STEVENAGE BOROUGH COUNCIL

RYE MEADS WATER CYCLE STRATEGY

DETAILED STUDY REPORT

FINAL REPORT

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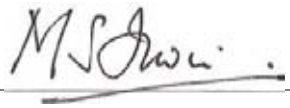
Approver	Mike Irwin	

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1 Introduction and Summary of Key Outcomes

1.1 Why is a strategy needed?

Stevenage Borough Council (SBC), in association with other project partners, appointed Hyder Consulting (UK) Limited in April 2008 to produce a Water Cycle Strategy (WCS) for the Rye Meads area. This includes the Rye Meads Wastewater Treatment Works (WwTW) catchment and any surrounding areas that could potentially be pumped to it. There is a concern that existing water infrastructure in the area may not have the capacity to handle (or that current investment plans do not make provision for) the increased demands from new development proposed in the East of England Plan.

The East of England Plan (2008) is the Regional Spatial Strategy (RSS) for the East of England. The RSS is the top tier of the statutory development plans for a particular region. Its purpose is to provide a consistent regional framework, set out a regional strategy and cascade development policy from a regional level to the relevant Local Authority, for inclusion in their Local Development Documents (LDD), which form part of their statutory Local Development Frameworks (LDF). The RSS proposes ambitious growth targets for a region that is already described by the Environment Agency (EA) as experiencing serious water stress.

The RSS has tasked Local Authorities in (or surrounding) the Rye Meads WwTW catchment with providing ambitious levels of growth; almost 70,000 new dwellings between 2001—2021. A similar rate of growth is also required following 2021. At the time of writing this report, around 8,000 dwellings have been completed against the 2021 target.

The timeframe for this WCS extends to 2031, to include the current RSS (to 2021) and the future RSS review. This will provide an evidence base for the Local Authorities to ensure they comply with policy H1 of the RSS, which states that '*Local planning authorities should plan for the delivery of housing for at least 15 years from the adoption of the relevant development plan documents.'*

Throughout the development of the RSS, accompanying studies (see Sections 1.4 and 3.2) highlighted the need for a detailed assessment of the Rye Meads area due to potential water infrastructure capacity restrictions.

The RSS specifically mentions wastewater treatment as a key possible constraint to growth in the study area; see box below.

> ***Restrictions in capacity*** *at Rye Meads* [WwTW] *will need to be overcome without harm to the adjacent Lee Valley Special Protection Area or its qualifying features. A strategic review of the options is required, looking beyond incremental expansion to new facilities or other possible works. Depending on the necessary lead in times, this may bear on the rate of delivery.*

Box 1: East of England Plan (2008) extract

This WCS will assess these restrictions in relation to the proposed development in the Rye Meads catchment, and recommend suitable infrastructure provision that is economically, environmentally and socially sustainable.

As described in the above mentioned studies, a WCS should consider:

- Water resources;
- Potable water supply infrastructure;

- Sewerage network capacity;
- Wastewater Treatment;
- Flood risk and mitigation, including Sustainable Drainage Systems (SUDS);
- Water quality; and
- Conservation and other environmental opportunities.

A key function of a WCS is to involve all relevant stakeholders, such as water companies and the EA, in early discussions regarding infrastructure requirements. This allows the creation of an integrated sustainable approach, to ensure the water cycle and supporting infrastructure do not constrain development in the future, and protect and enhance the natural environment.

1.2 Who is it for?

This WCS is intended to form part of the **Local Authorities'** evidence base for their LDFs, and sets out the water and wastewater infrastructure, amongst other measures, that will need to be in place to achieve their growth targets. There are seven Local Authorities lying either entirely or partly within the catchment of the Rye Meads WwTW; Stevenage, Harlow, Welwyn Hatfield, East Herts, North Herts, Broxbourne and Epping Forest. As some only lie partly within the catchment, the relevance of the information to the LDF process contained within this report may be variable.

The WCS will give the **Environment Agency** the confidence it needs to support the scale of development that is proposed, making sure that no deterioration of the environment is felt. However, this WCS does not constitute the approval of the EA on any specific site allocation or development policy; the EA retain the right to comment upon site specific planning applications.

The **Water Companies** within the catchment - including Anglian Water Services (AWS), Thames Water Utilities (TWU) and Three Valleys Water (TVW) – will use this document as a mechanism to improve their knowledge of development proposals and increase the level of communication with the Local Authorities. It can be used to support the business plans of the water companies for the provision of key infrastructure to meet RSS targets. An integrated strategy based on the entire catchment, rather than individual water company boundaries, can allow for the development of more sustainable solutions and for possible collaborations to be explored.

This WCS will also provide guidance for **developers**, to ensure that new developments do not adversely affect the environment or existing infrastructure, and minimise flood risk where possible.

1.3 Who helped to develop this strategy?

This WCS was commissioned by SBC and Harlow District Council (HDC), in partnership with the EA. A full list of participating organisations is included in Appendix A.

The evolution of this strategy was facilitated by a number of workshops and presentations, to which all stakeholders were invited. Hyder Consulting presented the project group with progress reports at the end of both Phase 1 and 2 of this WCS, and the comments received throughout this process have been incorporated into the development of this strategy.

1.4 What does it comprise?

The EA guidance, recently finalised in January 2009, explains the components of a WCS. According to this guidance, a WCS comprises of three stages; Scoping, Outline and Detailed, as described below.

Scoping Stage

This stage of a WCS should compile the latest information regarding the water infrastructure and environment in the study area, and can highlight key constraints already known to the stakeholders.

In 2007 Halcrow Group Limited published a Scoping[1] report for the study area on behalf of the EA. The main conclusions of the Scoping report were that:

- Water resources in the study area are either over-abstracted or over-licensed;
- Rivers within the upper reaches of the catchment are suffering from low flows, which impacts adversely upon the ecology;
- Consumers in the study area have the highest per capita consumption rates in England and Wales;
- Water efficiency measures and demand management must be investigated to balance out any increased demand from the proposed development;
- The sewerage network may not have capacity for the proposed development in places (such as the trunk sewer draining the western side of Stevenage), which could result in an increase in flooding and pollution from sewers;
- The majority of rivers within the study area are compliant (in the period from 2003-2005) with the quality targets set for them by the EA, however nutrient levels are excessively high in places;
- The amount of proposed development will result in Rye Meads WwTW reaching capacity before 2021, hence upgrades to the works may be required; and
- Further work is needed to assess alternatives to the current wastewater treatment regime, perhaps incorporating local treatment options to return valuable water to the upper reaches of the catchment.

Outline Stage

An Outline WCS should analyse environmental and infrastructure constraints, and assess the sustainability and feasibility, at a high level, of possible solutions to such issues. An Outline Strategy should result from this, to provide an evidence base for Local Authorities when completing their Core Strategy documents, and preliminary guidance for developers.

Major infrastructure requirements should be highlighted, and a timeline for provision proposed. The Outline stage should determine if a Detailed WCS is required.

Detailed Stage

A Detailed WCS will identify the infrastructure needed for particular locations, and provide details on when this is needed, and who will be responsible. It will guide Local Authorities and

[1] Rye Meads Water Cycle Strategy Scoping, Halcrow Group Ltd and the EA, 2007

developers on site specific policies, and as such is best suited to feed into the latter stages of the planning process.

It should include assessments of the costs and benefits of individual infrastructure solutions, and provide guidance on the funding required.

The inception of this WCS occurred before the finalisation of the above mentioned guidance. Whilst this WCS does provide the results of a **detailed study**, it is unable at this time to fully confirm a detailed strategy (as per the EA guidance), as all Local Authority LDFs within the Rye Meads study area have not yet progressed to a stage where the relevant site specific information is available. **Further work** will be required to finalise detailed long-term solutions beyond 2021, particularly the provision of wastewater treatment and detailed phasing and costing of the identified infrastructure solutions. Recommendations regarding this work are included below.

Box 2: The context of this WCS

This WCS complies with the project brief as it provides the stakeholders with a clear understanding of the options that are available, viable and deliverable to allow the proposed RSS targets to be met up to 2021. Stakeholders should be reassured that predicted increases in efficiency, and the work already being proposed by the water companies in the study area, means that strategic water infrastructure should not constrain the growth proposed in the RSS up to 2021.

However, there remains uncertainty on a number of issues within the study area, such as:

- The implication of the Water Framework Directive (WFD) and what this will mean for future discharge consents;
- The likely location and phasing of development, and associated water services infrastructure solutions, given the current economic climate; and
- The localised benefits of supplementing low flows in rivers with locally treated wastewater.

These uncertainties preclude the most appropriate long-term (post 2021) infrastructure solution, including its overall cost and delivery times, being recommended at this time. This WCS instead sets out a framework for the completion of further work in parallel with Local Authority LDF preparation to ensure growth is not constrained in the long term due to water infrastructure and environmental capacity constraints.

1.5 How does it work?

This detailed study report is structured into the following sections:

Section 1 – Introduction and Summary of Key Constraints explains the purpose and objectives of this study, and summarises the key results that have emerged from the review of the existing data, consultation with the stakeholder group and the subsequent analysis.

Section 2 – The Rye Meads Study Catchment explains the study area in more detail, describing its location, and main features such as rivers, underground water resources, environmental conservation sites and existing water infrastructure layout. Key environmental constraints such as water quality and flood risk are identified and explained.

Section 3 – Planning Policy Context explains the national, regional and local policies that will steer development within the study area. A breakdown of the proposed development is provided, and the impact this will have on the Rye Meads WwTW (in terms of new dwellings connected to the sewerage network) is assessed.

Section 4 – Development Impact Calculations explores the effect that the above mentioned development will have on the water supply and sewerage networks in the study area. The key variables and methodology used for these calculations are explained.

Section 5 – Catchment Capacity provides more detail regarding the capacity of the study area, in terms of water infrastructure, flood risk and the wider water cycle. This section explores the views of the stakeholders on how the development mentioned above can be accommodated within the study area, and highlights any existing plans for increasing capacity, and any opportunities that may exist to further enhance the environment.

Section 6 – Preliminary Optioneering assesses the options that are available to solve the issues described as critical in the previous sections, most notably wastewater treatment and sewerage network capacity. These options are screened to identify those that require further investigation. Catchment wide solutions are also discussed.

Section 7 – Development of the Preferred Strategy to address Key Strategic Constraints builds on and further assesses the options identified in the previous sections, and concludes which of the options should be included in the preferred strategy.

Section 8 – Recommended Strategy explains the strategy the stakeholders should adopt regarding potable water supply, wastewater collection and treatment, and flood risk management to ensure development can be delivered in a timely and sustainable fashion. Details of the sewerage network upgrades required, and the required phasing of wastewater treatment and sewerage upgrades, are provided, as these issues have been deemed critical constraints throughout the consultation process.

Section 9 – Strategy Guidance provides guidance to the stakeholders on complying with the strategy mentioned above. Detailed information regarding the optimum location of developments in each Local Authority, with regards to the sewerage network, is provided along with a description of the types of SUDS that may be suitable. A high-level developer checklist is included, as a tool with which to ensure planning applications comply with the strategy mentioned above. It also indicates where there are opportunities for developers to go 'beyond what is required' and therefore significantly lessen the impact of the development on the water infrastructure and wider water environment.

Section 10 – Conclusions and Recommendations brings together and concludes the key themes that have emerged throughout the development of this WCS. Also, it provides recommendations on further work required by the stakeholders to ensure water infrastructure does not constrain development, and growth is therefore accommodated in the most sustainable fashion.

1.6 What are the key outcomes?

Overall Conclusion

The WCS stakeholders (including the water companies and the EA) recognise that the findings and the recommendations of this WCS and its evidence base show that there are no overwhelming technical constraints to the planned growth (to deliver the RSS targets to 2021) in the Rye Meads catchment.

However, the scale, cost and time to deliver the required sewerage infrastructure, especially to serve the planned development in Stevenage, should not be underestimated. Whilst this does not prevent growth being achievable, it could be a real constraint, as it impacts on the number of new dwellings that could be delivered by 2021 and beyond.

Water supply - Resources

Three Valleys Water (TVW) are confident that optimisation of existing resources coupled with an extensive demand management scheme, involving accelerated penetration of customer water meters, will prevent a supply/ demand deficit occurring in the study area prior to 2035.

Thames Water Utilities Ltd (TWU) is planning to implement a range of solutions, including the development of new raw water resources, to prevent a predicted deficit in their London zone. This should ensure that supply issues do not constrain development in the south of the study area.

The importance of adopting the Code for Sustainable Homes water efficiency targets in new dwellings of 105 l/p/d (as a minimum), and aiming for Defra's aspirational target of 130 l/p/d by 2030 in existing dwellings, has been highlighted. Reducing demand in existing dwellings unlocks capacity for new development.

The potential to go beyond these targets has also been discussed. If enough capacity is unlocked in this manner, 'water neutrality' can be achieved; i.e. where demand for water does not increase following development. Demand reduction across all dwellings uses less energy, reduces adverse impacts on water resources and provides a greater safety margin against future uncertainties such as climate change and pollution events.

Water supply – Network

TVW have advised that all known proposed development areas are within suitable distance of their strategic mains network. The need to upgrade this network, to provide capacity for new development, will be assessed by TWV through network modelling on a site by site basis. There may occasionally be local issues to overcome but the supply network should not constrain development.

Sewerage network

The sewerage network is known to be close to capacity in certain areas of the Rye Meads WwTW catchment. This increases the risk of flooding from sewers, particularly during storm events. TWU are already proposing upgrades in Harlow, to alleviate the identified capacity issues. Strategic scale new developments should be subject to appropriate planning conditions where sewerage infrastructure constraints and upgrade requirements have been highlighted, unless sufficient capacity can be demonstrated through further investigations and consultations with the water companies. Uncertainty in the development proposals at present has meant that funding for specific solutions has not been allocated in the TWU PR09 business plan.

This WCS has identified that the proposed upgrades can accommodate the main planned growth in and around Harlow. Therefore, the capacity of the network will not constrain development in this location, providing the appropriate funding becomes available and the upgrades are implemented in a timely fashion.

TWU has assessed a number of development scenarios to assess the impact of the developments on the wastewater network in Stevenage. Where the risk of flooding is increased, TWU has developed indicative solutions to mitigate this risk. Where development is outside of TWU's operational boundary, but closest to the existing TWU network, the neighbouring sewerage undertaker (in this case AWS) may seek a bulk transfer agreement, under Section 110a of the Water Industry Act, for additional infrastructure to be provided. The TWU sewerage network can be upgraded to create the capacity for all the additional Stevenage development and the remaining development expected within the Rye Meads catchment past 2021, although the overall sustainability of this cannot be assessed until a long term treatment solution is

finalised, as discussed below. Due to uncertainty in the location, timing and proposed connection locations of development in and around Stevenage, no specific funding for network upgrades resulting from new development have been included in TWU's PR09 business plan.

Apart from in Stevenage and Harlow, no major strategic sewerage upgrades are anticipated to be required elsewhere in the Rye Meads catchment provided the development sites are sited as per the guidance given in this report. However, on a more local level, the development of large strategic housing sites in the other Local Authority areas may require the construction of new strategic outfall sewers to link the new sites to the existing trunk sewer network whilst bypassing the network of the existing towns and villages. This WCS highlights the importance of continued consultation between stakeholders to assess these issues in the future as more information becomes available.

Local Authorities, water companies and developers should adopt policies to ensure that surface water drainage from new developments does not enter the existing foul sewerage network. This reduces the risk of sewer flooding, as foul sewers are not designed to accept surface water flows. Where development is currently served by foul sewers known to be influenced by surface water during times of storm, there should be a requirement for separate surface and foul systems to be investigated as the first choice for the development site.

The impact of the development on the sewerage network across all seven Local Authorities can be reduced by pursuing ambitious water efficiency targets in both new and existing properties.

