway. Hammer Stream currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the status of invertebrates (Moderate), phosphate (Poor) and surface water mitigation measures (Moderate). The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

WFD Compliance test – No Deterioration

As Biddenden WwTW discharges to the freshwater Hammer Stream, a range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine the ammonia and phosphate quality conditions that would be required to ensure no deterioration in ammonia and phosphate status. C2 demonstrates where the risk of deterioration arises in relation to increasing flow.

Figure C2: Biddenden WwTW DWF permit, DWF permit exceedance and additional DWF from growth



The results showed that for ammonia the WwTW is currently treating the discharge (which exceeds the permitted DWF, as illustrated in Figure C-2) to below LCT. A revised ammonia quality condition (below LCT) and a new phosphate quality condition (above LCT) on the discharge permit would be required to ensure no deterioration in status. Ammonia at Biddenden is already being treated below LCT (0.83 mg/l) and so the revised condition (0.82 mg/l) although also below LCT is not deemed to be significant in relation to amount of growth in the WwTW's catchment.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can be achieved with within LCT.

WFD Compliance – Achieve Future Target Status

The Hammer Stream has an alternative objective of 'Moderate' Ecological status set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than Good status of phosphate as well as invertebrates and surface water mitigation measures.

The Reasons for Not Achieving Good (RNAG) as outlined in the Thames RBMP (which includes catchments draining the Medway), relevant to the Hammer Stream have been provided in Table C1 below.

Table C1: Reasons for not achieving good status on the Hammer Stream (GB106040018290)

Category	Activity	Activity Certainty	Classification Element	Objective
Agriculture and rural land management	Mixed agricultural	Suspected	Phosphate	Moderate by 2027
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Moderate by 2027
Urban and transport	Unsewered domestic sewage	Probable	Phosphate	Moderate by 2027

The Hammer Stream currently has high phosphorus concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge, including probable unsewered domestic sewerage. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the invertebrate communities, preventing the waterbody from achieving 'Good' Ecological status.

To determine whether growth itself is a barrier to attaining a future 'Good' status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

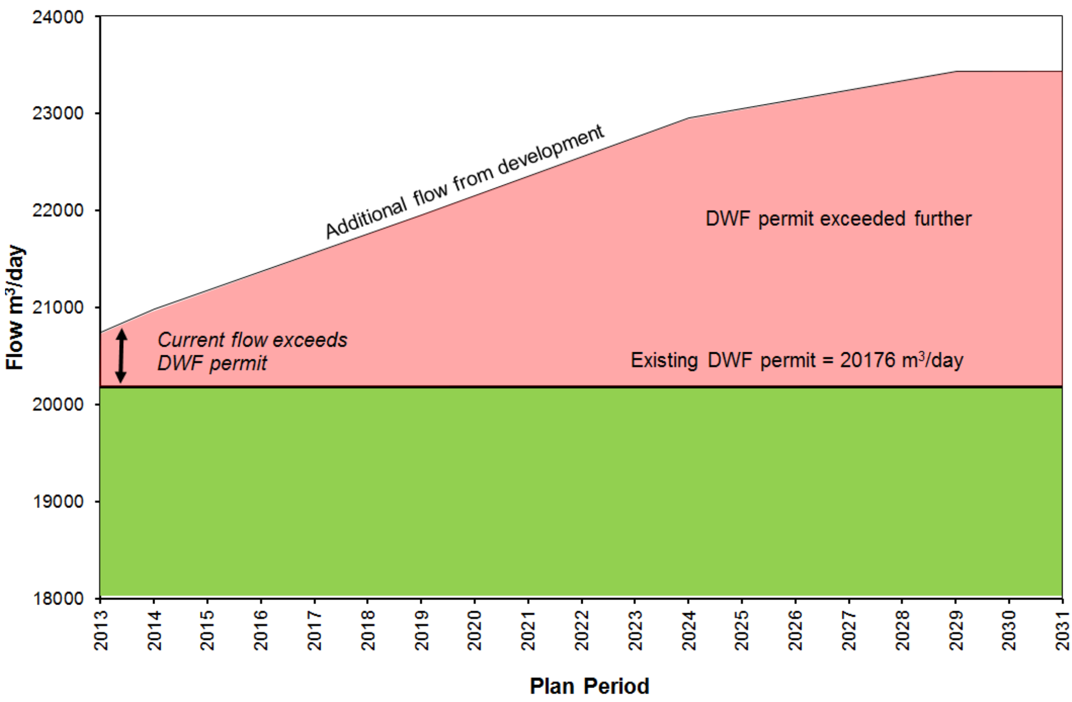
C.2 Canterbury WwTW

Headroom phasing

The headroom assessment has demonstrated that Canterbury WwTW does not currently have sufficient flow headroom in its existing discharge permit to accept development[85]. In addition, according to data provided by Southern Water, the WwTW is already exceeding its existing DWF permit as shown in Figure C3.

Therefore, until additional flow headroom can be made available at the WwTW, any development connecting to the WwTW would result in the existing DWF permit being exceeded further, and by a total volume of 3258 m^3/d (equivalent to approximately 11092 dwellings) by the end of the plan period.

Figure C3: Canterbury WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Canterbury WwTW discharges to the Great Stour and forms part of the Stour catchment. The Great Stour (section between the A2 and West Stourmouth) currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the 'Moderate' status of fish, 'Poor' status of Phosphate and 'Moderate or less' status of surface water in the supporting elements of the mitigation measures assessment. The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

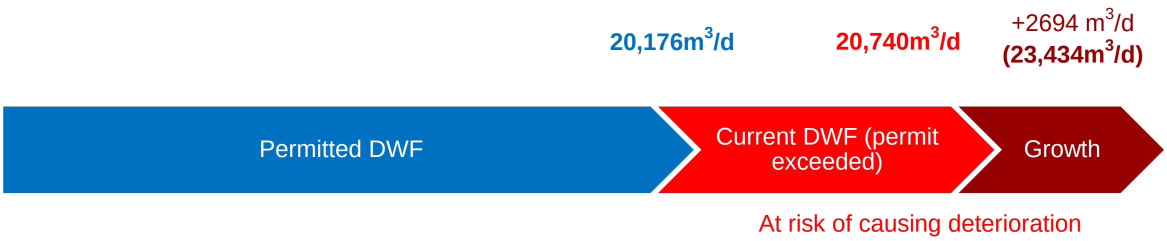
As Canterbury WwTW discharges to the freshwater Great Stour, a range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in

[85] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

ammonia and phosphate status. RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine the ammonia and phosphate quality conditions that would be required to ensure no deterioration in ammonia and phosphate status. Figure C4 demonstrates where the risk of deterioration arises in relation to increasing flow.

Figure C4: Canterbury WwTW DWF permit, DWF permit exceedance and additional DWF from growth



The results showed that a new phosphate quality condition (above LCT) on the discharge permit would be required to ensure no deterioration in status, but that the existing ammonia quality condition on the permit could be retained.

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

WFD compliance – Achieve Future Target Status

The Great Stour has an alternative objective of 'Moderate' Ecological set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than 'Good' status of phosphate as well as fish and surface water mitigation measures.

The RNAG as outlined in the South East RBMP (which includes catchments draining the Stour), relevant to the Great Stour have been provided in Table C2.

Table C2: Reasons for not achieving good status on the Great Stour (between A2 and West Stourmouth) (GB107040019743)

Category	Activity	Activity Certainty	Classification Element	Objective
Agriculture and rural land management	Mixed agricultural	Probable	Phosphate	Moderate by 2027
Agriculture and rural land management	Mixed agricultural	Probable	Phosphate	Moderate by 2027
Urban and transport	Drainage - mixed	Suspected	Phosphate	Moderate by 2027
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Moderate by 2027

The Great Stour currently has high phosphorus concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge, including drainage from urban areas and transport. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving 'Good' Ecological status.

To determine whether growth itself is a barrier to attaining a future 'Good' target for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

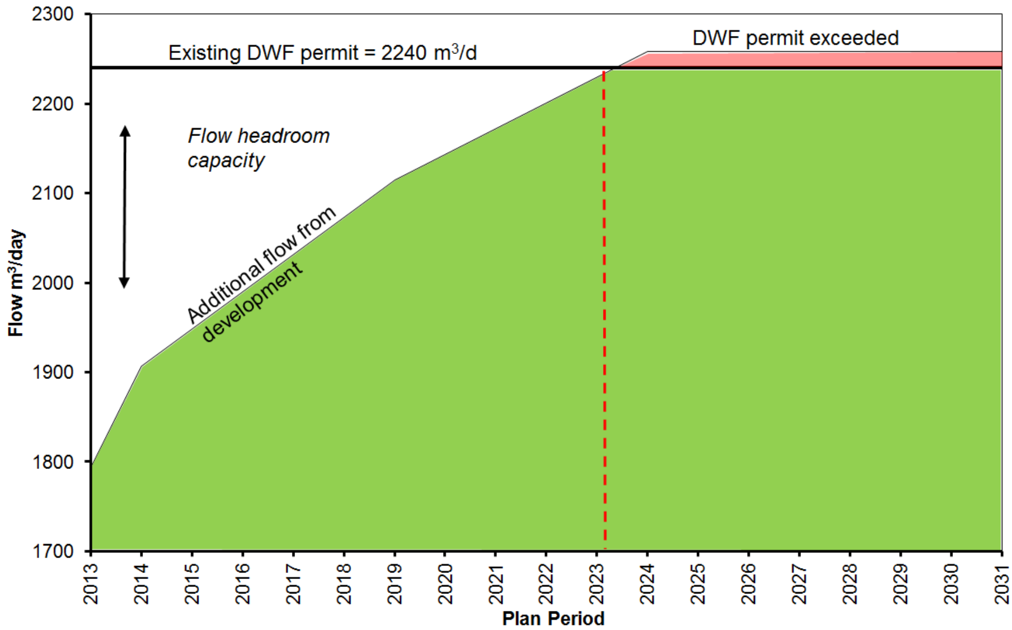
C.3 Edenbridge WwTW

Headroom phasing

The headroom assessment has demonstrated that Edenbridge WwTW currently has flow headroom in its existing discharge permit and can accept development of approximately 1,094 dwellings[86]. Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded in 2023, as shown in Figure C5 thereby demonstrating that most of the proposed growth can be accommodated.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 1,094 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 18 m^3/d (equivalent to approximately 61 dwellings) by the end of the plan period.

Figure C5: Edenbridge WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Edenbridge WwTW discharges to the Lower Eden WFD waterbody and forms part of the Medway catchment. The Lower Eden currently has an overall waterbody status of 'Moderate', with the alternative objective set to retain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the 'Moderate' status of BOD, macrophytes & phytobenthos combined and the moderate or less status of the surface water supporting elements of the mitigation measures assessment. The overall status is also limited to 'Moderate' due to the 'Poor' status of phosphate. The waterbody has a 'High' status for ammonia.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that for ammonia a revised quality condition on the permit would be required to ensure no deterioration in status (above LCT) and a new permit for phosphate (below LCT). Phosphate at Edenbridge is already being treated below LCT (0.37 mg/l) and so the revised condition (0.22 mg/l) although also below LCT is not deemed to be significant in relation to amount of growth in the WwTW's catchment.

[86] KCC completed, allocated & extrapolated unallocated housing allocation 2017-21

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

WFD compliance – Achieve Future Target Status

The Lower Eden has an alternative objective of ‘Moderate’ Ecological status set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of phosphate, BOD, macrophytes and phytobenthos combined, and surface water mitigation measures.

The RNAG as outlined in the Thames RBMP, relevant to the Lower Eden have been provided in Table C3below.

Table C3: Reasons for not achieving good status on the Lower Eden (GB106040018160)

Category	Activity	Activity Certainty	Classification Element	Objective
Domestic General Public	Unsewered domestic sewage	Suspected	Phosphate	Poor by 2021
Water Industry	Sewage discharge (continuous)	Probable	Phosphate	Poor by 2021
Agriculture and rural land management	Mixed agricultural	Probable	Phosphate	Poor by 2021

The Lower Eden currently has high phosphorus concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge, including suspected unsewered domestic sewerage. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the macrophyte and phytobenthos communities, preventing the waterbody from achieving ‘Good’ Ecological status.

To determine whether growth itself is a barrier to attaining a future ‘Good’ status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

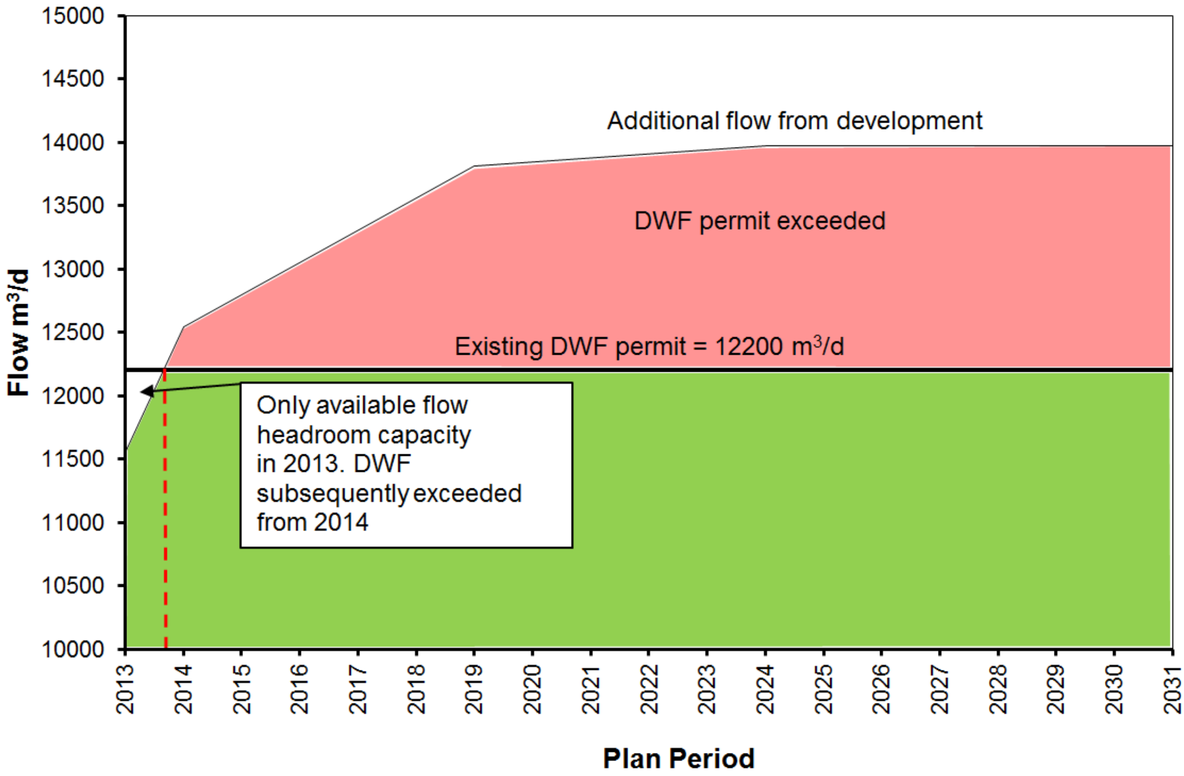
C.4 Ham Hill WwTW

Headroom phasing

The headroom assessment has demonstrated that Ham Hill WwTW had flow headroom only in 2013, and that subsequently, additional growth caused the DWF permit to be exceeded in 2014[87]. A cautious approach is taken as the measured DWF is based on the 3 year 20%ile average (2013-2015) but is plotted for 2013. Allocated, completed and extrapolated unallocated growth for the KCC period 2012-2016 is assumed to take place in 2014. Based on the latest housing trajectory provided by KCC, the existing discharge permit was exceeded in 2014, as shown in Figure C6.

Unless additional flow headroom can be made available at the WwTW to accept further development, connecting this development to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 1772 m^3/d (equivalent to approximately 6034 dwellings) by the end of the plan period.

Figure C6. Ham Hill WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Ham Hill WwTW discharges to the River Medway. The Medway Estuarine waterbody status does not have a status for phosphate, BOD or ammonia and so the upstream status from the 'Medway at Maidstone' riverine waterbody was used. Although Ham Hill WwTW discharges into an estuarine influenced waterbody the intensity of saline influence varies over time at this position. A precautionary approach has been taken using RQP and load standstill as a riverine waterbody. The 'Medway at Maidstone' currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the status of fish (Poor), phosphate (Poor) and surface water mitigation measures (Moderate or less). The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

[87] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that a revised ammonia quality condition and a new phosphate quality condition (both above LCT) on the discharge permit would be required to ensure no deterioration in status.

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

WFD compliance – Achieve Future Target Status

The ‘Medway at Maidstone’ waterbody has an alternative objective of ‘Moderate’ Ecological set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of fish, phosphate and surface water mitigations.

The RNAG as outlined in the Medway RBMP, relevant to the ‘Medway at Maidstone’ waterbody have been provided in Table C4.

Table C4: Reasons for not achieving good status on the ‘Medway at Maidstone’ (GB106040018440)

Category	Activity	Activity Certainty	Classification Element	Objective
Urban and transport	Sewage discharge (diffuse)	Suspected	Phosphate	Poor by 2021
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Poor by 2021
Agriculture and rural land management	Mixed agricultural	Probable	Phosphate	Poor by 2021
Domestic General Public	Unsewered domestic sewage	Probable	Phosphate	Poor by 2021

The ‘Medway at Maidstone’ currently has high phosphorus concentrations attributable to surrounding agricultural land uses (arable and livestock) and diffuse sewerage discharge from urban areas and transport, together with point sources of continuous wastewater discharge and unsewered domestic sewerage. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving ‘Good’ Ecological status.

To determine whether growth itself is a barrier to attaining a future ‘Good’ status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

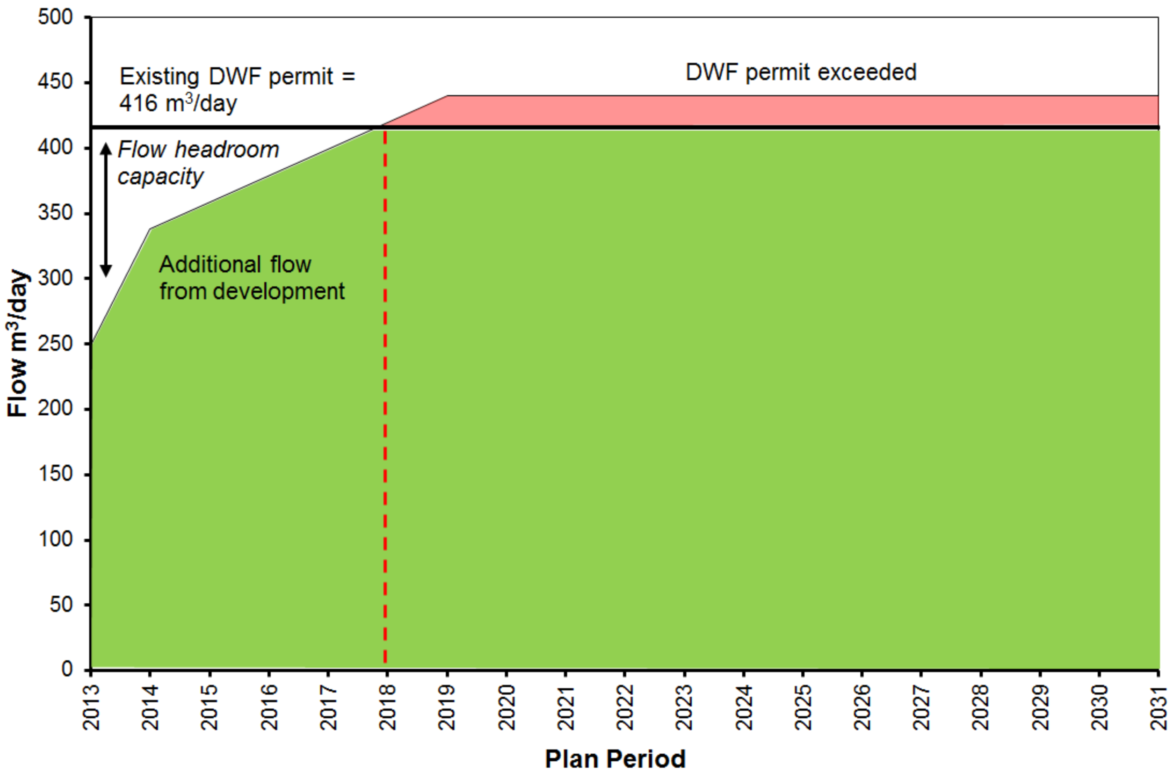
C.5 Harrietsham WwTW

Headroom phasing

The headroom assessment has demonstrated that Harrietsham WwTW currently has flow headroom in its existing discharge permit and can accept development of approximately 303 dwellings[88]. Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded in 2018, as shown in Figure C7.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 303 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 54 m^3/d (equivalent to approximately 82 dwellings) by the end of the plan period.

Figure C7: Harrietsham WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Harrietsham WwTW discharges to River Len and forms part of the Medway catchment. The River Len currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the 'Poor' status of fish, 'Moderate' status of Phosphate and 'Moderate or less' status of surface water in the supporting elements of the mitigation measures assessment. The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled, as agreed with the Environment Agency to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that a revised ammonia quality condition and a new phosphate quality condition (both above LCT) on the discharge permit would be required to ensure no deterioration in status.

[88] KCC completed, allocated & extrapolated unallocated housing allocation 2012-16

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

WFD compliance – Achieve Future Target Status

The River Len has an alternative objective of ‘Moderate’ Ecological set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of phosphate as well as fish and surface water mitigation measures.

The RNAG as outlined in the Thames RBMP, relevant to the River Len have been provided in Table C5 below.

Table C5: Reason for not achieving good status on the River Len (GB106040018430)

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

The River Len currently has high phosphorus concentrations attributable to point sources of wastewater discharge. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving ‘Good’ Ecological status.

To determine whether growth itself is a barrier to attaining a future ‘Good’ status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

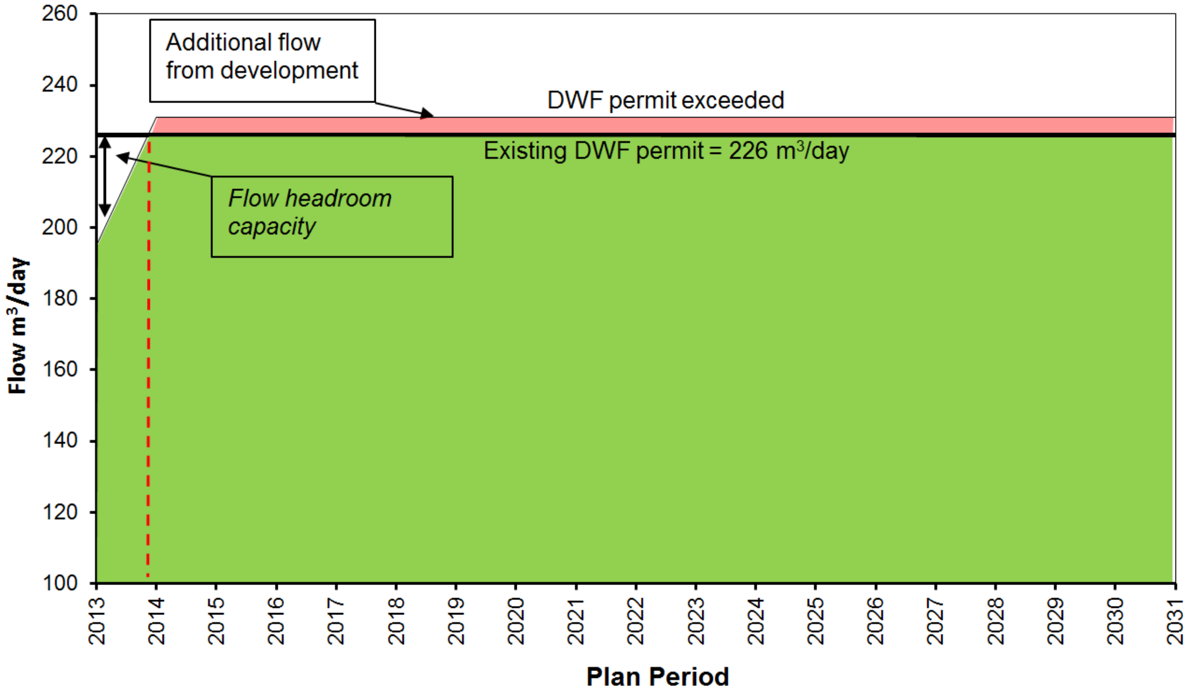
C.6 High Halden WwTW

Headroom phasing

The headroom assessment has demonstrated that High Halden WwTW had flow headroom only in 2013, and that subsequently additional growth caused the DWF permit to be exceeded in 2014[89]. A cautious approach is taken as the measured DWF is based on the 3 year 20%ile average (2013-2015) but is plotted for 2013. Allocated, completed and extrapolated unallocated growth for the KCC period 2012-2016 is assumed to take place in 2014. Based on the latest housing trajectory provided by KCC, the existing discharge permit was exceeded in 2014, as shown in Figure C8.

Unless additional flow headroom can be made available at the WwTW to accept further development, connecting this to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 8 m^3/d (equivalent to approximately 18 dwellings) by the end of the plan period.

Figure C8: High Halden WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

High Halden WwTW discharges to Upper Beult (High Halden & Bethersden Stream) and forms part of the Medway catchment. The Upper Beult (High Halden & Bethersden Stream) currently has an overall waterbody status of ‘Bad’, with the alternative objective to achieve ‘Moderate’ status by 2027. Its current overall status is limited to ‘Bad’ due to the ‘Bad’ status of fish, ‘Poor’ status of phosphate and ‘Poor’ status of dissolved oxygen. The current status for ammonia is ‘High’ and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that a revised ammonia quality condition (above LCT) on the discharge

[89] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

permit would be required to ensure no deterioration in status, but that the current phosphate quality condition (permit) was sufficient to ensure no deterioration in status.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can be achieved with current conventional treatment technology (within LCT).

WFD compliance – Achieve Future Target Status

The Upper Beult (High Halden & Bethersden Stream) has an alternative objective of 'Moderate' Ecological status set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than 'Good' status of phosphate, dissolved oxygen and fish.

The RNAG as outlined in the Thames RBMP, relevant to the Upper Beult (High Halden & Bethersden Stream) have been provided in Table C6.

Table C6:: Reason for not achieving good status on the Upper Beult (High Halden & Bethersden Stream) (GB106040018280)

Category	Activity	Activity Certainty	Classification Element	Objective
Agriculture and rural land management	Mixed agricultural	Suspected	Phosphate	Poor by 2021
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Poor by 2021
Urban and transport	Unsewered domestic sewage	Suspected	Phosphate	Poor by 2021

The Upper Beult currently has high phosphorus concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge, including drainage from unsewered domestic urban areas and transport. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations and macrophytes & phytobenthos combined, preventing the waterbody from achieving 'Good' Ecological status.

To determine whether growth itself is a barrier to attaining a future 'Good' status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

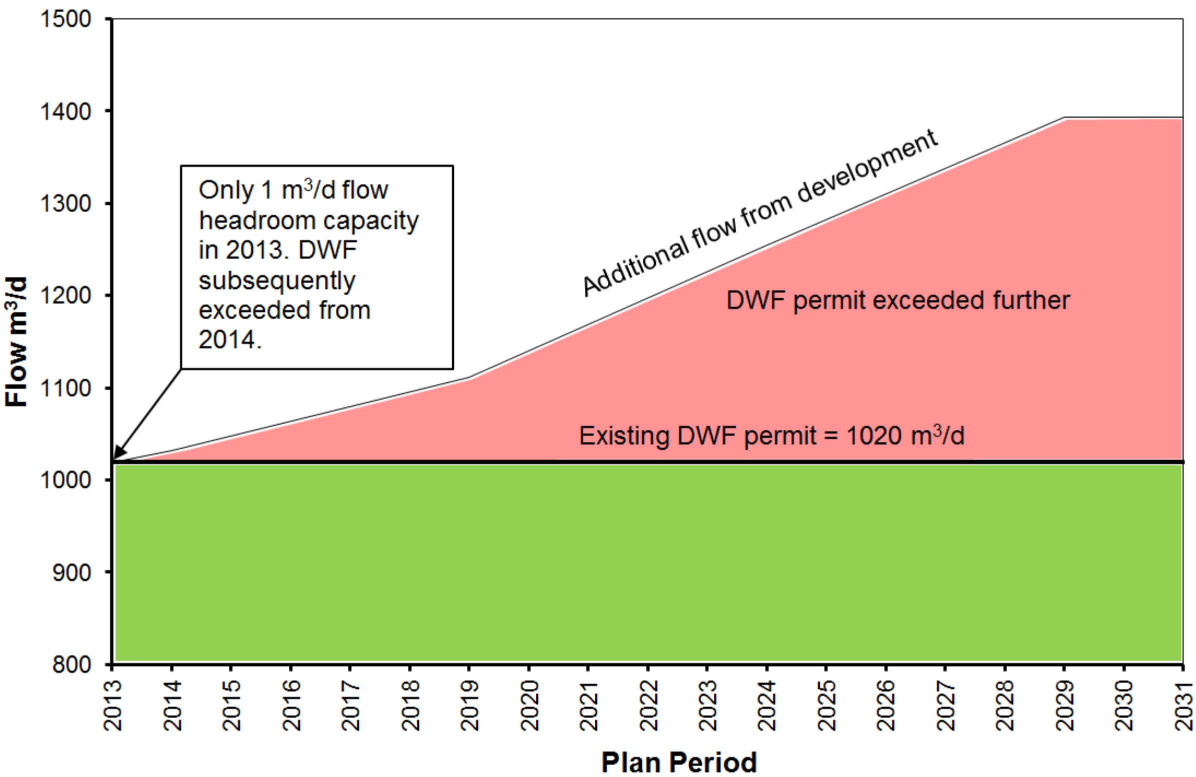
C.7 Leeds WwTW

Headroom phasing

The headroom assessment has demonstrated that Leeds WwTW had minimal flow headroom in 2013, and that subsequently additional growth caused the DWF permit to be exceeded in 2014[90]. A cautious approach is taken as the measured DWF is based on the 3 year 20%ile average (2013-2015) but is plotted for 2013. Allocated, completed and extrapolated unallocated growth for the KCC period 2012-2016 is assumed to take place in 2014. Based on the latest housing trajectory provided by KCC, the existing discharge permit was exceeded in 2014, as shown in Figure C9.

Unless additional flow headroom can be made available at the WwTW to accept further development, connecting this to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 373 m^3/d (equivalent to approximately 1269 dwellings) by the end of the plan period.

Figure C9: Leeds WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Leeds WwTW discharges to the River Len, part of the Middle Medway which drains into the Medway. The River Len currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the status of fish (Poor), phosphate (Moderate) and surface water mitigation measures (Moderate or less). The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled, to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

[90] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that for ammonia a revised quality condition on the permit would be required to ensure no deterioration in status (above LCT) and a new permit for phosphate (below LCT). Phosphate at Leeds WwTW is already being treated below LCT (0.22 mg/l) and so the revised condition (0.21 mg/l) although also below LCT is not deemed to be significant in relation to amount of growth in the WwTW's catchment.

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

WFD compliance – Achieve Future Target Status

The River Len has an alternative objective of 'Moderate' Ecological status set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than 'Good' status of fish, phosphate and surface water.

The RNAG as outlined in the Thames RBMP relevant to the River Len have been provided in Table C7.

Table C7: Reason for not achieving good status on the River Len (GB106040018430)

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

The River Len currently has high phosphorus concentrations attributable to point sources of wastewater discharge. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving 'Good' Ecological status.

To determine whether growth itself is a barrier to attaining a future 'Good' status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

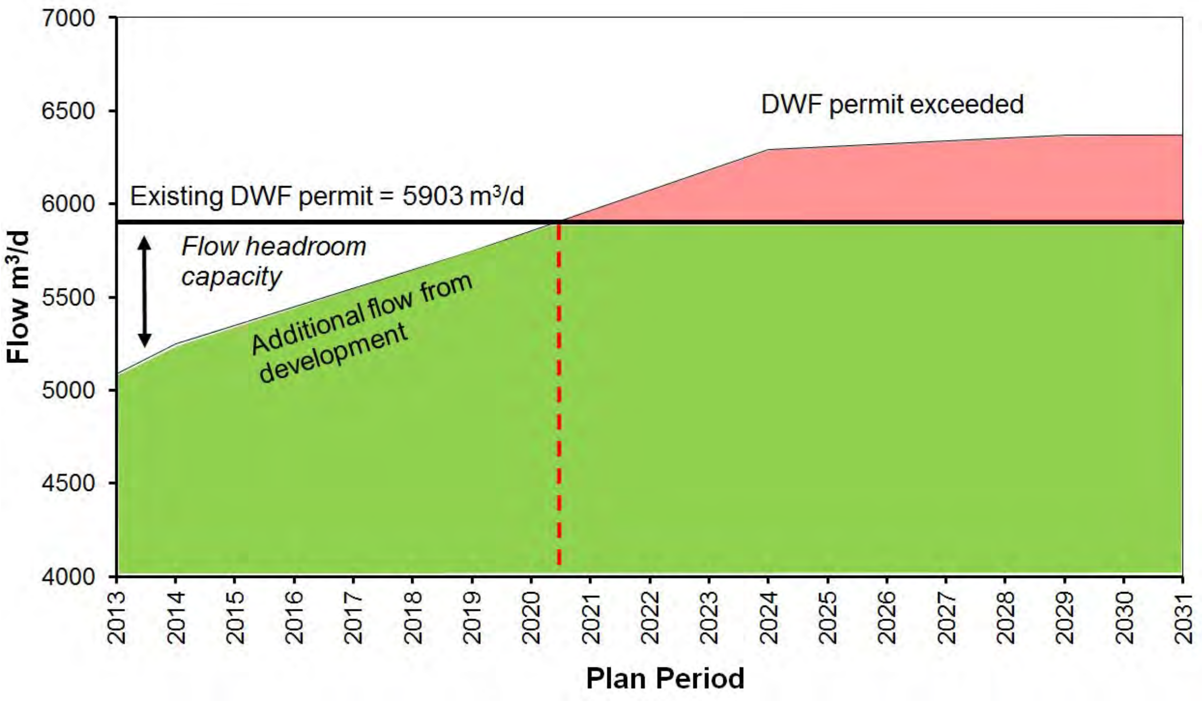
C.8 May Street Herne Bay (Stour Outflow)

Headroom phasing

The headroom assessment has demonstrated that May Street Herne Bay (Stour Outflow) WwTW currently has flow headroom in its existing discharge permit and can accept development of approximately 2256 dwellings. Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded in 2020, as shown in Figure C10.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 2256 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 468 m^3/d (equivalent to approximately 1592 dwellings) by the end of the plan period.

Figure C10: May Street Herne Bay (Stour Outflow) WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

May Street Herne Bay WwTW discharges to the Great Stour (section Great Stour between A2 and West Stourmouth). The Great Stour currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the status of fish (Moderate), phosphate (Poor) and surface water mitigation measures (Moderate or less). The current status for ammonia is 'High' and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions. The RQP and load standstill calculations for this assessment assume all water from May Street Herne Bay WwTW is discharged directly to the Stour and does not enter other watercourses with a WFD designation or designated sites prior to entering the river. As the effluent outfall is located proximal to complex channelisation and the Chislet Marshes SSSI, more complex modelling together with a detailed site investigation would be required to account for flows from May Street Herne Bay entering these watercourses.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status (assuming all flows are directly piped to the Great Stour at 623742 E; 163189 N).

The results showed that for both phosphate and ammonia it is possible to retain the existing quality condition on the permit to ensure no deterioration in status.

The results of the load standstill calculation for BOD showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can be achieved with current conventional treatment technology (within limits of conventional treatment).

WFD compliance – Achieve Future Target Status

The Great Stour has an alternative objective of ‘Moderate’ Ecological status set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of fish, phosphate and surface water.

The RNAG as outlined in the South East RBMP, relevant to the Great Stour have been provided in Table C8.

Table C8: Reasons for not achieving good status on the Great Stour (between A2 and West Stourmouth) (GB107040019743)

Category	Activity	Activity Certainty	Classification Element	Objective
Agriculture and rural land management	Mixed agricultural (arable)	Probable	Phosphate	Moderate by 2027
Agriculture and rural land management	Mixed agricultural (livestock)	Probable	Phosphate	Moderate by 2027
Urban and transport	Drainage - mixed	Suspected	Phosphate	Moderate by 2027
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Moderate by 2027

The Great Stour currently has high phosphorus concentrations attributable to surrounding agricultural land uses (arable and livestock) together with point sources of continuous wastewater discharge and urban/transport drainage. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving ‘Good’ Ecological status.

To determine whether growth itself is a barrier to attaining a future ‘Good’ status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was above LCT demonstrating that growth would not limit attainment of Good Status and that good status could be achieved in a future condition.

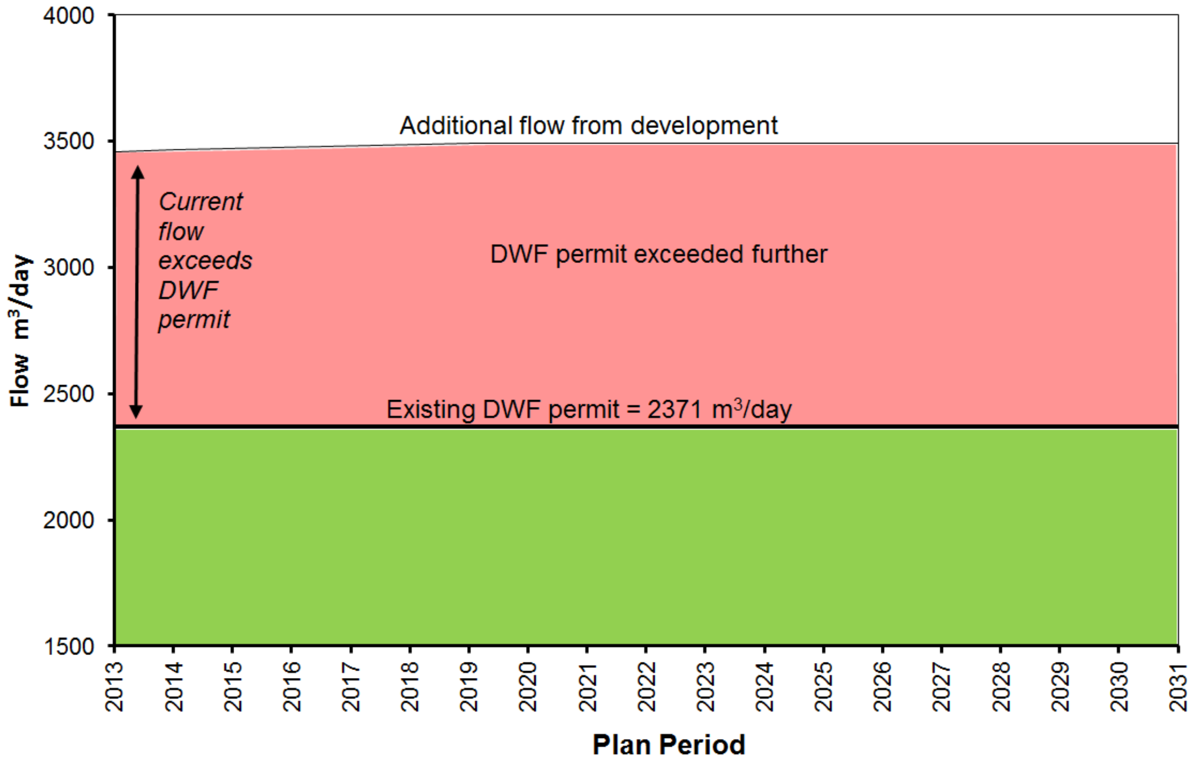
C.9 Newnham Valley Preston

Headroom assessment

The headroom assessment has demonstrated that Newnham Valley Preston WwTW does not currently have flow headroom in its existing discharge permit. In addition, according to data provided by Southern Water, the WwTW is already exceeding its existing DWF as shown in Figure C11.