Wastewater treatment

Initial calculations have suggested that Rye Meads WwTW should be able to operate within its existing volumetric discharge consent limit past 2021. However, upgrades will be needed in this period to increase the existing treatment capacity of the works, to ensure the required chemical and biological standards of the discharged effluent are met. These upgrades, with appropriate measures, can be implemented without significantly impacting the adjacent Rye Meads nature reserve and the Lee Valley Special Protection Area. For TWU to receive the appropriate permissions and funds for these upgrades, in a timeframe that matches the proposed development, an iterative discussion between TWU, the Local Authorities, the EA and Ofwat is required.

The requirement for an increased volumetric discharge consent at Rye Meads WwTW post 2021 will be dependent on the development that actually occurs within the catchment. Local Authorities such as Stevenage, East Herts and Welwyn Hatfield can reduce the risk of this by developing outside of the catchment where possible.

A key factor in this will be the destination of wastewater from any development sites to the North, East and West of Stevenage. Alternative options have been considered for treating this wastewater, such as upgrading a WwTW in the AWS region and the possibility of a new WwTW, closer to Stevenage, in the TWU region. Insufficient information is currently available on the economic, social and environmental costs and benefits of these options to make an informed decision.

Therefore, planned upgrades at Rye Meads WwTW should allow development to continue in the medium term, although a long-term solution beyond 2021 has not yet been agreed upon by the WCS stakeholders, as this will require further investigation.

Water quality

The current water quality of the rivers within the study area is generally compliant with the quality objectives set by the EA, with the exception being stretches of the Rivers Beane and

Lee. However, nutrient levels in the majority of the rivers are high. High levels of nutrients increase the risk of eutrophication, which can damage the ecology of the watercourse.

These high nutrient levels result in the majority of the watercourses being at risk of not complying with the Water Framework Directive (WFD) in the future. The low flows typically observed in some of the rivers within the study area, such as the Rivers Beane, Purwell, Mimram and Lee, are also causing failure against WFD criteria.

The stretch of the River Lee that the Rye Meads WwTW discharges treated effluent into is not currently achieving good ecological status (or good ecological potential in the navigable sections).

In the short to medium term water quality will not constrain development, as the Rye Meads WwTW can continue to operate within its current physio-chemical discharge consent limits. However, the demands of the WFD may result in the limits of this consent becoming tighter in the future (although this is unlikely to happen prior to 2021 according to the EA). A reduction in the volume of consented discharge post 2021 will also reduce the number of new dwellings that can be connected after that date. The technology required to meet more stringent quality standards in a discharge may be cost prohibitive, and delay development. Water quality improvements delivered by measures implemented during the first and second WFD planning cycles may also influence the quality of discharge required from Rye Meads WwTW, although the uncertainty should reduce over time as the results of the implementation of the RBMPs emerge.

There is some desire from a number of the WCS stakeholders to localise the treatment of wastewater, particularly around Stevenage, to supplement the low flows on the River Beane. However, the high quality of discharge required to comply with WFD targets may be prohibitive to the water companies, requiring excessive cost according to the currently available technology. Until the benefits of such a proposal can be quantified it is not possible to recommend such a solution.

In this respect, there is a risk that water quality and wastewater treatment will constrain development in the long term beyond 2021. This WCS has recommended that further studies are completed, to inform future revisions to the WCS and the implementation of the WFD.

Flood risk

Whilst the SFRA that have been completed within the study area do highlight some areas of existing flood risk, there appears to be sufficient land available for the Local Authorities to steer development away from these areas.

Surface Water Management Plans are recommended by this WCS for Stevenage, Harlow and East Herts due to the large proposed growth and existing flood risk issues.

The need for developers to incorporate SUDS has been reinforced by this WCS, in order to better control surface water run-off and therefore reduce flood risk as well as pollution risk. Guidance as to the appropriate SUDS for each of the Local Authority Areas has been provided.

Incorporating the above suggestions within the planning process will ensure that flood risk does not significantly constrain development.

Environment/ Conservation

To date, some notable schemes have been completed to enhance the bio-diversity of the water environment within the study area. This WCS highlights the need to incorporate bio-diversity

considerations into all stages of the planning process, particularly when designing SUDS and wastewater treatment solutions.

Green Infrastructure Strategies are recommended for the Local Authorities, to identify opportunities to conserve and enhance bio-diversity in the water (and wider) environment throughout the planning process. Harlow District Council have already completed a Green Infrastructure Strategy.

The possible environmental impact of the proposed water infrastructure solutions will have to be carefully assessed and managed. However, no 'show-stoppers' have been identified for the recommended solutions to 2021.

Funding

Water companies have a duty under the Water Industry Act to serve their customers by maintaining and extending the network they provide. Funding for this activity is secured through the regulatory funding process subject to approval by Ofwat. The price that the water companies can charge for their services, and hence the funds available for new infrastructure and improvements, are determined in five year Asset Management Periods (AMP) by Ofwat.

Localised infrastructure improvements can also be funded through the developer requisition process, whereby developers pay back the water companies the deficit between the required infrastructure costs and the revenue generated by the new customers on the site, in either a lump sum or over a 12 year period.

The forthcoming Community Infrastructure Levy will allow Local Authorities to stipulate a contribution from developers towards local and sub-regional infrastructure. It is intended that this contribution can be passed from the Local Authorities to other providers of infrastructure, such as water companies. Further work will be required to ascertain to what extent the Community Infrastructure Levy can aid in the provision of the infrastructure identified in this WCS. The regulations to underpin the Community Infrastructure Levy are not expected until October 2009[2]. However, Local Authorities, in partnership with County and Regional bodies, should begin assessing the infrastructure schemes that they wish to be included, and preparing the supporting information with which to formulate the appropriate charging schedules.

Further Work

There is much work still to be completed by the stakeholders in order to ensure the most sustainable long-term solution for wastewater collection and treatment in the study area is selected whilst best resolving the constraints from the water cycle and wider environment. The details of this further work are included in Section 10.2.

Further work is also required to confirm the detailed phasing and costing of the recommended short to medium term infrastructure solutions when site specific details are better known, following recovery from the current economic downturn. Due consideration to the time required for design, construction and commissioning infrastructure should be evaluated in addition to securing funding.

[2] Commons Hansard, 28 Jan 2009 : Column 629W

2 The Rye Meads Study Catchment

2.1 Location

The study area for the Rye Meads Water Cycle Strategy lies within the region of the East of England, within the counties of Hertfordshire and Essex, to the north of London.

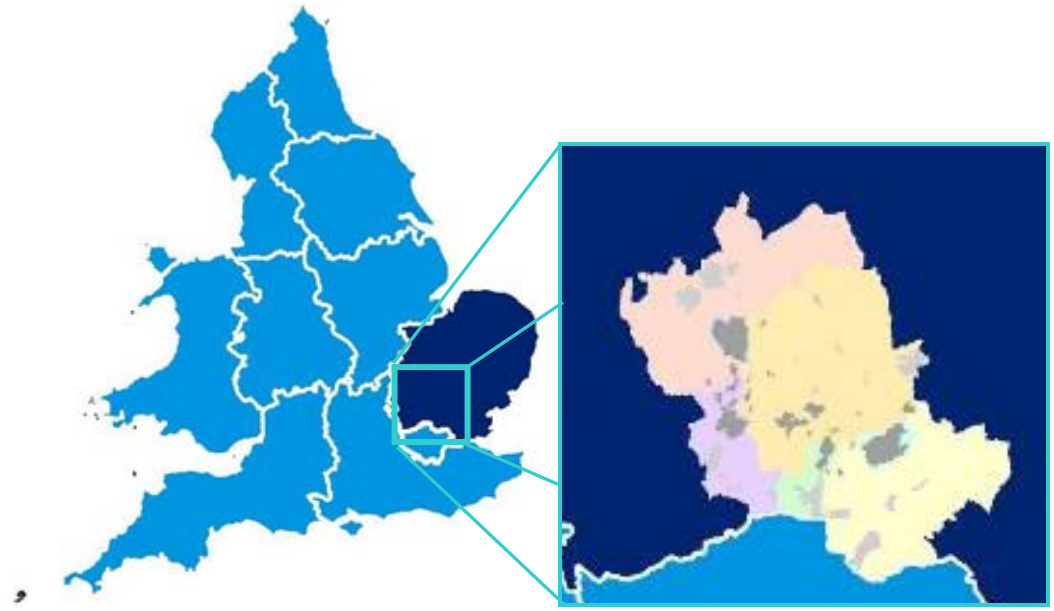


Figure 2-1 Rye Meads Study Area

The study area includes the entirety of the Local Authorities of Stevenage Borough Council and Harlow District Councils, as well as significant parts of Welwyn Hatfield District, East Hertfordshire District and Broxbourne Borough Councils. The study area also includes small parts of North Hertfordshire and Epping Forest District Councils.

The study area was primarily chosen to include the areas that are connected to the sewerage system of the Rye Meads WwTW. The study area also encompasses the wider area in order to assess the potential to divert flow from the Rye Meads catchment.

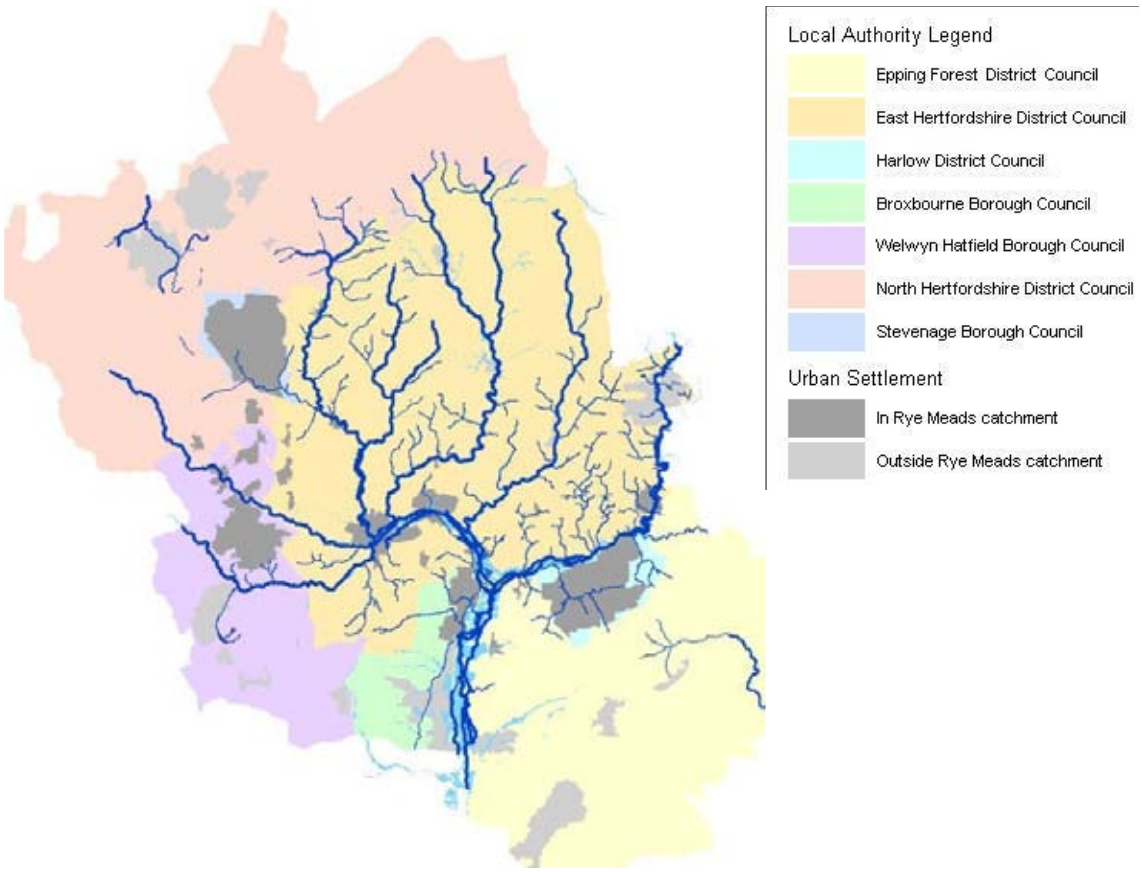


Figure 2-2 Local Authorities in Study Area

The towns within the study area have historically seen significant housing growth since the 1950s, with a number of "New Towns" being created as commuter areas for London and District centres in their own right. Many of the towns have good transport links to London and the surrounding area and have therefore been earmarked as being future growth locations within the London – Stansted – Cambridge growth area.

Now a large town with a population of 80,000[3], **Stevenage** was originally the first of the post war New Towns and was substantially developed from a small village during the late 1940s. **Harlow** was also transformed from a market community of 4,500 population into a thriving, modern town and now has a population of 79,000 with plans to develop further to the north, east and south/ west of the town. **Welwyn Garden City** lies within Welwyn Hatfield District Council and was founded in the 1920s. The town centre is dominated by the central mall or 'scenic parkway', almost a mile long, named 'Parkway'. Within the District of East Hertfordshire, **Hertford** was historically a major market for corn and other agricultural produce. The town centre is now largely a conservation area and features a water sculpture depicting the four rivers that meet in Hertford - the Rib, Beane, Mimram and Lee. There are a number of smaller East Hertfordshire towns and villages within the study catchment including Ware, Sawbridgeworth, Stanstead Abbotts and Watton-at-Stone. **Hoddesdon** in the Borough of Broxbourne has a large conservation area in the town centre.

Throughout the whole of the East of England, there are a number of other Water Cycle Studies in various stages of completion. A notable example is the WCS currently being conducted for Uttlesford District Council, which lies to the northeast of the study area.

[3] Approximation from the Office of National Statistics 2001 Census

2.2 Hydrology

This section will briefly describe the hydrological arrangement and interactions between the main rivers within the catchment. It will then highlight the key issues followed by the current strategies that are in place to help with the hydrological regime.

2.2.1 Rivers

There are six main rivers within the study catchment that fall within the Environment Agency's Thames Region; the Lee, Mimram, Beane, Rib, Ash and Stort.

The River Purwell/ Hiz and Pix Brook, in the Environment Agency's Anglian region, flow to the northwest of the study area.