Therefore, until additional flow headroom can be made available at the WwTW, any development connecting to the WwTW would result in the existing DWF permit being exceeded further, and by a total volume of 1121 m^3/d (equivalent to approximately 3815 dwellings) by the end of the plan period.

Figure C11: Newnham Valley Preston WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Newnham Valley WwTW discharges to the Little Stour (Wingham and Little Stour waterbody) and forms part of the Stour catchment. The Little Stour (Wingham and Little Stour waterbody) currently has an overall waterbody status of 'Poor', with the alternative objective to achieve 'Moderate' status by 2027. Its current overall status is limited to 'Poor' due to the 'Poor' status of fish, phosphate and dissolved oxygen. The current status for ammonia is 'Good' and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that existing permit conditions would be adequate to maintain WFD status.

WFD compliance – Achieve Future Target Status

The Little Stour (Wingham and Little Stour waterbody) has an alternative objective of ‘Moderate’ Ecological status set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of phosphate, dissolved oxygen and fish.

The RNAG as outlined in the South East RBMP (which includes catchments draining the Stour), relevant to the Little Stour have been provided in Table C9.

Table C9: Reason for not achieving good status on the Little Stour (Wingham and Little Stour waterbody) (GB107040019570)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (diffuse)	Suspected	Phosphate	Poor by 2021
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Poor by 2021
Sector under investigation	Unsewered domestic sewage	Suspected	Phosphate	Poor by 2021

The Little Stour currently has high phosphorus concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge, including drainage from unsewered domestic sewerage. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the fish populations, preventing the waterbody from achieving ‘Good’ Ecological status.

To determine whether growth itself is a barrier to attaining a future ‘Good’ status for phosphate, modelling was carried out. For both current and future discharge quality required phosphate was above LCT demonstrating that growth would not limit attainment of Good Status and that good status could be achieved in a future condition.

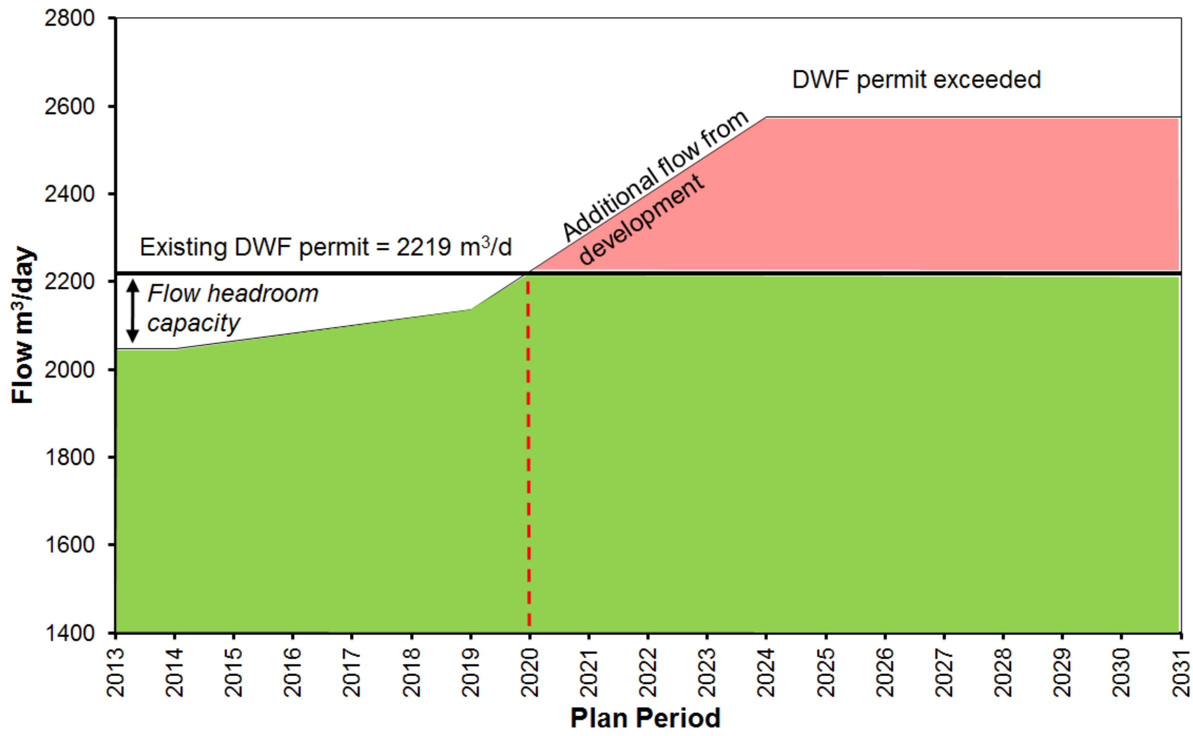
C.10 Paddock Wood

Headroom phasing

The headroom assessment has demonstrated that Paddock Wood WwTW currently has t flow headroom in its existing discharge permit and can accept development of approximately 302 dwellings (KCC completed, allocated & extrapolated unallocated cumulative housing allocation to 2017-21). Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded in 2020, as shown in Figure C12.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 302 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 355 m^3/d (equivalent to approximately 1208 dwellings) by the end of the plan period.

Figure C12: Paddock Wood WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Paddock Wood WwTW discharges to the Lower Teise and forms part of the Medway catchment. The Lower Teise currently has an overall waterbody status of ‘Moderate’, with the alternative objective to achieve ‘Good’ status by 2027. Its current overall status is limited to ‘Moderate’ due to the ‘Poor’ status of fish, ‘Moderate’ status of invertebrates and ‘Moderate or less status’ of surface water in the supporting elements of the mitigation measures assessment. The current status for phosphate in 2015 Cycle 2 is not available so the 2014 Cycle 1 ‘Poor’ status for phosphate is used. The current status for ammonia is ‘High’ and the waterbody does not have a status for BOD.

WFD compliance – No Deterioration

A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that a revised ammonia quality condition (below LCT) and a new phosphate quality condition (above LCT) on the discharge permit would be required to ensure no deterioration in status. Ammonia at Paddock Wood WwTW is already being treated below LCT (0.67 mg/l) and so the revised condition (0.63 mg/l) although also below LCT is not deemed to be significant in relation to the proposed growth numbers within the treatment catchment.

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

WFD compliance – Achieve Future Target Status

The current target status on the Lower Teise waterbody is ‘Good’ by 2027 which is higher than the waterbody’s current status of ‘Moderate’ and so there is the requirement to assess if it is technically feasible to achieve ‘Good’ status for phosphate once growth is included. For both the current and future discharge volumes, the quality required for phosphate was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

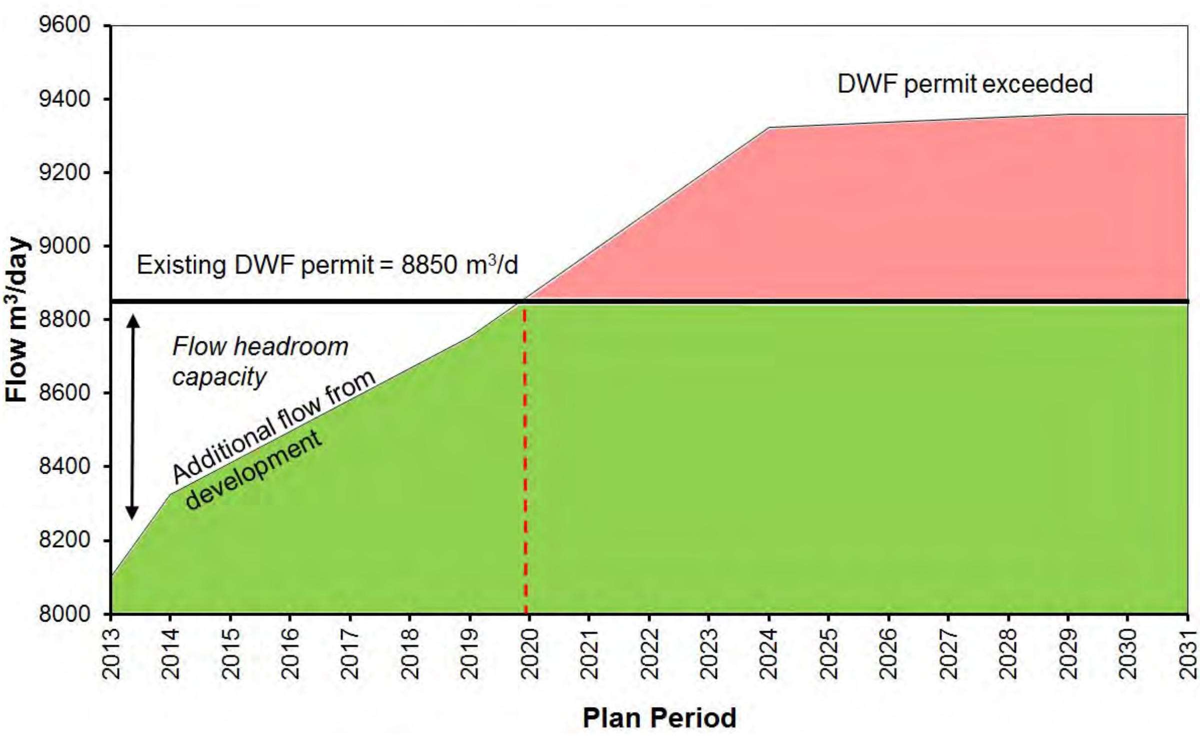
C.11 Tunbridge Wells South

Headroom phasing

The headroom assessment has demonstrated that Tunbridge Wells South WwTW currently has flow headroom in its existing discharge permit and can accept development of approximately 8753 dwellings. Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded in 2020, as shown in Figure C13.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 8753 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 508 m^3/d (equivalent to approximately 1728 dwellings) by the end of the plan period.

Figure C13: Tunbridge Wells South WwTW DWF across plan period and DWF permit exceedance



Environmental baseline

Tunbridge Wells South WwTW discharges to the River Grom and forms part of the Medway catchment. The River Grom currently has an overall waterbody status of 'Moderate', with the alternative objective set to retain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the 'Moderate' status of ammonia, phosphate and invertebrates. The waterbody does not have a status for BOD.

WFD compliance – No Deterioration

As Tunbridge Wells South WwTW discharges to the freshwater River Grom, A range of scenarios have been modelled to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

RQP Modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status. The results showed that the current ammonia quality condition was acceptable to ensure no deterioration in status, but that a new phosphate quality condition (below LCT) on the discharge permit would be required to ensure no deterioration in status. Phosphate at Tunbridge Wells South WwTW is already being treated below LCT (0.31 mg/l) and so the revised condition (0.29 mg/l) although also below LCT is not deemed to be of significant in relation to amount of growth in the WwTW's catchment.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can also be achieved with current conventional treatment technology (within LCT).

WFD compliance – Achieve Future Target Status

The River Grom has an alternative objective of ‘Moderate’ Ecological status set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than ‘Good’ status of phosphate, dissolved oxygen and fish.

The RNAG as outlined in the Thames RBMP, relevant to the River Grom have been provided in Table C11 below.

Table C11: Reasons for not achieving good status on the River Grom (GB106040018400)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Moderate by 2021
Water Industry	Sewage discharge (intermittent)	Confirmed	Phosphate	Moderate by 2021

The River Grom currently has high phosphorus concentrations attributable to point sources of continuous and intermittent wastewater discharge. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on invertebrate communities, preventing the waterbody from achieving ‘Good’ Ecological status.

However, to assess quality consents required if the ‘Good’ target for phosphate and ammonia is to be achieved modelling was carried out. For ammonia, both current and future discharge quality required was above LCT demonstrating it is technically feasible to achieve ‘Good’ status. For phosphate, both current and future discharge quality required was below LCT demonstrating that it is not growth limiting attainment of Good Status, but the limits of currently available treatment technologies.

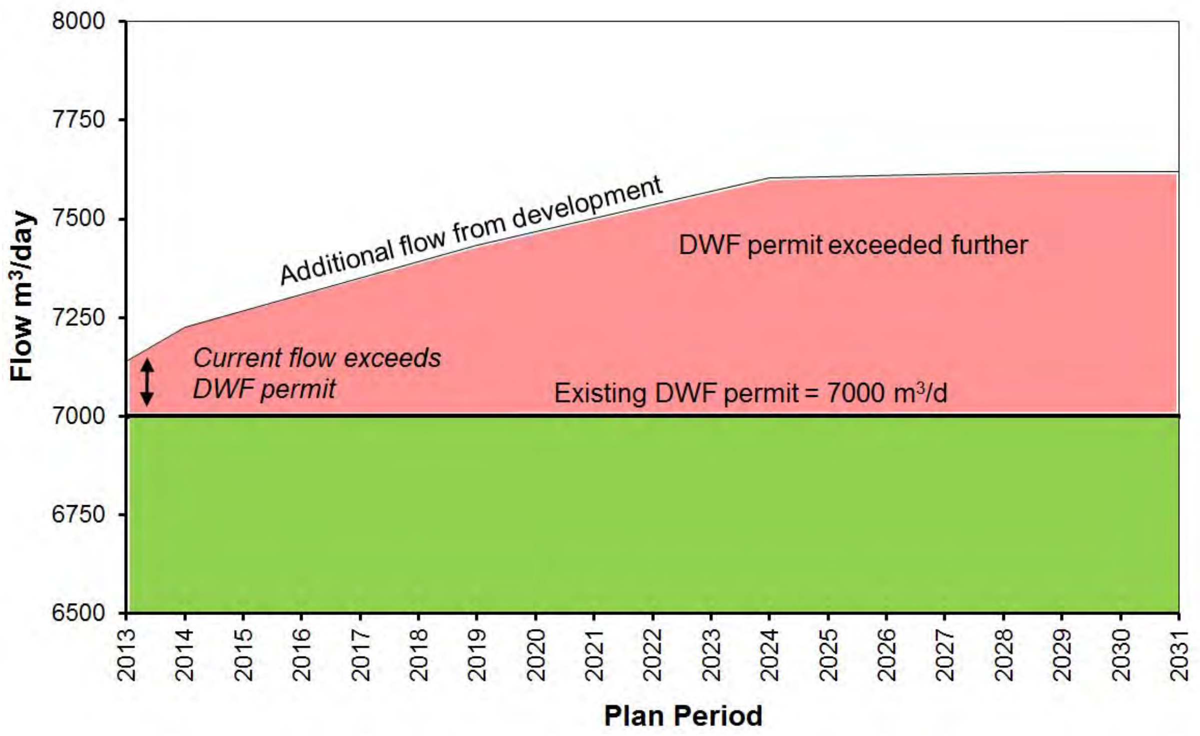
C.12 Faversham

Headroom phasing

The headroom assessment has demonstrated that Faversham WwTW does not currently have sufficient flow headroom in its existing discharge permit to accept development[91]. In addition, according to data provided by Southern Water, the WwTW is already exceeding its existing DWF as shown in Figure C14.

Therefore, until additional flow headroom can be made available at the WwTW, any development connecting to the WwTW would result in the existing DWF permit being exceeded further, and by a total volume of 620 m^3/d (equivalent to approximately 2113 dwellings) by the end of the plan period.

Figure C14: Faversham DWF across plan period and DWF permit exceedance



Environmental baseline

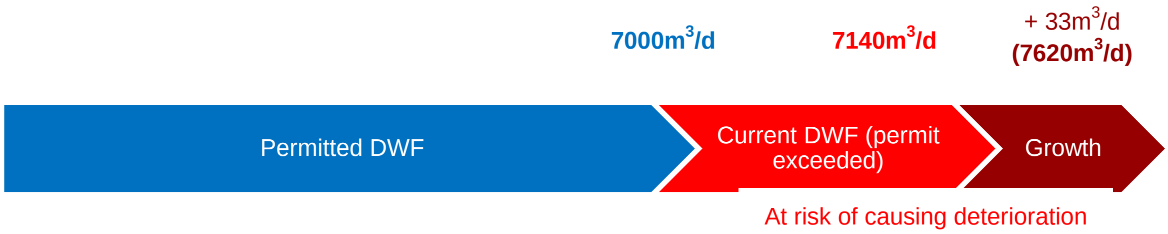
Faversham WwTW discharges to The Swale estuary. The Swale estuary currently has an overall waterbody status of ‘Moderate’, with the alternative objective to maintain ‘Moderate’ status by 2021. Its current overall status is limited to ‘Moderate’ due to the status of Dissolved Inorganic Nitrogen (DIN) and surface water mitigation measures (Moderate or less). The current status for dissolved oxygen is ‘High’. Faversham WwTW has a quality consent (permit) for BOD which needs to be modelled using load standstill to assess if tightening is required with future growth.

WFD compliance – calculation of future quality permits

A load standstill calculation has been used to determine the future BOD permit conditions. The results showed that a revised (tighter) BOD permit of 37.5 mg/l, on the discharge permit would be required compared with the current permit of 40 mg/l to maintain the current BOD load to the water body. The tighter BOD quality condition can be achieved with current conventional treatment technology (within limits of conventional treatment). However, flow headroom modelling has found that Faversham WwTW currently exceeds its DWF permit as indicated in Figure C15 and hence the risk of deterioration is likely to occur early in the plan period.

[91] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

Figure C15: Faversham WwTW DWF permit, DWF permit exceedance and additional DWF from growth



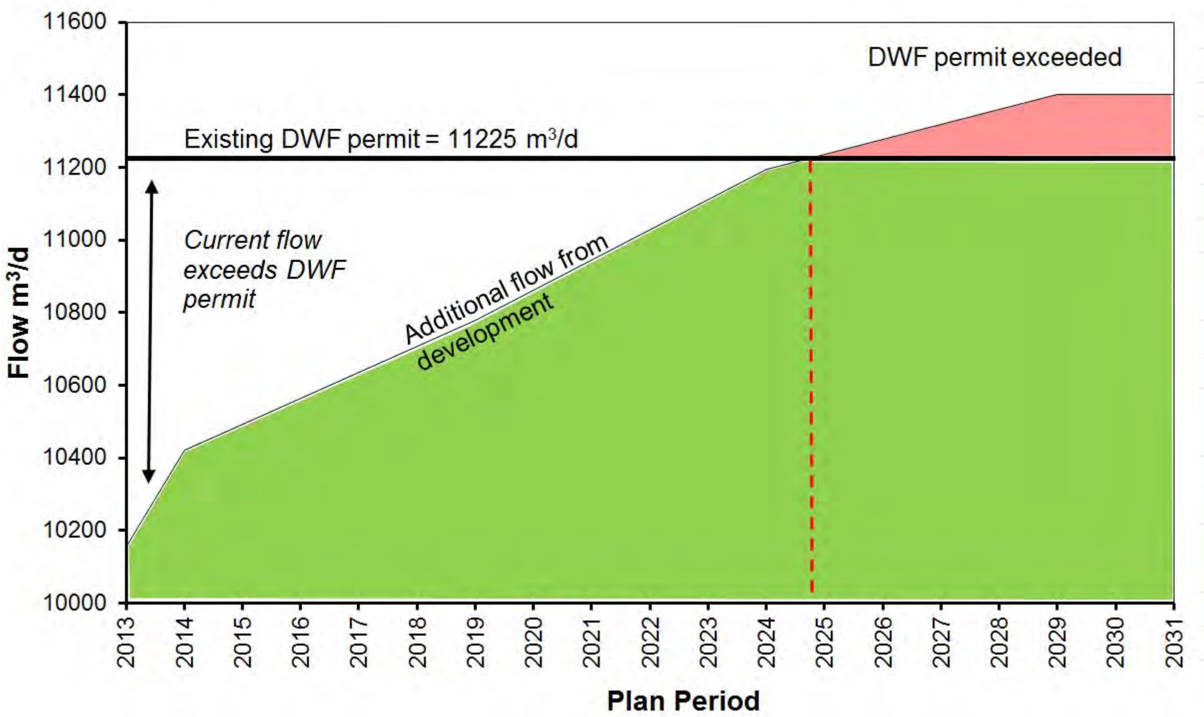
C.13 Queenborough

Headroom phasing

The headroom assessment has demonstrated that Queenborough WwTW currently has flow headroom in its existing discharge permit and can accept development of approximately 3532 dwellings Based on the latest housing trajectory provided by KCC, the existing discharge permit will be exceeded after 2024, as shown in Figure C16.

Unless additional flow headroom can be made available at the WwTW to accept development beyond 3532 dwellings, further development connecting to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 176 m^3/d (equivalent to approximately 599 dwellings) by the end of the plan period.

Figure C16: Queenborough DWF across plan period and DWF permit exceedance



Environmental baseline

Queenborough WwTW discharges to The Swale estuary. The Swale estuary currently has an overall waterbody status of ‘Moderate’, with the alternative objective to maintain ‘Moderate’ status by 2021. Its current overall status is limited to ‘Moderate’ due to the status of DIN (moderate) and surface water mitigation measures (Moderate or less). The current status for dissolved oxygen is ‘High’. Queenborough WwTW has a quality consent (permit) for BOD which needed to be modelled using load standstill to assess if tightening is required with future growth.

WFD compliance – calculation of future quality permits

A load standstill calculation has been used to determine the future BOD permit conditions. The results showed that a revised (tighter) BOD permit of 35.6 mg/l on the discharge permit would be required compared with the current permit of 40 mg/l to maintain the current BOD load into the receiving water body. The tighter BOD quality condition can be achieved with current conventional treatment technology (within limits of conventional treatment).

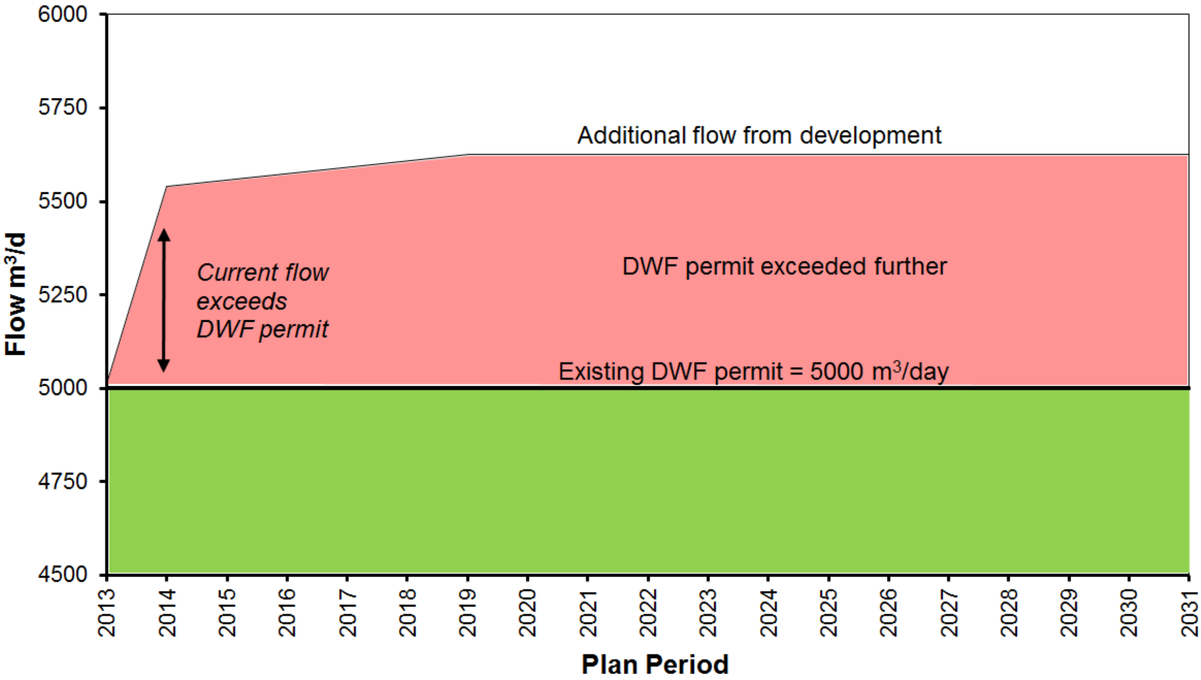
C.14 Whitewall Creek

Headroom phasing

The headroom assessment has demonstrated that Whitewall Creek WwTW does not currently have sufficient flow headroom in its existing discharge permit to accept development[92]. In addition, according to data provided by Southern Water, the WwTW is already exceeding its existing DWF as shown in Figure C17.

Therefore, until additional flow headroom can be made available at the WwTW, any development connecting to the WwTW would result in the existing DWF permit being exceeded further, and by a total volume of 625 m^3/d (equivalent to approximately 2126 dwellings) by the end of the plan period.

Figure C17: Whitewall Creek DWF across plan period and DWF permit exceedance



Environmental baseline

Whitewall Creek WwTW discharges to the estuarine section of the River Medway. The Medway estuary currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to 'Moderate' due to the status of DIN (moderate) and surface water mitigation measures (Moderate or less). The current status for dissolved oxygen is 'Good'. Whitewall Creek WwTW has quality consent (permit) conditions for BOD and ammonia which needs to be modelled using load standstill to assess if tightening is required with future growth.

WFD compliance – calculation of future quality permits

A load standstill calculation has been used to determine the future BOD and ammonia permit conditions. The results of the load standstill calculation for BOD showed that a revised (tighter) BOD permit of 22.3 mg/l, on the discharge permit would be required compared with the current permit of 25 mg/l to maintain the current BOD load into the estuary. The tighter BOD quality condition can be achieved with current conventional treatment technology (within LCT).

The results of the load standstill calculation for ammonia showed that a revised (tighter) ammonia permit of 17.8 mg/l, on the discharge permit would be required compared with the current permit of 20 mg/l to maintain the current ammonia load. The tighter ammonia quality load can be achieved with current conventional treatment technology (within LCT).

[92] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

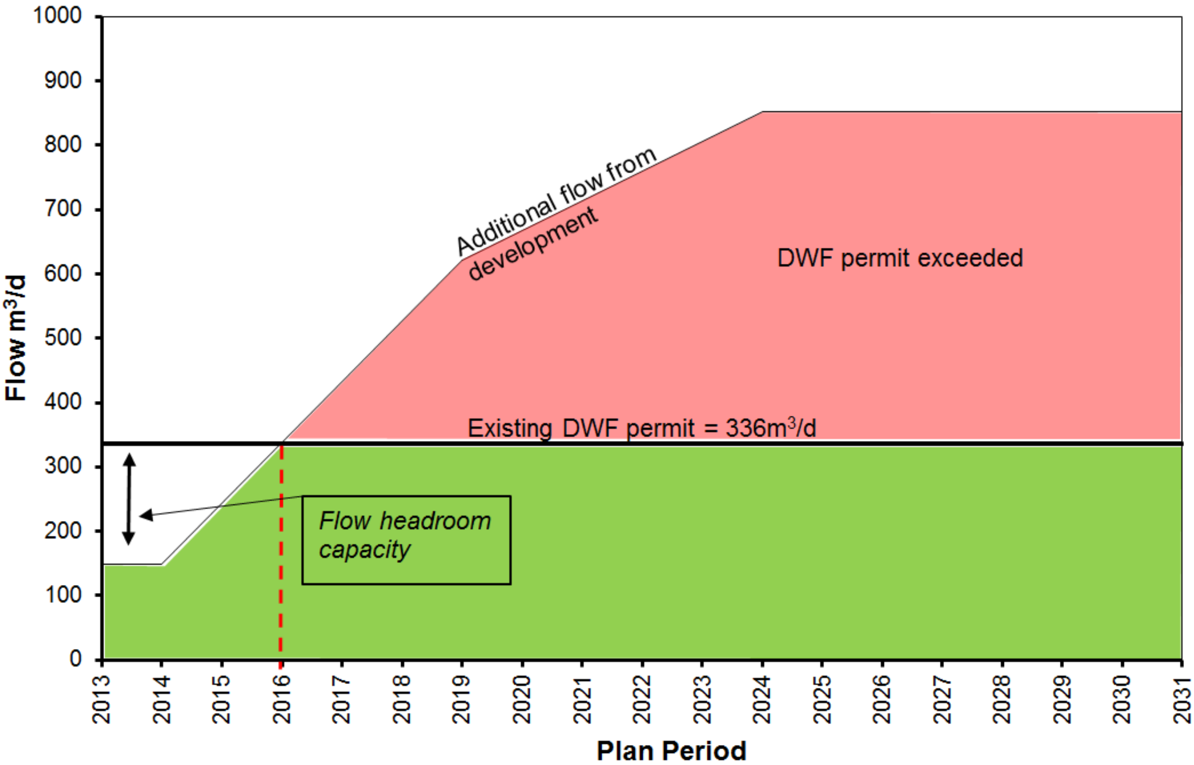
C.15 Wouldham

Headroom phasing

The headroom assessment has demonstrated that Wouldham WwTW had sufficient flow headroom until 2015, and that subsequently additional growth caused the DWF permit to be exceeded in 2016[93]. A cautious approach is taken as the measured DWF is based on the 3 year 20%ile average (2013-2015) but is plotted for 2013. Allocated, completed and extrapolated unallocated growth for the KCC period 2012-2016 is plotted from 2014. Based on the latest housing trajectory provided by KCC, the existing discharge permit was exceeded in 2016, as shown in Figure C18.

Unless additional flow headroom can be made available at the WwTW to accept further development, connecting this to the WwTW would result in the existing discharge permit being exceeded, and by a total volume of 517 m^3/d (equivalent to approximately 1761 dwellings) by the end of the plan period.

Figure C18: Wouldham DWF across plan period and DWF permit exceedance



Environmental baseline

Wouldham WwTW discharges to the estuarine part of the River Medway. The Medway estuary currently has an overall waterbody status of ‘Moderate’, with the alternative objective to maintain ‘Moderate’ status by 2021. Its current overall status is limited to ‘Moderate’ due to the status of DIN (moderate) and surface water mitigation measures (Moderate or less). The current status for dissolved oxygen is ‘Good’. Wouldham WwTW has a quality consent (permit) for BOD which needs to be modelled using load standstill to assess if tightening is required with future growth.

WFD compliance – calculation of future quality permits

A load standstill calculation has been used to determine the future BOD and permit condition. The results of the load standstill calculation for BOD showed that a revised (tighter) BOD permit of 12.3 mg/l, on the discharge permit would be required compared with the current permit of 70 mg/l to maintain the current BOD loan in the

[93] It is understood that Southern Water may have more recent DWF data that was not available to this study, this indicates that the site may be below its current permit level for dry weather flow, indicating some potential capacity. This may change the point in the future when the permit condition may be exceeded but does not change the assessment and conclusions of the water quality assessment.

estuary. The tighter BOD quality condition can be achieved with current conventional treatment technology (within limits of conventional treatment).

Appendix D - Designated sites detail

D.1 Designated sites and WwTW influences

Table 6-1: Designated sites and linked pathways from WwTW discharging to tidal water bodies

WwTW	Designated site	Discharge point
Faversham WwTW	The Swale Estuary MCZ (Proposed – TR065672)	Discharges directly into Faversham Creek which is part of the Proposed MCZ
	The Swale Ramsar site (UK11071 – TR001665)	Discharges directly into Faversham Creek which is part of the Ramsar site
	The Swale SPA (UK9012011 - TR001665)	Discharges directly into Faversham Creek which is part of the SPA
	The Swale Estuary MCZ (Proposed – TR065672)	Discharges directly into The Swale which is part of the Proposed MCZ
Queenborough WwTW	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	Discharges directly into The Swale which is part of the SPA.
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	Discharges directly into The Swale which is part of the Ramsar site.
	The Swale SPA (UK9012011 - TR001665)	0.5 km downstream from the discharge point
	The Swale Ramsar site (UK11071 – TR001665)	0.5 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	5 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	8 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	8 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	Discharges directly into River Medway/Medway Estuary which is part of the MCZ
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	3 km downstream from the discharge point
Whitewall Creek WwTW	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	3 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	20 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	20 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	3 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	12.5 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	12.5 km downstream from the discharge point
Wouldham WwTW	Medway Estuary MCZ (Designated – TQ846718)	3 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	12.5 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	12.5 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	29.5 km downstream from the discharge point

Table 6-2: Designated sites and linked pathways from WwTW discharging to fluvial water bodies

WwTW	Designated site	Discharge point
Biddenden WwTW Discharges directly into Hammer Stream	Medway Estuary MCZ (Designated – TQ846718)	58 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	67.5 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	67.5 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	83.5 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	83.5 km downstream from the discharge point
	Stodmarsh SPA (UK9012121 – TR210612)	1.5 km downstream from the discharge point
Canterbury WwTW Discharges directly into the Great Stour	Stodmarsh SAC (UK0030283 – TR226619)	1.5 km downstream from the discharge point
	Stodmarsh Ramsar Site (UK11066 – TR210612)	1.5 km downstream from the discharge point
	Sandwich Bay SAC (UK0013077 – TR354604)	27 km downstream from the discharge point
	Thanet Coast & Sandwich Bay SPA (UK9012071 – TR355621)	27.5 km downstream from the discharge point
	Thanet Coast & Sandwich Bay Ramsar (UK11070 – TR362552)	27.5 km downstream from the discharge point
	Thanet Coast SAC (UK0013107 – TR339712)	39 km downstream from the discharge point
	Thanet Coast MCZ (TR322714)	39.5 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	33.5 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	43 km downstream from the discharge point
Harrietsham WTW Discharges directly into the River Len	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	43 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	59 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	59 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	65.5 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	75 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	75 km downstream from the discharge point
High Halden WwTW Discharges directly into Upper Beult - High Halden and Bethersden Stream	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	91 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	91 km downstream from the discharge point
	Sandwich Bay SAC (UK0013077 – TR354604)	17 km downstream from the discharge point
	Thanet Coast & Sandwich Bay SPA (UK9012071 – TR355621)	17.5 km downstream from the discharge point
	Thanet Coast & Sandwich Bay Ramsar (UK11070 – TR362552)	17.5 km downstream from the discharge point

WwTW	Designated site	Discharge point
	Thanet Coast SAC (UK0013107 – TR339712)	29 km downstream from the discharge point
Newnham Valley Preston WwTW Discharges directly into the Little Stour which flows into the Little Stour	Thanet Coast MCZ (TR322714)	29.5 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	35 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	44.5 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	44.5 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	60.5 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	60.5 km downstream from the discharge point
Paddock Wood WwTW Discharges into the Lower Teise	Medway Estuary MCZ (Designated – TQ846718)	63.5 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	73 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	73 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	89 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	89 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	66.5 km downstream from the discharge point
Tunbridge Wells South WwTW Discharges into the River Grom	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	76 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	76 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	92 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	92 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	27 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	36.5 km downstream from the discharge point
Edenbridge WwTW Discharges into the River Eden	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	36.5 km downstream from the discharge point
	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	52.5 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	52.5 km downstream from the discharge point
	Sandwich Bay SAC (UK0013077 – TR354604)	18 km downstream from the discharge point
	Thanet Coast & Sandwich Bay SPA (UK9012071 – TR355621)	18.5 km downstream from the discharge point
	Thanet Coast & Sandwich Bay Ramsar (UK11070 – TR362552)	18.5 km downstream from the discharge point
Leeds WwTW Discharges into the River Len	Thanet Coast & Sandwich Bay Ramsar (UK11070 – TR362552)	18.5 km downstream from the discharge point
	Thanet Coast SAC (UK0013107 – TR339712)	30 km downstream from the discharge point

WwTW	Designated site	Discharge point
	Thanet Coast MCZ (TR322714)	30.5 km downstream from the discharge point
	Medway Estuary MCZ (Designated – TQ846718)	7.5 km downstream from the discharge point
	Medway Estuary & Marshes SPA (UK9012031 – TQ849709)	17 km downstream from the discharge point
	Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)	17 km downstream from the discharge point
May Street Herne Bay WwTW Stour Discharges into the River Stour	Thames Estuary & Marshes SPA (UK9012021 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
Ham Hill WwTW Discharges into the River Medway	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point
	Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)	33 km downstream from the discharge point

D.2 Medway Estuary MCZ (Designated – TQ846718)

The Medway Estuary Marine Conservation Zone (MCZ) is an inshore site located on the north Kent coast. It forms a single tidal system with the Swale, and the Medway joins the Thames Estuary at its mouth between the Isle of Grain and Sheerness. The MCZ boundary begins near Rochester and extends seawards into the mouth and encompasses everything up to mean high water. The upper reaches of the site are narrow, resulting in an over wide middle section containing some low lying islands. The estuary mouth is narrow and constrained.

Within the site there is a complex and dynamic ecosystem. The mix of fresh and sea waters, combined with the tidal movement, create changing levels of salinity and nutrients providing a fertile environment for wildlife, particularly invertebrates, fish and birds.

Surrounded by low lying intertidal areas of saltmarsh and mudflat, which are conserved under other designations, the broad-scale habitat features of this MCZ help to complete the protection of habitats in the Medway. In particular, the subtidal channel is now afforded some protection. Tentacled lagoon-worm, estuarine rocky habitats and intertidal rock features were noted during the selection of the site for designation as being relatively rare within the South East.

Designated for the following habitats:

- Estuarine rocky habitats;
- Interidal mixed sediments (A2.4);
- Intertidal sand and muddy sand (A2.2);
- Low energy intertidal rock (A1.3);
- Peat and clay exposures;

- Subtidal coarse sediment (A5.1);
- Subtidal mud (A5.3); and,
- Subtidal sand (A5.2).

Designated for the following species:

- Tentacled lagoon-worm, *Alkmaria romijni*.