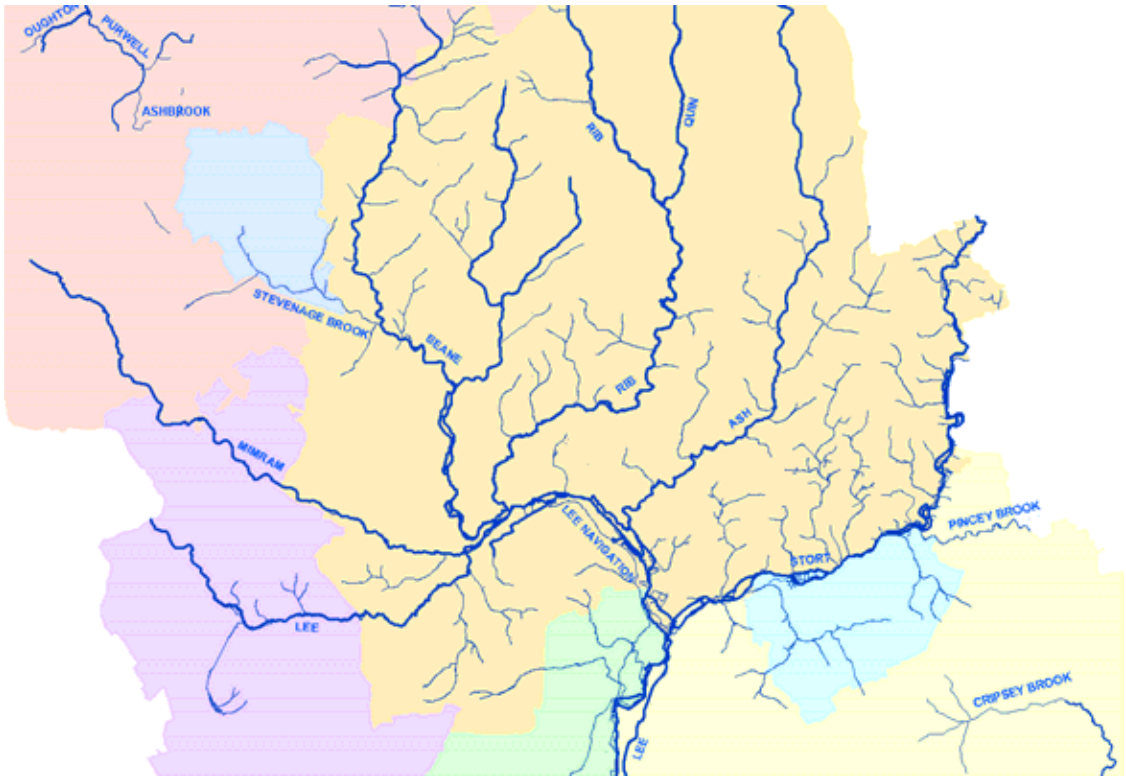


Figure 2-3 Main Rivers in Study Area

The ***River Lee***[4] is 42 miles long and travels from its source near Luton to its confluence with the Thames. As it passes through the catchment the characteristics change from being a largely unmodified channel supporting excellent bank-side habitat with wide areas of marsh and wet grassland, to becoming more constrained within the urban fabric of the town with canal interactions and locks. From Hertford to its confluence with the Thames at Bow Creek the main channel of the river Lee is split between the River Lee Navigation (with water levels and associated structures controlled by British Waterways) and the old course of the river. This reach also includes the convergence of four of the five major tributaries of the Upper Lee (Ash, Beane, Mimram and Rib), resulting in a section of major flow accretion with a minimum of 25 Ml/d even in times of drought.

[4] Information from the Upper Lee Catchment Abstraction Management Strategy (CAMS), Environment Agency, 2006

The Lower Lee **Flood Risk Management Strategy** is being developed to set out a detailed strategy to manage flooding within the Lower Lee and to prioritise actions for a more effective management approach within the area. It is currently under consultation and is likely to be finalised in 2009. There is also a Flood Risk Management Strategy being developed for Hertford due to the high risk of flooding in the town. This strategy is currently in the early stages of development and therefore at present the completion date is unknown.

Box 3: Flood Risk Management Strategies

The ***River Mimram*** is 12 miles long and represents one of the most pristine chalk rivers in the Upper Lee area. The river flows from the Chiltern Hills through a predominately grassland landscape to its confluence at Hertford with the River Lee. The upper part of the catchment is largely rural, with increasing urbanisation as it passes downstream. In the lower reaches, the river is impacted by manmade structures such as weirs and sluices, and drains an increasingly urbanised area.

The ***River Beane*** is a river of 11 miles in length that derives much of its flow from chalk aquifers, which form springs in several places along the length of the river. The river has a predominately natural character with low, often shallow banks and a clear moderate to fast flow over gravels. The River Beane is joined by the Stevenage Brook upstream of Watton-at-Stone. This increases peak flows in the Beane, caused by the urban runoff from Stevenage. The Stevenage Brook drains a highly urbanised catchment area (75%), therefore the town of Stevenage significantly influences the river system. Basic statistical analysis of the gauged data indicates a catchment dominated by peak flows rather than base flows as would be expected in such a catchment.

Low flows in the catchment rivers are currently being assessed under the Environment Agency **Restoring Sustainable Abstraction programme (RSAp)**. The programme has highlighted that water re-use should be pursued within the area, as water is currently abstracted from each of these river catchments and then discharged at sites downstream, outside of the catchment. The programme is also assessing the implications of abstractions on the flows in rivers. More information can be found in Appendix B.

Box 4: Restoring Sustainable Abstraction Programme

The ***River Rib*** and its main tributary, the *River Quinn*, retain a semi-natural appearance supporting a wide range of geomorphological features. The River Rib flows for 19 miles through a distinctively rural landscape of large arable fields interspersed with mature woodlands and hedgerows. The River Quinn, which has similar characteristics, joins the Rib downstream of Braughing. The upper reaches show winterbourne characteristics being prone to low flows and drying in prolonged dry periods. There are a number of wastewater treatment works discharging into the river, but water quality is still of GQA grade A (excellent quality). The WwTW discharges boost flows in the river and provide suitable conditions for salmonid fisheries.

The ***River Ash*** travels 16 miles from its source near Brent Pelham to its confluence with the River Lee at Stanstead Abbotts. The catchment of the River Ash is predominantly overlain by till drift deposits, which cause significant surface runoff. There is also a significant base flow as the riverbed is in continuity with the chalk below, and there are deposits of sand and gravel near to the river. The upper reaches of the Ash show winterbourne characteristics, drying for much of the year.

From its source in the Langley Hills, the ***River Stort*** travels for 24 miles through a number of urban areas such as Bishops Stortford and Harlow. From Bishops Stortford to its confluence with the River Lee, the Stort has been heavily modified to make it navigable, with water levels and structures controlled by British Waterways. Much of the River Stort catchment has been

heavily modified by urbanisation and agricultural improvement. Within the floodplain of the River Stort, agricultural improvements have been much less intensive. The restriction of modern practices has meant that the valley supports rich assemblages of habitats that make up one of the most intact areas of floodplain habitat in southeast England.

There are also a number of rivers on the periphery of the study catchment that lie within other river basin catchments.

To the northwest of Stevenage within the Bedford Ouse catchment of the Anglian region, the Ash Brook and the Ippollitts Brook converge near Hitchin to form the **River Purwell**. The Purwell then flows through Hitchin itself before joining the **River Hiz**. The Ash Brook, the closest of these to Stevenage, is a relatively short stream that is fed from a combination of groundwater, treated effluent and surface water.

To the south of Harlow flow a number of small brooks including the **Cripsey Brook** that converge and ultimately flow into the River Roding. These lie within the Roding, Beam and Ingrebourne catchment.

2.2.2 Hydrological Issues

A key hydrological issue that has been identified within the study area is the reduction in average **river base flows** that has been observed on certain rivers within the catchment including the Rivers Mimram, Beane, Rib, and Stort, and mid sections of the Rivers Lee and Hiz. Flows are thought to be reducing due to the amount of abstraction that is occurring within the catchment lowering the groundwater levels. A reduction in river flow has the potential to affect the balance of biodiversity within the river corridors as well as reducing the quantity of water available for abstraction from river fed groundwater sources. Currently, there are mitigation measures in place on the River Hiz where TVW and the EA supplement flows using water pumped from boreholes during periods of low flow.

Flood risk has also been identified as a key hydrological issue. There are a number of areas within the catchment that are at risk from flooding from rivers, such as the towns along the middle Lee, Watton-at-Stone and Sawbridgeworth. The town of Hertford is especially at risk as the Rivers Mimram, Beane and Rib all converge with the River Lee in the town centre. There is therefore a significant risk of flooding within the town, and a history of regular flood events.

The strategic flood risk policies for the majority of the catchment can be found in the Thames **Catchment Flood Management Plan (CFMP)**. The area to the north west of Stevenage is covered in a separate document, the Bedford Ouse CFMP which is currently in draft form. In summary, the management of the Upper Lee area should remain the same as at present; a range of actions are discussed within the CFMP to maintain flood risk at current levels. In contrast, in the Middle Lee more should be done to increase the frequency of local flooding, to reduce the risk of flooding downstream. Land where future flood storage could be implemented should be safeguarded through LDF planning policies. Detailed information from both CFMPs can be found in Appendix B, and will be discussed later in the report.

Box 5: Catchment Flood Management Plan

Strategic Flood Risk Assessments (SFRA) are also required to be undertaken within the catchment to assess the risk of flooding for new developments and to promote sustainable land use planning as required under Planning Policy Statement 25. Level 1 SFRAs have been completed for Broxbourne, North Herts, East Herts, Stevenage and Welwyn Hatfield councils. Harlow and Epping Forest are currently undertaking a sub-regional joint SFRA. Level 2 SFRAs may be required depending on the growth locations identified.

Box 6: Strategic Flood Risk Assessment

Downstream of Ware, the River Lee is joined by the River Ash at the Amwell Quarry SSSI and then the River Stort at the Rye Meads SSSI. These confluences have significant areas of flood risk as well as supporting some key areas of **wetland habitats**. These key sites are reliant upon constant water levels being maintained to provide habitats for the important species that are present. Any changes in water regime could affect the integrity of these sites. The specific characteristics of the sites are discussed later in this chapter.

2.3 Hydrogeology

2.3.1 Groundwater

The geology underlying the catchment contains a significant chalk aquifer, which is extensively used for water abstraction. Groundwater within the chalk feeds many of the rivers, streams and wetlands of the area. In the upper reaches of the Lee, Mimram and Beane winter rainfall percolates into the underlying chalk aquifer where it is stored. The chalk aquifer releases the stored groundwater slowly as base flow to these watercourses, attenuating the response of river flows to rainfall events.

Flow rates within the chalk aquifer vary from location to location due to the large number of fissures within the rock. This presents difficulty in modelling the groundwater flow using conventional methods, and increases the risk of contamination from polluted surface water entering boreholes and wells without being percolated through the rock matrix.

The majority of the abstractions from this aquifer are by the water supply company within the study area, Three Valleys Water (TVW), who serve over 3 million customers in the region north of London. The study area makes up a large proportion of TVW's Northern Water Resource Zone (WRZ). See Section 2.6.1 for more information regarding the WRZ in the study area.

A draft **Water Resource Management Plan (WRMP)** is currently being amended by Three Valleys Water and sets out the strategy for the company to ensure the sustained supply of potable water to their customers in the future. One of the future constraints that the company will face is the reduction in available water resources due to the effects of climate change. Through its strategy for delivering a reduction in demand, TVW has predicted that enough water will be available to meet the needs of its customer base in 2035 and beyond.
Caution has been used when analysing information from the WRMP as it is understood it is only a draft starting from 2010 onwards, and may be subject to change when the final plan is published in April 2009. The response to the draft WRMP by the Environment Agency was recently published[5] which shows areas where changes will need to be made.

Box 7: Draft Water Resource Management Plan

[5] Representation on Three Valleys Water's draft water resources management plan, EA, 2008

Initial Investigations under the aforementioned Restoring Sustainable Abstraction programme (RSAp) found that the Rivers Beane and Mimram specifically have been suffering from a history of low flows, primarily due to groundwater abstraction. A report was published identifying a number of possible alleviation schemes and recommended that further feasibility studies would be required to determine the best solution. Further studies have looked at various alleviation scenarios for both rivers, and the TVW are currently undertaking to drill test boreholes to see whether it is feasible to relocate these abstractions. The EA have also outlined concerns with moving these abstractions due to environmental degradation at downstream sites.

The Catchment Abstraction Management Strategy (CAMS) for the Upper Lee recognises that the development targets proposed by the RSS, particularly around Stevenage and Harlow, will place pressure on existing abstractions. Within the region of the Upper Lee CAMS, which includes the study catchment, Luton and Bishops Stortford, about 74% of the 380.82 Ml/d current licensed abstractions are for Public Water supply purposes. When looking at actual recent abstractions from the catchment, public water supply makes up approximately 95% of all abstractions. The distribution of these abstractions can be seen in Figure 2-4 below.

A **Catchment Abstraction Management Strategy (CAMS**) assesses the availability of both ground and surface water sources by looking at the environmental status of the rivers and aquifers in the catchment. The EA are continuously monitoring the CAMS process through five year cycles. During the first period of review, it is likely that steps will be taken in the future to restrict the allocation of abstraction licences where the resultant removal of water could have a negative impact on the environment. Unused licences are also likely to be reviewed and potentially removed following a period of consultation. Regular monitoring of abstractions will be maintained by issuing fixed period licenses, which are usually for 12 year periods.

Box 8: Catchment Abstraction Management Strategy

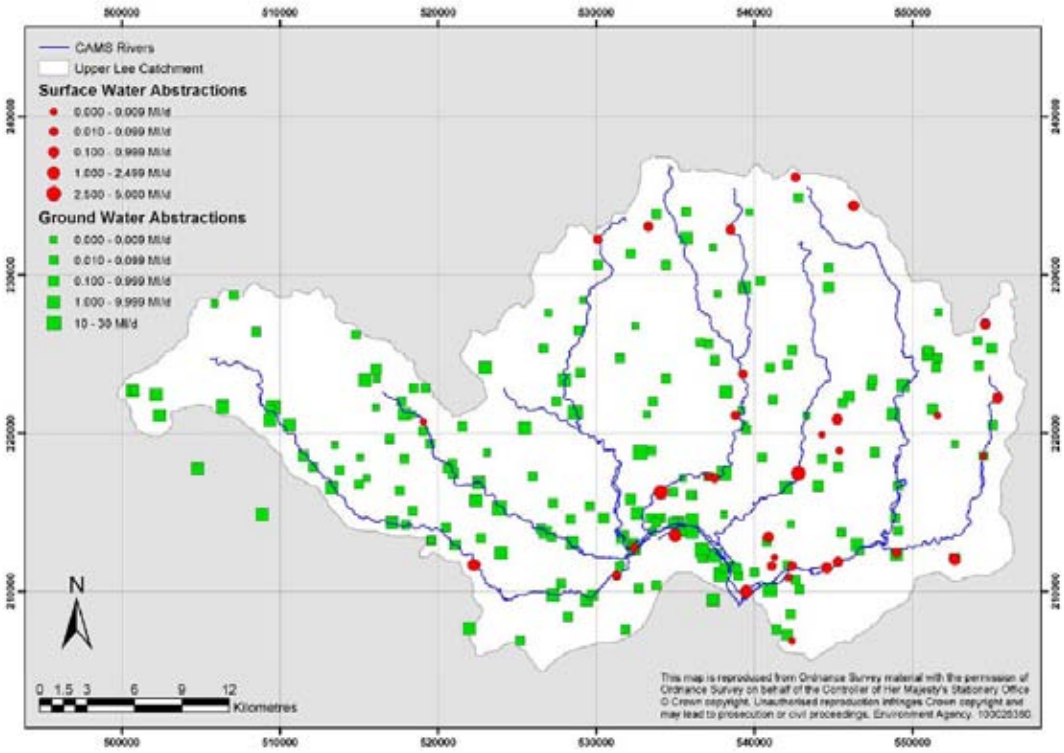


Figure 2-4 Abstractions in the Upper Lee catchment

(Upper Lee CAMS, Environment Agency 2006)

As the majority of current abstractions are for public water supply purposes, the water efficiency of both new and existing properties is becoming more important in order to reduce the amount of water required for abstraction. The CAMS for the Upper Lee suggests that the increase in demand may have to be met from outside the catchment, whilst emphasising water efficiency at every stage.

2.3.2 Groundwater Pollution Risks

The aquifer is predominantly unconfined and is therefore susceptible to groundwater contamination from the surface. Several locations have the potential to be affected by a number of different pollutants that would require additional water treatment to enable the source to remain in service for public supply. To prevent contamination from occurring, there are a number of source protection zones within the study area, which limit the allowable discharges to watercourses or land. These can be seen in Figure 2-5.

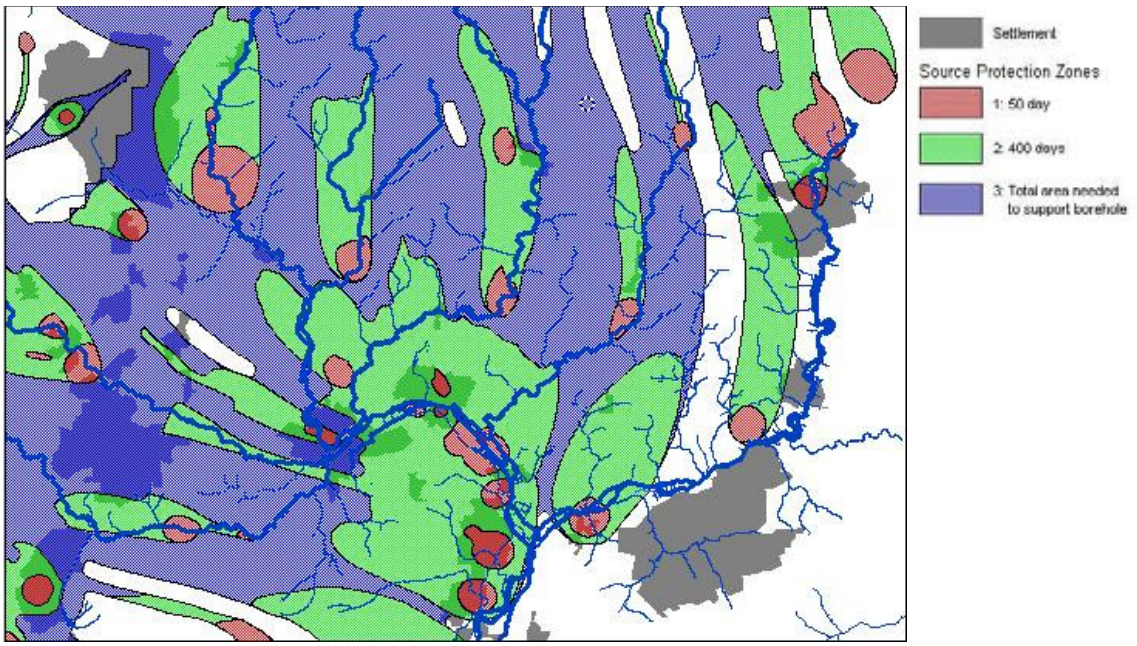


Figure 2-5 Source Protection Zones

The **Groundwater Directive**[6] aims to "*protect groundwater from pollution by controlling discharges and disposals of certain dangerous substances to groundwater*". This Directive is to be repealed by the Water Framework Directive[7] in 2013. New or amended regulations are expected before then to enact both the Water Framework Directive and its Daughter Directive on the protection of groundwater. This new Groundwater Directive is commonly referred to as the Groundwater Daughter Directive. The new Groundwater Directive[8] is designed to prevent and combat groundwater pollution.

Box 9: Groundwater Directive

The provisions of the Groundwater Directive include:

- A criteria for assessing the chemical status of groundwater;
- A criteria for identifying significant and sustained upward trends in groundwater pollution levels, and for defining starting points for reversing these trends; and
- Preventing and limiting indirect discharges (after percolation through soil or subsoil) of pollutants into groundwater.[9]

Unexpected pollution from any source is a threat that TVW constantly face and this has been allowed for in the headroom allowance for the draft WRMP. Such incidents can take between one and five years to overcome, resulting in a medium term loss of resource. In some cases,

[6] EC Groundwater Directive (80/68/EEC), 1980

[7] EC Water Framework Directive (2000/60/EC)

[8] EC Groundwater Directive (2006/118/EC)

[9] Europa, http://europa.eu/scadplus/leg/en/lvb/l28139.htm

the pollution may not be resolved within five years, which will lead to a longer term loss of resource.

In mid 2000, a Bromate contamination plume was discovered in the chalk aquifer, with the source believed to be from an area of contaminated land in Sandridge, Hertfordshire. The extent of the plume is believed to be close to 20 km in length from its source in Sandridge to the middle Lee Valley. Both Thames Water and Three Valleys Water have carried out extensive investigations that have highlighted the requirement for a better understanding of the groundwater/river interactions within the region, as it is currently unclear how the problem may develop in the future. The contamination has already impacted two TVW boreholes and several TWU boreholes in the area of the New River, close to Broxbourne. Mitigation measures have been implemented to ensure the quality of the water remains at a high standard.

2.4 Surface Water Quality

This section will describe the quality of the surface watercourses within the catchment, the current monitoring regime and forthcoming important changes in legislation.

Figure 2-6 A Lake in the Rye Meads Nature Reserve

2.4.1 Current Water Quality

The current method of assessing surface water quality in England and Wales is the General Quality Assessment (GQA), which is undertaken by the EA at monitoring stations, each of which represents the quality in a particular stretch of river. The GQA assesses the water quality of rivers and lakes against a number of parameters including Biological, Chemical, Aesthetic and Nutrient standards.

The GQA sampling programme also supports the River Quality Objectives (RQO) programme, whereby compliance with a River Ecosystem (RE) target is assessed. RE targets represent the water quality standards required for a watercourse to support a certain use, such as recreation, fisheries or abstraction.

Figure 2-7 below illustrates the compliance of the watercourses in the study area with their respective RE targets in 2006.

More information on GQA, RQO and RE targets is presented in Appendix C

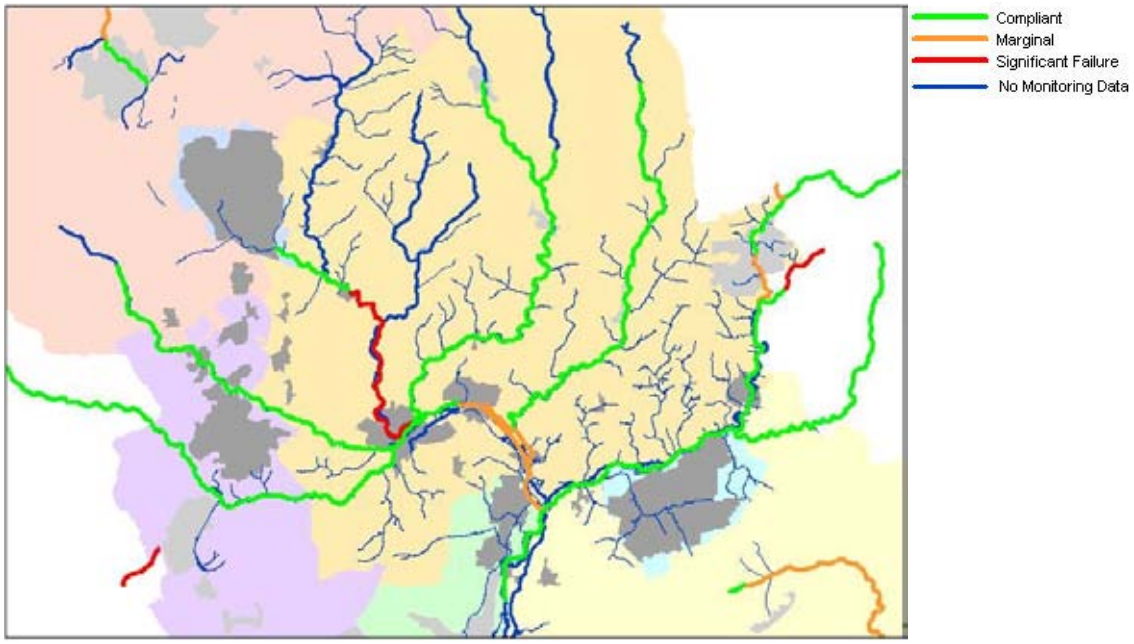


Figure 2-7 2006 Compliance of rivers with RE targets

Based on Environment Agency GQA/ RQO water quality data for the 2004-2006 monitoring period, the key areas that show reason for concern are:

- The ***River Beane*** section from Watton-at-Stone to Lee, which shows significant failure against its RE2 target, due to a lack of dissolved oxygen. During this period, river flows were low and recent monitoring has shown that this has returned to 'good' levels within this stretch;
- The ***River Lee*** from Ware Lock to Stort was reported to be showing marginal compliance against an RE2 target, as well as the Lee Navigation between Ware and the confluence with the Lee downstream;
- The ***Cripsey Brook*** from Delved Bridge to the River Roding was shown as having marginal quality against an RE3 target. This section of the watercourse is draining away from the study area to the south east of Harlow, and therefore unlikely to significantly impact development. However, an assessment of the mitigation and improvements required would be needed should this area be proposed for development in the future.
- The ***River Hiz*** in the Anglian region is also only marginally complying with its RE3 target, downstream of Hitchin.

2.4.2 Nutrients

Discharges from WwTW and industry, and surface water runoff (in particular from rural areas) can lead to nutrient enrichment, or eutrophication, of the receiving watercourses. High levels of nutrients such as phosphorous or nitrates can encourage excessive algal growth. This can adversely affect the biodiversity of the watercourse, particularly as it decreases the oxygen levels in the water that other life forms depend upon.

Nutrient levels are recorded as part of the GQA, but are not included within the RQO, as effects of these nutrients on the ecology of a river differ between watercourses.

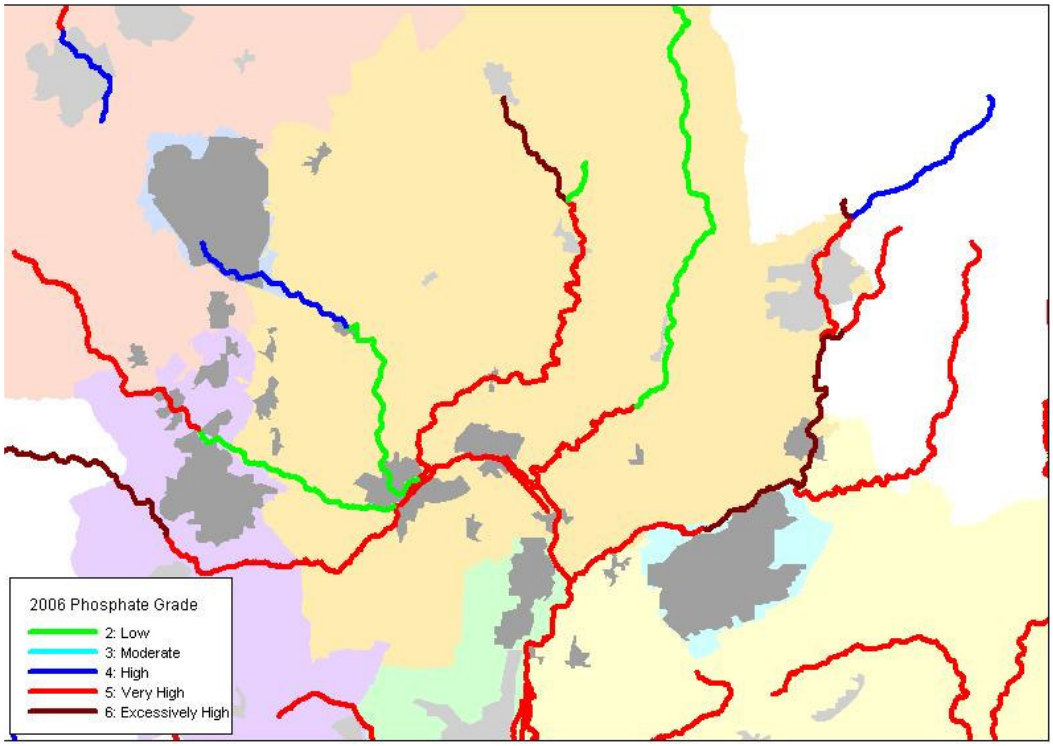


Figure 2-8 2006 GQA Phosphate Grade of rivers in study area

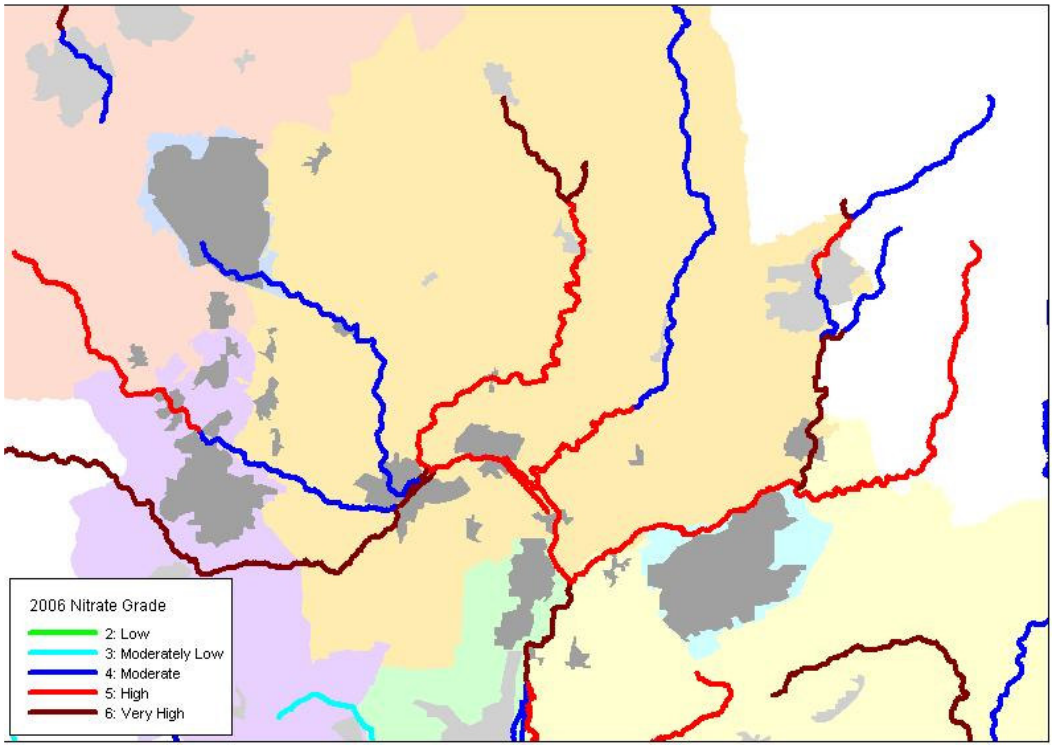


Figure 2-9 2006 GQA Nitrate Grade of rivers in study area

2.4.3 Water Framework Directive

The GQA/ RQO are currently being superseded by the standards of the Water Framework Directive, which also takes into account morphological and ecological aspects of water quality. The main objective of the WFD is to bring all water bodies up to 'good status' by 2015. The actual parameters for the assessment of a river have been set by the UK Technical Advisory Group (UK TAG)[10]. A requirement of the WFD is that a no deterioration policy is adopted for the WFD parameters, which could have potential implications for future developments.

Water quality has always been an important consideration; however, more stringent standards on river quality (and hence discharges into rivers) than present are likely to be applied by the EA, as the Water Framework Directive (WFD) is gradually implemented at a local level.

The European **Water Framework Directive (WFD)** sets out a strategy for protecting and enhancing the quality of groundwater, rivers, lakes, estuaries and coasts. It introduces the integrated approach to river basin management that the EA is currently applying to the 11 River Basin Districts in England and Wales; identifying and characterising water bodies and protected areas in each district, and the pressures and risks upon them. The risk assessments themselves are used to show the risk that a water body could fail to meet 'good status' by 2015, a key aim of the directive.

Box 10: Water Framework Directive

A number of the watercourses in the catchment have initially been classified as being Heavily Modified under the WFD. This means that the channel has undergone significant morphological changes and therefore has different water quality requirements. The requirement for Heavily Modified Water Bodies (HMWB) is to reach good ecological potential (GEP) as opposed to 'good status'.

The classification of water bodies, and the assessment of current compliance with the WFD, is being assessed though River Basin Management Plans. The study area falls within the Thames and Bedford Ouse RBMP catchments.