D.3 Medway Estuary & Marshes Ramsar site (UK11040 – TQ849709)

A complex of rain-fed, brackish, floodplain grazing marsh with ditches, and intertidal saltmarsh and mudflat. These habitats together support internationally important numbers of wintering waterfowl. Rare wetland birds breed in important numbers. The saltmarsh and grazing marsh are of international importance for their diverse assemblages of wetland plants and invertebrates.

Designated for:

<u>Ramsar criterion 2</u>: The site supports a number of species of rare plants and animals.

The site holds several nationally scarce plants, including sea barley *Hordeum marinum*, curved hard-grass *Parapholis incurva*, annual beard-grass *Polypogon monspeliensis*, Borrer's saltmarsh-grass *Puccinellia fasciculata*, slender hare`s-ear *Bupleurum tenuissimum*, sea clover *Trifolium squamosum*, saltmarsh goose-foot *Chenopodium chenopodioides*, golden samphire *Inula crithmoides*, perennial glasswort *Sarcocornia perennis* and one-flowered glasswort *Salicornia pusilla*. A total of at least twelve British Red Data Book species of wetland invertebrates have been recorded on the site. These include a ground beetle *Polistichus connexus*, a fly *Cephalops perspicuus*, a dancefly *Poecilobothrus ducalis*, a fly *Anagnota collini*, a weevil *Baris scolopacea*, a water beetle *Berosus spinosus*, a beetle *Malachius vulneratus*, a rove beetle *Philonthus punctus*, the ground lackey moth *Malacosoma castrensis*, a horsefly *Atylotus latistriatuus*, a fly *Campsicnemus magius*, a solider beetle, *Cantharis fusca*, and a cranefly *Limonia danica*. A significant number of non-wetland British Red Data Book species also occur.

<u>Ramsar criterion 5</u>: Assemblages of international importance: Species with peak counts in winter:

47637 waterfowl (5 year peak mean 1998/99-2002/2003)

<u>Ramsar criterion 6</u>: species/populations occurring at levels of international importance:

Qualifying Species/populations (as identified at designation):

Species with peak counts in spring/autumn:

- Grey plover, *Pluvialis squatarola;*
- Common redshank, *Tringa totanus tetanus;*

Species with peak counts in winter:

- Dark-bellied brent goose, *Branta bernicla bernicla;*
- Common shelduck, *Tadorna tadorna;*
- Northern pintail, *Anas acuta;*
- Ringed plover, *Charadrius hiaticula;*
- Red knot, *Calidris canutus islandica; and,*
- Dunlin, *Calidris alpina alpine.*

Species/populations identified subsequent to designation for possible future consideration under criterion 6.

Species with peak counts in spring/autumn:

- Black-tailed godwit, *Limosa limosa islandica.*

D.4 Medway Estuary & Marshes SPA (UK9012031 – TQ849709)

The Medway Estuary feeds into and lies on the south side of the outer Thames Estuary in Kent. It forms a single tidal system with the Swale, and joins the Thames Estuary between the Isle of Grain and Sheerness.

The site comprises tidal channels which drain around saltmarsh and grazing marsh. The mud-flats support invertebrates and beds of *Enteromorpha* and some eelgrass (*Zostera* sp.). Some small shell beaches occur. The diverse range of coastal habitats supports important numbers of birds throughout the year, comprising breeding waders and terns in the summer and geese, ducks, grebes and waders in the winter. However, the site is also of importance during the spring and autumn migration periods.
This site qualifies by supporting populations of European importance of the following species, listed on Annex I of the Directive:

- Breeding season:
  - Avocet, *Recurvirostra avosetta* (4.7% of breeding population in Great Britain); and
  - Little tern, *Sterna albinfrons* (1.2% of breeding population in Great Britain).
- Over winter:
  - Avocet (24.7% of the wintering population in Great Britain)

This site also qualifies under Article 4.2 by supporting populations of European importance of the following migratory species:

- On passage;
  - Ringed plover, *Charadrius hiaticula* (2.7% of European/North Africa wintering population)
- Over winter;
  - Black tailed godwit, *Limosa limosa islandica* (1.4% of wintering Iceland breeding population)
  - Dark-bellied brent goose, *Branta bernicla bernicla* (1.1% of wintering Western Siberia/Western Europe population)
  - Dunlin, *Calidris alpina alpina* (1.9% of wintering Northern Siberia/Europe/Western Africa population)
  - Grey plover, *Pluvialis squatarola* (2.3% of wintering Eastern Atlantic population)
  - Pintail, *Anas acuta* (1.2% of wintering Northwestern Europe population)
  - Redshank, *Tringa totanus* (2.5% of wintering Eastern Atlantic population)
  - Ringed plover, *Charadrius hiaticula* (1.5% of wintering Europe/Northern Africa population)
  - Shelduck, *Tadorna tadorna* (1.5% of wintering Northwestern Europe population)

The site also qualifies under Article 4.2 by regularly supporting at least 20,000 waterfowl. Over winter, the area regularly supports 65,274 individual waterfowl (5 year peak mean 1991/2 – 1995/6). This includes Little Grebe *Tachybaptus ruficollis*, Dark-bellied Brent Goose, Shelduck, Pintail, Ringed Plover, Grey Plover, Dunlin, Avocet, Redshank, Curlew *Numenius arquata*, Great Crested Grebe *Podiceps cristatus*, Cormorant *Phalacrocorax carbo,* Wigeon *Anas penelope*, Teal *Anas crecca*, Oystercatcher *Haematopus ostralegus*, Lapwing *Vanellus vanellus*, Black-tailed Godwit and Whimbrel *Numenius phaeopus*.

D.5 Sandwich Bay SAC (UK0013077 – TR354604)

Sandwich Bay is a largely inactive dune system, with extensive areas of fixed dune grassland, the only large area of this habitat in the extreme south-east of England. The vegetation of the dunes is species-rich, and the site supports a number of rare and scarce species, including fragrant evening-primrose (*Oenothera stricta*), bedstraw broomrape (*Orobanche caryophyllacea*) and sand catchfly (*Silene conica*), as well as the UK's largest population of lizard orchid (*Himantoglossum hircinum*).

The northern end of the site supports embryonic shifting dune communities.

The site is designated for the following habitats:

- Embryonic shifting dunes
- Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")

- Fixed coastal dunes with herbaceous vegetation (“grey dunes”)
- Dunes with Salix *repens* ssp. *Agentea (Salicion arenariae*)

The site also supports humid dune slacks, although this is not a primary reason for selection of the site.

D.6 Stodmarsh Ramsar Site (UK11066 – TR210612)

Stodmarsh comprises a number of wetland habitats including open water, reedbeds, grazing marsh and alder (*Alnus glutonisa*) carr. The site supports uncommon wetland invertebrates and plants, and provides breeding and wintering habitats for important assemblages of wetland bird species.

Designated for:

<u>Ramsar criterion 2:</u> The site supports a number of species of rare plants and animals.

The site supports six British Red Data Book wetland invertebrates, two nationally rare plants, and five nationally scarce species, as well as a diverse assemblage of rare wetland birds including;
Species supporting during breeding season;

- Gadwall, *Anas strepera strepera* (1% of Great Britain population)

Species with peak counts in spring/autumn;

- Gadwall (1.5% of GB population)

Species with peak counts in winter:

- Great bittern, *Botaurus stellaris stellaris* (2% of GB population)
- Northern shoveler, *Anas clypeata* (1.8% of the GB population)
- Hen harrier, Circus *cyaneus* (1.2% of GB population)

The site supports the nationally scarce plants *Taraxacum hygrophilum, Myriophyllum verticillatum, Wolffia arrhiza, Carex divisa, Lepidium latifolium, Sonchus palustris* and the vulnerable *Potamogeton acutifolius*.

The site also supports the following British Red Data Book species of wetland invertebrates: *Segmentina nitida, Grammotaulius nitidus, Deltote banksianna, Polistichus connexus, Cercyon granarius, Haliplus mucronatus, Hydrophilus piceus and Vertigo moulinsiana* (RDB3).

D.7 Stodmarsh SAC (UK0030283 – TR226619)

Stodmarsh comprises a number of wetland habitats. The site is designated for its population of Desmoulin’s whorl snail (*Vertigo moulinsiana*).

D.8 Stodmarsh SPA (UK9012121 – TR210612)

This wetland site comprises a range of wetland habitats including open water, extensive reedbeds, grazing marsh and alder (*Alnus glutinosa*) carr. The site supports a number of uncommon wetland invertebrates and plants and provides wintering habitats for wetland bird species.

The site qualifies under Article 4.1 by supporting populations of European importance over winter of:

- Bittern, *Botaurus stellaris (*2% of wintering population in Great Britain)
- Hen harrier, *Circus cyaneus (*1.2% of wintering population in Great Britain)

D.9 Thames Estuary and Marshes Ramsar site (UK11069 – TQ805794)

This site comprises a complex of brackish floodplain grazing marsh ditches, saline lagoons and intertidal saltmarsh and mudflat habitats. The site supports internationally important numbers of wintering waterfowl, and the saltmarsh and grazing march are of international importance due to their diverse assemblage of wetland plants and invertebrates.

Designated for:

Ramsar criterion 2: The site supports a number of species of rare plants and animals.
The site supports a number of species of rare plants and animals. The site holds several nationally scarce plants, including sea barley *Hordeum marinum*, curved hard-grass *Parapholis incurva*, annual beard-grass *Polypogon monspeliensis*, Borrer's saltmarsh-grass *Puccinellia fasciculata*, slender hare`s-ear *Bupleurum tenuissimum*, sea clover *Trifolium squamosum*, saltmarsh goose-foot *Chenopodium chenopodioides*, golden samphire *Inula crithmoides*, perennial glasswort *Sarcocornia perennis* and one-flowered glasswort *Salicornia pusilla*.
A total of at least twelve British Red Data Book species of wetland invertebrates have been recorded on the site. These include a ground beetle *Polistichus connexus*, a fly *Cephalops perspicuus*, a dancefly *Poecilobothrus ducalis*, a fly *Anagnota collini*, a weevil *Baris scolopacea*, a water beetle *Berosus spinosus*, a beetle *Malachius vulneratus*, a rove beetle *Philonthus punctus*, the ground lackey moth *Malacosoma castrensis*, a horsefly *Atylotus latistriatuus*, a fly *Campsicnemus magius*, a solider beetle, *Cantharis fusca*, and a cranefly *Limonia danica*. A significant number of non-wetland British Red Data Book species also occur.
Ramsar criterion 5: Assemblages of international importance:

The site supports a peak count of 47,637 waterfowl in winter (5 year peak mean 1998/99 – 2002/2003). Species include little grebe, *Tachybaptus ruficollis ruficollis*, little egret, *Egretta garzetta*, ruff, *Philomachus pugnax*, common greenshank, *Tringa nebularia,* common shelduck, *Tadorna tadorna*, gadwall, *Anas strepera strepera*, northern shoveler, *Anas clypeata*, water rail, *Rallus aquaticus,* pied avocet, *Recurvirostra avosetta*, and spotted redshank, *Tringa erythropus*.

Ramsar criterion 6: species/populations occurring at levels of international importance:
The site supports internationally important levels of the following species in the spring/autumn:

- Grey plover, *Pluvialis squatarola* (1.2% of population)
- Common redshank, *Tringa totanus totanus* (1.4% of population)
- Ringed plover, *Charadrius hiaticula* (1.8% of GB population)
- Black-tailed godwit, *Limosa limosa islandica* (4.6% of population)

The site also supports internationally important levels of the following species in winter:

- Dark-bellied brent goose, *Branta bernicla bernicla* (1.1% of population)
- Common shelduck, *Tadorna tadorna* (3.3% of GB population)
- Northern pintail, *Anas acuta* (1.8% of population)
- Ringed plover, *Charadrius hiaticula* (1.6% of GB population)
- Red knot, *Calidris canutus islandica* (1.% of GB population)
- Dunlin, *Calidris alpina alpina* (1.4% of GB population)

The site also supports the following species identified after designation, for future consideration

- Black-tailed godwit, *Limosa limosa islandica* (2% of population)

D.10 Thames Estuary & Marshes SPA (UK9012021 – TQ805794)

The Thames Estuary and Marshes SPA extends for around 15km along the south side of the Thames Estuary, and also includes intertidal areas in the north side of the estuary. To the south of the river is brackish grazing marsh. At Cliffe, there are flooded clay and chalk pits. Outside the sea wall is a small extent of saltmarsh and intertidal mud-flats.

The site qualifies under Article 4.1 by supporting populations of European importance of the following species:

Over winter:

- Avocet *Recurvirostra avosetta* (21.7% of GB wintering population);
- Hen harrier, *Circus cyaneus* (0.9% of GB wintering population); and,
- Ringed plover, *Charadrius hiaticula* (1.1% of wintering Europe/Northern Africa population).

On passage:

- Ringed plover, *Charadrius hiaticula* (1.1% of Europe/North Africa wintering population)

The site also qualifies under Article 4.2 by regularly supporting at least 20,000 waterfowl.

Over winter, the area regularly supports 33,433 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Redshank *Tringa totanus*, Black-tailed Godwit *Limosa limosa islandica*, Dunlin *Calidris alpina alpina*, Lapwing*Vanellus vanellus*, Grey Plover *Pluvialis squatarola*, Shoveler *Anas clypeata*, Pintail *Anas acuta*, Gadwall *Anas strepera*, Shelduck *Tadorna tadorna*, White-fronted Goose *Anser albifrons albifrons,* Little Grebe *Tachybaptus ruficollis*, Ringed Plover *Charadrius hiaticula*, Avocet *Recurvirostra avosetta*, Whimbrel *Numenius phaeopus*.

D.11 Thanet Coast MCZ (TR322714)

This inshore site stretches from the east of Herne Bay, around Thanet to the northern wall of Ramsgate Harbour, comprising an area of approximately 64km^2. The MCZ partially overlaps with an existing SAC.

The MCZ contains areas of subtidal chalk extending seawards from the chalk reefs, cliffs and coves designated within the SAC. The chalk seabed within this area is the longest continuous stretch of coastal chalk in the UK. The MCZ also contained an unusual composition of blue mussel (*Mytilus edulis*) beds and ross worm (*Sabellaria spinulosa*) reefs. The site also supports the stalked jellyfish (*Lucernariopsis cruxmelitensis*).

The MCZ is designated for:

- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand
- Moderate energy *infralittoral* rock
- Moderate energy *circalittora*l rock
- Blue mussel beds (*Mytilus edulis)*
- Peat and clay exposures
- Ross worm (*Sabellaria spinulosa*) reefs
- Subtidal chalk
- Stalked jellyfish (*Haliclystus auricula)*
- Stalked jellyfish (*Lucernariopsis cruxmelitensis).*

D.12 Thanet Coast & Sandwich Bay Ramsar (UK11070 – TR362552)

This coastal site comprises a long stretch of rocky shore with adjoining areas of estuary, sand dune, maritime grassland, saltmarsh and grazing marsh. The wetland habitats support 15 British Red Data Book invertebrates as well as a large number of nationally scarce species. The site is also used by a large number of migratory birds. The site is designated for Ramsar criterions 2 and 6.

<u>Ramsar criterion 2</u>: The site supports a number of species of rare plants and animals.
The site supports the following nationally important plant species: *Juncus acutus, Potamogeton coloratus, Ceratophyllum submersum, Myriophyllum verticillatum, Carex divisia, Althaea officinalis, Frankenia laevis, Inula crithmoides*, *Himantoglossum hircinum* (90% UK population on dunes at Sandwich Bay); *Orobanche caryophyllacea*, *Brassica oleracea var. oleracea; Matthiola incana; Matthiola sinuata; Limonium binervosum*.
The site supports Sand lizards, *Lacerta agilis* and the following nationally important invertebrate species: *Lixus vilis, Stigmella repentiella, Bagous nodulosus, Deltote bankiana, Poecilobothrus ducalis, Emblethis verbasci, Pionosomus varius, Nabis brevis, Euheptauclacus sus, Melanotus punctolineatus, Eluma purpurescens, Ectemnius ruficornis, Alysson lunicornis, Orthotylus rubidus,* Cerceris *quadricincta* (RDB 1; largest UK colony discovered on site in Pegwell area); *Philanthus triangulum* (RDB2, pRDB4); *Hedychrum niemelai* (RDB3); *Smicromyrme rufipes* (Notable b species); *Andrena minutuloides* (Notable a species); *Andrena pilipes* (Notable b species*); Melitta leporine* (Notable b species); *Nomada fucata* (Notable a species), *Idaea ochrata* (BAP priority species); *Aplasta ononaria* (RDB3); and *Phibalapteryx virgata* (Nationally Scarce).
The site also supports the following bird species, at levels of national importance: ringed plover, *Charadrius hiaticula*, common greenshank, *Tringa nebularia*, red-throated diver, *Gavia stellata*, great crested grebe, *Podiceps cristatus cristatus*, European golden plover, *Pluvialis apricaria apricaria* and Sanderling, *Calidris alba*.

<u>Ramsar criterion 6</u>: Species/populations occurring at levels of international importance.
The site supports 1% of the population of ruddy turnstone, *Arenaria interpres interpres* over the winter.

D.13 Thanet Coast SAC (UK0013107 – TR339712)

This SAC comprises chalk reef habitats of national and international importance. The Thanet coasts chalk reef is considered some of the best examples of their kind, and has unusually rich littoral algal flora and submerged and partially submerged sea caves.

The site is designated for the following habitats:

- Reefs; this site represents approximately 20% of the UK resource of this type and 12% of the European resource.
- Submerged or partially submerged sea caves; the Thanet coast provides the second most extensive representation of chalk caves in the UK on the extreme south-east coast of England.

D.14 Thanet Coast & Sandwich Bay SPA (UK9012071 – TR355621)

This SPA is a coastal site comprising a long stretch of rocky shore, areas of estuary, sand dune, maritime grassland, saltmarsh and grazing marsh.

The site qualifies under Article 4.2 by supporting populations of European importance of turnstone, *Arenaria interpres*. Over winter the site supports 940 individuals, representing at least 1.3% of the wintering Western Palearctic population.

D.15 The Swale Estuary MCZ (Proposed – TR065672)

This site is considered to be highly biodiverse, and is an important spawning and nursery ground for various fish species. The main channel of the Swale Estuary comprises important seabed habitats.
The site is designated for the following features:

- Estuarine rocky habitats
- Low energy intertidal rock
- Intertidal mixed sediments
- Intertidal course sediment
- Intertidal sand and muddy sand
- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand
- Subtidal mud

D.16 The Swale Ramsar site (UK11071 – TR001665)

This Ramsar site comprises a complex of brackish and freshwater floodplain grazing marsh with ditches, and intertidal saltmarsh and mudflat. These habitats support internationally important numbers of wintering waterfowl, including rare wetland birds breeding in important numbers. The site is also of international importance for its diverse assemblage of wetland plants and invertebrates.

Designated for:

<u>Ramsar criterion 2</u>: The site supports a number of species of rare plants and animals
The site holds several nationally scarce plants, including: *Chenopodium chenopodioides, Peucedanum officinale, Bupleurum tenuissimum, Spartina maritima, Inula crithmoides, Carex divisa, Trifolium squamosum,* and *Hordeum marinum.*

The site supports several nationally important invertebrate species, including *Bagous cylindrus, Erioptera bivittata, Lejops vittata, Peocilobothris ducalis, Philonthus punctus, Micronecta minutissima, Malchius vulneratus, Campsicnemus majus, Elachiptera rufifrons,* and *Myopites eximia.*

The site also supports nationally important levels of birds, including Mediterranean gull, *Larus melanocephalus*, black-headed gull, *Larus ridibundus,* little tern, *Sterna albifrons albifrons,* little egret, *Egretta garzetta,* whimbrel, *Numenius phaeopus*, Eurasian curlew*, Numenius arquata arquata,* spotted redshank, *Tringa erythropus*, common greenshank, *Tringa nebularia*, little grebe, *Tachybaptus ruficollis ruficollis*, greater white-fronted goose, *Anser albifrons albifrons*, common shelduck, *Tadorna tadorna*, Eurasian teal, *Anas crecca*, Eurasian oystercatcher, *Haematopus ostralegus ostralegus*, pied avocet, *Recurvirostra avosetta*, European golden plover, *Pluvialis apricaria apricaria*, northern lapwing, *Vanellus vanellus*, red knot, *Calidris canutus islandica*, dunlin *Calidris alpina alpina*, and ruff, *Philomachus pugnax*.

<u>Ramsar criterion 5</u>: Assemblages of international importance
The site supports a peak winter count of 77,501 waterfowl (5 year peak mean 1998/1999 – 2002/2003).

<u>Ramsar criterion 6</u>: species/populations occurring at levels of international importance

Species with peak counts in spring/autumn:

- Common redshank, *Tringa totanus totanus (*1.4% of GB population)

Species with peak counts in winter:

- Dark-bellied brent goose, *Branta bernicla bernicla* (1.6% of GB population)
- Grey plover, *Pluvialis squatarola* (3.9% of GB population)

A number of species/populations have been identified subsequent to the designation, for possible future consideration under criterion 6:

Species with peak counts in spring/autumn:

- Ringed plover, *Charadrius hiaticula* (1.2% of population)

Species with peak counts in winter:

- Eurasian wigeon, *Anas penelope* (1% of population)
- Northern pintail, *Anas acuta* (1.2% of population)
- Northern shoveler, *Anas clypeata* (1.2% of population)
- Black-tailed godwit, *Limosa limosa islandica* (4.2% of population)

D.17 The Swale SPA (UK9012011 - TR001665)

This site is located on the south side of the outer part of the Thames Estuary. The Swale is an estuarine area separating the Isle of Sheppey from the Kent mainland. It is a complex of brackish and freshwater floodplain grazing marsh with ditches, and intertidal saltmarshes and mud-flats. The SPA contains the largest extent of grazing marsh in Kent.

This site qualifies under Article 4.1 by supporting populations of European importance of the following species:

During the breeding season;

- Avocet, *Recurvirostra avosetta* (17.5% of GB breeding population)
- Marsh harrier, Circus *aeruginosus* (15% of GB breeding population)
- Mediterranean gull, *Laurs melanocephalus* (120% of GB breeding population)

Over winter:

- Avocet (7% of GB wintering population)
- Bar-tailed godwit*, Limosa lapponica* (1% of GB wintering population)
- Golden plover*, Pluvialis apricaria* (1.1% of GB wintering population)
- Hen harrier, *Circus cyaneus* (3.1% of GB wintering population)

This site also qualified under Article 4.2 by supporting populations of European importance of the following migratory species:

On passage;

- Ringed plover, *Charadrius hiaticula*

Over winter;

- Black-tailed godwit, *Limosa limosa islandica*
- Grey plover, *Pluvialis squatarola*
- Knot, *Calidris canutus*
- Pintail, *Anas acuta*
- Redshank, *Tringa totanus*
- Shoveler, *Anas clupeata*

The site also qualifies under Article 4.2 by regularly supporting at least 20,000 waterfowl. Over winter, the area regularly supports 65,390 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: White-fronted Goose *Anser albifrons albifrons,* Golden Plover *Pluvialis apricaria*, Bar-tailed Godwit *Limosa lapponica*, Pintail *Anas acuta*, Shoveler *Anas clypeata*, Grey Plover *Pluvialis squatarola*, Knot *Calidris canutus*, Black-tailed Godwit *Limosa limosa islandica*, Redshank *Tringa totanus*, Avocet *Recurvirostra avosetta*, Cormorant *Phalacrocorax carbo*, Curlew *Numenius arquata*, Dark-bellied Brent Goose *Branta bernicla bernicla*, Shelduck *Tadorna tadorna*, Wigeon *Anas penelope*, Gadwall *Anas strepera*, Teal *Anas crecca*, Oystercatcher *Haematopus ostralegus*, Lapwing *Vanellus vanellus*, Dunlin *Calidris alpina alpina*, Little Grebe *Tachybaptus ruficollis*.

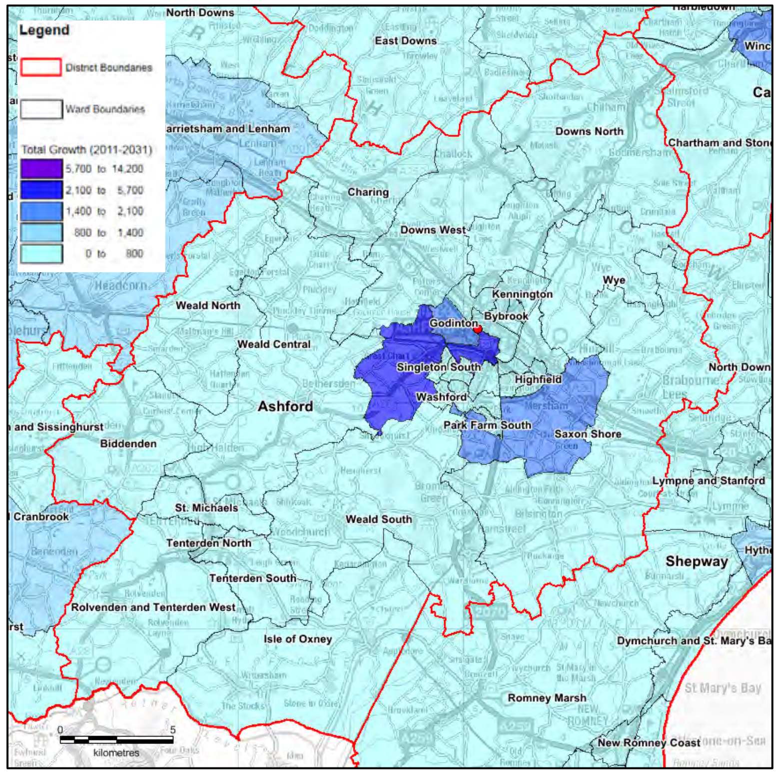
Appendix E – Local Authority Digests

E1 Ashford Digest

E1.1 Growth summary

A total of 14,543 dwellings have been assessed across the LPA area up to 2031, and of the total growth, approximately half is to be phased for delivery earlier in the plan period, up to 2021[1]. Figure E1.1 demonstrates that Growth in Ashford is focused in and around the town of Ashford.

Figure E1.1 Spatial distribution of housing growth within Ashford



E1.2 Water systems in Ashford

Figure E1.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The northern section of Ashford is largely underlain by Lewes Chalk Formation, Gault Formation, Folkestone Formation, Sandgate Formation and Hythe Formation, the central section by Weald Clay Formation and the southern section by Weald Clay Formation and Tunbridge Wells Sand Formation. Lewes Chalk Formation, Folkestone Formation and Hythe Formation are classified as principal aquifers, Tunbridge Wells Sand Formation as secondary aquifer and Gault Formation, Sandgate Formation and Weald Clay Formation as aquicludes. In terms of surface hydrology, drainage of the LPA area is divided across three catchments, with the town of Ashford broadly marking the location of catchment divides and hence being located approximately at the headwaters of three main river catchments. The majority of the town of Ashford (and north of the LPA area) forms part of the Stour Management Catchment draining to the North Sea. West of the town of Ashford, the LPA area forms the upper reaches of the Beult catchment draining to the Medway Management Catchment. The southern section of the LPA area drains to a combination of the Romney Marshes and the River Rother Management Catchment

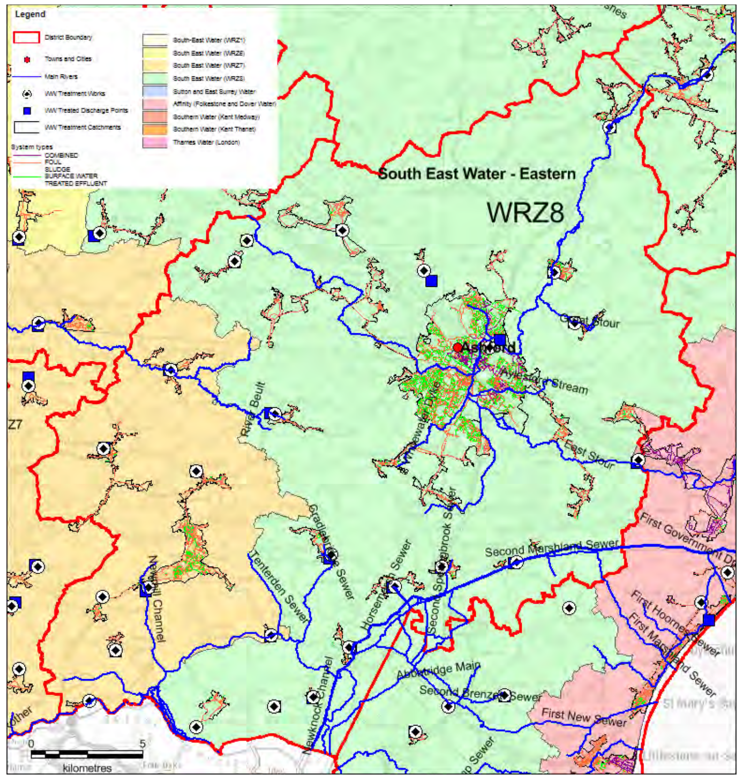
[1] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Ashford is supplied with drinking water by South East Water. The very west of Ashford is located within South East Water's WRZ 7, whilst the central and eastern sections of Ashford are located in WRZ 8. Drinking water is therefore supplied by a mixture of groundwater, surface water and imported water in the west section (approximate area covering the High Weald AONB) and by groundwater for the rest of the LPA area.

Without planned measures to manage demand and new resources, the WRZs serving the Ashford LPA area would be in a deficit of available supply of 20.6 Ml/d by the end of the plan period (2031) and this deficit would be shared across all LPAs served by South East Water's WRZ 7 and 8. Therefore, South East Water are proposing a range of measures to meet this deficit which will benefit growth in Ashford

Figure E1.2: Water systems within Ashford



Wastewater treatment systems

Southern Water provides wastewater services for all of Ashford. The LPA area is mostly served by a separate foul and surface water sewer system, with the exception of some parts of Ashford town centre which is combined.

Wastewater treatment is provided at 25 WwTWs spread across the LPA area

E1. 3 Water resources assessment summary

South East Water are proposing a range of measures to close the deficit within the WRZs serving Ashford up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. For the majority of the LPA area within WRZ 8, South East Water has largely planned for the proposed housing numbers assessed in this study. However, WRZ 7 covering the western portion of the site has options planned to meet demand for only approximately 40% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 0.32 Ml/d in the Ashford LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Ashford has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 18.3Ml/d and the additional demand from projected residential growth is estimated to be 4.58Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 18.3 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[2] (Building Regulation Part G Mandatory); and, 5% of existing homes in Ashford would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[3] (Building Regulation Part G Mandatory); and, 5% of existing homes in Ashford would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that both the mandatory and optional requirement scenarios would reduce post development demand (in 2031) sufficiently to meet the estimated shortfall in supply within South East Water's current planned supply and demand balance.

The mandatory scenario would potentially deliver a post development demand reduction of 0.34Ml/d (8% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.85 Ml/d (19% reduction in additional demand). Figure E1.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Ashford. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E1.3: Costs of achieving water neutrality targets in Ashford

Neutrality Scenaro	Outstanding housing	Existing properties				Costs Summary		
	New build efficiency costs	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2450	£ 539,000	£ -	£ 539,000	£ 539,000
BRO + 5%retrofit	£ 118,800	£ -	5.00%	2450	£ 539,000	£ 118,800	£ 539,000	£ 657,800
Theoretical water neutrality	£ 54,080,400	£ 612,500	34.62%	16963	£ 3,731,795	£ 54,080,400	£ 4,344,295	£ 58,424,695

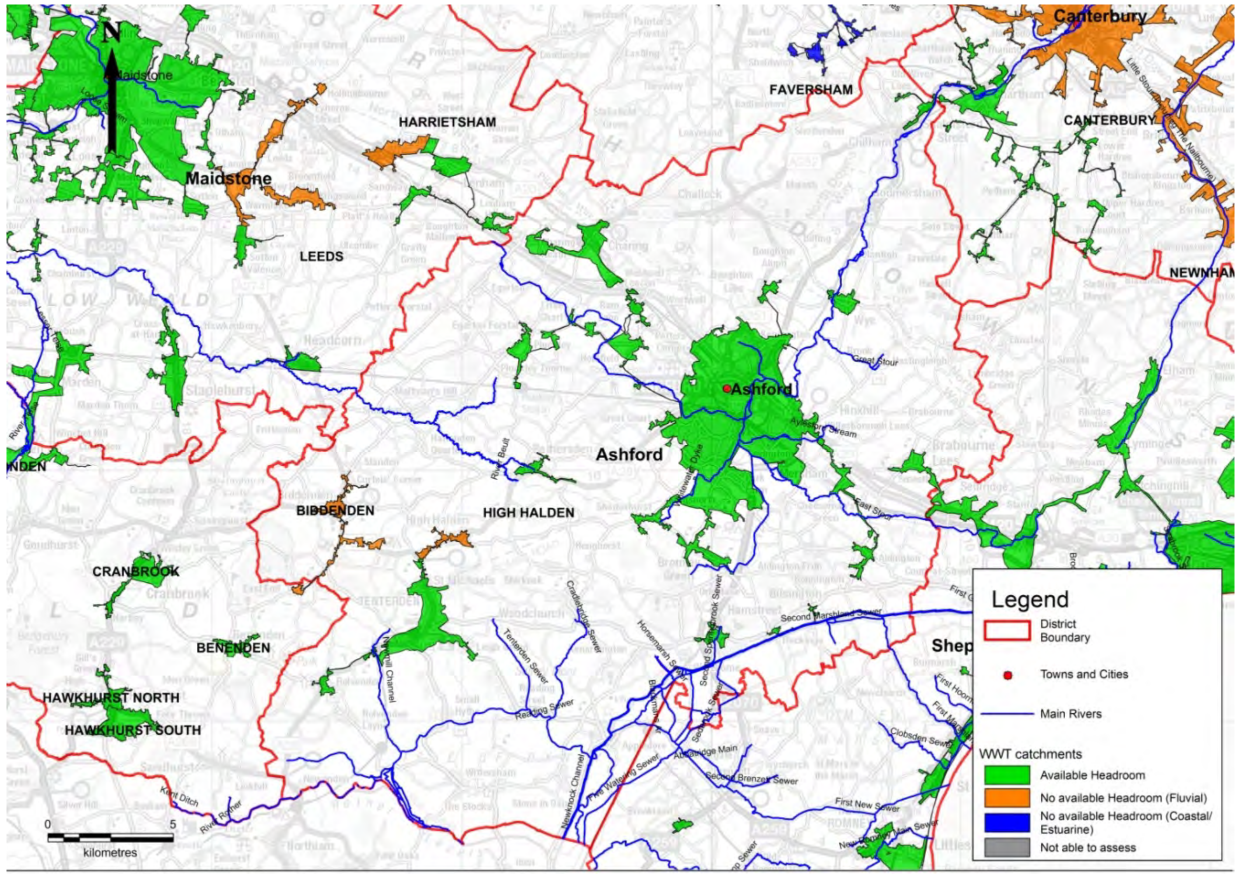
E1.4 Wastewater and water quality assessment summary

The growth planned within Ashford has been compared to the available headroom at WwTWs serving the LPA area. Figure E1.5 demonstrates the results of this assessment and shows that the majority of WwTWs, including Ashford WwTW, have permitted capacity (green) to accept growth. However, growth, in Biddenden WwTW which serves the village of Biddenden and its vicinity and in High Halden WwTW which serves the village of High Halden and its vicinity would require Southern Water to apply for a new discharge permit for the associated WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

[2] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

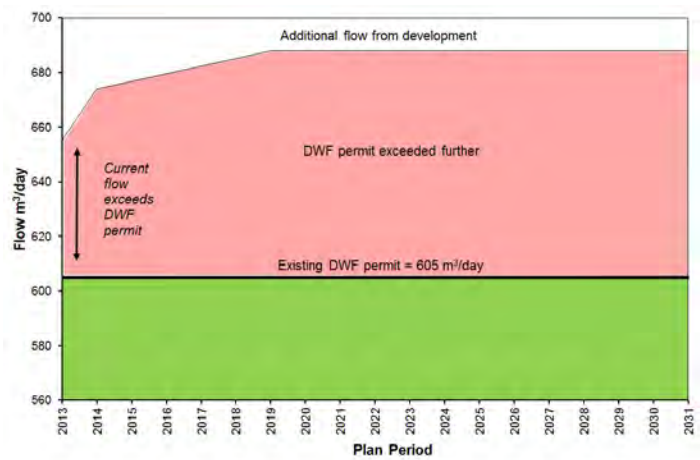
[3] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Figure E1.5: Headroom capacity at WwTWs serving Ashford



Biddenden WwTW

Figure E1.6: Biddenden- Headroom capacity phasing



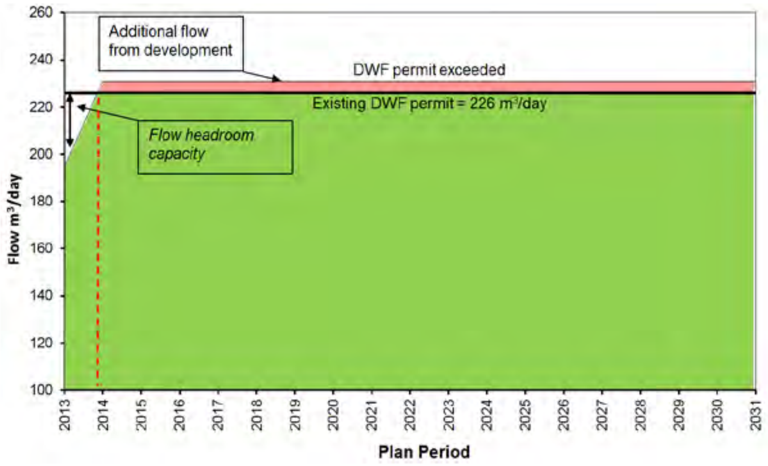
Headroom capacity at Biddenden WwTW is already limited and there is insufficient capacity for additional growth. Water quality modelling using RQP and calculations of load have been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to phosphate and a new BOD limit required to ensure no deterioration in WFD targets in the Hammer Stream. The changes required with respect to BOD and phosphate can be achieved with conventional treatment and hence a technical solution will be feasible.

Ammonia at Biddenden is already being treated below conventional treatment and would need to continue to do so in order to prevent impact on the WFD standards in the Hammer Stream. The relative impact of growth in the catchment is small and although some investment to improve the discharge quality is likely, Southern Water would need to ensure Biddenden WwTW can continue to treat to such a high standard to ensure no deterioration in WFD status.

High Halden WwTW

Figure E1.7 High Halden - Headroom capacity phasing



Based on current estimate of the growth trajectory in Ashford, headroom capacity at the WwTW was used in 2013. Water quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to ammonia and BOD to ensure no deterioration in WFD targets in Upper Beult. The current phosphate quality condition (permit) would be sufficient to ensure no deterioration in status.