River Basin Management Plans (RBMP) have been developed by the various areas of the Environment Agency and are being consulted on from December 2008 until June 2009, with the aim of publishing final plans in December 2009. The RBMPs will set out a strategy, including a Programme of Measures, for each catchment to comply with the requirements of the WFD. An assessment of the current status of the rivers will be made, showing the rivers and lakes that currently fall below the 'good' status required to meet the WFD. The documents will then set out those rivers that should be at 'good' status by 2015 with the remainder being at 'good' status by 2027.

Box 11: River Basin Management Plans

The methodology of assessing the status of a watercourse, and contributing factors, is shown below in Figure 2-10.

[10] UK Environmental Standards and Conditions, UK Technical Advisory Group, April 2008

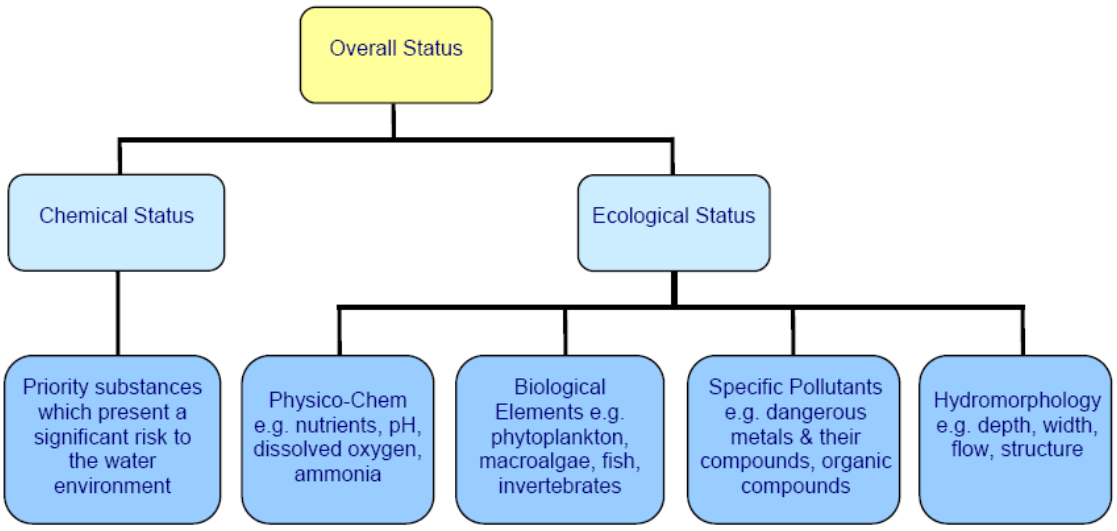


Figure 2-10 Components of WFD surface water status

(Environment Agency Draft River Basin Management Plan, Thames River Basin District December 2008)

Surface water status, and ecological status, is assessed on a scale from high to bad, shown below in Table 2-1. Concentrations of individual priority substances and other chemicals deemed dangerous by the EU are classed as either good, or failing to meet good. Water bodies are classified based on the lowest ranked component.

Ecological Status	Chemical Status Grades
High	Good
Good	
Moderate	Fail
Poor	
Bad	

Table 2-1 WFD classification of surface water status

More information regarding the classification of surface water under the WFD is displayed in Appendix C.

Key dates for the implementation of the WFD and RBMPs are:

- 2008: Draft River Basin Management Plans for each river basin district completed;
- 2009: Final River Basin Management Plans completed following consultation;
- 2012: Programs of measures for improvements to be fully operational;
- 2015: Achieve the first set of water body objectives, publish second RBMP;
- 2021: Achieve the second set of water body objectives, publish third RBMP;
- 2027: Achieve the third set of water body objectives, final deadline for achieving objectives.

However, if it is determined that the solutions required to bring a watercourse up to good status by 2015 are either technically infeasible or disproportionately costly, lower objectives can be set for the short term, with 2027 being the latest date at which the objectives should be met.

Under the WFD, there is also a provision for good status to not be met for reasons of overriding public interest.

The current status of the watercourses in the study area, regarding compliance with WFD good status is described in Table 2-2 and Table 2-3 below.

River	Reach	Current Ecological Status (or EP in the case of HMWB)	Current Chemical Status	Barriers to Good status (or GEP for HMWB)	Proposed Date for Achieving Good status (or GEP)
Ash	Bury Green Brook to Lee	Poor	Not Yet Assessed	Fish population: Poor Flow may not yet support good status	2027
Beane	Roe Green to Stevenage Brook	Moderate	Not Yet Assessed	Invertebrate population: Moderate Flow may not yet support good status	2027
Beane	Stevenage Brook to Lee (HMWB)	Moderate	Not Yet Assessed	Fish population: Bad Flow may not yet support good status	2027
Lee	At Hertford (HMWB)	Moderate	Not Yet Assessed	Fish population : Bad Phosphate: Poor Flow may not yet support good status	Ensure flow supports good status by 2015, achieve GEP by 2027
Lee	Luton to Hertford (HMWB)	Moderate	Not Yet Assessed	Phosphate: Poor Flow may not yet support good status	Ensure flow supports good status by 2015, achieve GEP by 2027
Lee (Navigation)	Hertford and Ware	Moderate	Not Good	Phosphate: Poor Flow: not good Benzo perelyene and indeno pyrene: Moderate	2027
Mimram	Welwyn to Lee	Bad	Good	Fish population: Bad Flow may not yet support good status	2027
Rib	Quin to Lee Navigation	Poor	Not Yet Assessed	Fish population: Poor Phosphate: Poor Flow may not yet support good status	2027
Stevenage Brook	N/A	Moderate	Not Yet Assessed	Phosphate: Moderate Flow may not yet support good status	2027
Stort (Navigation)	Sawbridgeworth Lock	Moderate	Not Good	Phosphate: Bad Tributyltin Compounds: Moderate	Ensure flow supports good status by 2015, achieve good status by 2027

Table 2-2 WFD status of study area watercourses in Thames region

(Thames RBMP: Appendix B, Environment Agency 2008)

River	Reach	Current Ecological Status (or GEP in the case of HMWB)	Current Chemical Status	Barriers to Good status (or GEP for HMWB)	Proposed Date for Achieving Good status (or GEP)
Hiz	Charlton PH to Purwell (HMWB)	Moderate	Not Yet Assessed	Phosphate: Poor Hydromorphological factors affecting GEP	2027
Hiz	Purwell to Ivel (HMWB)	Moderate	Good	Phosphate: Poor Invertebrate population: Poor Fish Population: Moderate Hydromorphological factors affecting GEP	2027
Pix Brook (HMWB)	N/A	Not Yet Assessed	Not Good	Flow may not yet support good status Nickel: Moderate Phosphate: Poor Invertebrate population: Moderate	Ensure flow supports good status by 2015, Achieve GEP by 2027
Purwell (HMWB)	N/A	Moderate	Not Yet Assessed	Phosphate: Poor Flow may not yet support good status Hydromorphological factors affecting GEP	Phosphate to reach good status by 2015, ensure flow supports good status by 2015, achieve GEP by 2027

Table 2-3 WFD status of study area watercourses in Anglian region

(Anglian RBMP: Appendix B, Environment Agency 2008)

With the exception of the Beane, Mimram and Ash, all the watercourses in the study area will currently fail to meet WFD good status due to high levels of phosphate (although it must be noted that the three rivers mentioned currently receive minimal discharges from WwTWs). This highlights the need to work towards catchment wide solutions. The majority of watercourses also display low flows, which is also detrimental to the ecology.

Of particular importance will be dealing with pollution of watercourses from sources other than WwTW discharges. Policies and practices must also be developed to deal with diffuse pollution from urban and rural surface runoff. Ensuring that all new development includes features such as SUDS to attenuate (and possibly treat) such runoff can help to improve water quality by preventing pollutants being transported from highways, hard standing and farmland into rivers.

Whilst the EA is the 'competent body' tasked with carrying out the WFD in England and Wales, other stakeholders will have an important part to play. The Programmes of Measures included in the RBMPs (currently up for consultation) will be integrated solutions requiring input and action from Natural England, the water companies, Local Authorities and developers.

Liaison panels have been setup within each of the River Basin areas, and include representatives from water companies, agriculture and industry, and non-government organisations amongst others.

2.5 Environment and Conservation

This section will introduce the environmental elements to this Water Cycle Strategy. It will firstly set out the Habitats and Species that are protected within the study catchment as part of the Habitats Directive and UK Biodiversity Action Plan schemes. The section will refer to the current initiatives and strategies that are in place to enforce and monitor the environment.

2.5.1 Designated Sites

There are a number of sites within the catchment that have been designated under the Habitats Directive as being of either Local, National or International importance.

> The aim the **EU Habitats Directive** is to "contribute towards ensuring the future of biodiversity through the conservation of natural habitats and of wild fauna and flora by maintaining or restoring to favourable conservation status, the natural habitats and species of wild fauna and flora of national interest" [11]. Sites that are designated under the Habitats Directive are legally protected and therefore fall under strict requirements for any local developments or changes. In order to develop close to a designated site, an Appropriate Assessment is required to be carried out to ensure all possible alternatives have been considered and that the impact on the site will be minimal.

Box 12: EU Habitats Directive

Key designated Sites of Special Scientific Interest within the catchment are Rye Meads SSSI, Amwell Quarry SSSI, Hunsdon Meads SSSI and Tewinbury SSSI. The current condition of these and other relevant sites can be found in below in Table 2-4.

[11] EU Habitats Directive (92/43/EEC)

SSSI Name (Water Dependant)	Associated River	Condition	Potential Adverse Impact
Amwell Quarry	Lee	Favourable	Change of water levels Water quality
Cornmill Stream and old River Lee	Lee	Favourable	Change of water levels Water quality
Hunsdon Mead	Stort	South Unit = unfavourable but recovering North Unit = unfavourable	Change of water levels Pollution from agriculture and surface runoff Water quality
Rye Meads	Stort/Lee	Fen = favourable Open water = unfavourable but recovering	Backing up of Toll House Stream WwTW and Nature Reserve have degree of co-dependency
Tewinbury	Mimram	Unfavourable but recovering	Change of water levels Water quality
Turnford and Cheshunt Pits	Lee	Standing water and open canals = favourable	Change of water levels Water quality
Waltham Abbey	Lee	Unfavourable recovering	Change of water levels Water quality
Non Water Dependant SSSI			
Harlow Woods	None (Harlow)	Unfavourable condition with more than half declining	Human intervention due to proximity to Harlow

Table 2-4 Key SSSI in Study Area

One of the most important of these sites is the **Rye Meads Nature Reserve**, which lies to the north of the Rye Meads WwTW. It is managed by the Hertfordshire and Middlesex Wildlife Trust (HMWT) and consists of the Rye Meads RSPB reserve and various wildlife sites. It is of international importance as it is a notified SSSI, and lies within the Lee Valley Park Special Protection Area. A management plan for the period 2008-2013 has been produced by HMWT[12]. It documents the strategy for the control and maintenance of the nature reserve to ensure the longevity and environmental integrity of the site. The Rye Meads Nature Reserve supports a diversity of habitats including flood meadow, reed bed, tall fen, willow carr/ scrub and open water. Recent surveys identify at least 150 species of birds, more than 20 species of mammals, three species of amphibians and more than 500 species of invertebrates.

[12] Rye Meads Management Plan 2008-2013, Hertfordshire and Middlesex Wildlife Trust 2006

Figure 2-11 Natural habitat management at the Rye Meads SSSI

The Lee Valley SPA (and Ramsar site) consists of Amwell Quarry SSSI, Rye Meads SSSI, Turnford and Cheshunt Pits SSSI and Walthamstow Reservoirs SSSI (although the latter is outside the study area). These wetland sites are of international importance to birds, and are protected under the European Community Directive on Wild Birds and the Ramsar convention, as well as being established as protected areas under the Water Framework Directive. The potential detriment in water quality and changes in water level, arising from the proposed development, must be carefully mitigated against to ensure these sites are not adversely affected.

2.5.2 Biodiversity Action Plans

As well as the above mentioned designated sites, locally and nationally important species and habitats are identified through the **UK Biodiversity Action Plan** programme. Key habitats within the UK plan include Chalk Rivers, Reed beds and Ancient Woodlands – with key species including Otters, Water Voles and Bitterns. Around the country, a number of Local Biodiversity Action Plans have also been developed in conjunction with the national action plan in order to protect and improve locally identified habitats and species. The UK BAP Partnership is currently undergoing its 2008 Reporting Round where data will be used with other indicators to show how the UK has progressed towards the 2010 targets. The reports of this stage are due to be released in early 2009.

Within the Rye Meads WCS catchment, two **Local Biodiversity Action Plans (LBAPs)** have been developed. A LBAP for the whole of Hertfordshire[13] was developed between 1995 and 1996 and finally published in 1998. It covers the majority of the Rye Meads WwTW catchment and includes species such as the Great Crested Newt, Bittern, Otter and Water Vole. The Habitats that have also been included in the action plan include Species Rich Hedgerows, Cereal Field Margins, Chalk Rivers and Urban Areas. The Biodiversity Action Plan for the Lee Valley Regional Park[14] covers the lower end of the catchment past the Rye Meads WwTW. It was launched in 2000 and contains similar actions for the enhancement of the environment.

Box 13: Local Biodiversity Action Plans

The **Hertfordshire Biodiversity Action Plan** sets out targets for specific species and habitats. The most relevant habitat that is considered is wetlands – specifically Chalk Rivers and Reed Beds. The targets for the improvement of the county's wetlands can be seen in Table 2-5 below.

Target	Description
WE/T/1	To minimise damage to wetland Wildlife Sites by development
WE/T/2A	95% of the area of wetland SSSIs in favourable conservation status by 2010
WE/T/2B	50% of wetland Wildlife Sites in favourable conservation status by 2008
WE/T/3A	Restore 5 km of chalk rivers and 30 ha of reed bed by 2010
WE/T/3B	Restore/create five ponds and 1 km of ditches annually
WE/T/4A	Hold ten public events and a training workshop annually
WE/T/4B	Provide access to five large wetlands, with interpretation

Table 2-5 Wetland targets for Hertfordshire

These targets provide opportunities to integrate the requirements of biodiversity with possible mitigation measure. These options will be discussed further later in this report.

The presence of **Water Voles** around the catchment is widespread. There are a number of focus areas for the latest (2000-2007) records from the Hertfordshire Biological Records Centre. These key focus areas are in the Lee Valley Park, the River Mimram, the River Purwell and the River Oughton. Other areas where sightings have recently been reported include Watton-at-Stone, Hertford and the Stevenage Brook.

The Hertfordshire LBAP contains a species action plan for Water Voles, which highlights the major factors that affect the population numbers of Water Voles. It states that, *"Water Voles are relatively tolerant of low water quality but the full impacts of differing types of pollution such as biocides are unknown. Low flows and droughts such as those caused by over-abstraction of groundwater can lead to the loss of Water Voles from the stretches of watercourses affected. Conversely, high flows, flashy rivers and prolonged flooding can also be detrimental."* It also states that Water Voles are affected by the disturbance and fragmentation of their habitats and predation by Mink.

[13] A 50 Year Vision for the Wildlife and Natural Habitats of Hertfordshire, Hertfordshire Middlesex Wildlife Trust, 1998 (Updated 2006)

[14] A Biodiversity Action Plan for the Lee valley Regional Park, Lee Valley Regional Park Authority 2000

The Wetlands for Water Voles and People Project was launched in January 2008 and aims to provide people with a better understanding of water voles as well as surveying and monitoring key water vole sites. The five sites highlighted as being 'wetland havens' for water voles are:

- Purwell Ninesprings Nature Reserve in the Purwell Valley near Hitchin;
- Tewinbury Nature Reserve in the Mimram Valley near Welwyn Garden City;
- Silvermeade in the Lee Valley near Broxbourne;
- Frogmore Meadows Nature Reserve in the Chess Valley near Sarrat; and
- Cassiobury Park Nature Reserve in the Colne Valley in Watford.

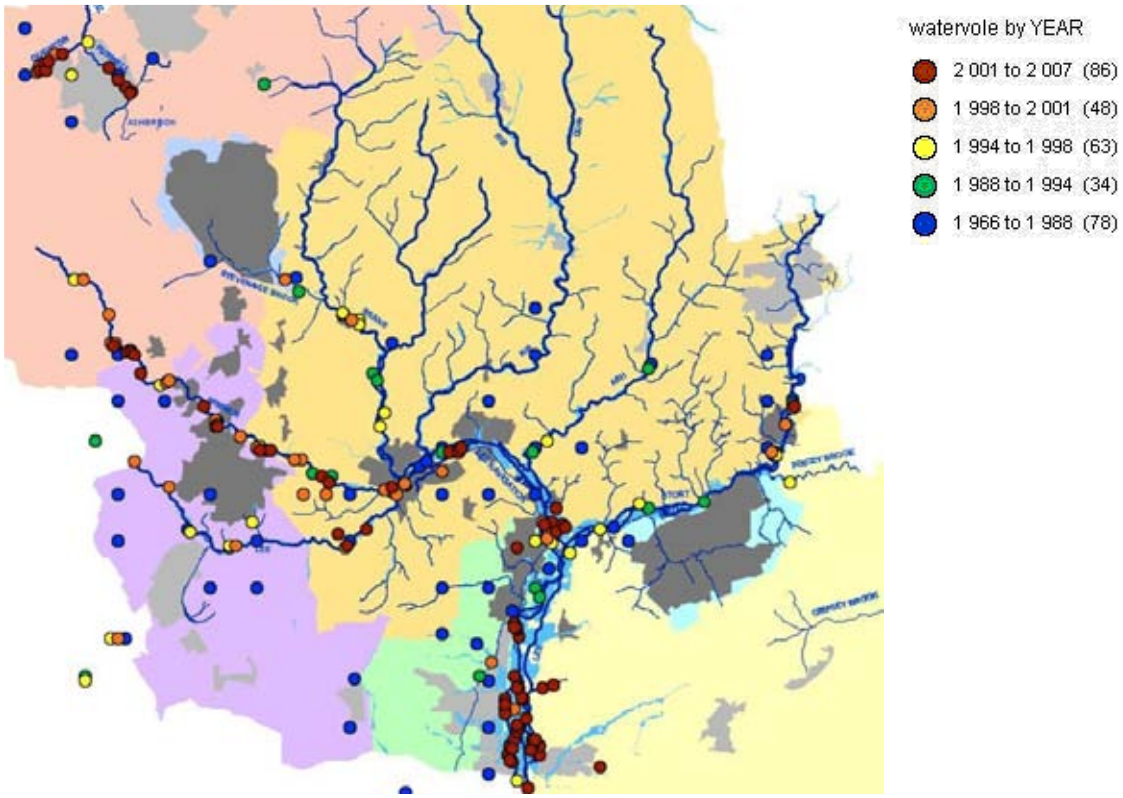


Figure 2-12 Water Vole sighting distribution

Of these five sites, three are located directly within, or close to, the study area of the WCS and will require further analysis.

River water dropwort was first recognised as a distinct species in Hertfordshire, and the county contains some of the most important locations in the UK for this plant. River water dropwort can be currently found in:

- The lower River Ash;
- The lower River Beane; and
- Most significantly, in the New River between the Lee and Waltham Abbey.

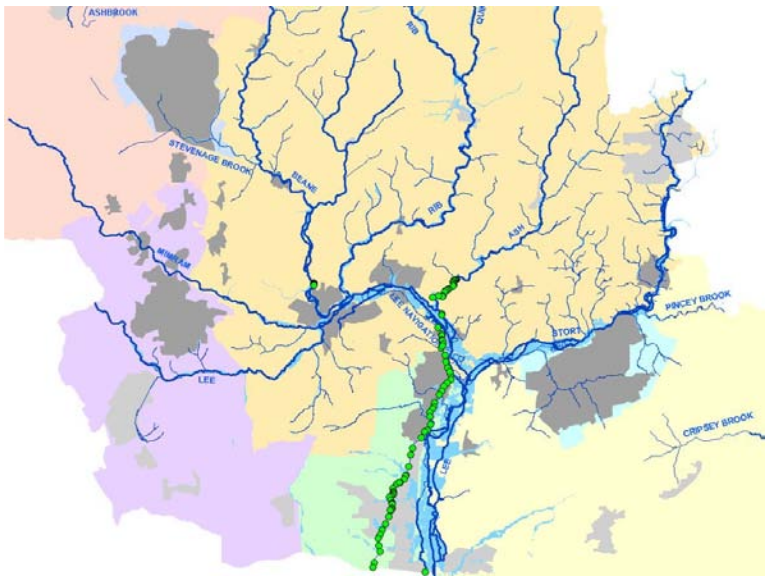


Figure 2-13 Extents of River Water Dropwort in the catchment

Factors that are affecting the current distribution include:

- River management and maintenance;
- Water quality; and
- River flows.

The effects of the various options for the treatment of wastewater within the catchment will need to take account of the areas where river water dropwort is prevalent, to retain the current population and aim to help increase the current coverage.

Great Crested Newts are found in a selection of locations throughout the catchment but the population has been steadily reducing in recent years. The location of most relevance is the population at Frogmore Pit, which lies close to the confluence of the River Beane and the Stevenage Brook. The factors that have lead to the decline of Great Crested newts include:

- Loss of habitat;
- Pond management;
- Fragmentation of ponds; and
- Pollution of ponds from road and urban runoff.

Other LBAP in the vicinity of the study include the Essex BAP (incorporating the upper reaches of the river Stort, and the authorities of Harlow and Epping Forest) and the Lee Valley Regional Park BAP, which translates targets from the Hertfordshire, Essex and London LBAPs to a local level for the Lee Valley Regional Park.

Local Authorities should consult these BAPs to ensure that opportunities to conserve and enhance biodiversity are incorporated throughout the planning process.

2.5.3 River Restoration Projects

A number of river restoration projects have been carried out within the study catchment and are documented by the River Restoration Centre. The distribution of these projects can be seen in Figure 2-14 below.

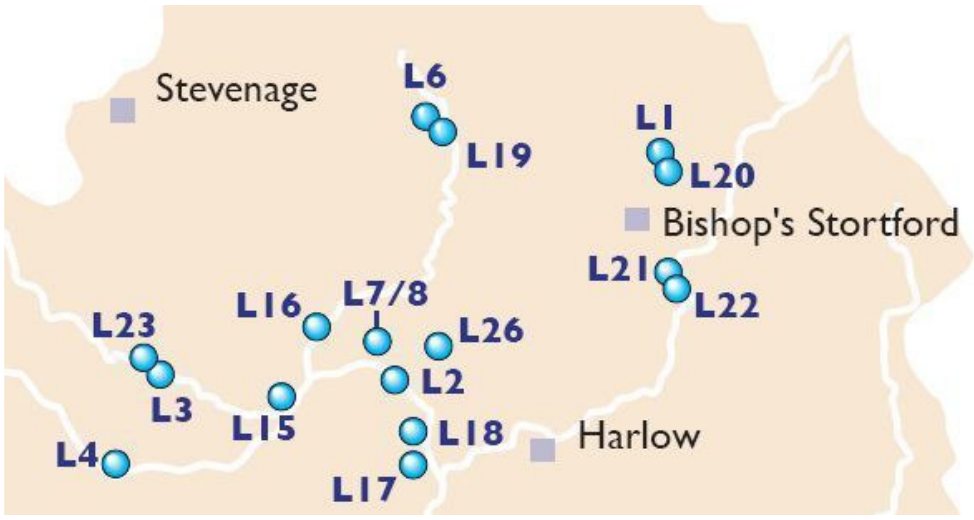


Figure 2-14 River Restoration Projects in the Study Area

Key to sites (* within the study catchment)

L1 River Stort Navigation Research Project (Stort)

***L2** Amwell Magna Channel Improvements (Lee)

***L3** Archers Green Enhancement (Mimram)

***L4** Bank Stabilisation at Hatfield Broadwater (Lee)

L6 Braughing Bridge Enhancement (Quin)

***L7** Enhancement at Amwell Loop, Ware - Phase 1(Lee)

***L8** Enhancement at Amwell Loop, Ware - Phase II(Lee)

***L15** Otter Planting, Bengeo (Beane)

***L16** Otter Planting, Ware Park (Rib)

***L17** Reedbed Creation, Rye House Quay (Lee)

***L18** Reedbed Enhancement Project- Bittern Sanctuary Phase I (Lee)

L19 Rib Phase 2 (Rib)

L20 Stort Riverside Revival (Stort)

L21 Thorley Flood Pond - Maintenance of SSSI (Stort)

L22 Water Level Control (Little Hallingbury Marsh)

***L23** Weir Removal/Wetland Management at Tewinbury SSSI (Mimram)

***L26** River Ash, Wild trout Trust (Ash)

Habitat restoration projects (www.therrc.co.uk)

Recently, a weir has been upgraded on the River Lee at Hartham Common in Hertford. The old structure was constructed in the 1970s, marking the location of the main sewer from Stevenage to Rye Meads WwTW as it crossed the River Lee. The old weir was showing signs of age and was beginning to expose the sewer due to erosion of the concrete and risked cracking of the pipe itself. The sewer is now buried beneath a gravel bed to ensure that there is no longer a risk of it being exposed. The new weir was also designed to help fish populations within the river by allowing them to pass up the stepped structure, which they could previously not do due to the height of the old weir. This new structure is also benefiting the local canoe club by giving them a new and interesting structure to practice white water kayaking on.

In late November 2008, another new weir was completed on the River Lee, further downstream at Amwell near Ware, to help to manage the water levels in the gravel pit lakes in the Amwell Quarry Nature Reserve. Both of these projects have shown that both the Environment Agency and local wildlife groups are **actively working to improve the quality of the habitats** within the region to improve the overall biodiversity of the regions waterways.

It has recently been perceived that fish numbers throughout the Lee Navigation have declined, because of poor fish habitat and predation of fish by cormorants. To remedy this, a series of floating marginal reed rafts were installed at a central location along the navigation between 2002 and 2004. The Lee Valley Fisheries Action Plan (Lee FAP) steering group, consisting of partners from British Waterways, the Environment Agency, Thames Water, and local angling groups initiated this project. The fish refuges cover 1.5 km of river, incorporate an anti-predator screen to help protect fish from cormorants, and were planted with native emergent plants with dense submerged roots providing fish with food and cover. This process can be adopted in suitable locations in order to mitigate against the impacts that increased flows have on the wildlife within river channels.

When looking into potential options and the capacity of the catchment, all of these limiting factors will be taken into account to ensure the appropriate integration of aspirations for the catchment is maintained.

2.6 Infrastructure

This section will introduce the key water infrastructure within the catchment and identify the water companies that are responsible for the management and implementation of this infrastructure. It will also refer to a number of strategies that are in place.

2.6.1 Potable Water Supply

The EA are currently developing a new Water Resource Strategy: **Water for People and the Environment**, following a consultation stage during 2007[15]. The strategy sets out some preliminary guidelines for the policy of water supply for the region. Due to the specific pressures within the WCS region, future housing development should go further than Sustainable Homes Code Level 1. Additional information regarding the EA strategy is included in Appendix B.

Box 14: Water for People and the Environment

Three Valleys Water

The majority of the population in the study area, with the exception of Broxbourne, southern areas of Epping Forest and a small area of East Herts are supplied with potable water by TVW, as shown in Figure 2-15. This supply is from a combination of 21 local groundwater sources within the TVW region, as well as both surface and groundwater sources outside the catchment.

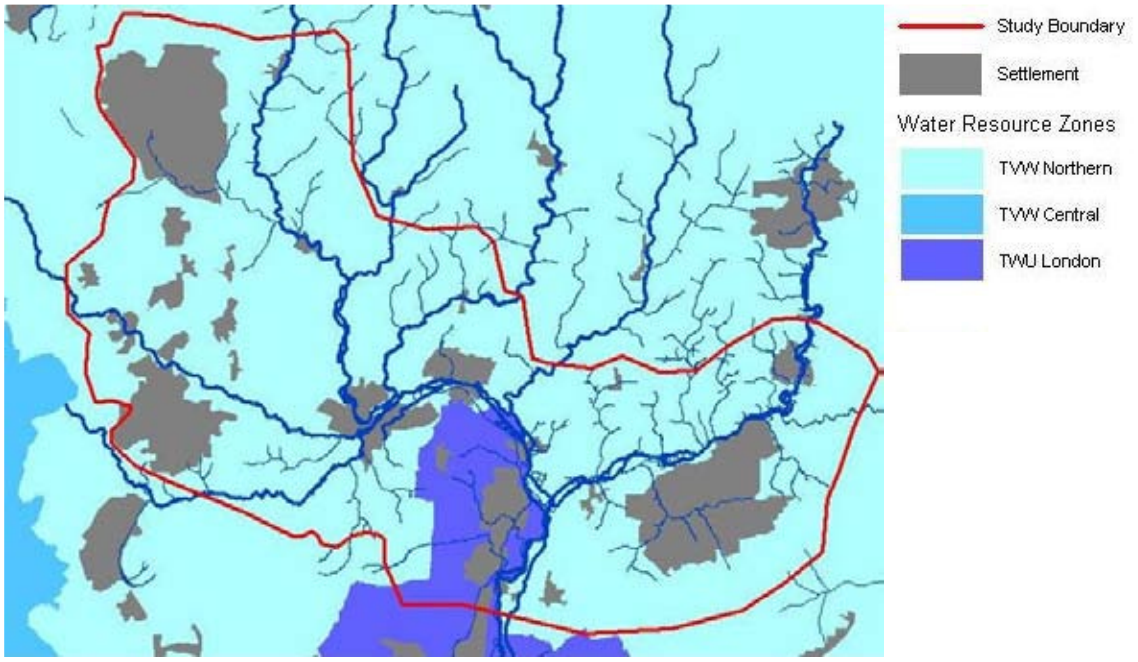


Figure 2-15 Water Resource Zones (WRZ) covering Study Area

A large proportion of the surface water for the study area is imported from the AWS Ruthamford Water Resource Zone, and is fed through the TVW trunk main system, via three service reservoirs as shown below.

[15] Water for People and Environment, Environment Agency, 2008

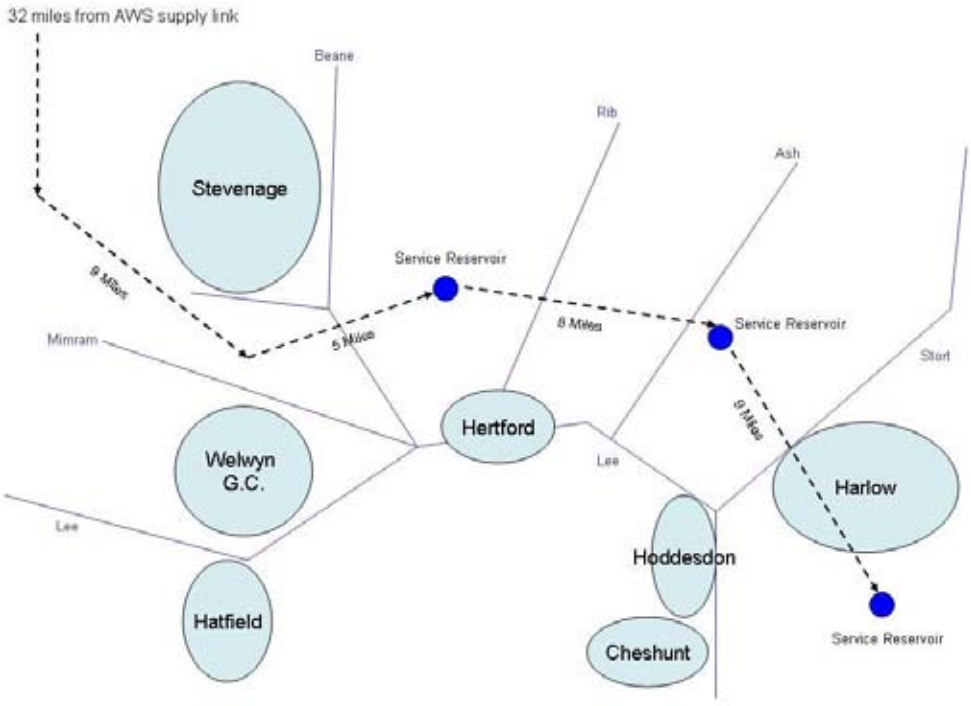


Figure 2-16 Water Supply Schematic

The volumes of water supplied from each of the sources, both within and outside the area, vary with time, serviceability and demand. The current demand is generally around 90 Ml/d for the study area. This is predominantly met by groundwater during normal demand periods (66%), and supplemented by additional imports during peak demand periods.