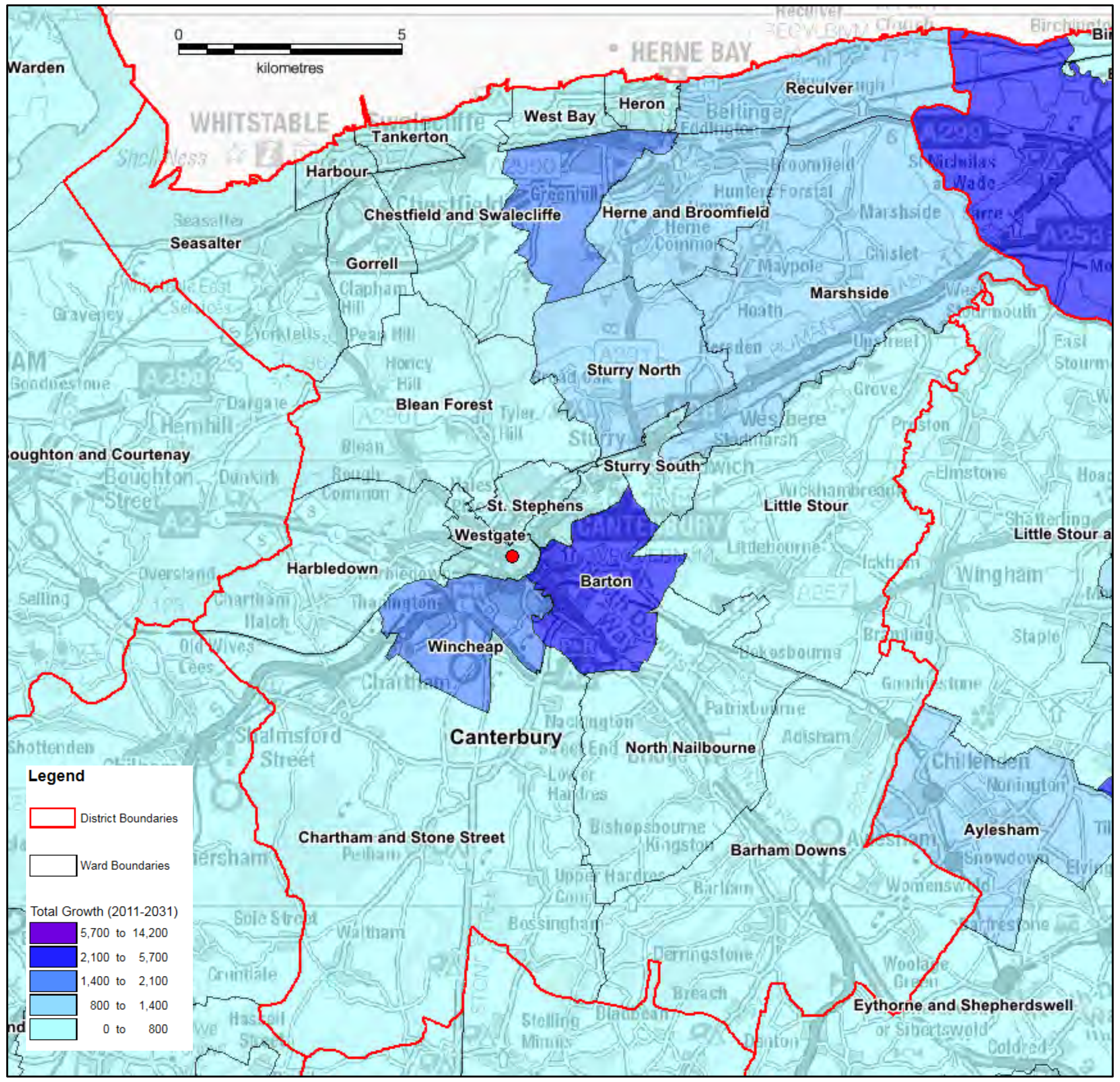
In relation to ammonia and BOD, the changes required can be achieved with conventional treatment and hence a feasible solution will be possible.

E2 Canterbury Digest

E2.1 Growth summary

A total of 16,000 dwellings have been assessed across the LPA area up to 2031, and of the total growth, almost half is to be phased early in the plan period up to 2021[4]. Figure E2.1 demonstrates that growth in the Canterbury is focused to the south of the City of Canterbury as well as some areas of growth south of Herne Bay and within the Wards of Reculver, Marshside, Sturry North and Herne and Broomfield.

Figure E2.1: Spatial distribution of housing growth within Canterbury



E2.2 Water systems in Canterbury

Figure E2.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

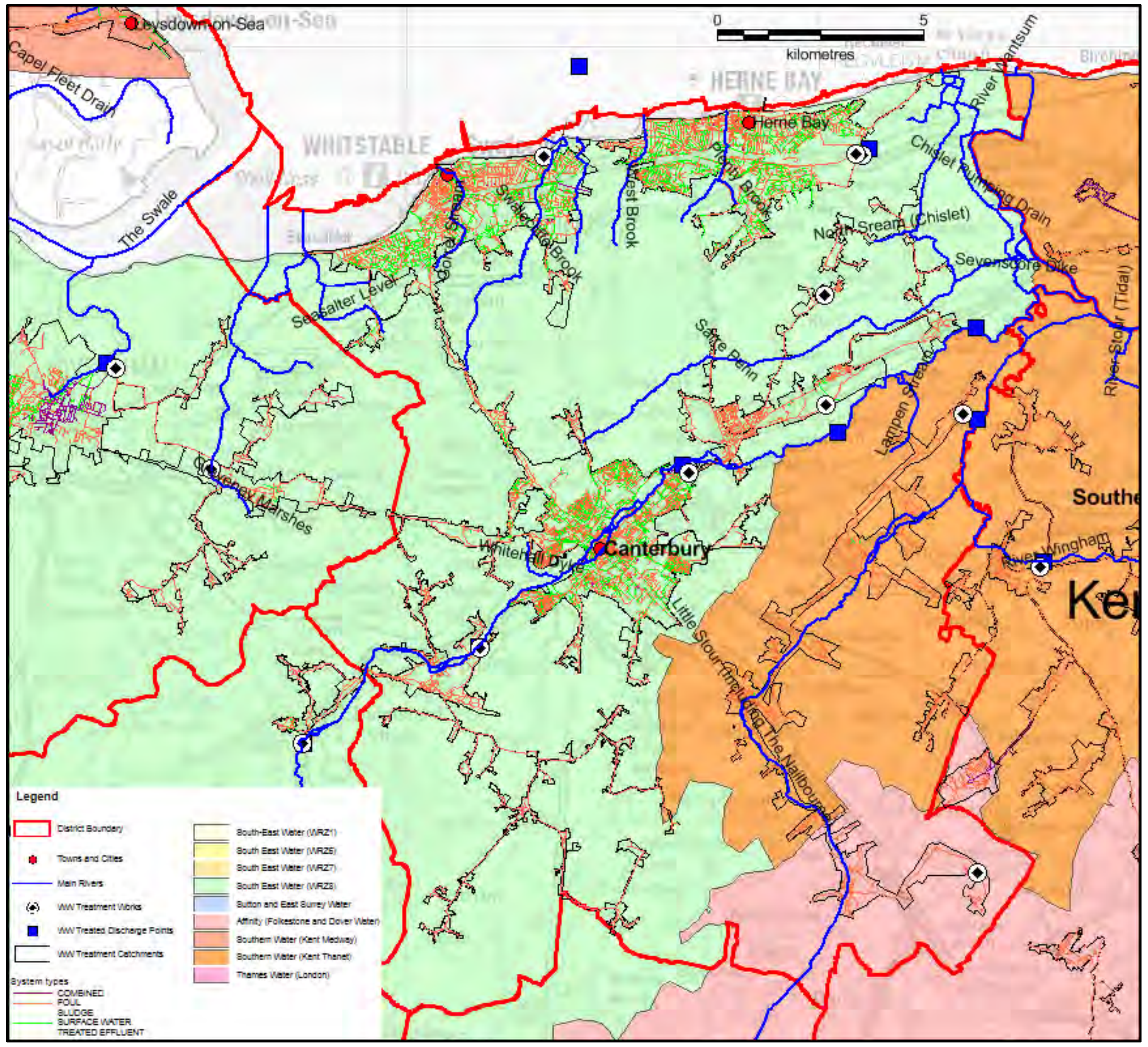
The southern section of Canterbury is overlain by Lewes Chalk Formation whilst the northern section is overlain by Thanet Sand Formation, London Clay Formation, Harwich Formation and Lambeth Group. Thanet Sand Formation and Lewes Chalk Formation are classified as primary aquifers, the Harwich Formation as secondary aquifer and London Clay Formation as aquiclude. The LPA area falls largely within the Stour Management Catchment, with the Great Stour and Little Stour draining the majority of the LPA area to the North Sea. The northern section of the LPA area is drained by a number of smaller watercourses to the North Sea.

Water supply systems

Canterbury is supplied with drinking water by South East Water, Southern Water and Affinity Water. The majority of the LPA area is located within South East Water's WRZ 8, whilst the central eastern section is located in Southern Water's Kent Thanet WRZ, and the far south eastern section of the LPA area is in Affinity Water's Dour WRZ (within their South East supply region). Drinking water is therefore mainly supplied by groundwater with some imported water between water companies and within water company WRZs.

Without planned measures to manage demand and new resources, the WRZs serving the Canterbury LPA area would be in a deficit of available supply of between 2.75 Ml/d and 20.6 Ml/d by the end of the plan period (2031) and this deficit would be shared across all LPAs served by the three WRZs. Therefore, the three water companies are proposing a range of measures to meet this deficit which will benefit growth in Canterbury.

Figure E2.2: Water systems within Canterbury



Wastewater treatment systems

Southern Water provide wastewater services for all Canterbury. The LPA area is served by a separate foul and surface water sewer system. Wastewater treatment is provided at 9 main WwTWs.

[4] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

E2.3 Water resources assessment summary

The three companies supplying Canterbury with water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. For the majority of the LPA area within WRZ 8, South East Water has largely planned for the proposed housing numbers assessed in this study. However, Affinity Water's WRZ and Southern Water's WRZ covering portions of the east and far south east of the LPA area has options planned to meet demand for between only 27% and 45% of the total growth within the WRZ. As a result, this study has estimated that Southern Water and Affinity Water's current WRMPs have a potential shortfall in supply of 1.1 Ml/d within the Canterbury LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMPs updates due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Canterbury has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 22.37Ml/d and the additional demand from projected residential growth is estimated to be 4.79Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 22.37Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[5] (Building Regulation Part G Mandatory); and, 5% of existing homes in Canterbury would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[6] (Building Regulation Part G Mandatory); and, 5% of existing homes in Canterbury would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenarios would reduce post development demand (in 2031) almost to the point of removing the estimated shortfall in supply within Affinity Water's and Southern Water's current planned supply and demand balance (85% of the shortfall would be mitigated); demonstrating the potential effectiveness of adopting such a scenario.

The mandatory scenario would potentially deliver a post development demand reduction of 0.42Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.93Ml/d (19% reduction in additional demand). Figure E2.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Canterbury. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E2.3 Costs of achieving water neutrality targets in Canterbury

Neutrality Scenaro	Outstanding housing	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	3075	£ 676,500	£ -	£ 676,500	£ 676,500
BRO + 5%retrofit	£ 126,000	£ -	5.00%	3075	£ 676,500	£ 126,000	£ 676,500	£ 802,500
Theoretical water neutrality	£ 57,358,000	£ 1,106,662	30.89%	18996	£ 4,179,040	£ 57,358,000	£ 5,285,701	£ 62,643,701

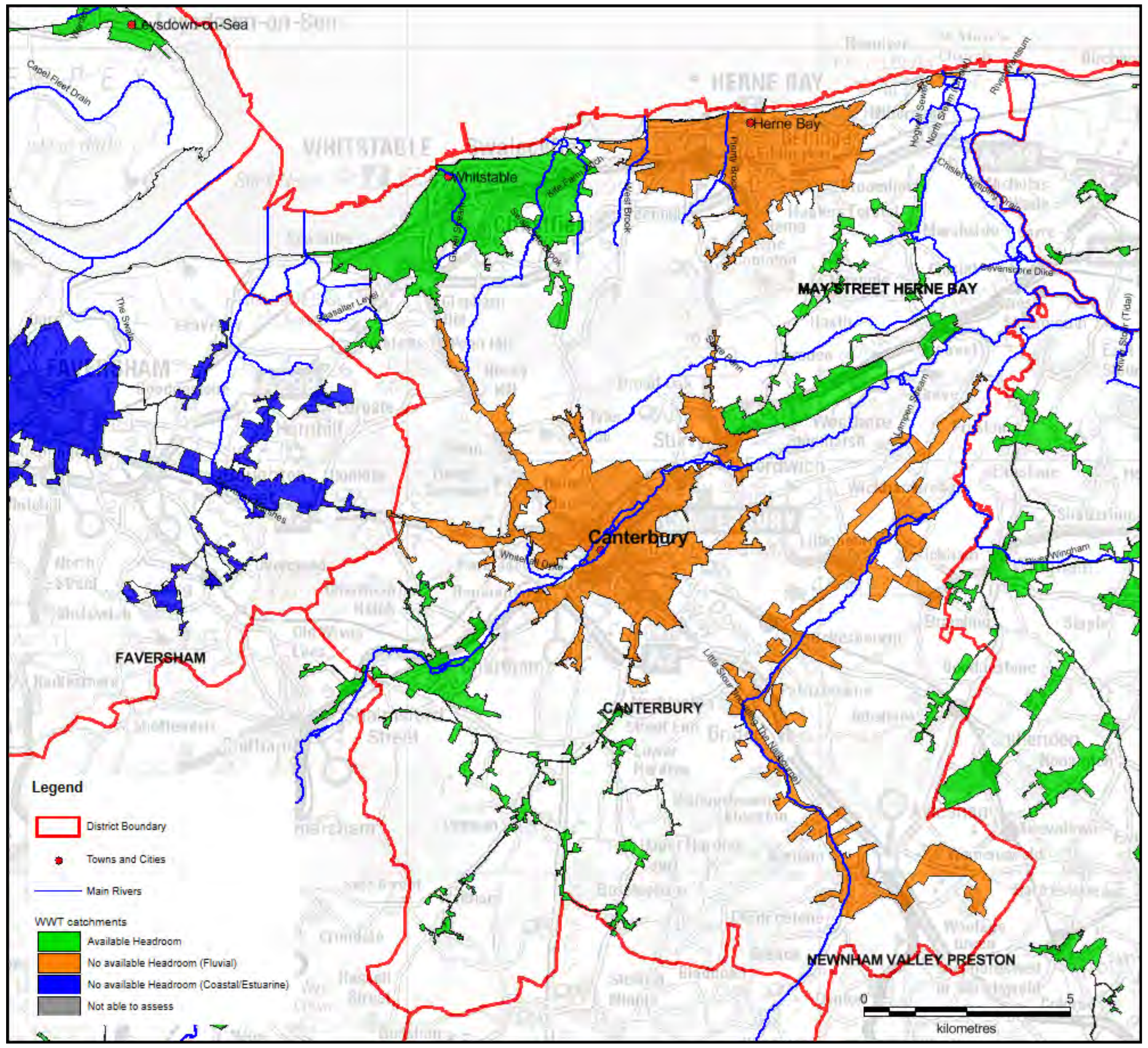
5 The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

6 The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

E2.4 Wastewater and water quality assessment summary

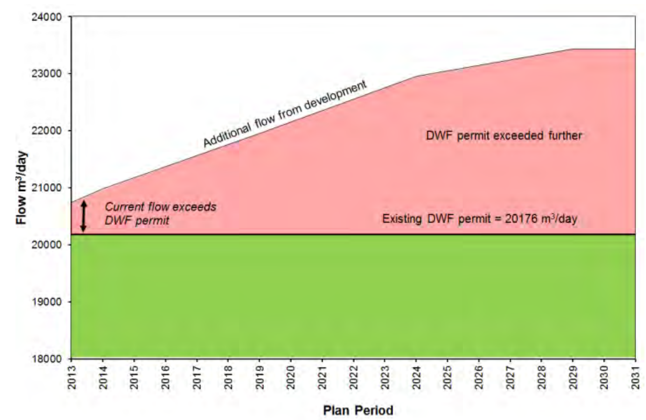
The growth planned within the Canterbury has been compared to the available headroom at WwTWs serving the LPA area. Figure E2.4 demonstrates the results of this assessment and shows that Chartham, Swalecliffe and Westbere WwTWs have permitted capacity (green) to accept growth. However, growth within the Canterbury WwTW catchment, May Street Herne Bay WwTW catchment, and in the Newnham Valley Preston WwTW catchment (which serves the town of Preston and its near vicinity) would require Southern Water to apply for a new discharge permit for these WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

Figure E2.4: Headroom capacity at WwTWs serving Canterbury



Canterbury WwTW

Figure E2.5 Canterbury - Headroom capacity phasing

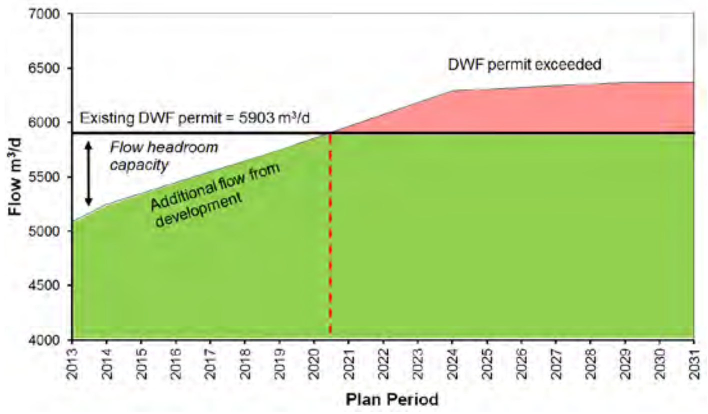


Canterbury WwTW already has limited headroom for additional wastewater flows. Water quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to BOD to ensure no deterioration in WFD targets in the Great Stour. The result also showed that a new phosphate quality condition (above LCT) on the discharge permit would be required to ensure no deterioration in status, but that the existing ammonia quality condition on the permit could be retained. In relation to phosphate and BOD, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible and would need to be implemented by Southern Water relatively early on in the planning period.

May Street Herne Bay WwTW

Figure E2.6: May Street Herne Bay - Headroom capacity phasing



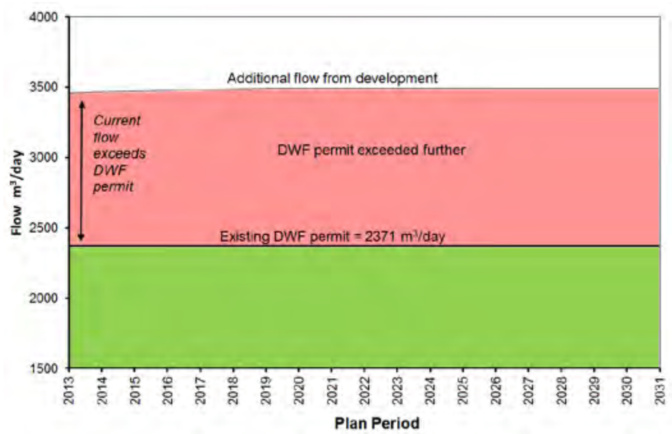
Based on current estimate of the growth trajectory in Canterbury, headroom capacity at the WwTW would be used by 2021. Water quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that existing quality conditions could be maintained on the permit relating to phosphate and ammonia to ensure no deterioration in WFD targets in the Great Stour. A tighter condition would be required for BOD to ensure the future WFD status of the Great Stour is achieved.

In relation to BOD, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible and would need to be implemented by Southern Water at some point in the future

Newnham Valley Preston WwTW

Figure E2.7 Newnham Valley Preston - Headroom capacity phasing



Newnham Valley Preston WwTW already has limited headroom for additional wastewater flows. Water quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that existing permit conditions for ammonia and BOD would be adequate to maintain WFD status in the Little Stour. A phosphate condition would not be required to protect WFD status.

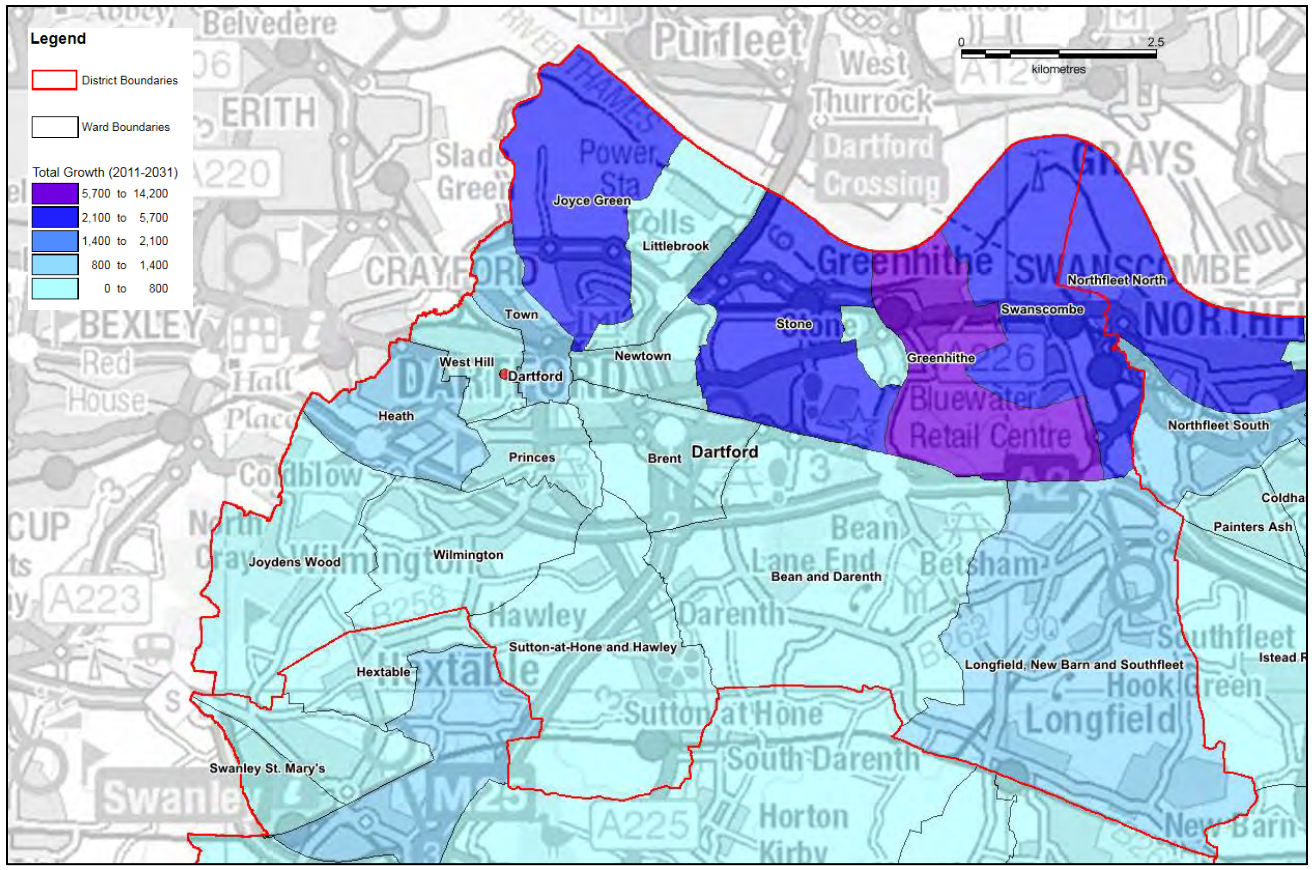
It is unlikely that significant process upgrades will be required at the WwTW based on the limited growth planned within the catchment. Some upgrades may be required in relation to hydraulic capacity in relation to headroom exceedance; however, the exact technical specification of the upgrades required should be determined by Southern Water for the AMP7 asset planning period. This demonstrates that a technical solution is feasible.

E3 Dartford Digest

E3.1 Growth summary

A total of 19,000 dwellings have been assessed across the LPA area up to 2031 and of the total growth, approximately 56% is to be phased early in the planning period up to 2021[7]. Figure E3.1 demonstrates that Growth in Dartford is focused north of Dartfort, and in and around Greenhithe, and Swanscombe.

Figure E3.1 Spatial distribution of housing growth within Dartford



E3.2 Water systems in Dartford

Figure E3.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

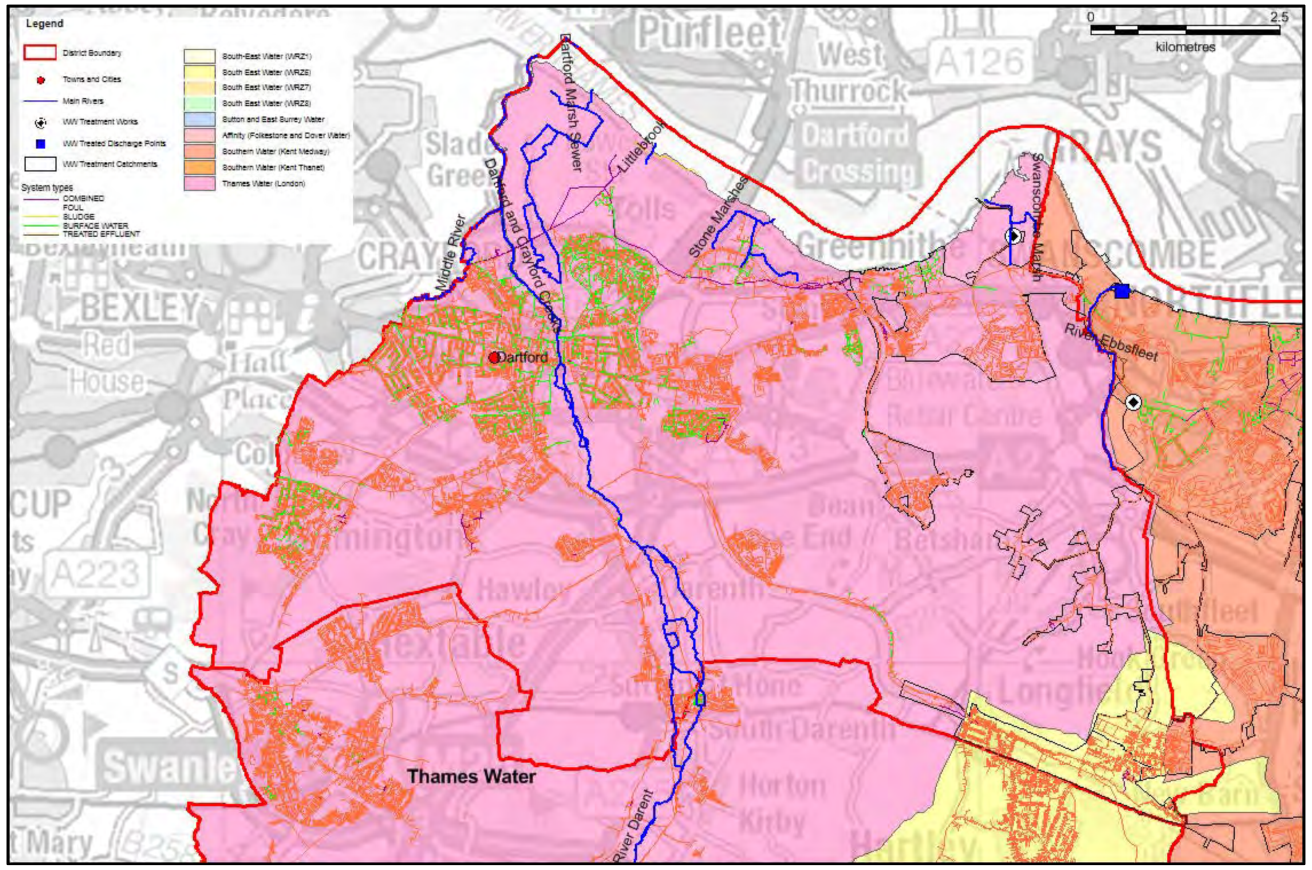
Dartford largely overlies the Lewes Chalk Formation and, close to the western border and the town of Bean and Betsham, it is underlain by Thanet Sand Formation, London Clay Formation and Lambeth Group. Lewes Chalk Formation is classified as a principal aquifer, Thanet Sand Formation as secondary aquifer and London Clay Formation as aquiclude. The majority of the LPA area is covered by the Darent catchment with a number of small watercourses draining directly to the Thames estuary along the northern boundary.

Water supply systems

The majority of Dartford is supplied with drinking water by Thames Water; the far south eastern section of the LPA area (covering Longfield and New Barn) is served by South East Water. Much of the LPA area is therefore within Thames Water's London WRZ, whilst the south eastern section of the LPA area is located in South East WRZ 6. Drinking water is therefore supplied by a complex mix of sources but with groundwater likely to be the dominant source in this location.

Without planned measures to manage demand and new resources, the WRZs serving the Darftord LPA area would be in a significant deficit of available supply dominated by the large deficit across the wider London WRZ. This deficit would be shared across all LPAs within the London WRZ. The far south east of the District would also be part of a WRZ where a deficit of 20 Ml/d is predicted across all LPA areas within that zone. Therefore, Thames Water and South East Water are proposing a range of measures to meet this deficit which will benefit growth in Dartford.

Figure E3.2: Water systems within Dartford



Wastewater treatment systems

Thames Water provide wastewater services for most of Dartford; however, Southern Water provide services to Swanscombe, Southfleet, Long Barn and Longfield. The LPA area is largely served by a separate foul and surface water sewer system.

Wastewater treatment is provided at 4 main WwTWs with Dartford and most of the LPA area south of the A2 draining to the Long Reach WwTW operated by Thames Water (which also serves a large proportion of south east London).

E3.3 Water resources assessment summary

Thames Water and South East Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Both Thames Water and South East Water have largely planned for the proposed housing numbers assessed in this study and as a result, this study has determined that there is no current shortfall in planned demand.

To further enhance strategic scale water resource measures planned by Thames Water and South East Water, the potential for a water neutral position across Dartford has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

[7] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Existing water demand (residential only) within the LPA area has been estimated as 15.18Ml/d and the additional demand from projected residential growth is estimated to be 5.95Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 15.18 M/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[8] (Building Regulation Part G Mandatory); and, 5% of existing homes in Dartford would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[9] (Building Regulation Part G Mandatory); and, 5% of existing homes in Dartford would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The mandatory scenario would potentially deliver a post development demand reduction of 0.25Ml/d (4% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.89Ml/d (15% reduction in additional demand). Figure E3.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Dartford. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E3.4 Costs of achieving water neutrality targets in Dartford

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2070	£ 455,400	£ -	£ 455,400	£ 455,400
BRO + 5%retrofit	£ 153,825	£ -	5.00%	2070	£ 455,400	£ 153,825	£ 455,400	£ 609,225
Theoretical water neutrality	£ 70,024,558	£ 9,479,275	37.95%	15712	£ 3,456,650	£ 70,024,558	£ 12,935,925	£ 82,960,483

E3.4 Wastewater and water quality assessment summary

The growth planned within Dartford has been compared to the available headroom at WwTWs serving the LPA area.

[8] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[9] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

demonstrates the results of this assessment for the WwTWs operated by Southern Water (Longfield, Greenhithe and Northfleet WwTWs). The rest of the LPA area is served by Thames Water's Long Reach WwTW which has sufficient capacity to accept the additional wastewater flow.

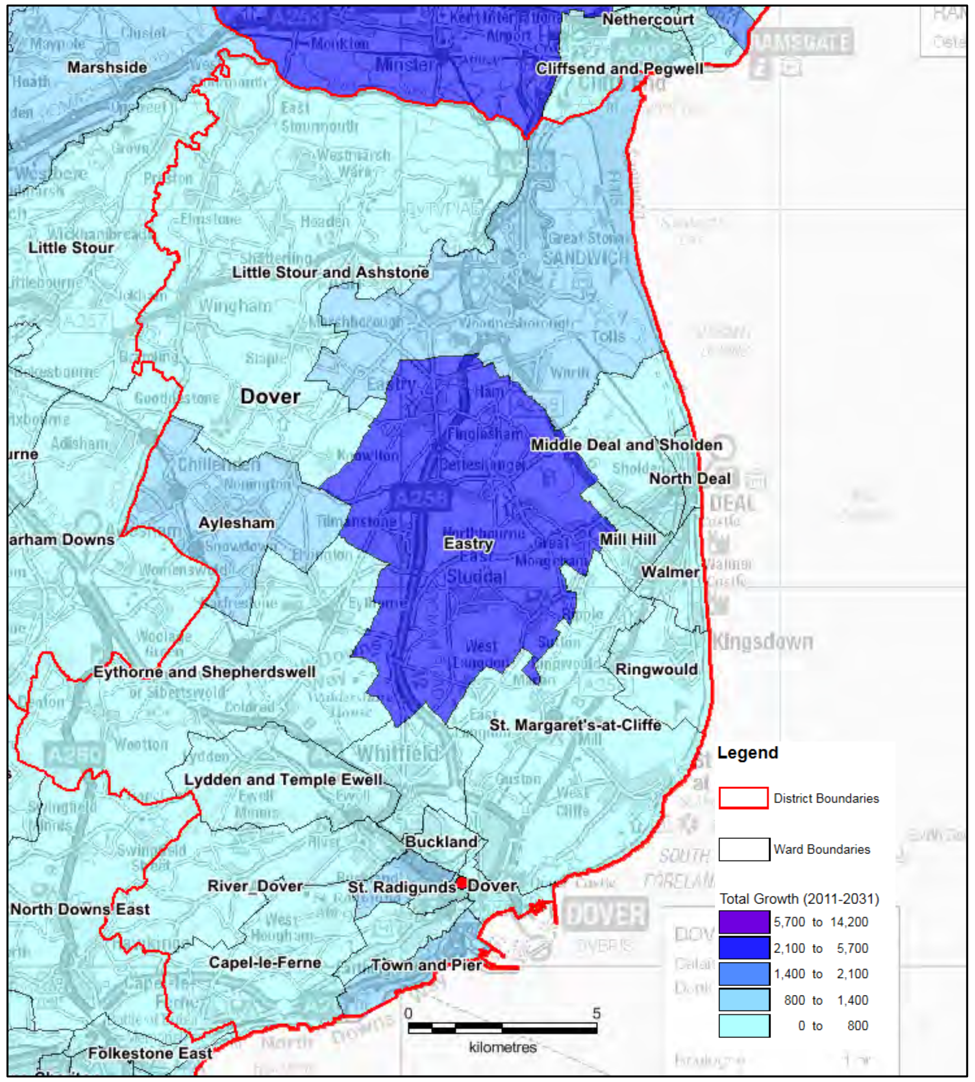
Discussions with Southern Water confirmed that Greenhithe and Northfleet WwTW do not current have quality conditions with which to undertake estuarine load standstill calculations and that treatment upgrades would likely be achievable within the planned timeframes should quality conditions need to be applied. Longfield WwTW currently operates under a descriptive consent, which means it has no numerical limits with respect to flow volumes or quality and a modelling exercise was not possible for this WwTW. Whilst Southern Water does not currently have any concerns regards the capacity of the WwTW, the requirement for changes to the discharge would need to be assessed as part of a site specific study into the capacity of the WwTW.

E4 Dover Digest

E4.1Growth summary

A total of 11,514 dwellings have been assessed across the LPA area up to 2031. Approximately half of this growth is likely to be phased before 2021 and the other half between 2021 and 2031[10]. Figure E4.1 demonstrates that Growth in Dover is focused in the ward of Eastry, with other growth areas focused in the Aylesham Ward, in and around Sandwich, and in and around the town of Dover.

Figure E4.1: Spatial distribution of housing growth within Dover



E4.2 Water systems in Dover

Figure E4.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

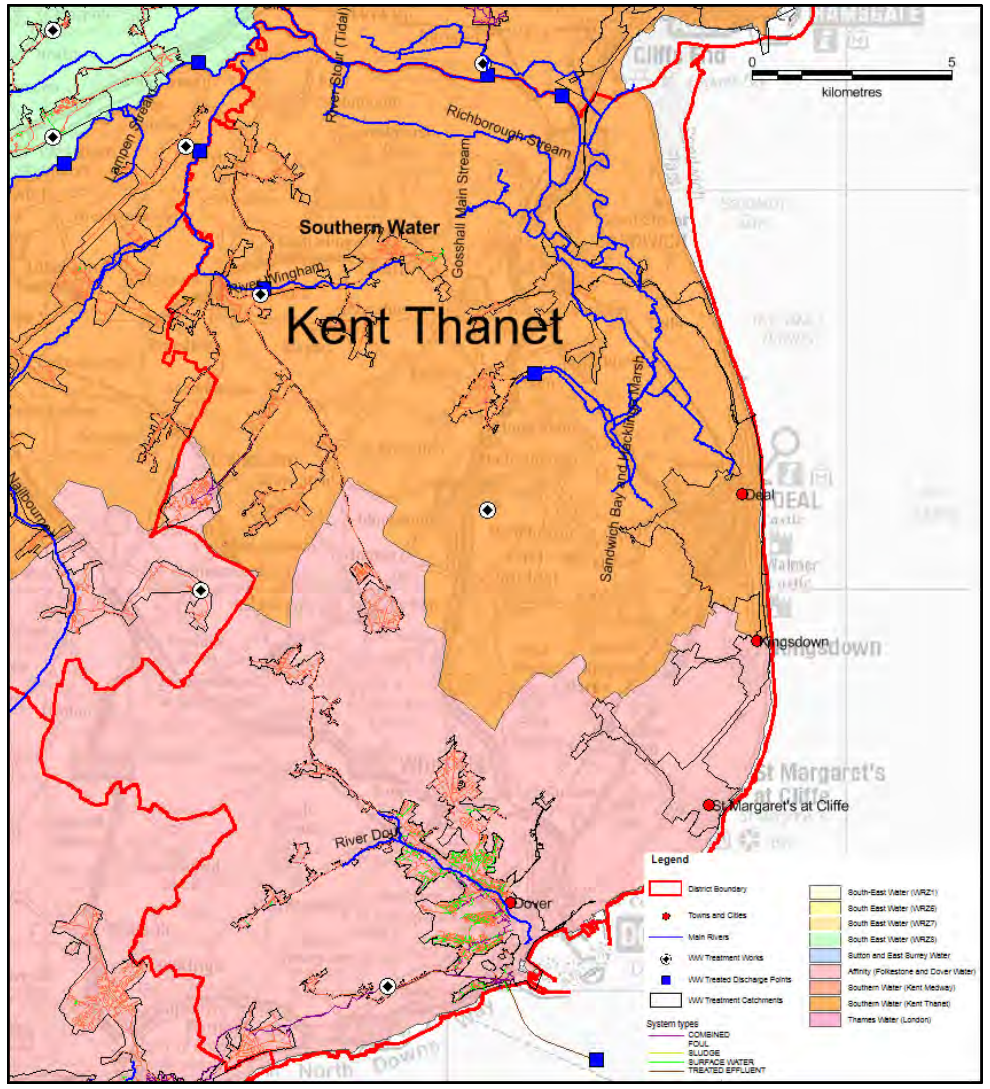
Dover is largely underlain by Lewes Chalk Formation and, close to the northern border of the LPA area, it is underlain by Thanet Sand Formation, the Lambeth Group, the Harwich Formation and the London Clay Formation. The Lewes Chalk Formation is classified as a principal aquifer, the Thanet Sand Formation and the Harwich Formation as secondary aquifers and the London Clay Formation as an aquiclude. Majority of the LPA area is within the Stour Management Catchment, with the Stour tributaries draining the north and centre of the LPA area to the North Sea. The southern section of the LPA area is drained by the Upper Dour to the English Channel.