The imported water from the AWS Ruthamford WRZ is a treated supply arrangement governed by the Great Ouse Water Act (1961) and currently has no restrictions imposed on it relating to drought or climate change. The TVW draft WRMP assumes that the full entitlement, amounting to 91 Ml/d at average and 109 Ml/d at peak, of the allowance in the Act will be available to be imported. This transfer was subject to a judicial review in 1999, which concluded that TVW average, and peak entitlements were not at risk.

The AWS Final Business Plan (April 2009) states that the assessment of Water Available for Use (WAFU) is net of bulk imports and exports. Therefore, the demand management and resource development options, planned by AWS in the Ruthamford WRZ in the medium to long term (2015–2020 and beyond), will take account of this bulk export to TVW. The loss of the bulk transfer is therefore not a significant risk to supply in the Rye Meads study area.

Investment in the TVW distribution network over the previous and current AMP periods has made it more robust and flexible and it is usually possible to cover the loss of one source by moving water from other parts of the network, where there is a surplus of supply over demand.

Asset Management Periods (AMP) are five yearly cycles that look at the improvement and upgrade works required for water company assets. The current AMP period is AMP 4 (2005-2010) and the water companies are in the final process of preparing their programme and capital expenditure plan for the next period, AMP 5 (2010-2015). Due to commercial considerations, water companies are generally reluctant to disclose their plans to external parties until the necessary financial approvals are received from Ofwat. The availability of funds, and the prices that can be set by each water company, are assessed by Ofwat during the Price Review (PR) process. PR09 is currently being finalised and, once approved by Ofwat, will set the amount that water companies can charge for water and wastewater services for AMP 5, in order to fund the operation, maintenance and upgrade of assets.

Box 15: Asset Management Plans

The TVW draft WRMP adopts a "twin track approach" to the future management of water by increasing supply as well as reducing demand. One key infrastructure related component of water demand is the amount of water lost through leakage. TVW have stressed that they will continue to make improvements in reducing the amount of water lost through both reactive and proactive leak detection mechanisms. There will also be additional environmental pressures from more stringent legislation such as the Water Framework Directive.

Thames Water Utilities (TWU)

Broxbourne and some southern areas of Epping Forest and East Herts lie within the TWU London Resource Zone. The TWU draft WRMP predicts that the London resource zone will have a baseline supply demand deficit of around 20% by 2035. TWU are proposing a number of solutions in their preferred option to address this expected deficit including:

- An enhanced leakage reduction programme in London;
- Higher meter penetration (77% in London by 2020) accompanied with water use tariffs;
- Promoting water efficiency to customers;
- Groundwater recharge schemes; and
- A new reservoir scheme.

TWU predict that these proposals will provide a surplus of supply of 103 Ml/d in the London WRZ by 2030, although there may be a deficit until 2013 as new resources will not be brought online in this timescale. Delivery of a number of these proposals is dependent on acceptance of TWU's PR09 strategic business plan by Ofwat.

The Deephams Transfer Main (DTM), described in more detail in subsequent sections, will augment flows in the River Lee upstream of the TWU raw water abstraction point, by up to 25 Ml/d during drought periods. The London WRZ should benefit from a greater security of supply, as more water will be available for abstraction. Extensions, currently under construction, to the London ring main will allow the supply of water within the TWU area to be based on availability and demand irrespective of where the water is initially sourced.

2.6.2 Sewerage Network

The sewerage network that delivers effluent to Rye Meads WwTW consists of four main trunk sewers:

- The Stevenage trunk sewer;
- The Welwyn Garden City trunk sewer which converges with the Stevenage trunk sewer at Hertford;

- Hertford and Ware trunk sewer; and
- Sawbridgeworth and Harlow trunk sewer.

Figure 2-17 overleaf gives an schematic of the sewerage network, including the key rivers in the study area.

Notionally, the sewers convey foul water only, although some surface water drainage is connected to the network throughout the catchment. Therefore, flows in the sewers react to rainfall. Flooding from the sewer network exists in a number of locations around the catchment where the network is currently unable to cope with storm flows. Qualifying incidents (where internal flooding of property was caused by overloading of the sewers) are entered in the water company's DG5 register until appropriate measures are taken, at which point such entries will be removed from the register.

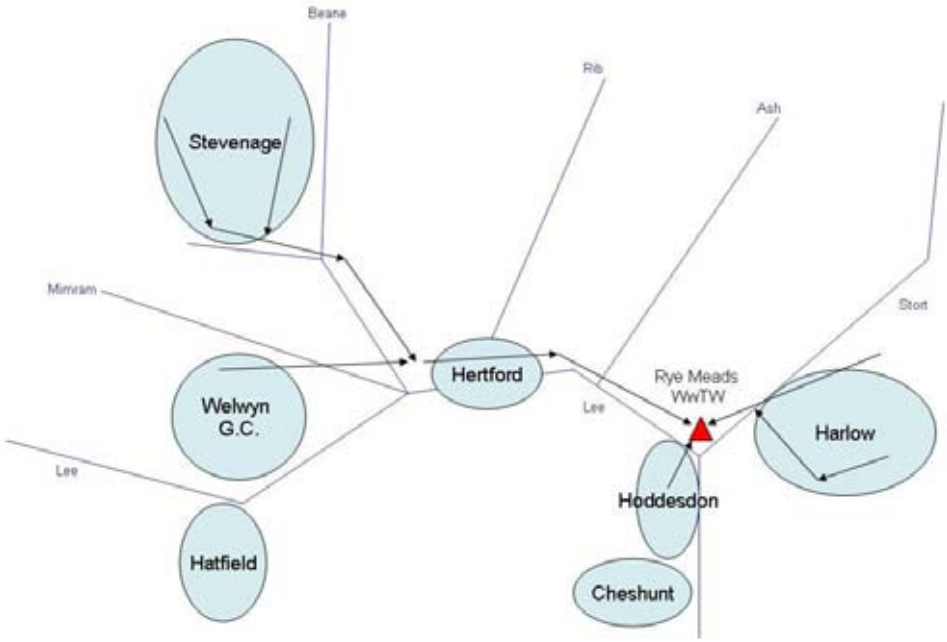


Figure 2-17 Wastewater Supply Schematic

Due to the centralised collection network within the catchment, raw wastewater travels considerable distances. The trunk sewer from Stevenage to Hertford is in excess of 10 km long. Similarly, the trunk sewer from Hertford to Rye Meads WwTW is around 9 km long. The diameter of this sewer is 1.25 m for some stretches as it approaches the WwTW. Due to the size and depth; any future work to upgrade the capacity is likely to cause considerable disruption.

A notable feature of the network, on a more localised level, is the area of north Stevenage in the AWS operational area. Wastewater from this area is currently pumped over the operational border, into the TWU network via the Coreys Mill pumping station.

A complex network of pumping stations and rising mains also delivers wastewater from the northern area of Hoddesdon to Rye Meads WwTW.

2.6.3 Wastewater Treatment

Thames Water Utilities (TWU)

The majority of the wastewater in the study area is treated by TWU at the Rye Meads Wastewater Treatment Works (WwTW), which treats a current domestic population of around 355,000. Flows received from trade sources equate to 35,000 population equivalent (PE). In total, the PE served by Rye Meads WwTW is approximately 390,000.

Rye Meads WwTW discharges treated effluent into the Tollhouse Stream, which passes through a siphon under the River Stort, and joins the River Lee just downstream of Fieldes Weir.

The WwTW is located within a SSSI and adjacent to a nature reserve, which creates additional constraints when considering substantial upgrades to the works.

The other significant WwTW within the study area is the Mill Green WwTW, which treats the majority of Hatfield and parts of southern Welwyn Garden City. There are also a number of smaller rural Thames Water WwTWs that treat some of the more isolated towns.

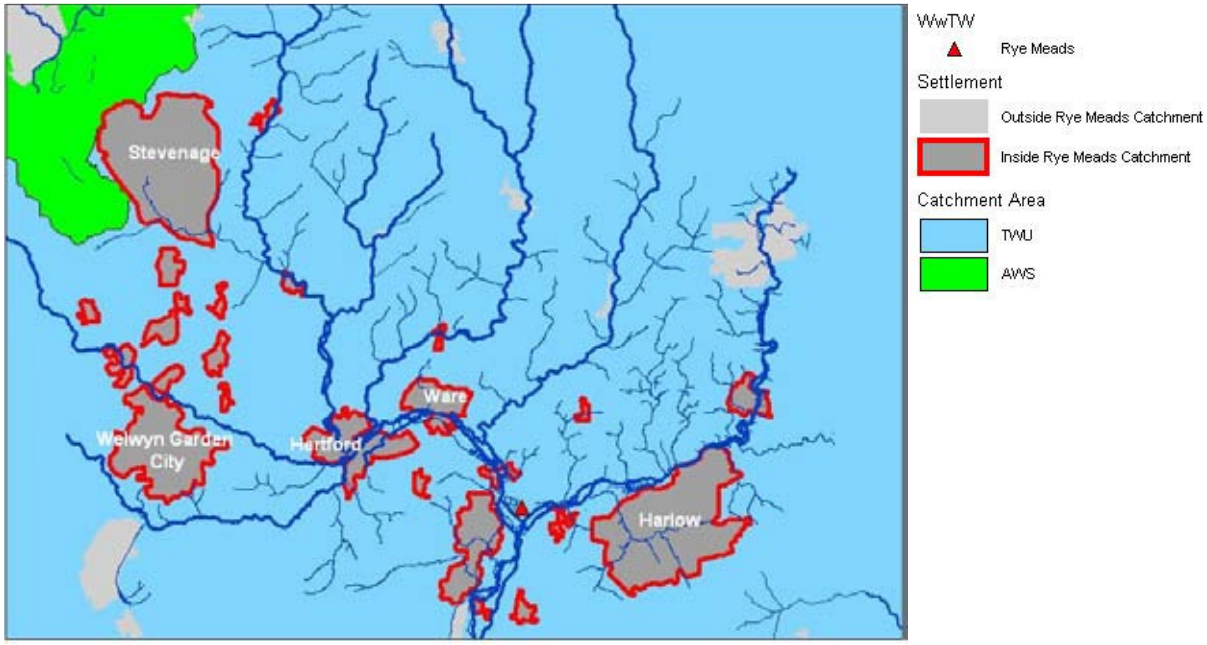


Figure 2-18 Rye Meads WwTW Catchment

Anglian Water Services

The catchment boundary between Anglian Water Services and Thames Water is illustrated in Figure 2-18 above at the north-west corner of the study area around Stevenage. The AWS treatment works that are located closest to the study area are the Ashbrook WwTW, serving a PE of approximately 2,800, and the Hitchin WwTW, which serves approximately 32,800 PE. The proximity of the catchment boundary to Stevenage is a key consideration that will be discussed later in the report. The potential to divert the flow from new properties in the Rye Meads WwTW catchment to the Anglian Water operational area is highest for the developments surrounding Stevenage.

2.7 Key Catchment Constraints

This section has given an overview of the catchment as it stands as well as setting out the policies and strategies that are in place to ensure and improve the sustainability of the area. The section has highlighted the very large extent of the catchment and the complex interaction between the various components of the water cycle. It has also demonstrated that a more detailed analysis of the implications of increased development is required. The key considerations for further analysis include:

- the **low flows** within a number of rivers in the catchment that are attributed to the current level of abstraction within the catchment;
- the **risk of flooding** from increased development within the catchment (from both surface water and sewers) ;
- the future **availability of water** due to imposed restrictions and significant increases in demand;
- the requirement to improve the quality of **designated sites**, species and habitats within the catchment;
- the current strategic **sewerage network** capacity and the potential for further major upgrades within the catchment; and
- the hydraulic and environmental capacity of the **Rye Meads WwTW** and **the receiving watercourses** and the impacts of potential upgrades.

These are all addressed later in the report and taken into account during the development of options and strategies.

3 Planning Policy Context

3.1 National Policies

The Planning and Compulsory Purchase Act, 2004[16], sets out the framework for planning and development in the UK. The act requires every region to create a Regional Spatial Strategy (RSS), and cascade policies from this into the Local Development Documents (LDD) of each Local Authority.

This section briefly sets out the national legislation and guidance regarding new development. Further information on each of the policies and guidelines can be found in Appendix D.

3.1.1 Planning Policy Statements

Planning Policy Statements (PPS) and some Planning Policy Guidance Notes (PPG), which have not yet been superseded by PPS, are national planning documents that provide guidance to Local Authorities on planning policy. Local Authorities should ensure that planning documents consider these policies, and may be able to use some of the policies contained within PPS to make decisions on individual planning applications.

The most relevant PPS to this WCS are:

- PPS1: Delivering Sustainable Development (and the 2007 Supplement entitled Planning and Climate Change);
- PPS3: Housing;
- PPS23: Planning and Pollution Control; and
- PPS25: Development and Flood Risk.

Relevant topics that consistently occur within the above mentioned PPS are:

- Resilience to climate change;
- Conservation / biodiversity;
- Sustainable use of resources;
- Mitigation of flood risk and the use of SUDS;
- Suitable infrastructure capacity; and
- Protection of groundwater and freshwater;

Key extracts from the above PPS are included in Appendix D.

[16] The Planning and Compulsory Purchase Act 2004 (Commencement No. 7), ODPM, 2006

3.1.2 Code for Sustainable Homes

The Code for Sustainable Homes (CSH) was introduced in England in April 2007. The code sets a framework, and acts as a tool, for developers to create homes to higher environmental standards than previously.

The CSH Levels require different levels of performance regarding water use. These are:

- Levels 1/2 – 120 l/p/d;
- Levels 3/4 – 105 l/p/d; and
- Levels 5/6 – 80 l/p/d.

It became mandatory for new homes to be assessed under the Code from May 2008; however, the achievement of a certain CSH Level is only a requirement for social housing.

As of April 2007, all housing built on English Partnerships land and from April 2008 all social housing funded through the Housing Corporation has to be built to Code level 3, a performance standard of 105 l/p/d, representing current best practice in water efficiency without requiring water reuse or rainwater harvesting.

The timetable for the implementation of the CSH requires that new homes are built to level 3 from 2010 onwards, and level 6 from 2016.[17]

3.1.3 Building Regulations

The Building Regulations prescribe the required performance of new dwellings (and alterations to existing dwellings) in England and Wales. The UK Government will amend the Building Regulation by April 2010[18], to require new buildings to achieve a calculated whole building performance (per capita consumption of potable water) of **125 l/p/d**. This is equivalent to CSH Levels 1 and 2, with an additional allowance of 5 l/p/d for outside use.

This will be reinforced with amendments to the Water Supply (Fittings) Regulations 1999, which set performance levels for individual fittings.