Water supply systems

Dover is supplied with drinking water by Southern Water and Affinity Water. The north of the LPA area is located within Southern Water's Kent Thanet WRZ, whilst the south of the LPA area is located in Affinity Water's Dour WRZ. Drinking water is therefore supplied primarily by groundwater across the LPA area with a smaller percentage supplied by imports.

Without planned measures to manage demand and new resources, the north of the LPA area would see a deficit of available supply of 2.75 Ml/d shared with other LPAs in the WRZ, whilst the south would see a deficit of 20 Ml/d shared with other LPAs in the WRZ up to 2031. Therefore, Southern Water and Affinity Water are proposing a range of measures to meet this deficit which will benefit growth within Dover.

Figure E4.2: Water systems within Dover



Wastewater treatment systems

Southern Water provide wastewater services for all of Dover. The LPA area is served by a separate foul and surface water sewer system. Wastewater treatment is provided at 5 main WwTWs.

[10] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

E4.3 Water resources assessment summary

Southern Water and Affinity Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Affinity Water's WRZ and Southern Water's WRZ covering the LPA area has options planned to meet demand for between only 27% and 45% of the total growth within the WRZ. As a result, this study has estimated that Southern Water's and Affinity Water's current WRMPs have a potential shortfall in supply of 3.79 Ml/d within the Dover LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMPs updates due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Dover has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 16.62 Ml/d and the additional demand from projected residential growth is estimated to be 3.89Ml/d[11]. To achieve neutrality, demand after all houses are built and occupied would need to be less than 16.62Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[12] (Building Regulation Part G Mandatory); and, 5% of existing homes in Dover would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[13] (Building Regulation Part G Mandatory); and, 5% of existing homes in Dover would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make some contribution to reducing the post development demand (in 2031) shortfall within Affinity Water's and Southern Water's current planned supply and demand balance; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by both companies to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.26Ml/d (8% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.61Ml/d (19% reduction in additional demand). Figure E4.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Dover. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E4.3: Costs of achieving water neutrality targets in Dover

Neutrality Scenario	Outstanding housing	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2445	£ 537,900	£ -	£ 537,900	£ 537,900
BRO + 5%retrofit	£ 94,698	£ -	5.00%	2445	£ 537,900	£ 94,698	£ 537,900	£ 632,598
Theoretical water neutrality	£ 43,108,634	£ 1,357,452	34.75%	16992	£ 3,738,211	£ 43,108,634	£ 5,095,663	£ 48,204,297

E4.4 Wastewater and water quality assessment summary

The growth planned within the Dover has been compared to the available headroom at WwTWs serving the LPA area.

[11] Including Otterpool garden community

[12] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

[13] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

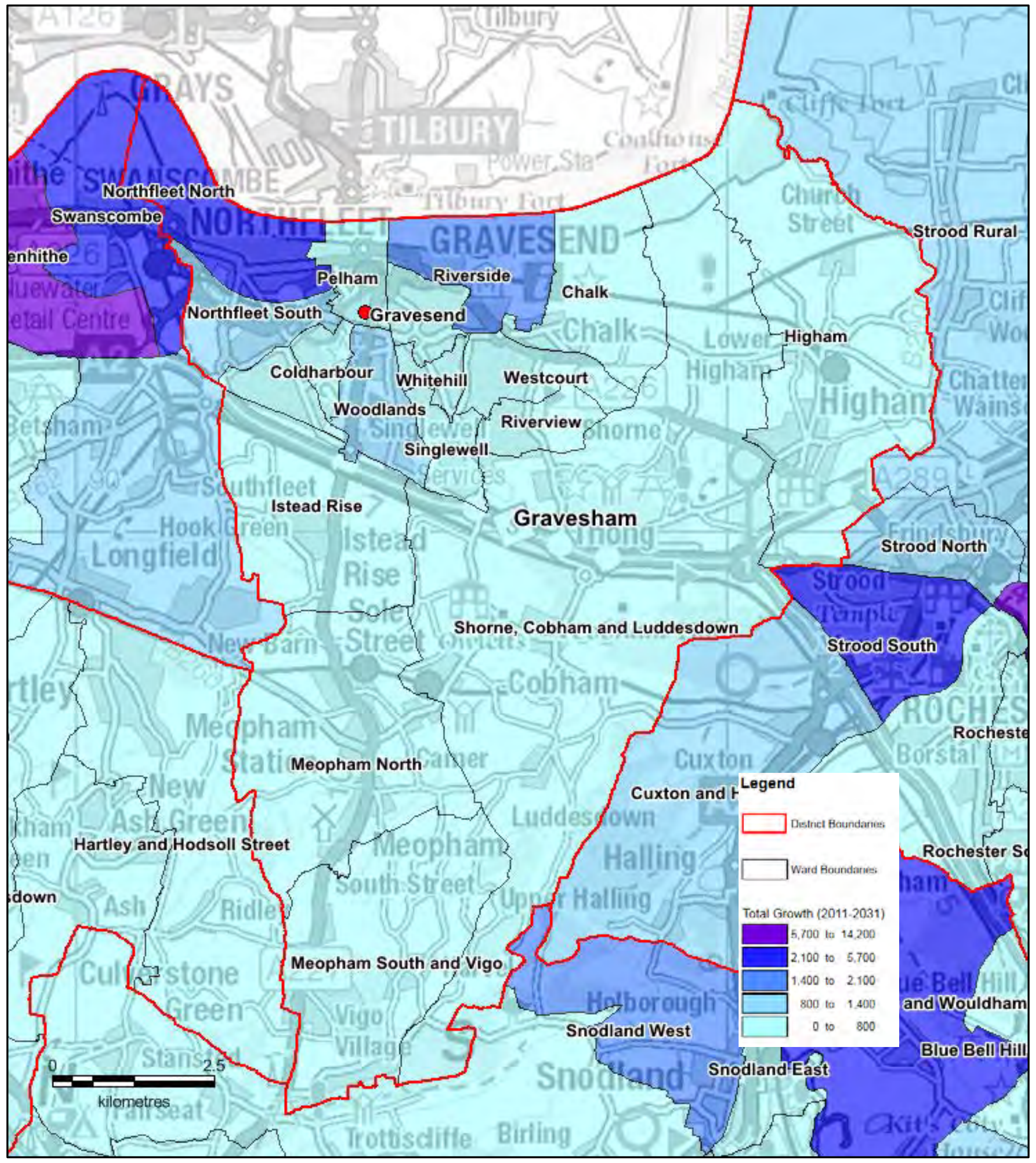
demonstrates the results of this assessment and shows that all WwTWs have capacity to accept growth within the current permit limits.

E5 Gravesham Digest

E5.1 Growth summary

A total of 7,139 dwellings have been assessed across the LPA area up to 2031, and of the total growth, 60% (approximately 4,299) is to be phased between 2016 and 2026[14]. Figure E5.1 demonstrates that Growth in Gravesham is focused in and around the towns of Northfleet and Gravesend.

Figure E5.1 Spatial distribution of housing growth within Gravesham



E5.2 Water systems in Gravesham

Figure E5.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

[14] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Natural systems

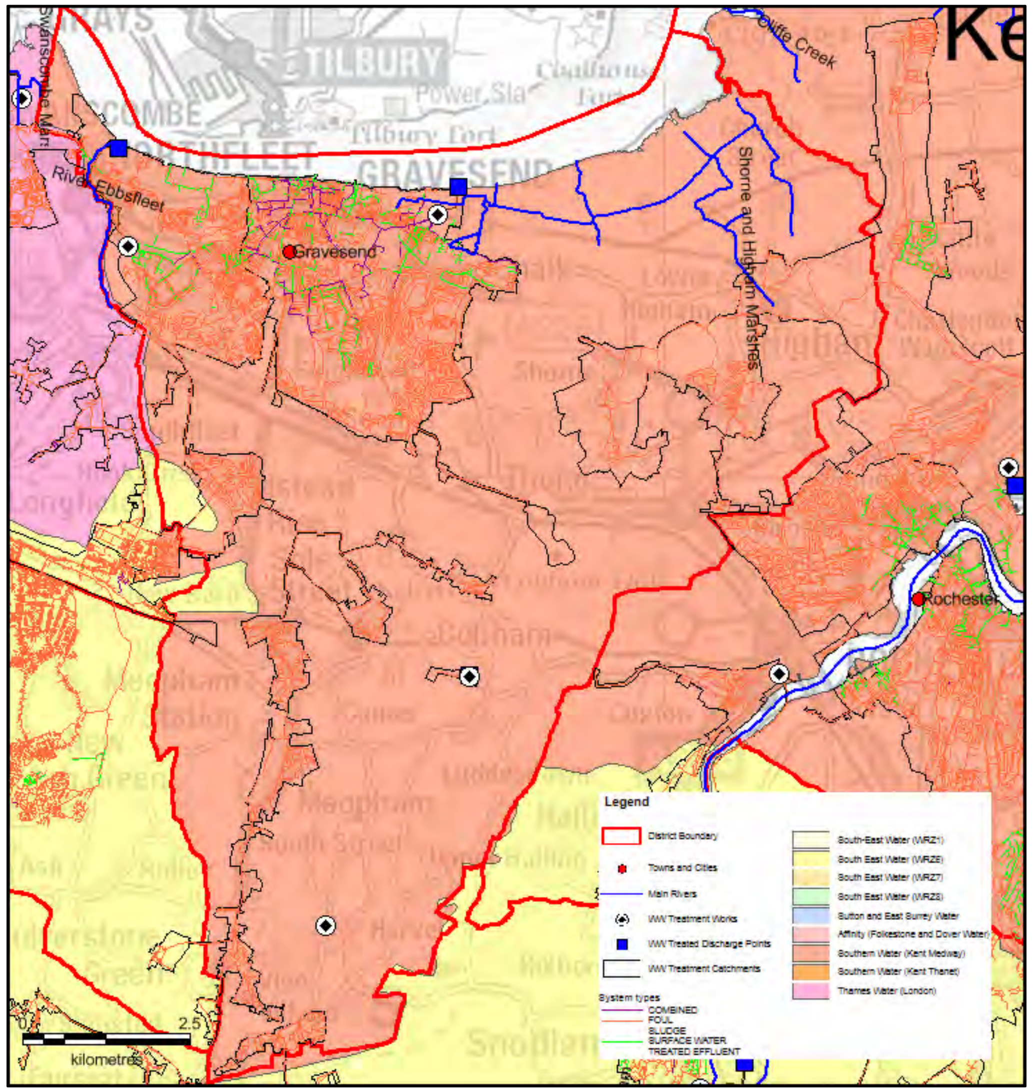
Gravesham is largely underlain by Lewes Chalk Formation and, close to north border of the LPA area, it is underlain by Lambeth Group, London Clay Formation and Harwich Formation. Close to the town of Gravesend, it is overlain by Thanet Sand Formation. The Lewes Chalk Formation is classified as a principal aquifer, the Harwich Formation and Thanet Sand Formation as secondary aquifers and London Clay Formation as an aquiclude. The north of the LPA area is drained by Shorne and Higham Marshes.

Water supply systems

Gravesham is supplied with drinking water by Southern Water with the exception of two small sections to the central west of the LPA area served by South East Water. Nearly all of the LPA area is located within Southern Water's Kent Medway WRZ and hence the assessment is based on water availability within this WRZ. Drinking water is therefore supplied by groundwater and water from surface water abstractions to most parts of the LPA area.

Without planned measures to manage demand and new resources, the majority of the LPA area would see a deficit of available supply of 20 Ml/d. Southern Water are proposing a range of measures to meet this deficit to the benefit of the Gravesham LPA area.

Figure E5.2: Water systems within Gravesham



Wastewater treatment systems

Southern Water provide wastewater services for all of Gravesham. The LPA area is largely served by a separate foul and surface water sewer system, with the exception of areas within Gravesend town centre which is combined. Wastewater treatment is provided at 4 main WwTWs of which two would be likely to receive wastewater from some growth.

E5.3 Water resources assessment summary

Southern Water are proposing a range of measures to close the deficit within the WRZ serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Southern Water's WRZ covering the LPA area largely has sufficient planned supply to meet the demand expected from the planned growth. Therefore, there is no shortfall in planned supply.

To further enhance strategic scale water resource measures, the potential for a water neutral position across Gravesham has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 15.68 Ml/d and the additional demand from projected residential growth is estimated to be 2.23Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 15.68 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[15] (Building Regulation Part G Mandatory); and, 5% of existing homes in Gravesham would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[16] (Building Regulation Part G Mandatory); and, 5% of existing homes in Gravesham would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The mandatory scenario would potentially deliver a post development demand reduction of 0.24Ml/d (11% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.48Ml/d (21% reduction in additional demand). Figure E5.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Gravesham. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E5.3 Costs of achieving water neutrality targets in Gravesham

Neutrality Scenaro	Outstanding housing	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2050	£ 451,000	£ -	£ 451,000	£ 451,000
BRO + 5%retrofit	£ 56,700	£ -	5.00%	2050	£ 451,000	£ 56,700	£ 451,000	£ 507,700
Theoretical water neutrality	£ 25,811,100	£ 1,018,440	24.08%	9873	£ 2,172,031	£ 25,811,100	£ 3,190,471	£ 29,001,571

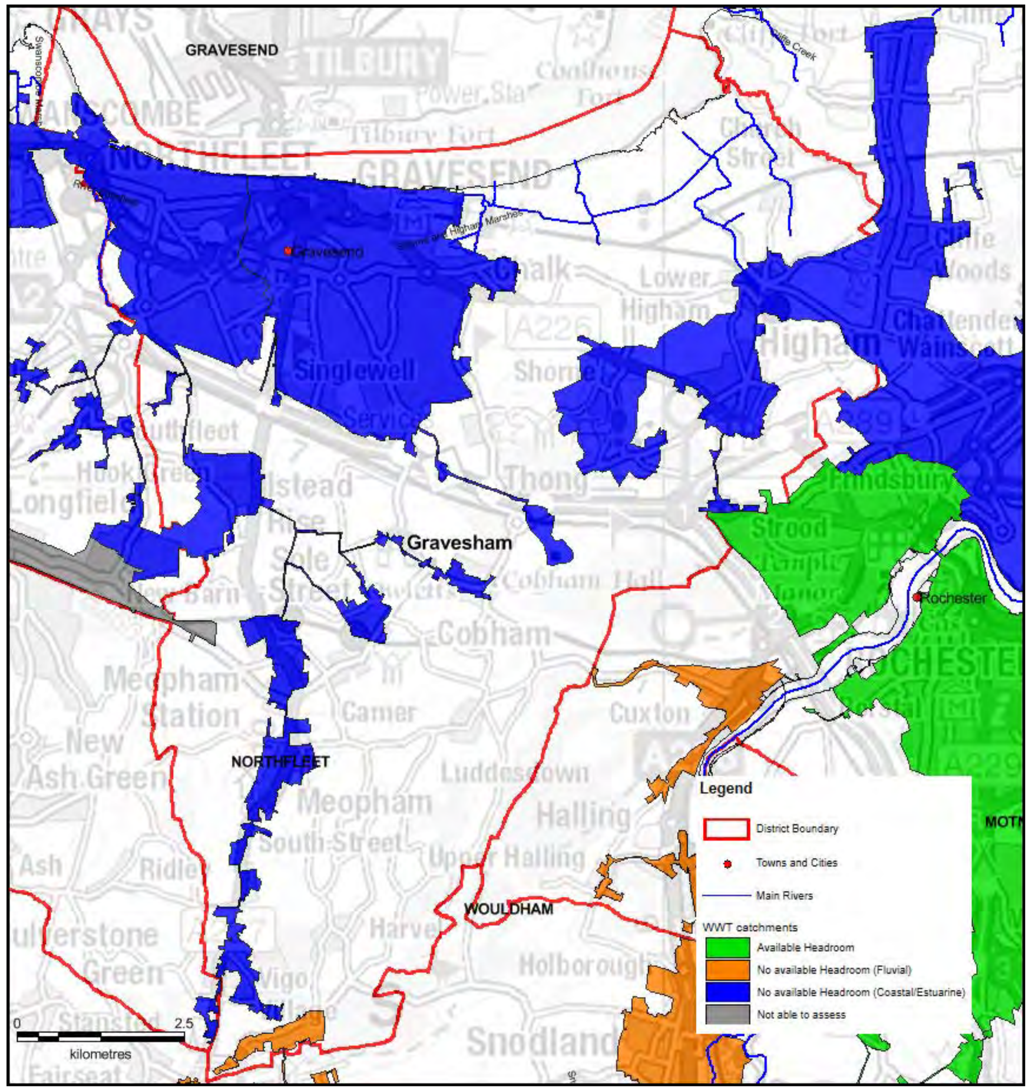
E5.4 Wastewater and water quality assessment summary

The growth planned within Gravesham has been compared to the available headroom at WwTWs serving the LPA area. Figure E5.4 demonstrates the results of this assessment and demonstrates that two WwTW, Gravesend and Whitewall Creek, would receive growth within their catchment and would not have sufficient permitted headroom to treat all the planned growth.

Discussions with Southern Water have confirmed that there are no quality conditions on the Gravesend discharge with which to undertake an assessment, therefore a water quality assessment was not possible. Southern Water have confirmed that there should be no significant constraints as a result of permit changes that may need to be introduced to protect water quality in the tidal Thames. In relation to Whitewall Creek, Southern Water would need to apply for a new discharge permit. To determine whether there is environmental capacity in relation to the permit, a water quality assessment exercise was completed.

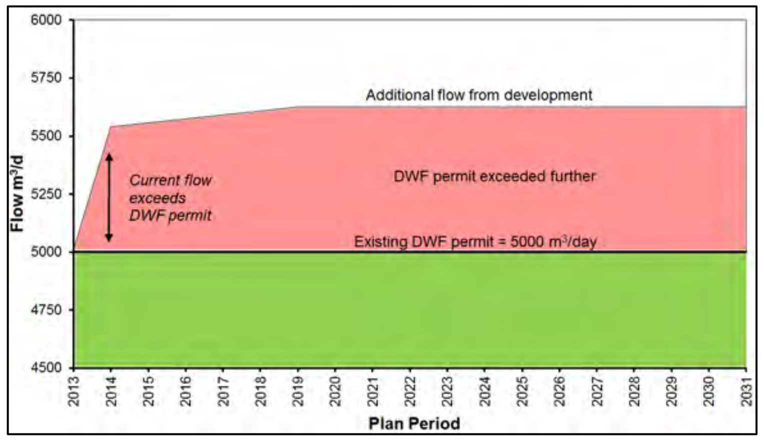
[15] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[16] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Figure E5.4: Headroom capacity at WwTWs serving Gravesham



Whitewall Creek WwTW

Figure E5.5: Whitewall Creek - Headroom capacity phasing



Based on current estimate of the growth trajectory in Gravesham, headroom capacity at the WwTW was utilised in 2013. Water quality assessment using calculations of load have been used to determine environmental capacity in relation to the new permit required.

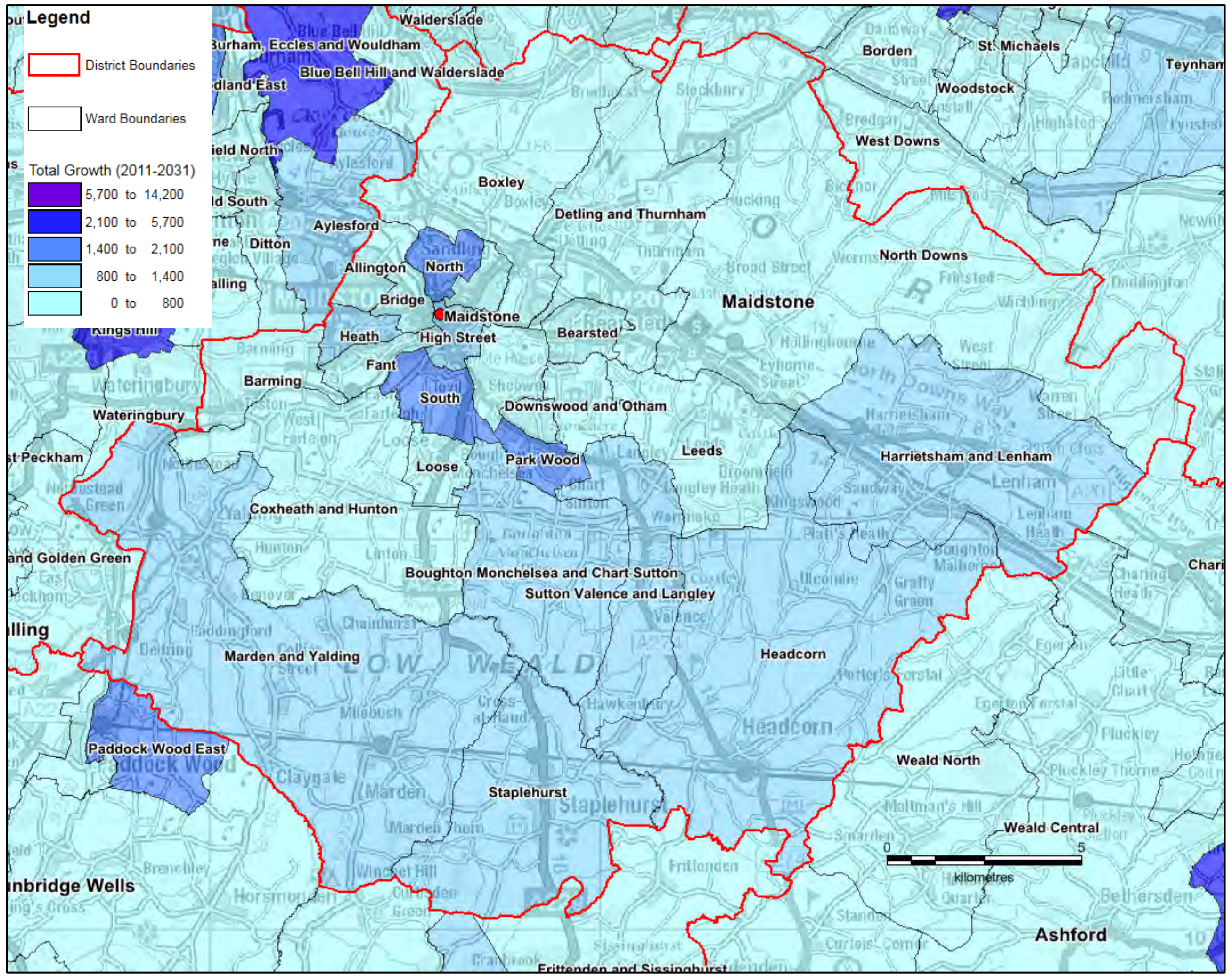
The assessment demonstrated that more stringent quality conditions would be required on the permit relating to ammonia and BOD to ensure no deterioration in WFD targets in the Medway estuary. However, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible.

E6 Maidstone Digest

E6.1 Growth summary

A total of 18,563 dwellings have been assessed across the LPA area up to 2031, and of the total growth, approximately 75%is to be phased before 2026[17]. Figure E6.1 demonstrates that Growth in Maidstone is focused in and around the town of Maidstone.

Figure E6.1: Spatial distribution of housing growth within Maidstone



E6.2 Water systems in Maidstone

Figure E6.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The north of Maidstone is underlain by the Lewes Chalk Formation, the south of the LPA area is underlain by Weald Clay Formation and the centre is underlain by Hythe Formation, Weald Clay Formation, Folkestone Formation and Sandgate Formation. The Lewes Chalk Formation, Folkestone Formation and Hythe Formation are classified as principal aquifers and Weald Clay Formation and Sandgate Formation as aquicludes. The majority of the LPA area is covered by the Medway Management Catchment, with the Teise, Beult and its tributaries and River Len draining the LPA area towards the River Medway.

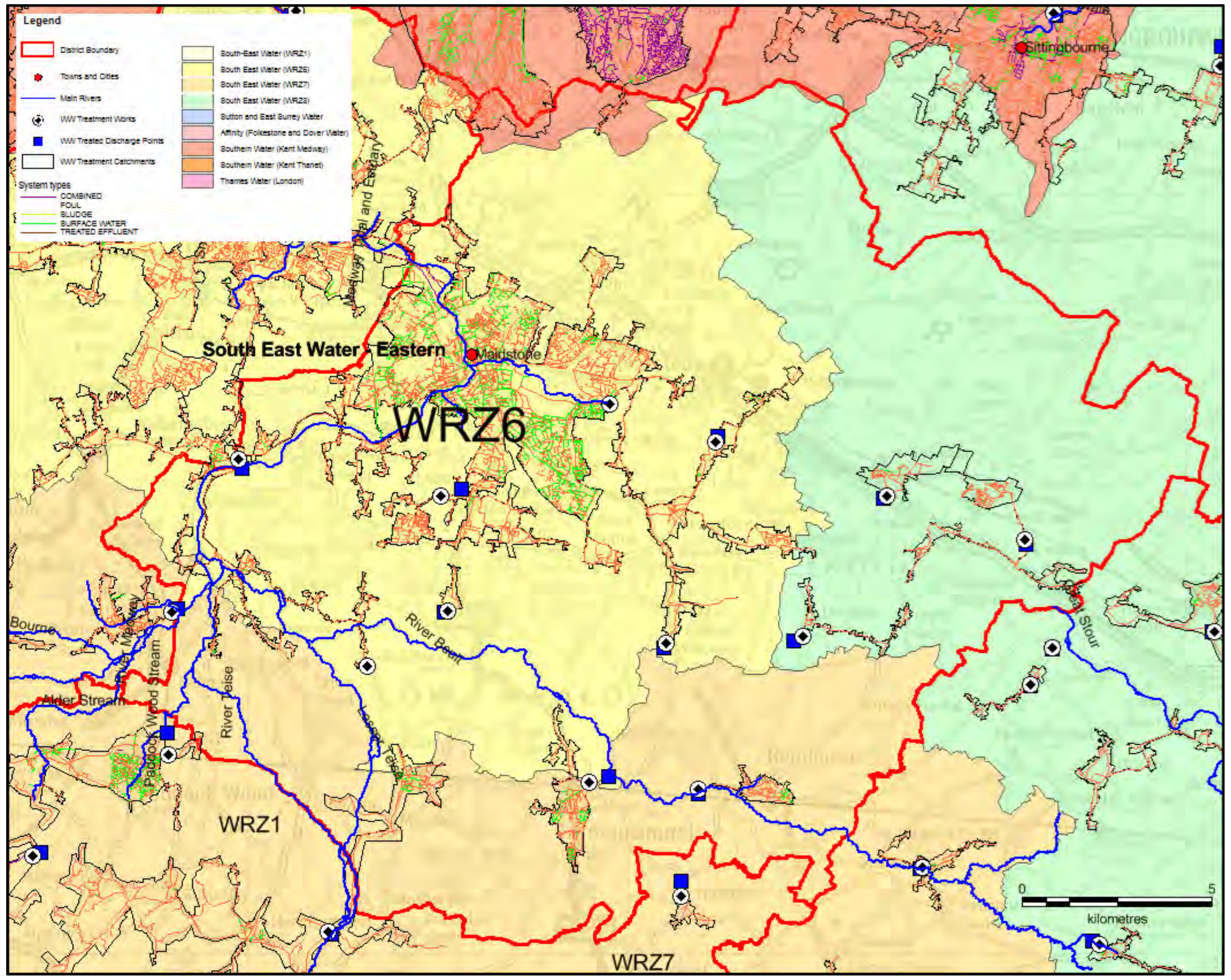
[17] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Maidstone is mainly supplied with drinking water by South East Water with a very small section to the north supplied by Southern Water. The south of the LPA area is located within South East Water's WRZ 7. The western section is located within South East water's WRZ 6 and the eastern section is located in South East Water's WRZ 8. Drinking water is therefore supplied by groundwater, surface water and imported water from Southern Water to the west, ground water to the east, and a mixture of ground water and surface water to the south.

Without planned measures to manage demand and new resources, majority of Maidstone would be part of wider WRZs which would see a deficit of available supply of 20.6 Ml/d shared with other LPAs within the WRZ. South East Water are proposing a range of measures to meet this deficit.

Figure E6.2: Water systems within Maidstone



Wastewater treatment systems

Southern Water provide wastewater services for all of Maidstone. The LPA area is served by a separate foul and surface water sewer system. Wastewater treatment is provided at 12 main WwTWs:

E6.3 Water resources assessment summary

South East Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. South East Water's WRZ 8 covering the eastern portion of the site largely has sufficient planned water to meet demand; however, the central, western and southern portions of the LPA area has options planned to meet demand for only approximately 40% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 2.37 Ml/d within the Maidstone LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Maidstone has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 23.85 Ml/d and the additional demand from projected residential growth is estimated to be 5.55 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 23.85 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[18] (Building Regulation Part G Mandatory); and, 5% of existing homes in Maidstone would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[19] (Building Regulation Part G Mandatory); and, 5% of existing homes in Maidstone would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make a significant contribution to reducing the post development demand (in 2031) shortfall within South East Water's current planned supply and demand balance to 2031, with the optional scenario meeting half the deficit; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by South East Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.48Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 1.07 Ml/d (19% reduction in additional demand). Figure E6.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Maidstone. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

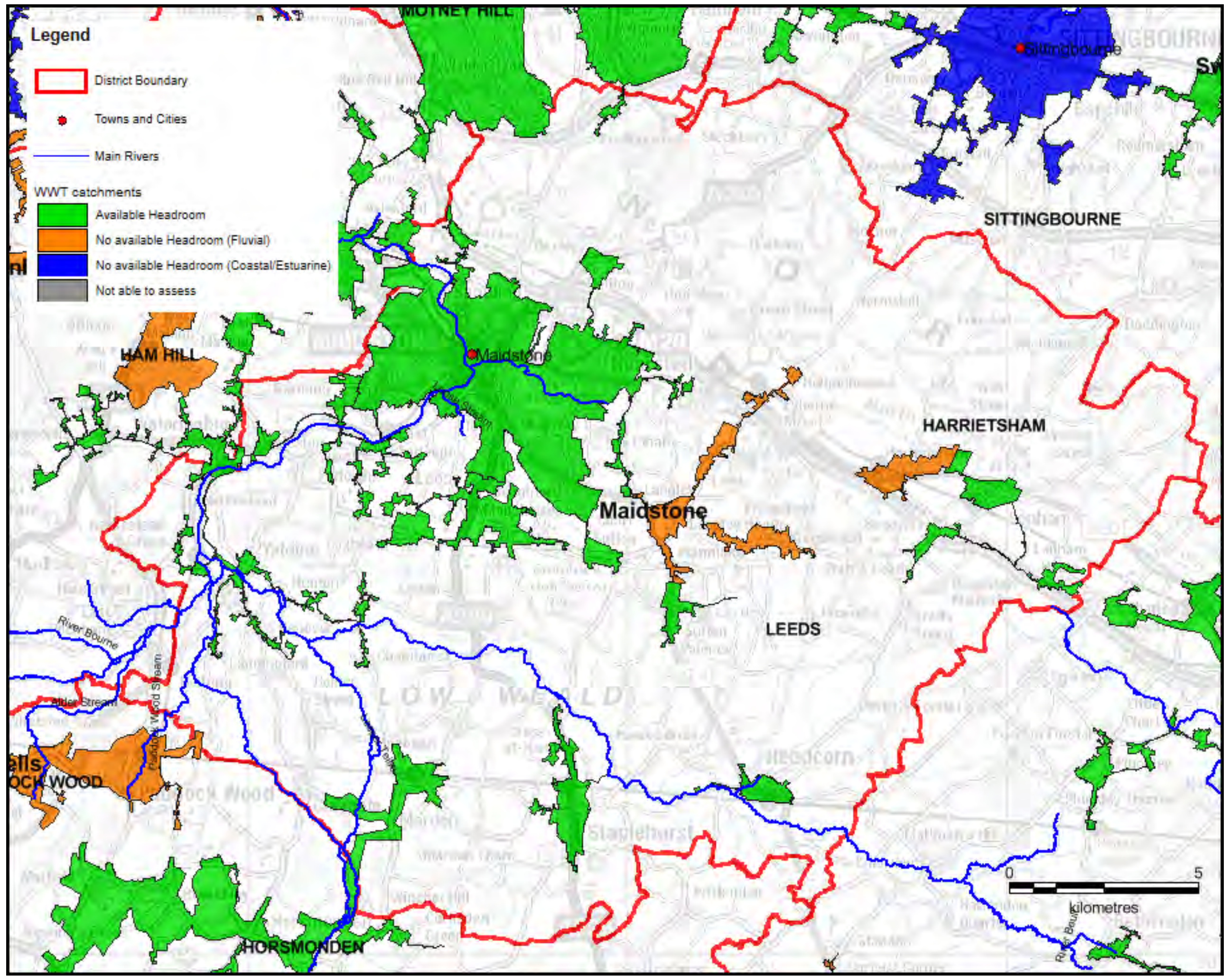
Figure E6.3 Costs of achieving water neutrality targets in Maidstone

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	3275	£ 720,500	£ -	£ 720,500	£ 720,500
BRO + 5%retrofit	£ 146,700	£ -	5.00%	3275	£ 720,500	£ 146,700	£ 720,500	£ 867,200
Theoretical water neutrality	£ 66,781,100	£ 831,277	31.64%	20722	£ 4,558,780	£ 66,781,100	£ 5,390,057	£ 72,171,157

E6.4 Wastewater and water quality assessment summary

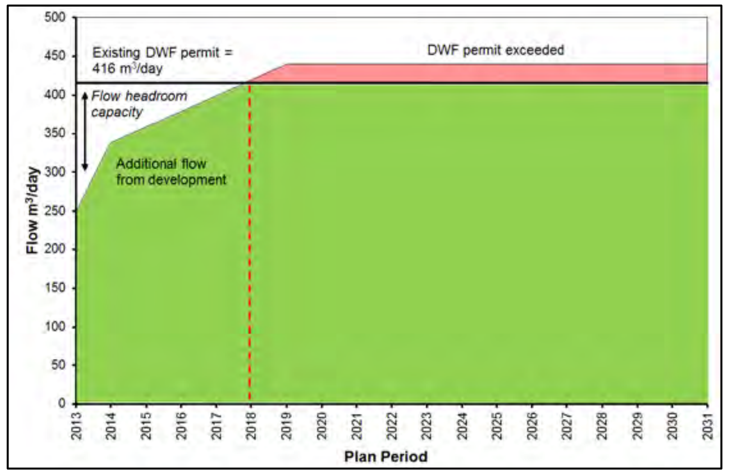
The growth planned within Maidstone has been compared to the available headroom at WwTWs serving the LPA area. Figure E6.4 demonstrates the results of this assessment and shows Aylesford, Coxheath, Headcorn, Horsmonden, Lenham, Motney Hill, Staplehurst, Sutton Valence and Wateringbury WwTWs have permitted capacity (green) to accept growth. However, growth in Harrietsham WwTW, which serves the village of Harrietsham, and in Leeds WwTW, which serves the villages of Leeds and Langley Heath, would require Southern Water to apply for a new discharge permit for the associated WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

Figure E6.4: Headroom capacity at WwTWs serving Maidstone



Harrietsham WwTW

Figure E6.5: Harrietsham - Headroom capacity phasing



Based on current estimate of the growth trajectory in Maidstone, headroom capacity at the WwTW would be used by 2018. Water quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

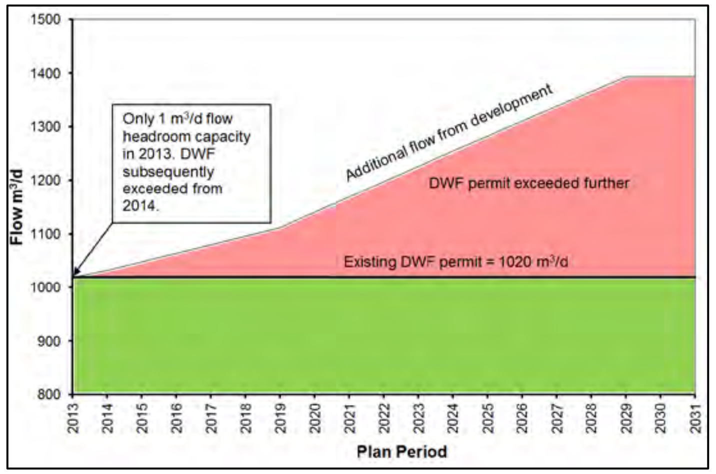
The assessment demonstrated that tighter quality conditions would be required on the permit relating to phosphate, ammonia and BOD to ensure no deterioration in WFD targets in the River Len.

The assessment demonstrates that the changes relating to all three parameters can be achieved with conventional treatment and hence a technical solution will be possible.

[18] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[19] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Leeds WwTW

Figure E6.6: Leeds - Headroom capacity phasing



Based on current estimate of the growth trajectory in Maidstone, headroom capacity at the WwTW is already limited. Water quality modelling using RQP and calculations of load have been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that tighter quality conditions would be required on the permit relating to ammonia and BOD to ensure no deterioration in WFD targets in the River Len.

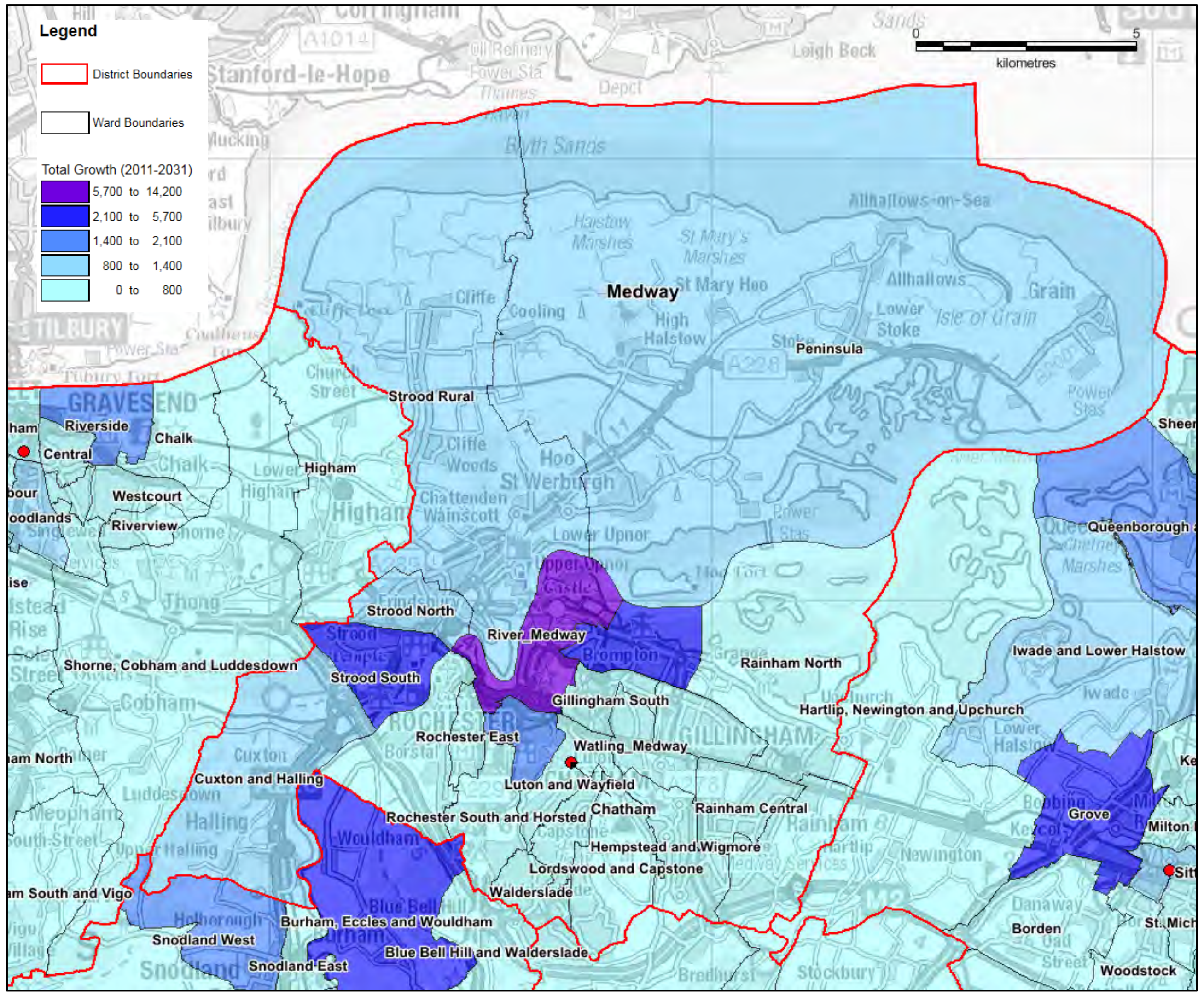
In relation to ammonia and BOD, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible. However, phosphate is currently being treated to a level below LCT (0.22 mg/l), with the revised permit also below LCT (0.21 mg/l). Southern Water need to ensure Leeds WwTW can continue to treat to this high standard with additional growth to ensure no deterioration in status.

E7 Medway Digest

E7.1 Growth summary

A total of 27,939 dwellings have been assessed across the LPA area up to 2031, and of the total growth, 69% (approximately 19,370) is to be phased later in the plan period between 2021 and 2031[20]. Figure E7.1 demonstrates that Growth in Medway is focused in and around the towns of Gillingham, Chatham and south west Rochester.

Figure E7.1 Spatial distribution of housing growth within Medway



E7.2 Water systems in Medway

Figure E7.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

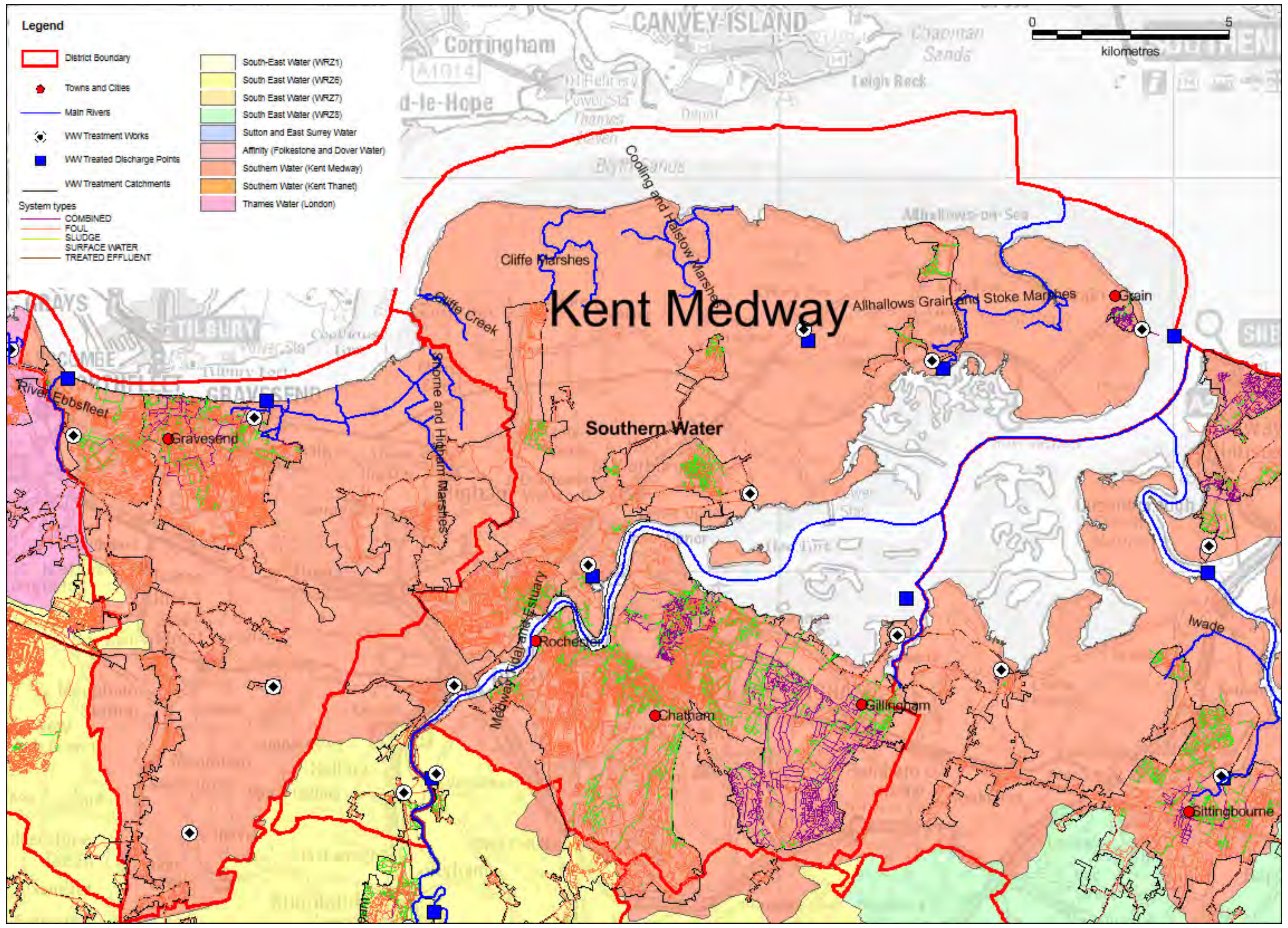
Medway is largely underlain by the London Clay Formation, Thanet Sand Formation and Lewes Chalk Formation to the north and is underlain by Lewes Chalk Formation to the south. The Lewes Chalk Formation is classified as principal aquifer, Thanet Sand Formation as secondary aquifer and London Clay Formation as aquiclude. The majority of the LPA area falls within the Medway Management Catchment, with the Tidal Medway Tidal draining to the Thames Estuary. The northern boundary of the LPA area is drained by Cliffe Marshes and Allhallows Grain and Stoke Marshes to the Thames Estuary.

Water supply systems

Medway is supplied with drinking water almost entirely by Southern Water, with most parts of the LPA area located within Southern Water's Kent Medway WRZ. A small section of Medway to the south west (Cuxton and Halling) is served by South East Water and is located in South East Water's WRZ 6. Drinking water is therefore supplied by a mixture of groundwater and water supply from rivers.

Without planned measures to manage demand and new resources, most parts of Medway would be part of a wider WRZ that would see a deficit of available supply of 20 Ml/d shared with other LPAs. Southern Water and South East Water are proposing a range of measures to meet this deficit.

Figure E7.2: Water systems within Medway



Wastewater treatment systems

Southern Water provides wastewater services for all of Medway. The LPA area is served by a mixture of separated and combined sewers. Locations of significant combined system include the towns of Gillingham, Grain and north Chatham.

E7.3 Water resources assessment summary

Both Southern Water and South East Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Southern Water's Kent Medway WRZ covering the vast majority of the Medway area has sufficient planned water to meet demand; however, the small part of the LPA area to the south west within South East Water's WRZ 6 has options

[20] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

planned to meet demand for only approximately 40% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 0.53 Ml/d within the Medway LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Medway has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 40.5 Ml/d and the additional demand from projected residential growth is estimated to be 8.89 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 40.5 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[21] (Building Regulation Part G Mandatory); and, 5% of existing homes in Medway would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[22] (Building Regulation Part G Mandatory); and, 5% of existing homes in Medway would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that both the mandatory and optional requirement scenarios would reduce post development demand (in 2031) sufficiently to meet the estimated shortfall in supply within South East Water's current planned supply and demand balance covering the Medway area; demonstrating the potential effectiveness of adopting such a scenario.

The mandatory scenario would potentially deliver a post development demand reduction of 0.64Ml/d (7% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 1.59 Ml/d (18% reduction in additional demand). Figure E7.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Medway For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

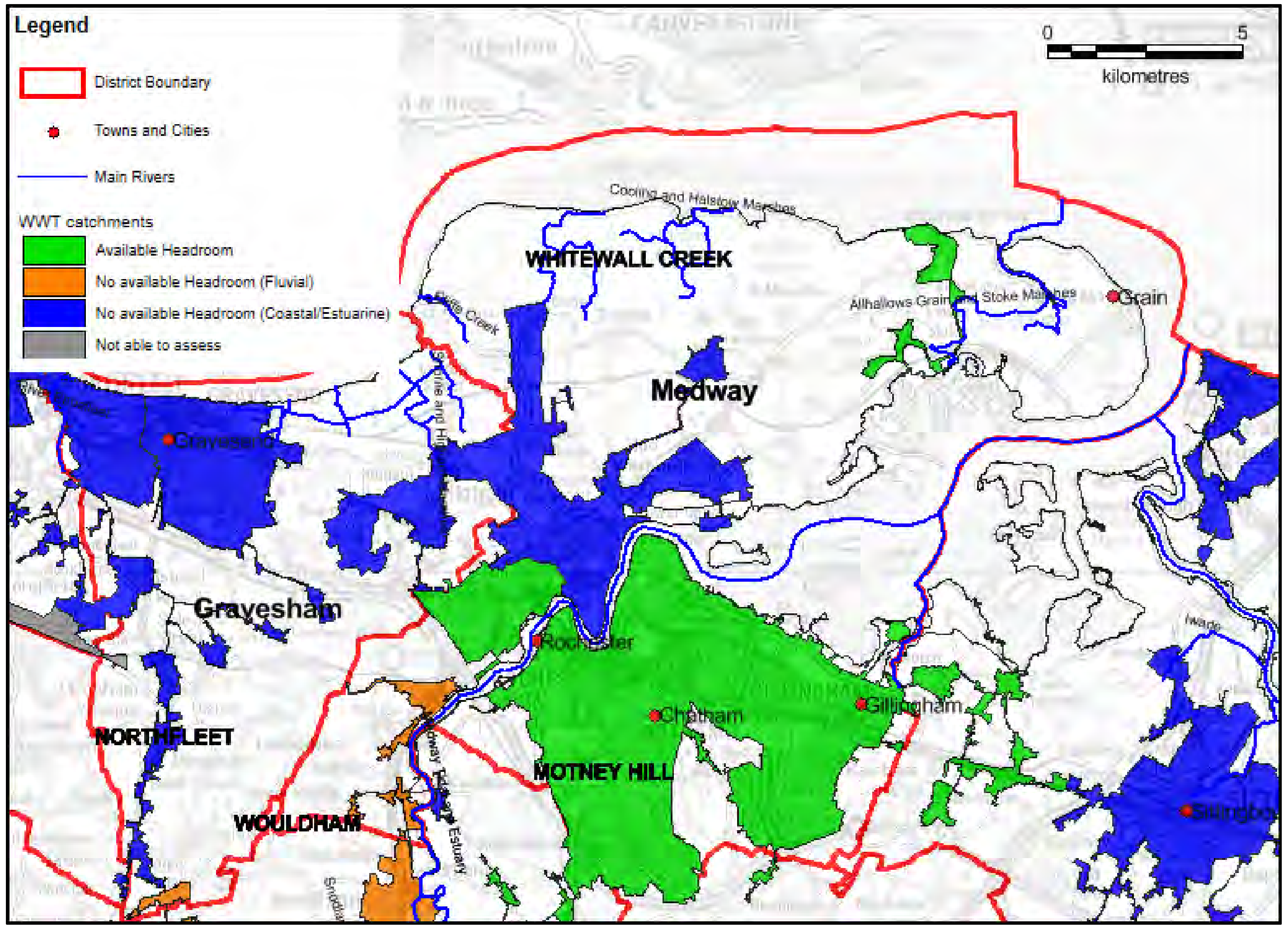
Figure E7.3: Costs of achieving water neutrality targets in Medway

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	5435	£1,195,700	£ -	£ 1,195,700	£ 1,195,700
BRO + 5%retrofit	£ 229,527	£ -	5.00%	5435	£1,195,700	£ 229,527	£ 1,195,700	£ 1,425,227
Theoretical water neutrality	£ 104,485,791	£ 2,665,052	36.68%	39874	£8,772,249	£ 104,485,791	£11,437,302	£ 115,923,093

E7.4 Wastewater and water quality assessment summary

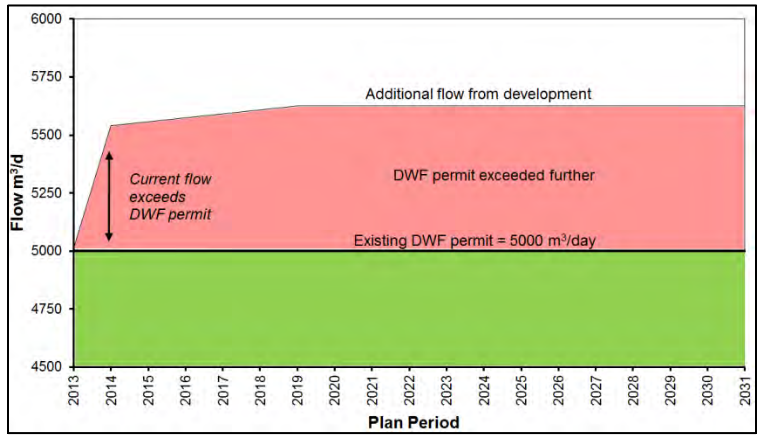
The growth planned within Medway has been compared to the available headroom at WwTWs serving the LPA area. Figure E7.4 demonstrates the results of this assessment and shows that Whitewall Creek WwTW, which serves parts of Rochester and Wainscot, would require Southern Water to apply for a new discharge permit. To determine whether there is environmental capacity in relation to the permit, a water quality assessment exercise was completed for this WwTW.

Figure E7.4: Headroom capacity at WwTWs serving Medway



Whitewall Creek WwTW

Figure E7.5: Whitewall Creek - Headroom capacity phasing



Based on the current estimate of the growth trajectory in Medway, headroom capacity at the WwTW is already limited. Water quality calculations have been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to ammonia and BOD to ensure no deterioration in WFD targets in the Medway estuary.

In relation to ammonia and BOD, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible.

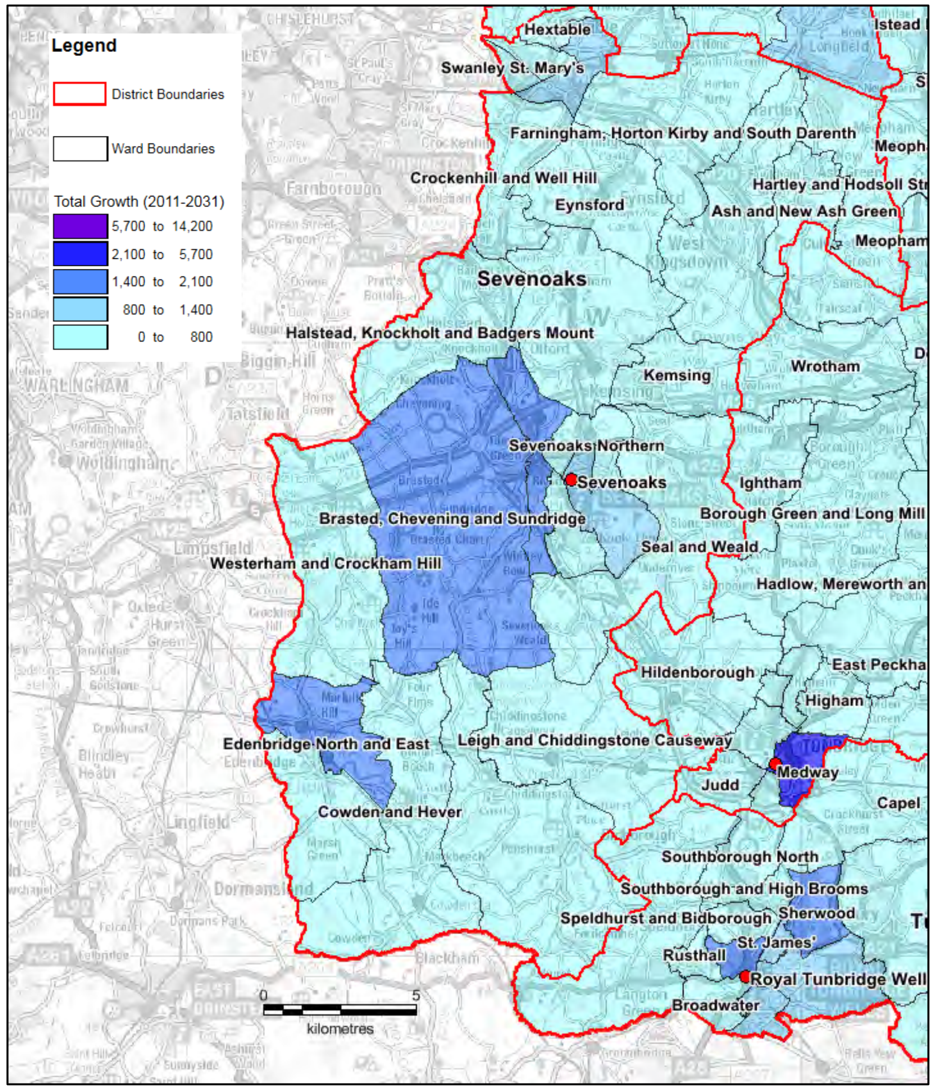
[21] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[22] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

E8 Sevenoaks Digest

E8.1 Growth summary

A total of 11,172 dwellings have been assessed across the LPA area up to 2031, and of the total growth, 69% (approximately 7720) is to be phased in the later stages of the plan period between 2021 and 2031[23]. Figure E8.1 demonstrates that Growth in Sevenoaks is focused to the west of the town of Sevenoaks as well as Edenbridge.

Figure E8.1: Spatial distribution of housing growth within Sevenoaks



E8.2 Water systems in Sevenoaks

Figure E8.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The northern section of Sevenoaks is largely underlain by Lewes Chalk Formation and Thanet Sand Formation, the central section by the Gault Formation, Folkestone Formation, Hythe Formation and Sandgate Formation and the southern section by Weald Clay Formation, Lower Tunbridge Wells Sand Formation, Ashdown Formation, Ardingly Sandstone and Cuckfield Stone Member. Lewes Chalk Formation, Folkestone Formation and Hythe Formation are classified as principal aquifers, Lower Tunbridge Wells Sand Formation, Thanet Sand Formation and Ashdown Formation as secondary aquifers and Gault Formation, Sandgate Formation and Weald Clay Formation as aquicludes. The majority of the LPA area is covered by the Darent Catchment, with River Darent draining the centre and north of the LPA area to the Thames Tidal and River Eden draining the south towards the Medway to the east of the LPA area.

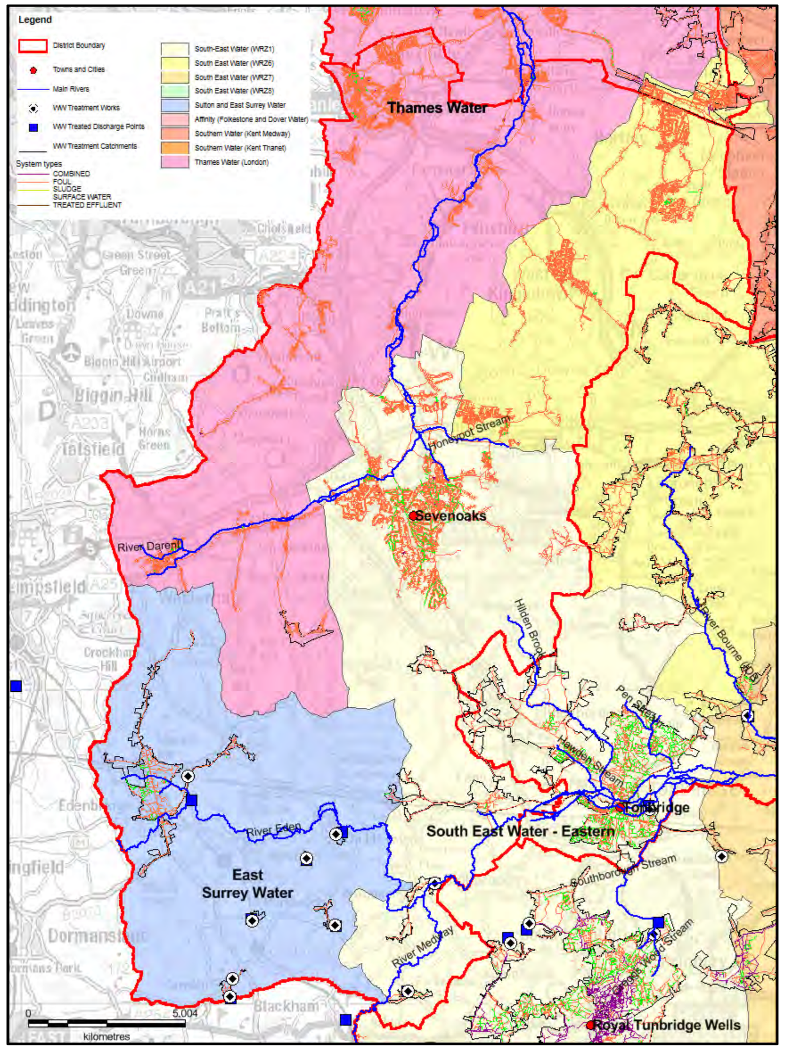
[23] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Sevenoaks is supplied with drinking water by South East Water, Thames Water and Sutton and East Surrey Water. The north and central western section of the LPA area is located within Thames Water's London WRZ; the north eastern section within South East Water's WRZ 6; the south west of the LPA area is located within Sutton and East Surrey Water's East Surrey WRZ; and, the central and south east sections of the LPA area (including the town of Sevenoaks) within South East Water's WRZ 1. Drinking water is therefore supplied by a mixture of groundwater, surface water and imported water but with groundwater the dominant source.

The majority of the study area is subject to a variable predicted supply and demand deficit (without water company measures in place) shared with other LPAs within the WRZs with the exception of the south west (Edenbridge and surrounds) where there is a planned surplus of water. Thames Water and South East Water are proposing a range of measures to meet the deficit across the rest of the LPA area including the town of Sevenoaks.

Figure E8.2: Water systems within Sevenoaks



Wastewater treatment systems

Thames Water provide wastewater services for most parts of Sevenoaks including the town of Sevenoaks itself. The central and northern sections all drain to Thames Water's Long Reach WwTW which also drains a significant proportion of South East London. Edenbridge and surrounds is served by a Southern Water WwTW, and small sections of the LPA area to the south east drain to Southern Water's Tonbridge WwTW. The LPA area is largely served by a separate foul and surface water sewer system.

E8.3 Water resources assessment summary

Both Thames Water and South East Water are proposing a range of measures to close the deficit within the WRZs serving the majority of the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Thames Water's London WRZ covering the western portion of the Sevenoaks LPA area has sufficient planned water to meet demand; however, the eastern and central sections covered by South East Water has options planned to meet demand for only approximately 40% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 2 Ml/d within the Sevenoaks LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Sevenoaks has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 17.45 Ml/d and the additional demand from projected residential growth is estimated to be 3.59 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 17.45 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[24] (Building Regulation Part G Mandatory); and, 5% of existing homes in Sevenoaks would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[25] (Building Regulation Part G Mandatory); and, 5% of existing homes in Sevenoaks would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make some contribution to reducing the post development demand (in 2031) shortfall within South East Water's current planned supply and demand balance to 2031 with the optional scenario reducing the deficit by 36%; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by South East Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.34Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.72 Ml/d (20% reduction in additional demand). Figure E8.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Sevenoaks. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E8.3: Costs of achieving water neutrality targets in Sevenoaks

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2380	£ 523,600	£ -	£ 523,600	£ 523,600
BRO + 5%retrofit	£ 93,600	£ -	5.00%	2380	£ 523,600	£ 93,600	£ 523,600	£ 617,200
Theoretical water neutrality	£ 42,608,800	£ 4,459,680	24.30%	11568	£ 2,544,998	£42,608,800	£7,004,678	£ 49,613,478

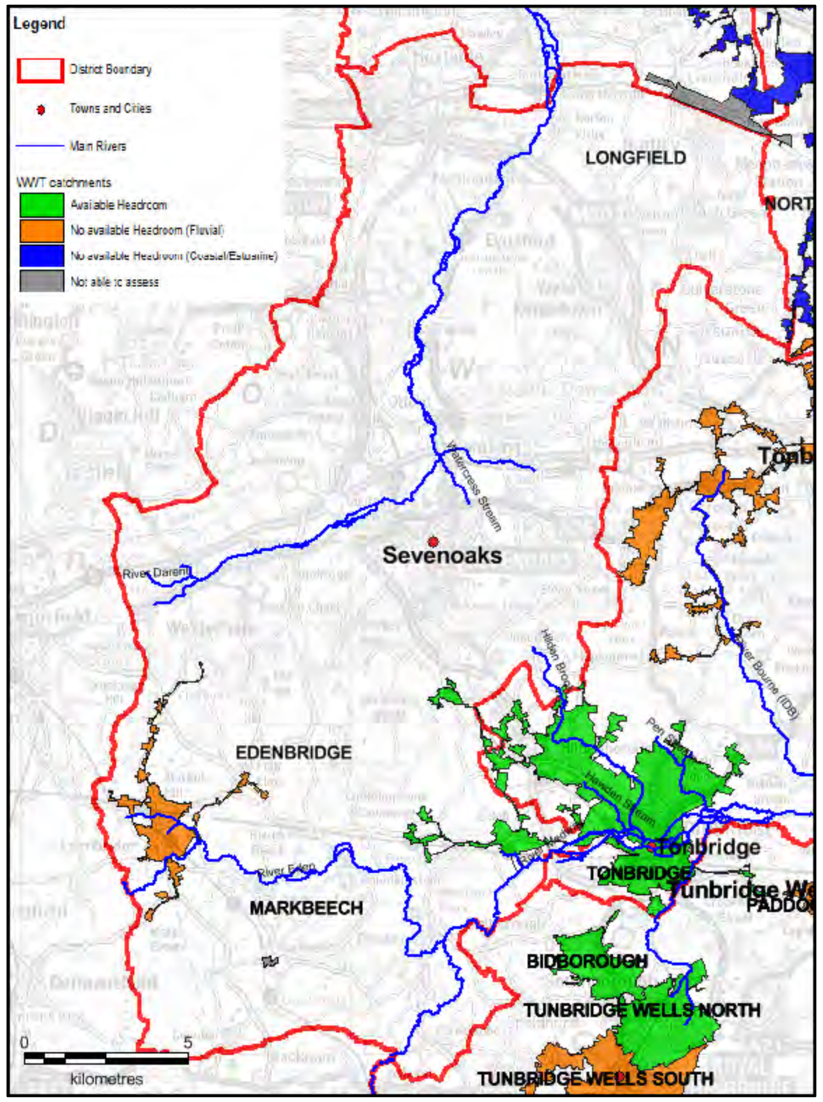
[24] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

[25] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

E8.4 Wastewater and water quality assessment summary

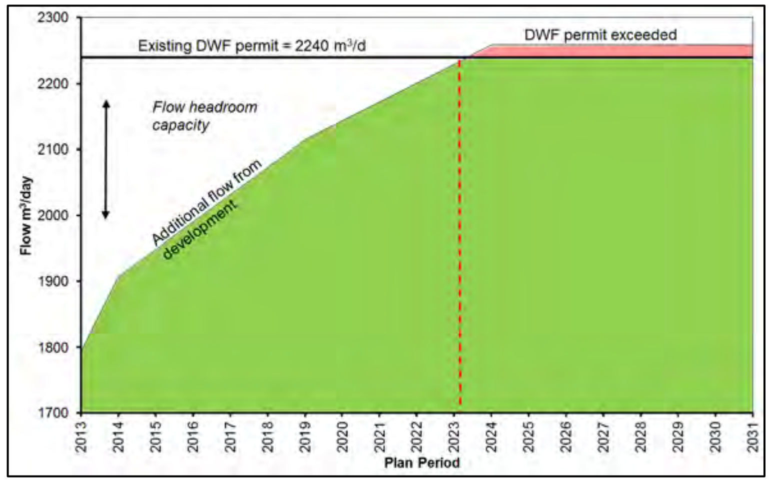
The growth planned within Sevenoaks has been compared to the available headroom at WwTWs serving the LPA area. Figure E8.4 demonstrates the results of this assessment and shows that Tonbridge WwTWs has permitted capacity (green) to accept the small amount of growth within the Sevenoaks. However, growth in the Edenbridge WwTW, would require Southern Water to apply for a new discharge permit for the WwTW. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for Edenbridge. Regards growth in the town of Sevenoaks and the rest of the central and north sections of the LPA area, Thames Water have confirmed that there is sufficient headroom capacity at Long Reach WwTW to take the planned growth in these locations.

Figure E8.4: Headroom capacity at WwTWs serving Sevenoaks



Edenbridge WwTW

Figure E8.5: Edenbridge - Headroom capacity phasing



Based on current estimate of the growth trajectory in Sevenoaks, headroom capacity at the WwTW would be used by 2023. Water Quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required beyond this point in time.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to ammonia and BOD to ensure no deterioration in WFD targets in the Lower Eden. A new permit for phosphate would also be required.

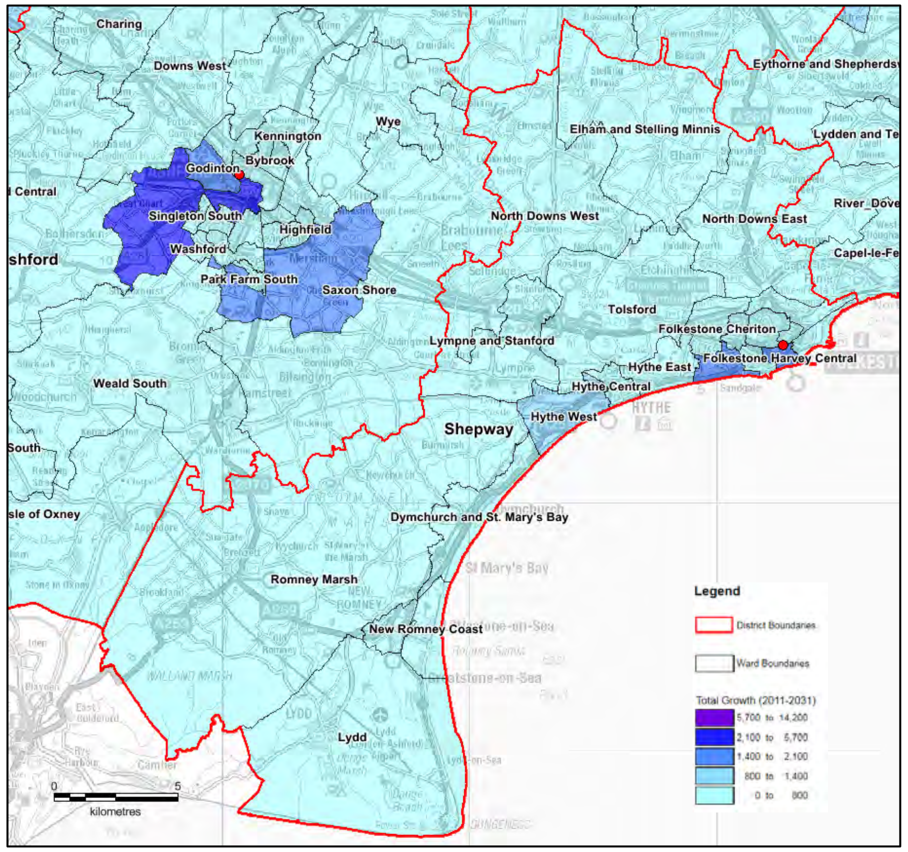
In relation to ammonia and BOD, the changes required can be achieved with conventional treatment and hence a technical solution will be feasible. The assessment demonstrates that phosphate is currently being treated to a level below LCT (0.30 mg/l), with the revised permit also below LCT (0.26 mg/l). Southern Water need to ensure Edenbridge WwTW can continue to treat below LCT with additional growth to ensure no deterioration in status.

E9 Shepway Digest

E9.1 Growth summary

A total of 7,495 dwellings have been assessed across the LPA area up to 2031. This total excludes the growth planned within the Otterpool Garden community (OGC). Of the total growth, 73% is to be phased later in the plan period between 2021 and 2031[26]. Figure E9.1 demonstrates that growth in the Shepway is fairly evenly distributed across the LPA area with some growth focused to the west of Folkestone.

Figure E9.1: Spatial distribution of housing growth within Shepway



E9.2 Water systems in Sevenoaks

Figure E9.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The north of the LPA area is largely underlain by the Lewes Chalk Formation. The central section is underlain by a succession of formations including the Folkestone, Sandgate, Hythe, the Atherfield Clay, the Gault, and the Weald Clay Formation. The southern section and it is underlain by the Tunbridge Wells Sand Formation and the Hastings Beds. The Lewes Chalk Formation, the Hythe Formation and the Folkestone Formation are classified as principal aquifers, the other formations are classified as aquicludes. The coastal stretches of the LPA area are drained via small watercourses directly to the English Channel or via drained marsh systems. drains to the English Channel as well as parts of the River Rother to the west. The central north and northern section of the LPA area drains to the Stour management catchment via the East Stour and Little Stour.

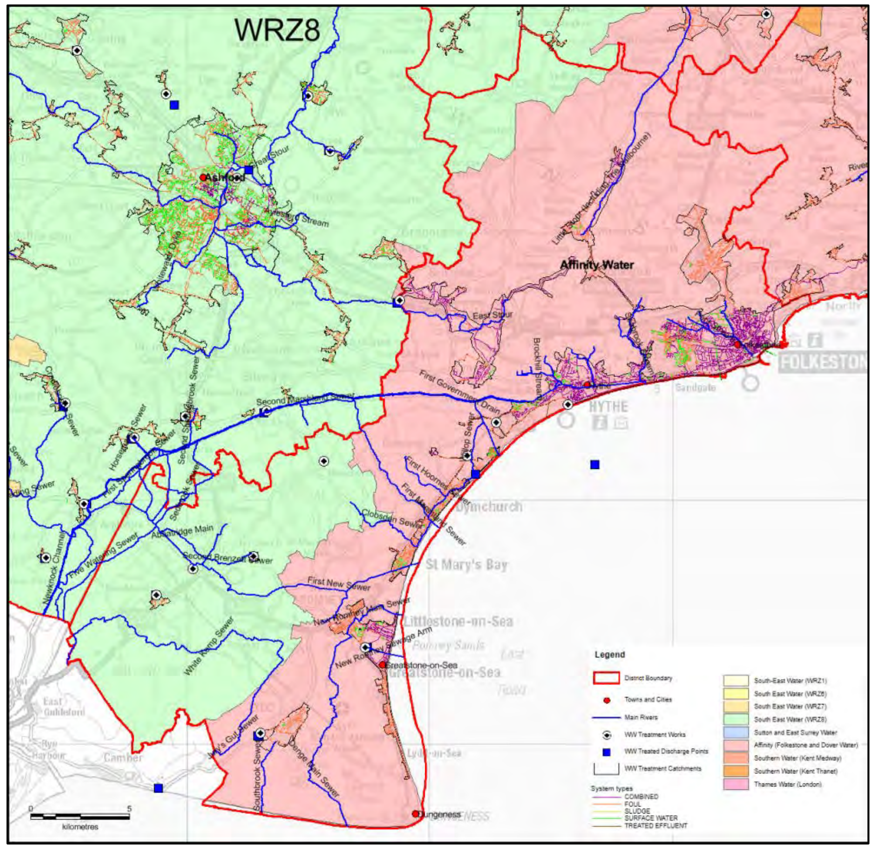
[26] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Shepway is supplied with drinking water by Affinity Water and South East Water. The very north and south west of the LPA area are located within South East Water's WRZ 8, whilst the rest (and majority) of the LPA area is located in Affinity Water's Dour WRZ. Drinking water is therefore supplied by water from a combination of chalk and greensand boreholes imported water from South-East Water and Southern Water for the majority of the LPA area, and groundwater in the very north and south west sections.

Without planned measures to manage demand and new resources, Shepway, along with other LPAs sharing the WRZ, would see a deficit of available supply ranging between 20.6 Ml/d and 28.8 Ml/d. Both Affinity Water and South East Water are proposing a range of measures to meet this deficit across the WRZs.

Figure E9.2: Water systems within Shepway



Wastewater treatment systems

Southern Water provide wastewater services for all of Shepway. The LPA area is served by a mixture of combined and separate foul and surface water sewer system. The towns of Folkstone, Hythe and Greatstone-on-Sea have significant proportions of combined sewer.

E9.3 Water resources assessment summary

Both Affinity Water and South East Water are proposing a range of measures to close the deficit within the WRZs serving the majority of the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. South East Water's WRZ8 covering the south western and very northern portion of the Shepway LPA area has mostly sufficient planned water to meet demand; however, the rest of the LPA area covered by Affinity Water has options planned to meet demand for only approximately 27% of the total growth within the WRZ. As a result, this study has estimated that Affinity Water's current WRMP has a potential shortfall in supply of 2.81 Ml/d within the Shepway LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Shepway has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 16.14 Ml/d and the additional demand from projected residential growth is estimated to be 3.85 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 16.14 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[27] (Building Regulation Part G Mandatory); and, 5% of existing homes in Shepway would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[28] (Building Regulation Part G Mandatory); and, 5% of existing homes in Shepway would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make some contribution to reducing the post development demand (in 2031) shortfall within Affinity Water's current planned supply and demand balance to 2031 with the optional scenario reducing the deficit by 23%; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by Affinity Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.25Ml/d (6% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.66 Ml/d (17% reduction in additional demand). Figure E9.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Shepway. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

Figure E9.3: Costs of achieving water neutrality targets in Shepway

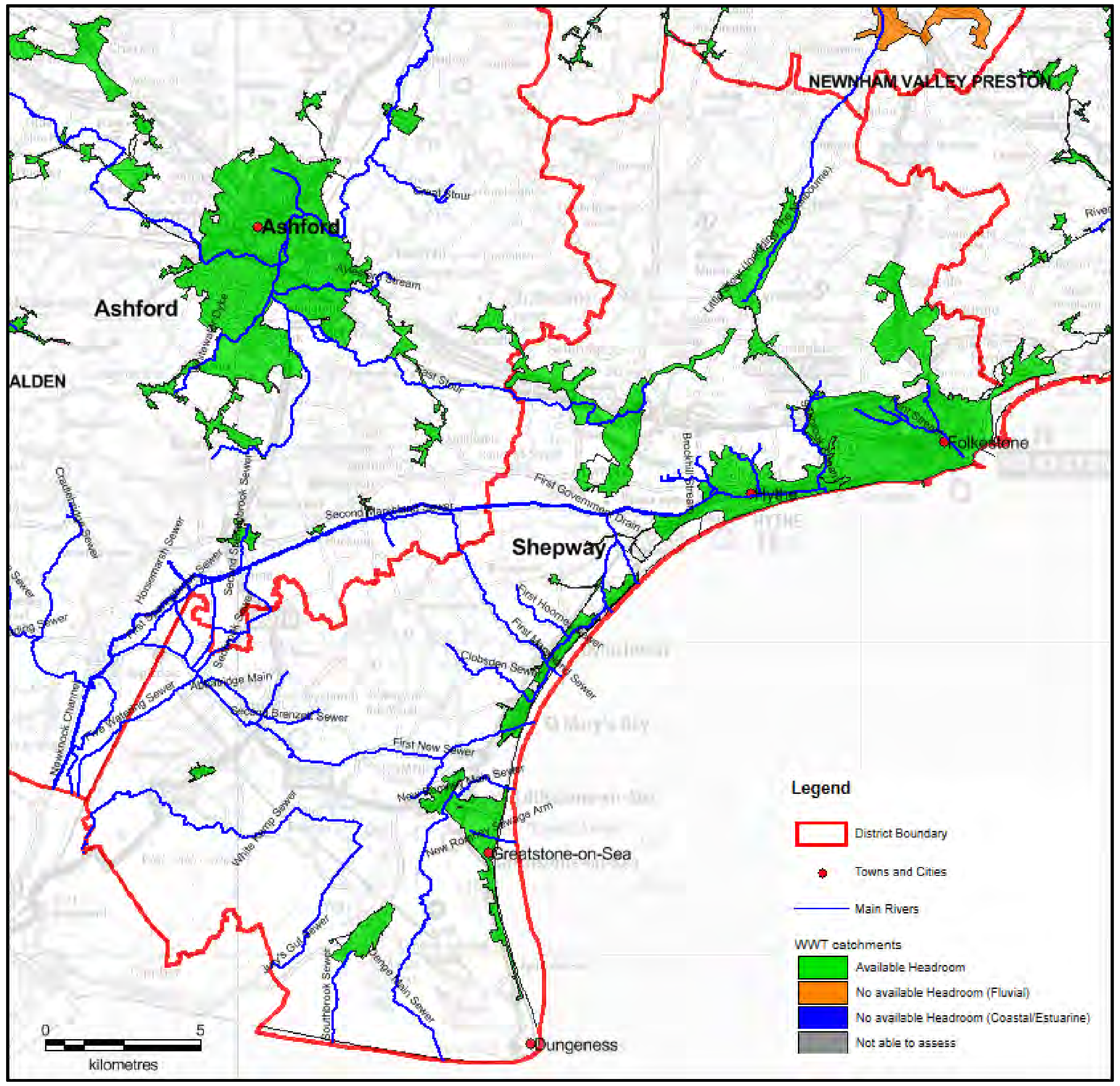
Neutrality Scenario	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2415	£ 531,300	£ -	£ 531,300	£ 531,300
BRO + 5%retrofit	£ 113,400	£ -	5.00%	2415	£ 531,300	£ 113,400	£ 531,300	£ 644,700
Theoretical water neutrality	£ 51,622,200	£ 603,750	42.95%	20744	£ 4,563,787	£ 51,622,200	£ 5,167,537	£ 56,789,737

E9.4 Wastewater and water quality assessment summary

Excluding growth within the planned OGC, the growth planned within the Shepway has been compared to the available headroom at WwTWs serving the LPA area. Figure E9.4 demonstrates the results of this assessment and shows all WwTWs have permitted capacity (green) to accept growth. No water quality assessment was required for WwTWs in Shepway.

Inclusion of growth at OGC would require a new treatment solution owing to limitations on the environmental capacity of the fluvial inland watercourses receiving flow from WwTWs nearest to the planned development. These watercourses are small, with low flows due to their location near to the headwaters of the wider catchments. Consultation with Southern Water has indicated that a range of options would be considered for the OGC, but the most likely solution is transfer of flows to Hythe WwTW. Initial assessment within this study has identified limited permitted capacity at Hythe, however its discharge to a coastal water body providing potentially more environmental capacity than discharge to a fluvial system. Further more detailed assessment of this option (including modelling) is likely to be required as plans for the OGC develop.

Figure E9.4: Headroom capacity at WwTWs serving Shepway



[27] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

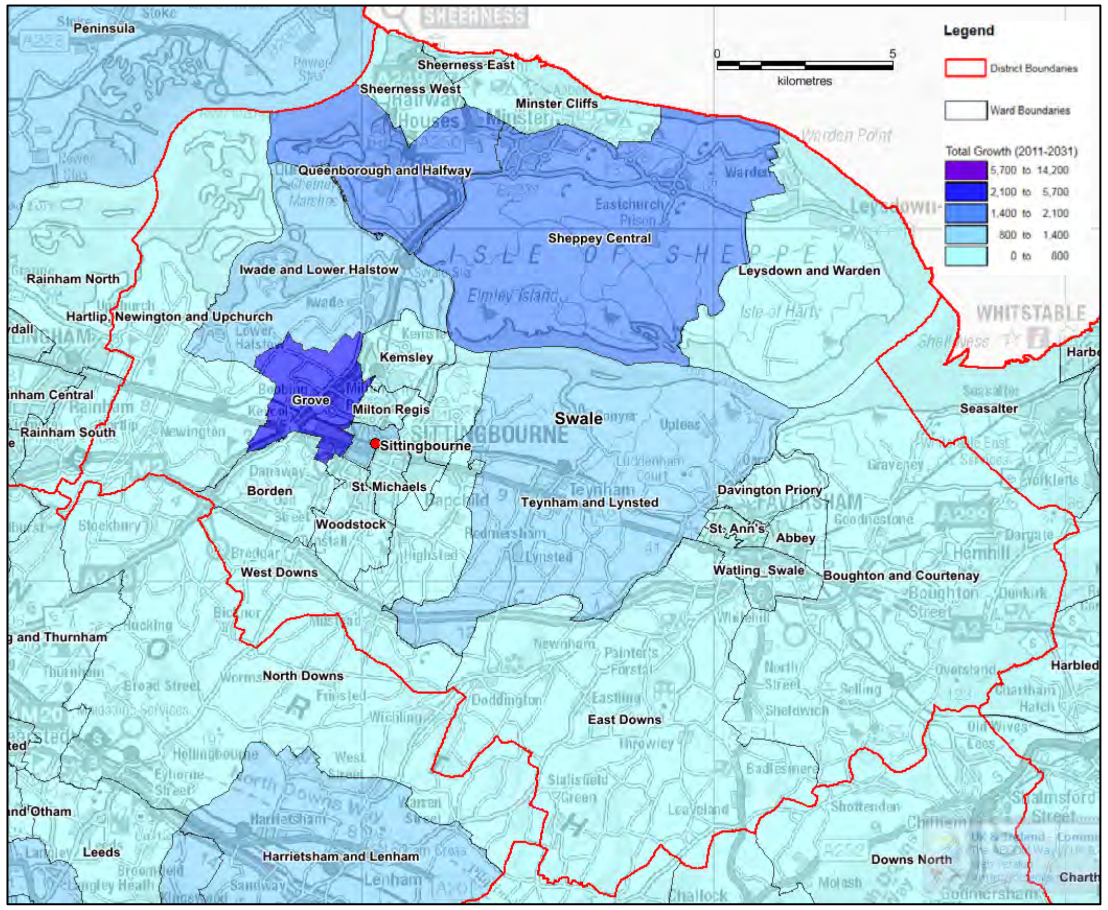
[28] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

E10 Swale Digest

E10.1 Growth summary

A total of 14,218 dwellings have been assessed across the LPA area up to 2031 and of the total growth, 60%is to be phased later in the plan period between 2021 and 2031[29]. Figure E10.1 demonstrates that Growth in Swale is focused north west of Sittingbourne and in Sheppey Central, and the Queenborough and Halfway ward.

Figure E10.1: Spatial distribution of housing growth within Swale



E10.2 Water systems in Swale

Figure E10.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The northern section of Swale is underlain by the London Clay Formation and, close to the town of Minster, it is overlain by the Bagshot Formation and Claygate Member. The central section is underlain by Thanet Sand Formation, Lambeth Group and Harwich Formation whilst the southern part is underlain by Lewes Chalk Formation. The Lewes Chalk Formation is designated as principal aquifer, the Thanet Sand Formation, Bagshot Formation and Harwich Formation as secondary aquifers, and the London Clay Formation as an aquiclude. Swale (including The Isle of Sheppey) is drained by a number of small watercourses discharging to The Swale.

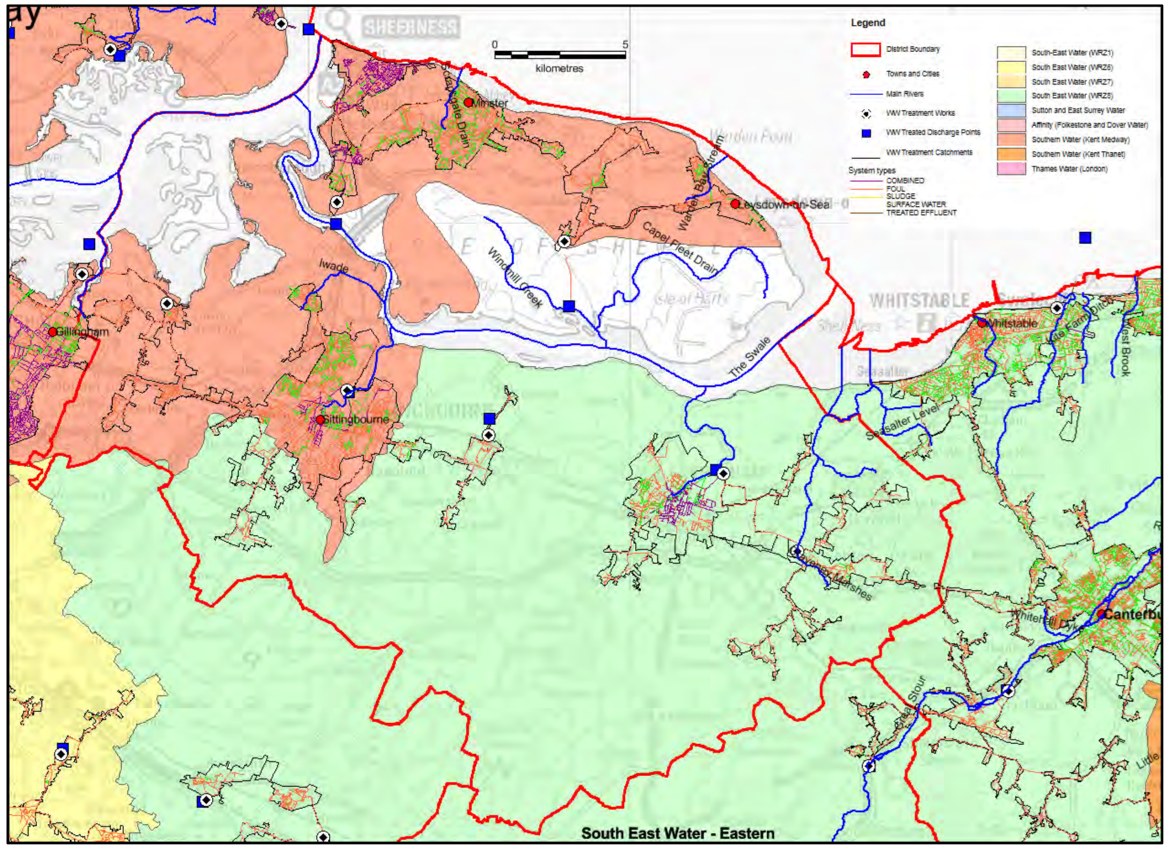
[29] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Swale is supplied with drinking water by Southern Water and South East Water. The north west of the LPA area, including the Isle of Sheppey is located within Southern Water's Kent Medway WRZ (supplied from a mixture groundwater and water from rivers, whilst the remainder of the LPA area is located in South East Water's WRZ 8 where drinking water is supplied by groundwater and imported water from Southern Water.

Without planned measures to manage demand and new resources, the LPA area would be part of wider WRZs seeing a deficit of supply of approximately 20Ml/d for the Critical Period shared by all LPAs within those WRZ. Southern Water and South East Water are proposing a range of measures to meet this deficit.

Figure E10.2: Water systems within Swale



Wastewater treatment systems

Southern Water provides wastewater services for all of Swale. The LPA area is largely served by a separate foul and surface water sewer system, with the exception of the town centres of Sittingbourne and Faversham and the town of Sheerness which are all combined. Wastewater treatment is provided at 6 main WwTWs.

E10.3 Water resources assessment summary

Both Southern and South East Water are proposing a range of measures to close the deficit within the WRZs serving the majority of the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Both South East Water's WRZ8 and Southern Water's Kent Medway WRZ has mostly sufficient planned water to meet demand. Therefore, there is no planned deficit in supply for the Swale LPA area.

To further enhance strategic scale water resource measures, the potential for a water neutral position across Swale has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 20.75 Ml/d and the additional demand from projected residential growth is estimated to be 4.32 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 20.75 Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[30] (Building Regulation Part G Mandatory); and, 5% of existing homes in Swale would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[31] (Building Regulation Part G Mandatory); and, 5% of existing homes in Swale would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The mandatory scenario would potentially deliver a post development demand reduction of 0.38Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.84 Ml/d (19% reduction in additional demand). Figure E10.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Swale. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

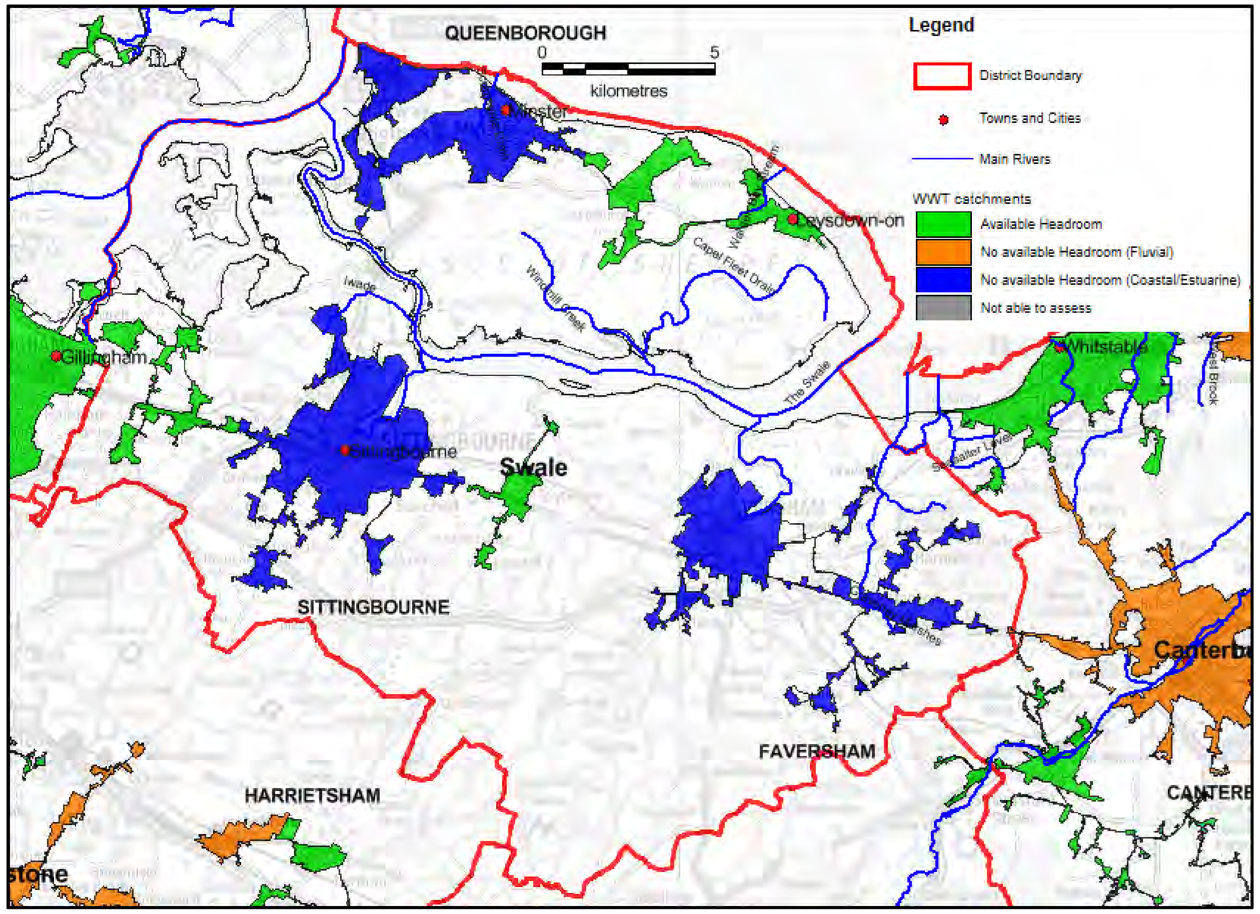
Figure E10.3: Costs of achieving water neutrality targets in Swale

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2840	£ 624,800	£ -	£ 624,800	£ 624,800
BRO + 5%retrofit	£ 115,200	£ -	5.00%	2840	£ 624,800	£ 115,200	£ 624,800	£ 740,000
Theoretical water neutrality	£ 52,441,600	£975,540	31.06%	17644	£ 3,881,672	£ 52,441,600	£ 4,857,212	£ 57,298,812

E10.4 Wastewater and water quality assessment summary

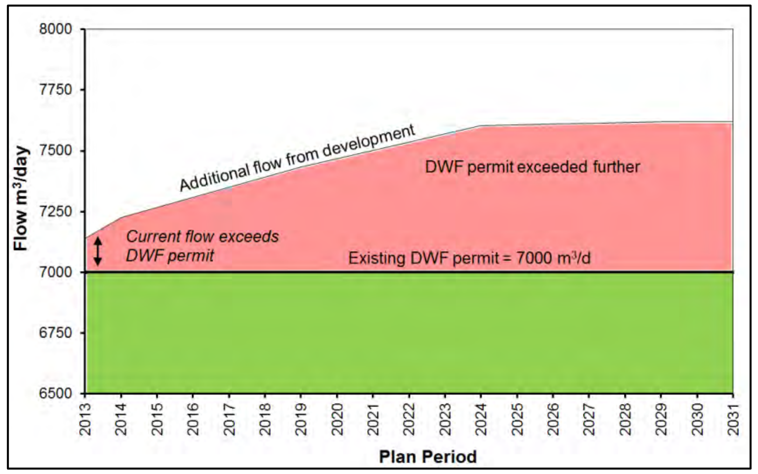
The growth planned within Swale has been compared to the available headroom at WwTWs serving the LPA area. Figure E10.4 demonstrates the results of this assessment and shows that Eastchurch, Motney Hill and Teynham WwTWs have permitted capacity (green) to accept growth. However, growth in Faversham WwTW, which serves the town of Faversham and its near vicinity, and in Queenborough WwTW, would require Southern Water to apply for a new discharge permit for the associated WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

Figure E10.4: Headroom capacity at WwTWs serving Swale



Faversham WwTW

Figure E10.5: Faversham - Headroom capacity phasing



Based on current estimate of the growth trajectory in Swale, headroom capacity at the WwTW is already limited. Water Quality calculations have been used to determine environmental capacity in relation to the new permit required.

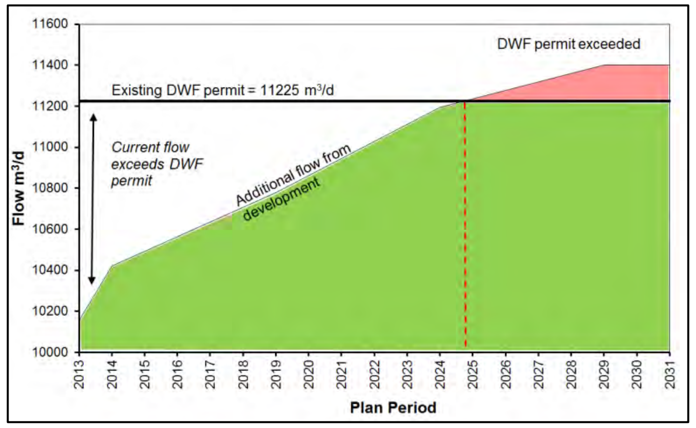
The assessment demonstrated that more stringent quality conditions would be required on the permit relating to BOD to ensure no deterioration in in the Swale Estuary.

The change required can be achieved with conventional treatment and hence a technical solution will be feasible.

[30] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[31] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Queenborough WwTW

Figure E10.6: Queenborough - Headroom capacity phasing



Based on current estimate of the growth trajectory in Swale, headroom capacity at the WwTW would be used by 2024. Water quality calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to BOD to ensure no deterioration in the Swale Estuary.

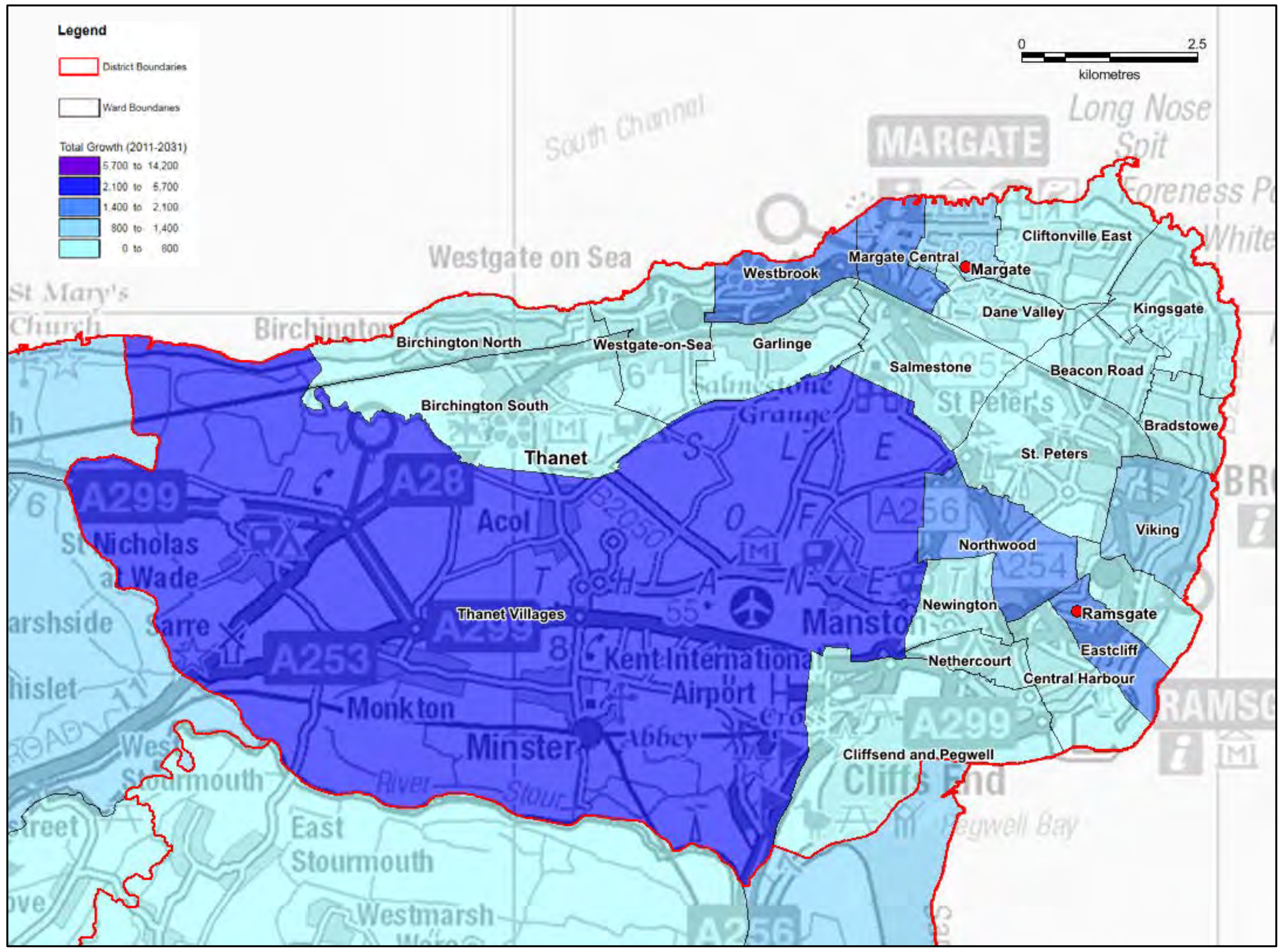
The change required can be achieved with conventional treatment and hence a technical solution will be feasible.

E11 Thanet Digest

E11.1 Growth summary

A total of 15,702 dwellings have been assessed across the LPA area up to 2031, and of the total growth, 74% is to be phased later in the plan period between 2021 and 2031[32]. Figure E11.1 demonstrates that Growth in Thanet is focused in the wards of Thanet Villages, Westbrook, Margate Central, Eastcliff, and Northwood.

Figure E11.1: Spatial distribution of housing growth within Thanet



E11.2 Water systems in Thanet

Figure E11.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

Thanet is largely underlain by the Lewes Chalk Formation and, close to the west and south border and the town of Northwood and Manston, it is underlain by the Thanet Sand Formation. The Lewes Chalk Formation is classified as principal aquifer and Thanet Sand Formation is classified as secondary aquifer. The majority of the LPA area falls into the Stour Management Catchment.

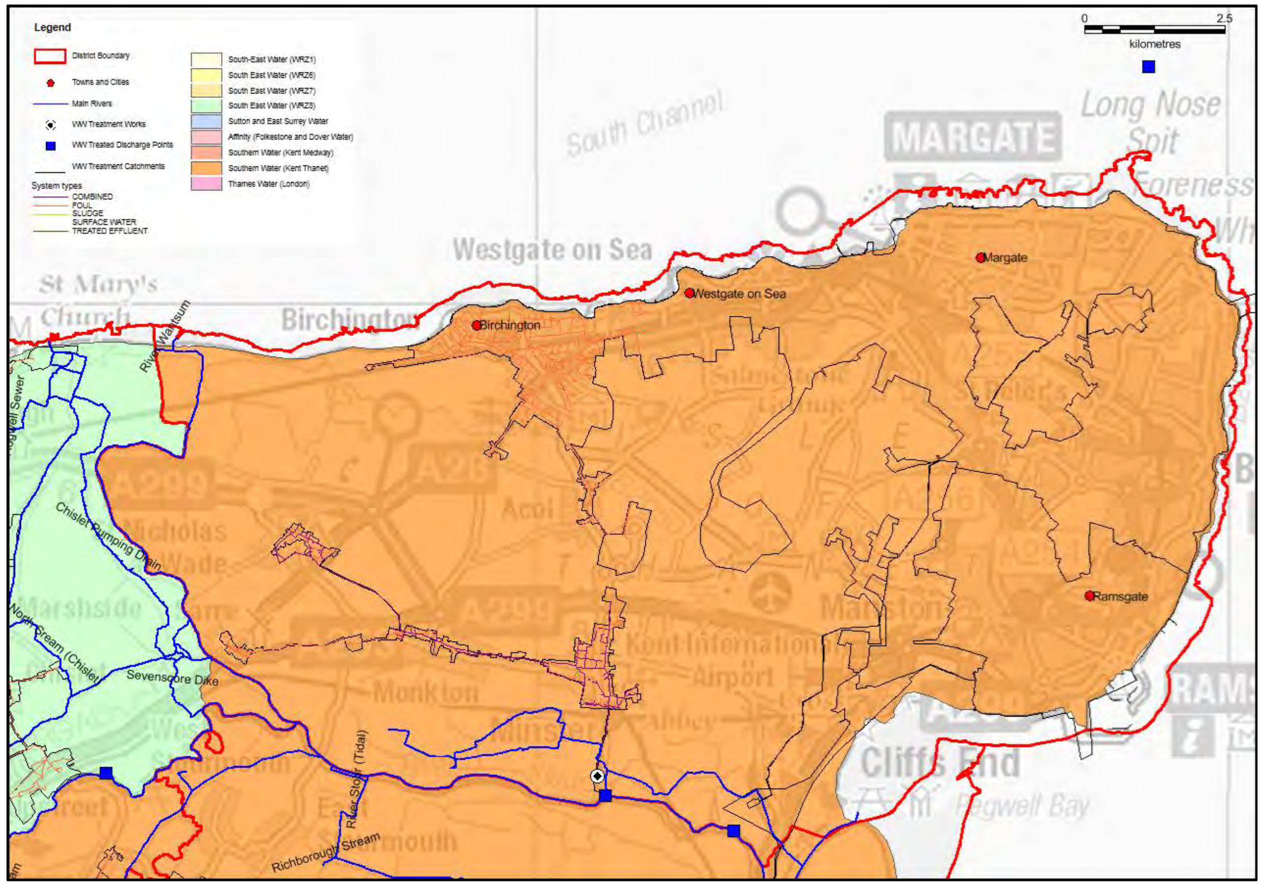
Water supply systems

Thanet is supplied with drinking water by Southern Water. The LPA area is located within Southern Water's Kent Thanet Water Resource Zone (WRZ). Drinking water is therefore supplied by groundwater and internally transferred water from Southern Water's Kent Medway WRZ.

[32] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Without planned measures to manage demand and new resources, Thanet would be part of a wider WRZ which would see a deficit of available supply of 2Ml/d for the Critical Period shared between all LPAs covered by the WRZ. Southern Water are proposing a range of measures to meet this deficit.

Figure E11.2: Water systems within Thanet



Wastewater treatment systems

Southern Water provides wastewater services for all of Thanet. The LPA area is largely served by a separate foul and surface water sewer system, with the exception of the area between the town of Minster and the town of St. Nicholas at Wade which is combined.

E11.3 Water resources assessment summary

Southern Water are proposing a range of measures to close the deficit within the WRZ serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. Southern Water's Kent Thanet WRZ has options planned to meet demand for only approximately 45% of the total growth within the WRZ. As a result, this study has estimated that Southern Water's current WRMP has a potential shortfall in supply of 1.29 Ml/d within the Thanet LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Thanet has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 20.4 Ml/d and the additional demand from projected residential growth is estimated to be 4.62 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 20.4Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[33] (Building Regulation Part G Mandatory); and, 5% of existing homes in Thanet would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[34] (Building Regulation Part G Mandatory); and, 5% of existing homes in Thanet would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make a significant contribution to reducing the post development demand (in 2031) shortfall within Southern Water's current planned supply and demand balance to 2031 with the optional scenario reducing the deficit by two thirds; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by Southern Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.36Ml/d (8% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.85 Ml/d (19% reduction in additional demand). Figure E11.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Thanet. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

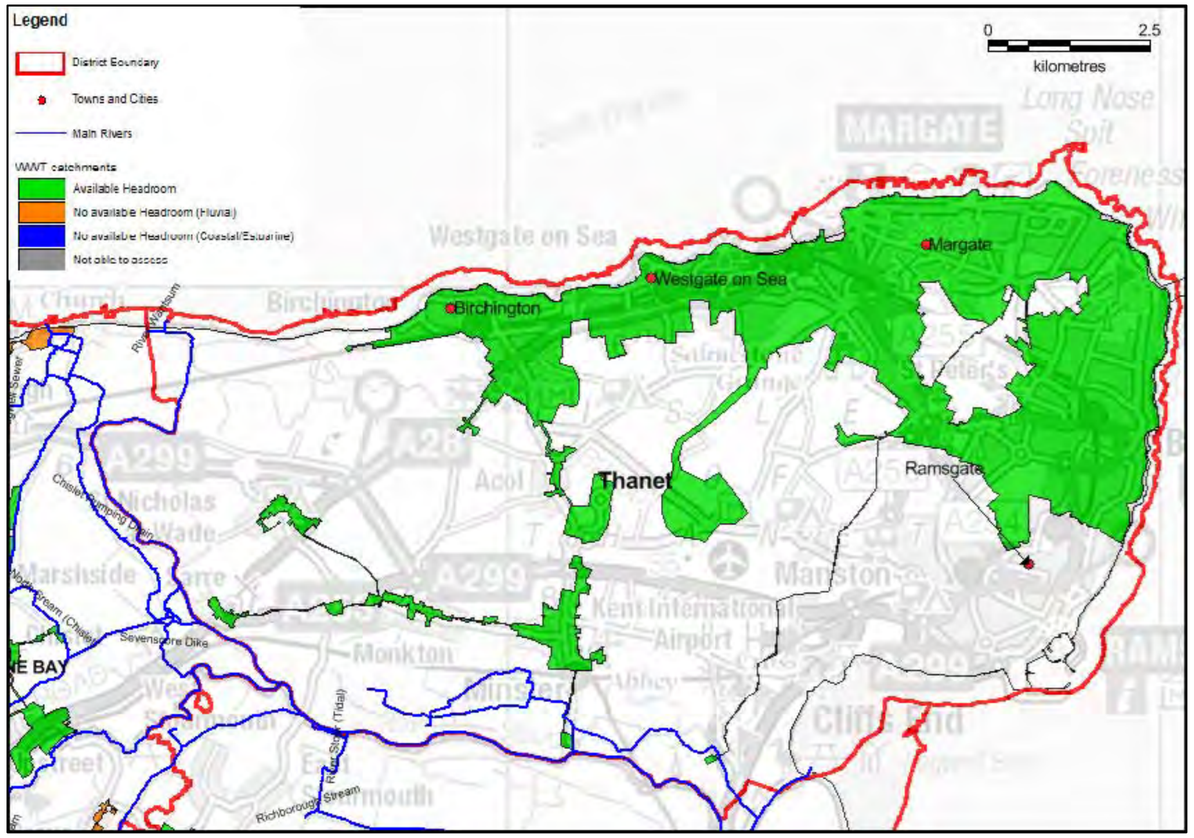
Figure E11.3: Costs of achieving water neutrality targets in Thanet

Neutrality Scenaro	Outstanding housing	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	3020	£ 664,400	£ -	£ 664,400	£ 664,400
BRO + 5%retrofit	£ 127,800	£ -	5.00%	3020	£ 664,400	£ 127,800	£ 664,400	£ 792,200
Theoretical water neutrality	£ 58,177,400	£ 2,416,000	34.22%	20670	£4,547,395	£ 58,177,400	£ 6,963,395	£ 65,140,795

E11.4 Wastewater and water quality assessment summary

The growth planned within Thanet has been compared to the available headroom at WwTWs serving the LPA area. Figure E11.4 demonstrates the results of this assessment and shows that Minster Lot and Weatherlees Hill WwTWs have permitted capacity (green) to accept growth and as such, no water quality assessment is required with respect to new permits. For the level of growth planned, the WwTW would have sufficient capacity.

Figure E11.4: Headroom capacity at WwTWs serving Thanet



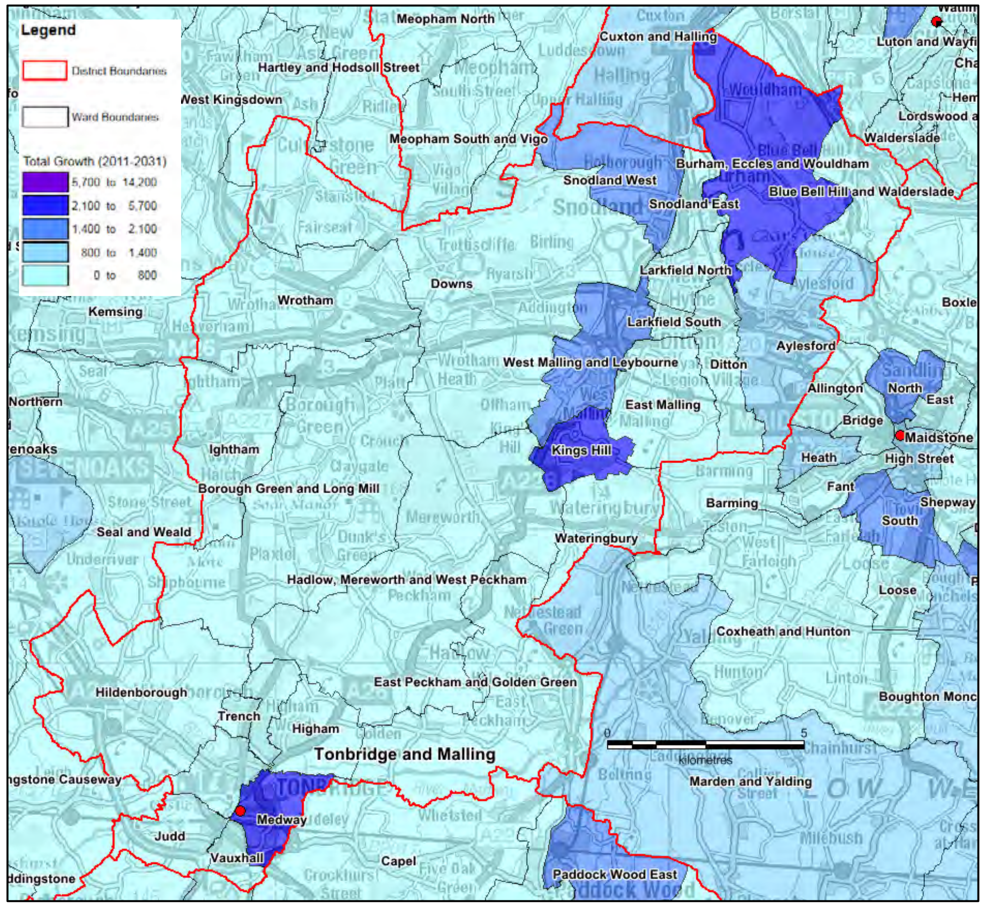
[33] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[34] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

E12 Tonbridge and Malling Digest

E11.1 Growth summary

A total of 13,495 dwellings have been assessed across the LPA area up to 2031, which has a relatively even phasing throughout the plan period[35]. Figure E12.1 demonstrates that growth in Tonbridge and Malling is focused east of Tonbridge, Kings Hill, around East Malling, West Malling, Larkfield, and Snodland East.

Figure E12.1: Spatial distribution of housing growth within Tonbridge and Malling



E11.2 Water systems in Tonbridge and Malling

Figure E12.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

The northern section of Tonbridge and Malling is underlain by the Lewes Chalk Formation, Folkestone Formation and Gault Formation; the central section is underlain by the Hythe Formation and the southern section by Weald Clay Formation, Tunbridge Wells Sand Formation and Ashdown Formation. The Lewes Chalk Formation, Folkestone Formation and Hythe Formation are classified as principal aquifers; the Tunbridge Wells Sand Formation and Ashdown Formation as secondary aquifers; and, the Weald Clay Formation and Gault Formation as aquicludes. The LPA area is covered by the Medway Management Catchment, with the Alder Stream and Hammer Dyke, Somerhill Stream, River Bourne and Medway Tidal and Estuary draining the LPA area to the main river Medway and eventually to the Thames Estuary.

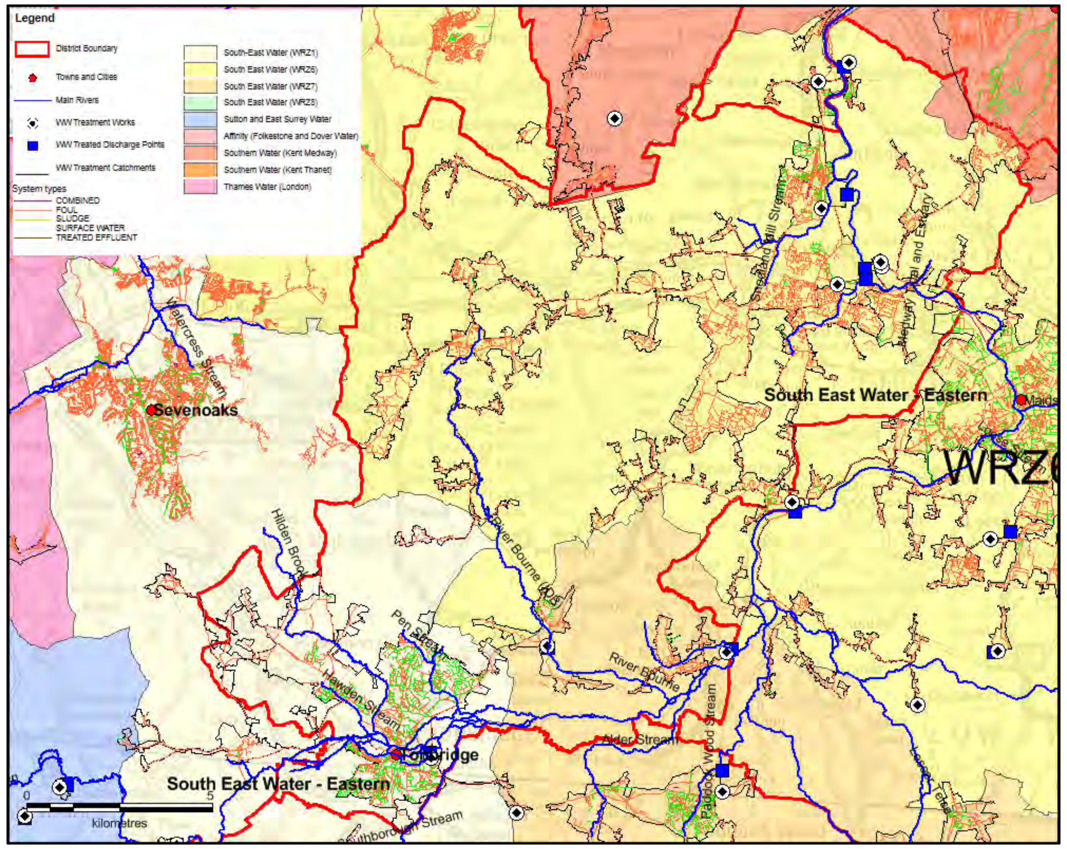
[35] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Water supply systems

Tonbridge and Malling is supplied with drinking water by South East Water. The majority of the LPA area covering the central and northern sections are located within South East Water's WRZ 6; the south-western section including the town of Tonbridge is located in South East Water's WRZ 1; and, the south-eastern section of the LPA area is located in WRZ 7. Drinking water is therefore supplied by a mixture of groundwater, surface water and water imported from Southern Water, with groundwater the predominant source.

Without planned measures to manage demand and new resources, Tonbridge and Malling would see a deficit of available supply of between 20.6 Ml/d and 28.8 Ml/d for the Critical Period shared with all other LPAs within the WRZs. South East Water are proposing a range of measures to meet this deficit.

Figure E12.2: Water systems within Tonbridge and Malling



Wastewater treatment systems

Southern Water provide wastewater services for all of Tunbridge and Malling. The LPA area is served by a separate foul and surface water sewer system.

E12.3 Water resources assessment summary

South East Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. South East Water's WRZ covering Tonbridge and Malling has options planned to meet demand for only approximately 38% to 43% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 2.99 Ml/d within the LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Tonbridge and Malling has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

Existing water demand (residential only) within the LPA area has been estimated as 18.45 Ml/d and the additional demand from projected residential growth is estimated to be 4.03 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 18.45Ml/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[36] (Building Regulation Part G Mandatory); and, 5% of existing homes in Tonbridge and Malling would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[37] (Building Regulation Part G Mandatory); and, 5% of existing homes in Tonbridge and Malling would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make some contribution to reducing the post development demand (in 2031) shortfall within South East Water's current planned supply and demand balance to 2031 with the optional scenario reducing the deficit by 27%; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by South East Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.37Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.8 Ml/d (20% reduction in additional demand). Figure E12.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Tonbridge and Malling. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

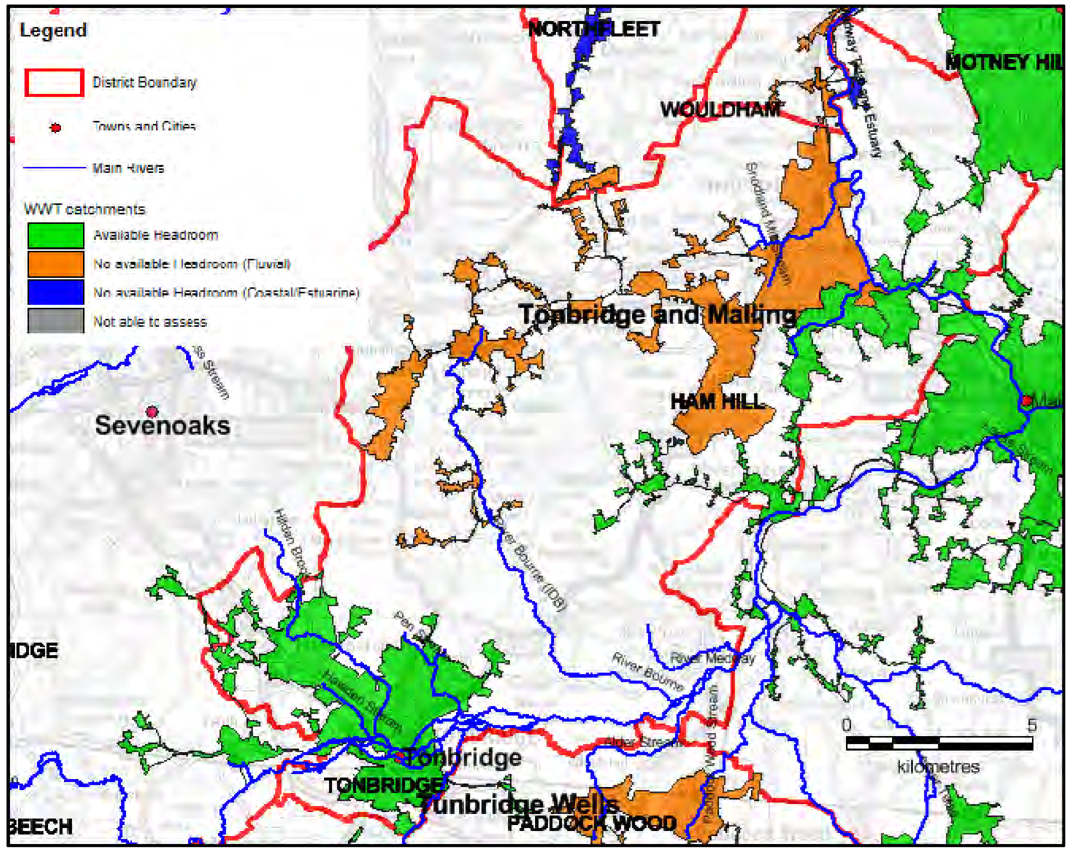
Figure E12.3 Costs of achieving water neutrality targets in Tonbridge and Malling

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	CSH cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2480	£ 545,600	£ -	£ 545,600	£ 545,600
BRO + 5%retrofit	£ 105,300	£ -	5.00%	2480	£ 545,600	£ 105,300	£ 545,600	£ 650,900
Theoretical water neutrality	£ 47,934,900	£ 625,580	30.03%	14894	£ 3,276,789	£ 47,934,900	£ 3,902,369	£ 51,837,269

E12.4 Wastewater and water quality assessment summary

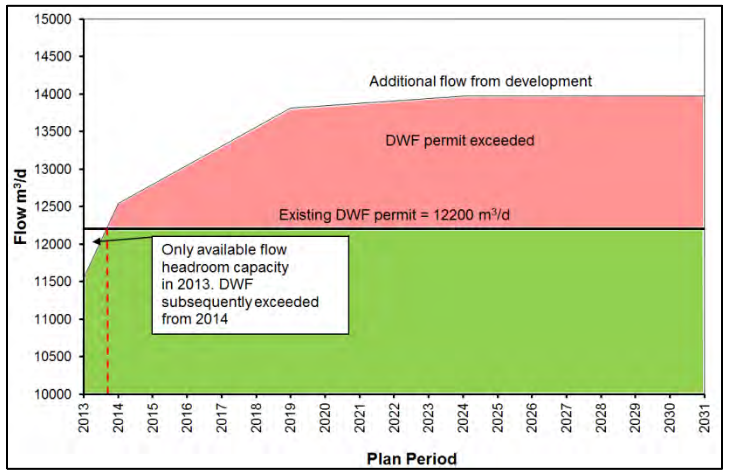
The growth planned within Tunbridge and Malling has been compared to the available headroom at WwTWs serving the LPA area. Figure E12.4 demonstrates the results of this assessment and shows that Aylesford, Ditton and Tonbridge WwTWs have permitted capacity (green) to accept growth. However, growth in Ham Hill WwTW, which serves West Malling and its near vicinity, and in Wouldham WwTW, which serves the town of New Hythe and its near vicinity, would require Southern Water to apply for a new discharge permit for the associated WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

Figure E12.4: Headroom capacity at WwTWs serving Tunbridge and Malling



Ham Hill WwTW

Figure E12.5: Ham Hill - Headroom capacity phasing



Based on current estimate of the growth trajectory in Tunbridge and Malling, headroom capacity at the WwTW is already limited. Water Quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

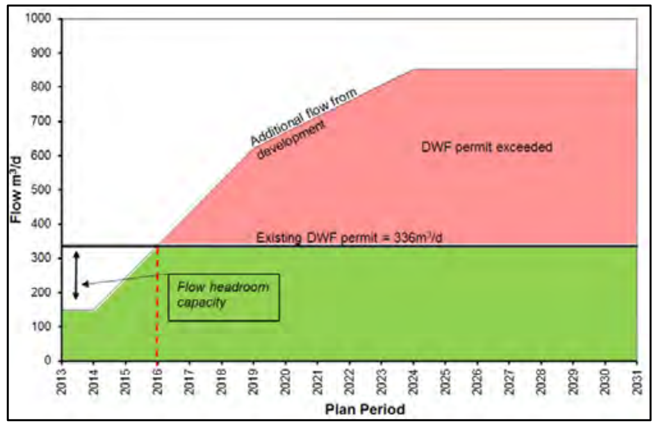
The assessment demonstrated that tighter quality conditions would be required on the permit relating to ammonia phosphate and BOD to ensure no deterioration in WFD targets in the River Medway and to ensure future good status is not limited by growth.

The changes required relating to ammonia, phosphate and BOD can be achieved with conventional treatment and hence a technical solution will be feasible.

[36] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[37] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Wouldham WwTW

Figure E12.6: Wouldham - Headroom capacity phasing



Based on current estimate of the growth trajectory in Tunbridge and Malling, headroom capacity at the WwTW is limited. Water Quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

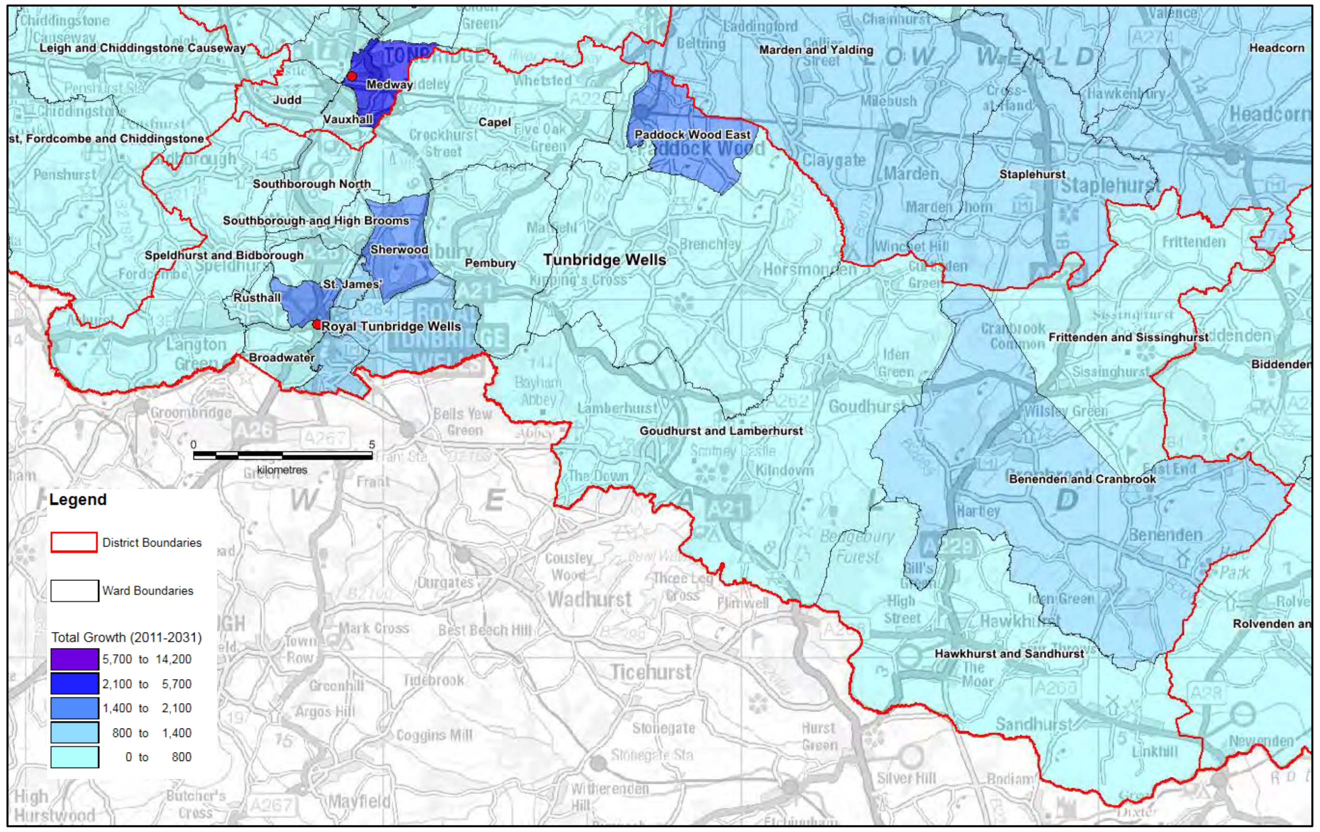
The assessment demonstrated that more stringent quality conditions would be required on the permit relating to BOD to ensure downstream status. the changes required can be achieved with conventional treatment and hence a feasible solution will be possible.

E13 Tunbridge Wells Digest

E13.1 Growth summary

A total of 11,495 dwellings have been assessed across the LPA area up to 2031. Almost 30% of the total growth has some spatial certainty (committed/completed and or site allocations) and of the total growth, 73% (approximately 8,390) is to be phased between 2021 and 2031[38]. Figure E13.1 demonstrates that Growth in Tunbridge Wells is focused in and around the towns of Royal Tunbridge Wells, Paddock Wood, Hawkhurst and Cranbrook.

Figure E13.1: Spatial distribution of housing growth within Tunbridge Wells



E13.2 Water systems in Tunbridge Wells

Figure E13.2 demonstrates the river systems, and the relevant water infrastructure serving the LPA area. These are described further below.

Natural systems

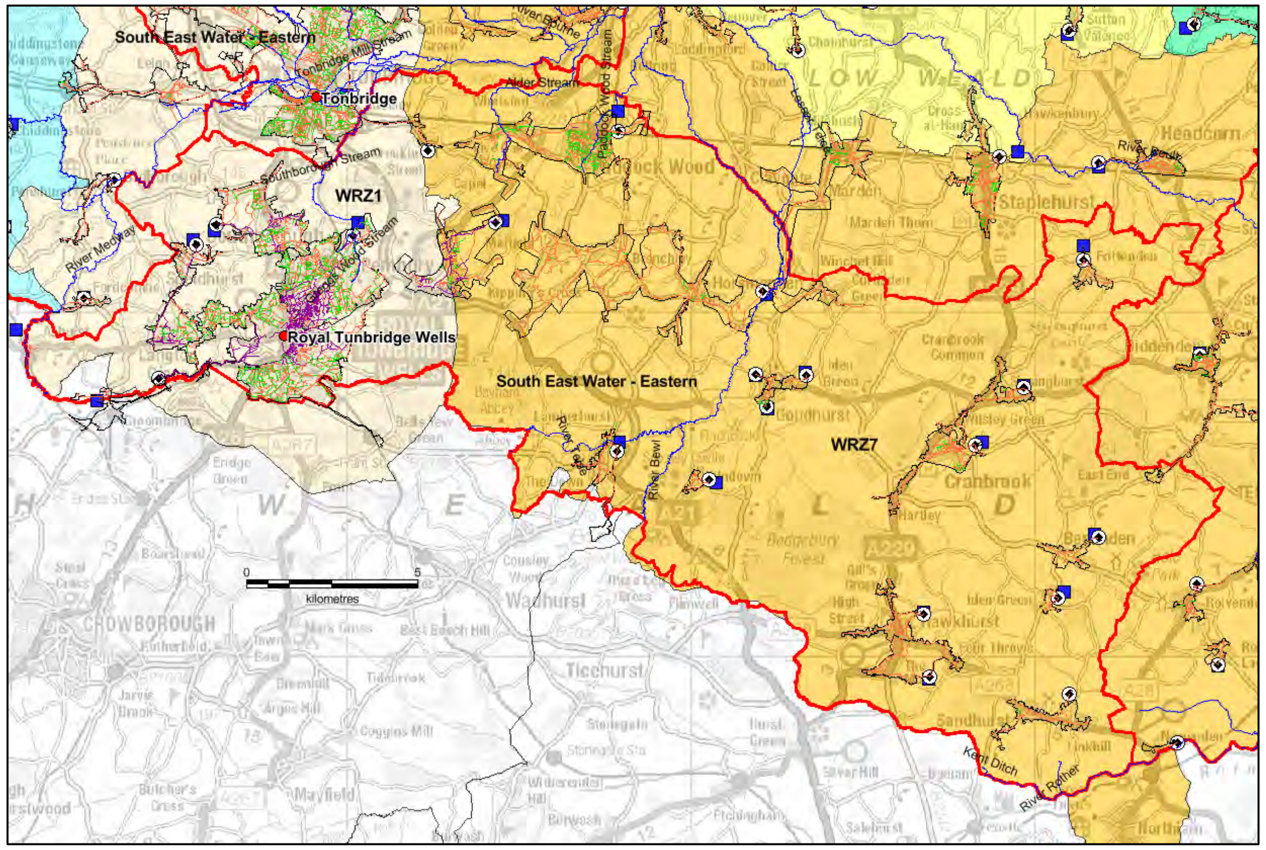
Tunbridge Wells is largely underlain by Weald Clay Formation, Tunbridge Wells Formation and, close to Royal Tunbridge Wells town, it is underlain by Ardingly Sandstone and Lower Tunbridge Wells Sand Formation. These features are classified as either minor or non-aquifers. The majority of the LPA area is covered by the Medway Management Catchment, with the Teise, Hammer Stream, Bewl, and Eden tributaries draining the majority of the LPA area to the north towards the River Medway. The south eastern section of the LPA area is drained by a number of tributaries to the River Rother.

Water supply systems

Tunbridge Wells is supplied with drinking water by South East Water. The very west of the LPA area is located within South East Water's WRZ 1, whilst the central and eastern sections of the LPA area are located in WRZ 7. Drinking water is therefore supplied by groundwater and imported water to the west and a mixture of groundwater, surface water and imported water in the central and eastern sections.

Without planned measures to manage demand and new resources, the western section of the LPA area would be part of a wider WRZ area seeing a deficit of available supply of 20.6 Ml/d, whilst the central and eastern sections would be part of a wider WRZ area seeing a deficit of 28.8 Ml/d for the Critical Period. South East Water are proposing a range of measures to meet this deficit.

Figure E13.2: Water systems within Tunbridge Wells



Wastewater treatment systems

Southern Water provide wastewater services for all of Tunbridge Wells. The LPA area is largely served by a separate foul and surface water sewer system, with the exception of Tunbridge Wells town centre which is combined. Wastewater treatment is provided at 21 main WwTWs:

E13.3 Water resources assessment summary

South East Water are proposing a range of measures to close the deficit within the WRZs serving the LPA area up to end of the Local Plan period (2031) and beyond to 2040. This study has considered whether the growth forecast by water companies in the current live WRMPs (from 2015) adequately covers the more recent growth forecasts used in the study; this is because water company planning numbers were based on 2013/14 growth forecasts whereas this study has used more recent forecasts from 2016. South East Water's WRZs covering Tunbridge Wells has options planned to meet demand for only approximately 40% of the total growth within the WRZ. As a result, this study has estimated that South East Water's current WRMP has a potential shortfall in supply of 2.17 Ml/d within the LPA area.

This study has therefore identified a range of measures that could be bought forward early (or included in addition) within the WRMP update due in 2019 which would allow this shortfall to be met. To further enhance strategic scale water resource measures, the potential for a water neutral position across Tunbridge Wells has also been considered within this study, to demonstrate the potential efficacy of policy to minimise demand from new property as well as joint initiatives to further reduce demand in existing housing stock.

[38] Growth figures were provided by the KCC Business Intelligence Research and Evaluation Team in June 2016

Existing water demand (residential only) within the LPA area has been estimated as 17.04 Ml/d and the additional demand from projected residential growth is estimated to be 3.67 Ml/d. To achieve neutrality, demand after all houses are built and occupied would need to be less than 17.04 M/d and this study has concluded that it would require unrealistic measures to achieve this including: all new development to minimise water demand through the use of extensive and expensive recycling technologies; all water companies to meet maximum water meter penetration in existing housing stock; and, a large funding pot to allow retrofit of a significant proportions of existing housing stock with water efficient fixtures and fittings. Therefore, two more realistic water demand management scenarios have been tested.

- *Mandatory requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 125 litres per person per day[39] (Building Regulation Part G Mandatory); and, 5% of existing homes in Tunbridge Wells would be retrofitted with low flush cisterns, as well as aerated taps and shower heads;
- *Optional requirements scenario plus retrofit* - All new homes would be built to deliver a water use of 110 litres per person per day[40] (Building Regulation Part G Mandatory); and, 5% of existing homes in Tunbridge Wells would be retrofitted with low flush cisterns, as well as aerated taps and shower heads.

The water neutrality analysis demonstrated that the optional requirement scenario would make some contribution to reducing the post development demand (in 2031) shortfall within South East Water's current planned supply and demand balance to 2031 with the optional scenario reducing the deficit by 34%; however, it highlights the importance of alternative strategic water resource options and demand management measures to be developed by South East Water to offset the current shortfall in planned supply.

The mandatory scenario would potentially deliver a post development demand reduction of 0.34Ml/d (9% reduction in additional demand) whilst the optional requirement would deliver a potential reduction of 0.73 Ml/d (20% reduction in additional demand). Figure E12.3 provides an output summary from the water neutrality calculator demonstrating the estimated costs for achieving the mandatory and optional requirement scenarios within Tunbridge Wells. For context, an estimate of the cost required to meet full neutrality is also provided. The outputs separate out the costs into those borne by developers and those which would need to be met by other stakeholders (e.g. water company, the LPA or KCC).

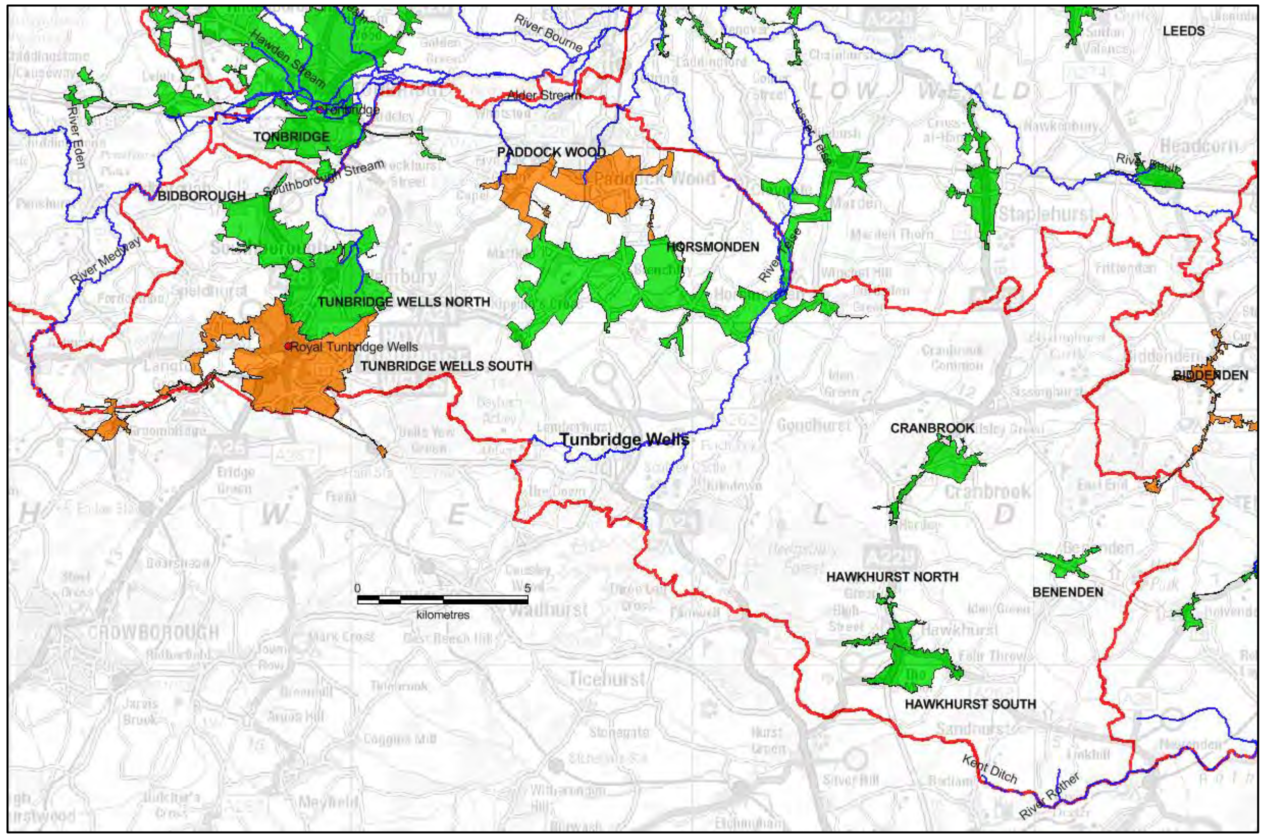
Figure E13.3: Costs of achieving water neutrality targets in Tunbridge Wells

Neutrality Scenaro	Outstanding	Existing properties				Costs Summary		
	new build efficiency costs cost	Metering cost	Retrofit %	Nos to retrofit	Retrofit cost	Developer	Non developer (including metering)	Total
BRM + 5% retrofit	£ -	£ -	5.00%	2370	£ 521,400	£ -	£ 521,400	£ 521,400
BRO + 5%retrofit	£ 99,000	£ -	5.00%	2370	£ 521,400	£ 99,000	£ 521,400	£ 620,400
Theoretical water neutrality	£ 45,067,000	£ 592,500	29.40%	13935	£ 3,065,794	£ 45,067,000	£ 3,658,294	£ 48,725,294

E13.4 Wastewater and water quality assessment summary

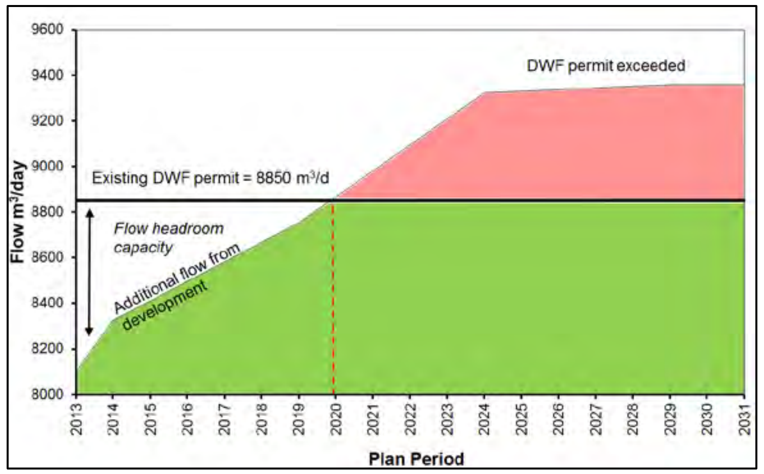
The growth planned within Tunbridge Wells has been compared to the available headroom at WwTWs serving the LPA area. Figure E13.4 demonstrates the results of this assessment and shows that Tonbridge, Bidborough, Tunbridge Wells North, Horsmonden, Cranbrook, Hawkhurst North, Hawkhurst South and Benenden WwTWs have permitted capacity (green) to accept growth. However, growth south of Tunbridge Wells WwTW, which serves the town of Royal Tunbridge Wells and its near vicinity, and in Paddock Wood WwTW, which serves the town of Paddock Wood and its near vicinity, would require Southern Water to apply for a new discharge permit for the associated WwTWs. To determine whether there is environmental capacity in relation to the permits, a water quality assessment exercise was completed for these WwTWs.

Figure E13.4: Headroom capacity at WwTWs serving Tunbridge Wells



Tunbridge Wells South WwTW

Figure E13.5: Tunbridge Wells South - Headroom capacity phasing



Based on current estimate of the growth trajectory in Tunbridge Wells, headroom capacity at the WwTW would be used by 2020. Water Quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

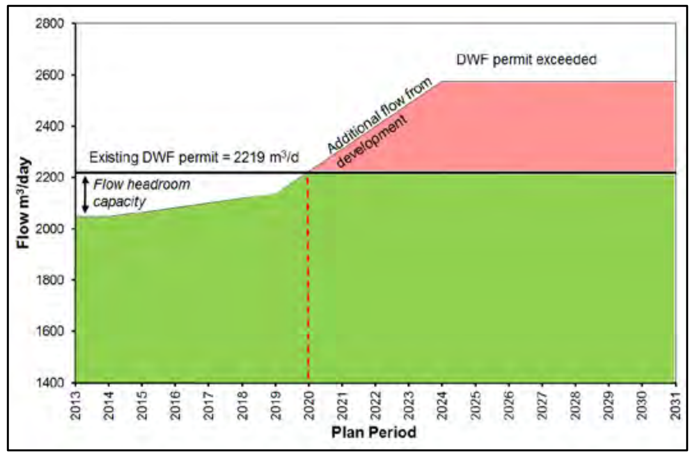
The assessment demonstrated that more stringent quality conditions would be required on the permit relating to phosphate and BOD to ensure no deterioration in WFD targets in the River Grom. An improvement to ammonia conditions would also be required to ensure the future WFD status of river Grom is achieved.

In relation to ammonia and BOD, the changes required can be achieved with conventional treatment and hence a feasible solution will be possible. The assessment demonstrates that the phosphate condition would need to be tighter than can usually be achieved by conventional treatment; however, the assessment demonstrates that the WwTW is already achieving similar standards and hence Southern Water would need to determine whether this improved quality can be maintained once all growth is connected. It is recommended that Southern Water and Tunbridge Wells Borough Council discuss the implications of planned growth phasing south of the town of Royal Tunbridge Wells on infrastructure upgrades required to ensure WFD targets can be maintained

[39] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.
[40] The water neutrality calculator includes a 16 litres per person per day additional allowance to reflect that the average water use per home in Kent is higher than the national average upon which Building regulations were developed, and to acknowledge that water use will increase with time as occupiers alter fixtures and fittings throughout the occupancy of the home.

Paddock Wood WwTW

Figure E13.6: Paddock Wood - Headroom capacity phasing



Based on current estimate of the growth trajectory in Tunbridge Wells, headroom capacity at the WwTW would be used by 2020. Water Quality modelling using RQP and calculations of load has been used to determine environmental capacity in relation to the new permit required.

The assessment demonstrated that more stringent quality conditions would be required on the permit relating to BOD and ammonia to ensure no deterioration in WFD targets in the River Lower Teis. An improvement to phosphate conditions would also be required to ensure the future WFD status of river Lower Teis is achieved.

In relation to BOD, the changes required can be achieved with conventional treatment and hence a feasible solution will be possible. The assessment demonstrates that the ammonia and phosphate condition would need to be tighter than can usually be achieved by conventional treatment; however, the assessment demonstrates that the WwTW is already achieving similar standards and hence Southern Water would need to determine whether this improved quality can be maintained once all growth is connected. It is recommended that Southern Water and Tunbridge Wells Borough Council discuss the implications of planned growth phasing south of the town of Paddock Wood and the near vicinity on infrastructure upgrades required to ensure WFD targets can be maintained.

Appendix F – Surface water body name list

1	Cradlebridge Sewer
2	Shorne and Higham Marshes
3	Second Speringbrook Sewer
4	Great Stour
5	River Beult
6	River Darent
7	Watercress Stream
8	River Dour
9	River Teise
10	Snodland Mill Stream
11	Hawden Stream
12	Pen Stream
13	Tonbridge Mill Stream
14	River Bourne (IDB)
15	Alder Stream
16	Lampen Stream
17	Allhallows Grain and Stoke Marshes
18	Scrapsgate Drain
19	Graveney Marshes
20	River Medway
21	East Stour
22	Iwade
23	Jury's Gut Sewer
24	Southbrook Sewer
25	Denge Main Sewer
26	New Romney Sewage Arm
27	First New Sewer
28	Second Brenzett Sewer
29	Sedbrook Sewer
30	First Speringbrook Sewer
31	Second Marshland Sewer
32	First Government Drain
33	Canal Cut
34	First Hoornes Sewer
35	First Marshland Sewer
36	Horsemarsh Sewer
37	Honeypot Stream
38	Middle River
39	Windmill Creek
40	Whitehall Dyke
41	Abbatridge Main
42	Blackmans Ar
43	Second Government Drain
44	Third Government Drain
45	Second New Sewer
46	Newknock Channel
47	Tenterden Sewer
48	Newmill Channel
49	River Bewl
50	Hogwell Sewer
51	Sevenscore Dike
52	River Eden
53	River Wingham
54	Lesser Teise
55	The Swale
56	Medway Tidal and Estuary
57	Capel Fleet Drain
58	Seasalter Level
59	Swalecliffe Brook
60	West Brook
61	Cooling and Halstow Marshes
62	Cliffe Marshes
63	Cliffe Creek
64	River Ebbsfleet
65	Swanscombe Marsh
66	Stone Marshes
67	Littlebrook
68	Dartford and Crayford Creeks
69	Dartford Marsh Sewer
70	River Wantsum
71	Chislet Pumping Drain
72	North Sream (Chislet)
73	River Stour (Tidal)
74	Aylesford Stream
75	Little Stour (Including The Nailbourne)
76	Richborough Stream
77	River Rother
78	Gosshall Main Stream
79	Sandwich Bay and Hacklinge Marsh
80	Greggs Wood Stream
81	River Bourne
82	Pent Stream
83	Gorrel Stream
84	Kite Farm Ditch
85	Plenty Brook
86	Seabrook Stream
87	River Len
88	Loose Stream
89	Hilden Brook
90	Saltwood and Mill Lease Stream
91	Brockhill Stream
92	Southborough Stream
93	Warden Bay Stream
94	Royal Military Canal
95	New Romney Main Sewer
96	Stanham River
97	Ruckinge Dyke
98	Kent Ditch
99	Reading Sewer
100	Paddock Wood Stream
101	Fourth Government Drain
102	Willop Sewer
103	Engine Sewer
104	Wallingham Main Sewer
105	Highnock Channel
106	Sarre Penn
107	Whitewater Dyke
108	Third Hoornes Sewer
109	Thames (Tidal)
110	White Kemp Sewer
111	Coult Stream
112	Clobsden Sewer
113	Five Watering Sewer
114	Fifth Government Drain

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