3.2 Regional Policies

The 2008 Revision to the Regional Spatial Strategy (RSS) for the East of England, entitled the East of England Plan, is the document that provides a consistent framework to inform the preparation of Local Development Documents in the counties of Norfolk, Suffolk, Cambridgeshire, Essex, Hertfordshire and Bedfordshire.

The evolution of the East of England Plan, and the accompanying studies concerning water infrastructure in the study area, are shown in the timeline below.

The accompanying studies are:

[17] Greener homes for the future, CLG, 2008

[18] Circular 10/2009, CLG, 2009

- The East of England Capacity Delivery Study (2006), commissioned by the EA and the East of England Regional Assembly; and
- The Rye Meads Water Cycle Study Scoping Report (2007), also commissioned by the EA.

The East of England Capacity Delivery Study (2006) recommended that a detailed WCS be carried out for the Rye Meads Wastewater Treatment Works (WwTW), linked to a study of the Stevenage area, as soon as possible.

The Scoping Report concluded that a WCS was needed for Rye Meads to:

- Identify appropriate water quality targets (and the implications of the Water Framework Directive);
- Identify infrastructure constraints;
- Assess a variety of WwTW options; and
- Consider the effects of climate change.

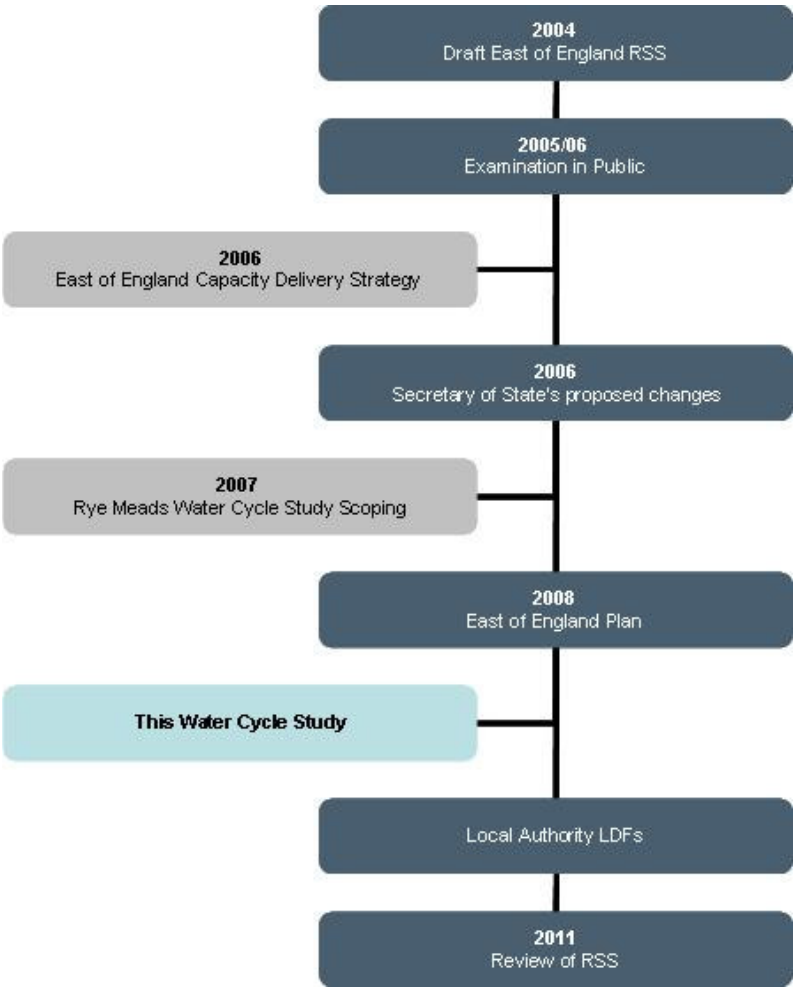


Figure 3-19 Context of this WCS in relation to planning process

Policy SS3 of the RSS describes the towns of Stevenage, Harlow and Welwyn Garden City as key centres for development and change.

An ambitious target for a minimum of half a million new homes between 2001 and 2021 is set for the East of England. Policy H1 apportions this development into targets for individual Local Authorities. The targets for those Local Authorities served fully, or in part, by the Rye Meads WwTW, are illustrated in Table 3-6.

Local Authority[1]	Broxbourne	East Herts.[4]	Epping Forest[4]	Harlow[3]	North Herts.[4]	Stevenage[2]	Welwyn Hatfield
RSS Target 2001 - 2021	5,600	12,000	3,500	16,000	6,200	16,000	10,000

Table 3-6 RSS Dwelling Allocations to Study Area Local Authorities

Notes on Table 3-6

1 Figures include the housing allocations within the whole local authority areas but Rye Meads WwTW catchment covers partial areas only.

2 Includes the dwelling allocation into adjoining North Hertfordshire area.

3 Includes the dwelling allocation into adjoining East Hertfordshire and Epping Forest areas.

4 Excludes the provision within Stevenage and Harlow growth areas.

One of the key ambitions of the East of England Plan is to "*accommodate higher levels of growth in sustainable ways.*"

Policy WAT2 seeks to ensure that water infrastructure is provided so as not to constrain development, whilst avoiding any adverse impacts on the environment. Water cycle studies are considered integral to this.

More information regarding WAT2, and other relevant policies within the RSS, are included in Appendix D

3.3 Local Policies

A Local Development Framework (LDF) is a collection of local development documents (LDD), comprising of both statutory and non-statutory planning documents for the local authorities. The document that timetables the creation, consultation and publication of each LDD is the Local Development Scheme (LDS).

During the creation of LDDs, it is possible to preserve policies from older plans. In some cases the LDF process is at such an early stage that the older plans have been used to inform this WCS, regardless of the fact that these do not fully take account of the RSS targets.

The progress of the seven Local Authorities in the study area at the time of writing this WCS is described in the table below.

Local Authority	Currently adopted plan/ draft documents	Stage in LDF process	Expected completion / update date
Broxbourne	Local Plan Second Review (Dec 2005). Core Strategy Issues and Options (May 2007).	Core Strategy Issues and Options consultation complete. Strategic Housing Land Availability Assessment consultation complete.	Preferred Options awaiting consultation Core Strategy Preferred Options and Site Allocations publication expected Spring 2009.
East Herts.	Local Plan Second Review (April 2007)	Core Strategy Issues and Options awaiting consultation	Issues and Options consultation expected by Autumn 2009. Submission of Core Strategy Preferred Option by Autumn 2010
Epping Forest	Adopted Local Plan 1998 and 2006 alterations	New LDS needed to review LDF timetable.	Unknown – to be advised
Harlow	Replacement Harlow Local Plan 2006	Consultation on Core Strategy Issues and Options planned for January 2010.	Unknown – to be advised
North Herts.	Core Strategy Preferred Option (Sep 2007)	Preferred Option consulted upon, awaiting submission to Secretary of State.	Adoption planned for Spring 2010
Stevenage	Stevenage District Plan Second Review 2004 Core Strategy Preferred Options 2007 *Stevenage and North Herts. Action Plan (SNAP) Issues and Options 2007*	Preferred Option consulted upon.	Additional consultation on Core Strategy planned for October 2009 *Consultation on SNAP Preferred Options expected early 2010*
Welwyn Hatfield	Welwyn Hatfield District Plan 2005	Gathering evidence for Core Strategy Issues and Options	Core Strategy Issues and Options expected to be consulted on in 2009

Table 3-7 LDF Progress of Local Authorities in Study Area

3.3.1 Development Trajectories

A statutory requirement of the LDF process is the Annual Monitoring Report (AMR). The most recent AMRs available to this WCS are for the 2006-07 period, and provide records of net completions and the most up to date projections for future completions. Local plans, yet to be superseded by the LDF process as mentioned in the table above, have often been used to inform the 06/07 round of AMRs. Using these projections has allowed an estimation of the location and phasing of some housing.

The remaining RSS target dwellings, with locations not yet allocated in older plans or LDDs, have been roughly allocated to indicative areas in keeping with aspirations mentioned in the above plans and through consultation with the Local Authorities.

These estimated trajectories were agreed upon during Phase 2 of this WCS, and have been used to calculate the possible impacts of the development on the water infrastructure and environment within the study area.

Brief descriptions of the housing trajectories used are included in the table below. Requirements for the period 2021-31 have been calculated in accordance with RSS policy H1, or advised by Local Authorities.

Local Authority	Housing Allocations from RSS	Annualised RSS Housing Rate (2001-2021)	Dwellings Completed (2001 – 2007)	Average Build Rate (2001 – 2007)	Dwellings Remaining (2007-2021)	Annualised Housing Rate (2007-2021)	Dwellings (2021-2031)
Stevenage	16,000	800	2,171	362	13,829	988	9,600
North Herts.[1]	6,200	310	2,837	405	3363	258	3,100
Harlow	16,000	800	1,275[2]	213	14,725	1,052	8,000
East Herts.	12,000	600	3,386[2]	564	8,614	615	6,000
Epping Forest	3,500	175	1,627[3]	253	1,981	142	1,750
Welwyn Hatfield	10,000	500	3,383	564	6,617	473	5,000
Broxbourne	5,600	280	2,215	369	3,385	242	2,800
Totals	**69,300**	**3,465**	**7,769**	**2,325**	**49,151**	**3,512**	**36,250**

Table 3-8 Summary of Housing Trajectories to meet RSS targets

Notes on Table 3-8

1: Figures advised during consultation, as 06/07 AMR did not take account of the RSS targets for NHDC being revised downwards to compensate for development around Stevenage

2: 2007 total completions revised during consultation

3: 07/08 completions advised during consultation

3.4 Development Locations

3.4.1 Stevenage

The East of England Plan highlights Stevenage as a key centre for development. Development is proposed within the Borough boundary, and in extensions to the North and West into the neighbouring District of North Herts. The RSS states that, by 2021, at least 9,600 homes should be constructed in this area by means of urban expansion into the greenbelt.

Policy H1 of the RSS requires the higher of the 2001—2021 or 2006—2021 annual completion rate to be continued post 2021. To comply, SBC (in partnership with NHDC) will have to allocate

space for a further 9,600 homes between 2021—2031, at sites within the Borough and the surrounding area.

SBC and NHDC have responded to these targets by participating in the Stevenage and North Herts Action Plan (SNAP), in addition to their own individual LDF process. SNAP is intended to operate alongside the Core Strategies of both authorities, and contain standalone policies more relevant to the SNAP area.

The SNAP Key Issues and Options document has been consulted upon, and a Preferred Option document is expected to be available for consultation in early 2010.

SBC and NHDC have also completed a joint Strategic Housing Land Availability Assessment to identify potential sites for meeting the RSS targets, and form part of their individual LDF evidence bases. This study identified a surplus of suitable, available and viable sites within Stevenage Borough, but noted that, as yet, not enough sites had been identified in the SNAP area. However, the study notes that if broad locations are considered within the SNAP area, there is enough capacity to meet the RSS targets.

Consultation with SBC allowed the identification of some of the more likely development sites. This includes a potential 5,000 home development to the west of Stevenage, and a number of smaller sites to the north.

The remaining development required by the RSS was assumed to be located to the north of Stevenage. As described above, the operational border between AWS and TWU bisects Stevenage. For this reason, a pragmatic approach of dividing the unallocated development equally between the two water companies was considered.

Figure 3-20 below illustrates the layout of Stevenage development sites used in consultations with the water companies to inform the latter stages of this WCS.

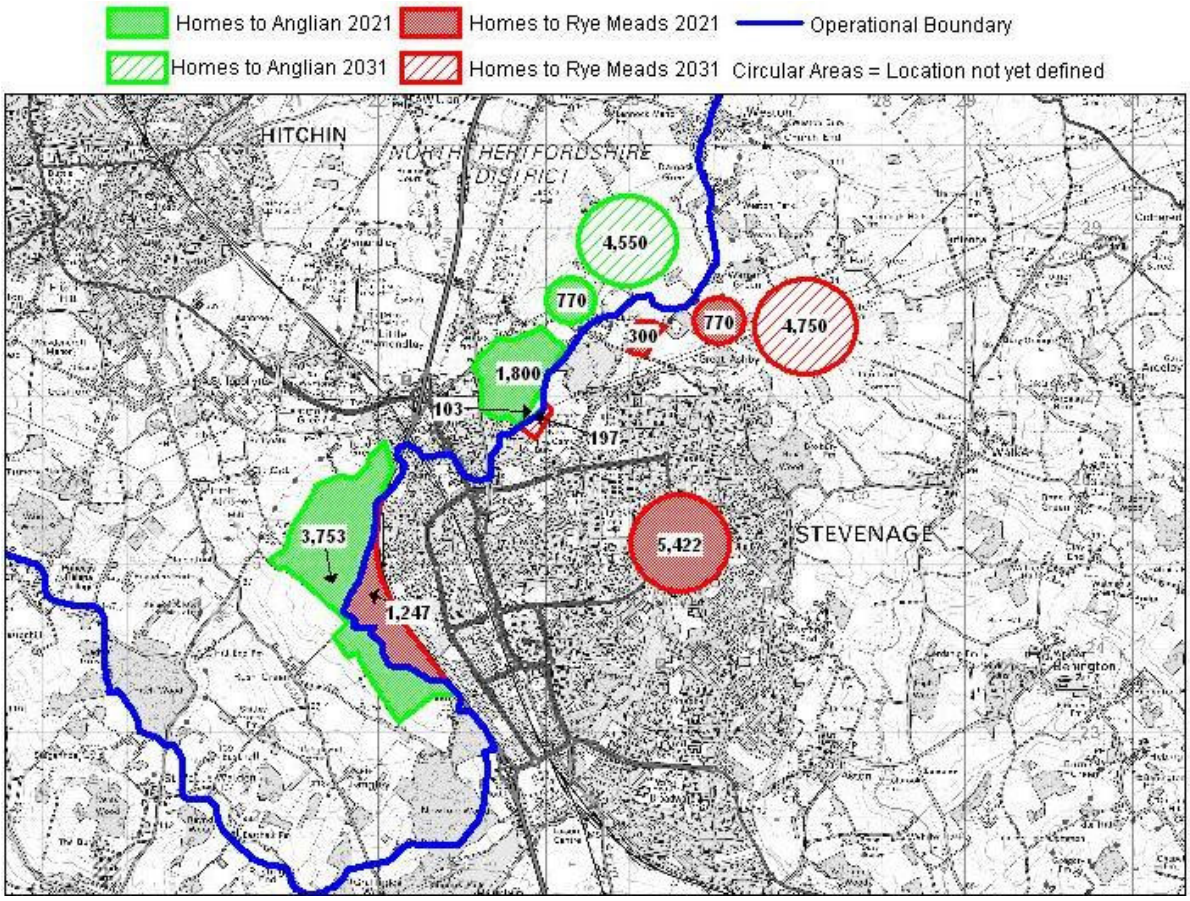


Figure 3-20 Stevenage Development Sites

Figure 3-20 shows clearly the area to the northwest of Stevenage that falls within the AWS catchment. Wastewater from these properties is pumped over the catchment boundary to the TWU network via the Coreys Mill pumping station.

The potential to remove some of the Stevenage development, and existing properties within Stevenage, from the Rye Meads sewerage network is explored in subsequent sections of this report.

3.4.2 Harlow

The East of England plan requires significant development in and around Harlow, including a target of 16,000 dwellings to be shared between Harlow, East Herts and Epping Forest prior to 2021. Development on the eastern fringe of the town has already commenced, and some infill development within the existing town is assumed. However, in order to meet the RSS targets urban extensions will be required.

Possible locations suggested by the RSS for these are:

- To the east, between the existing urban area and the M11;
- To the north, across the river Stort, into East Herts; and
- On a lesser extent, to the south and west, into Epping Forest.

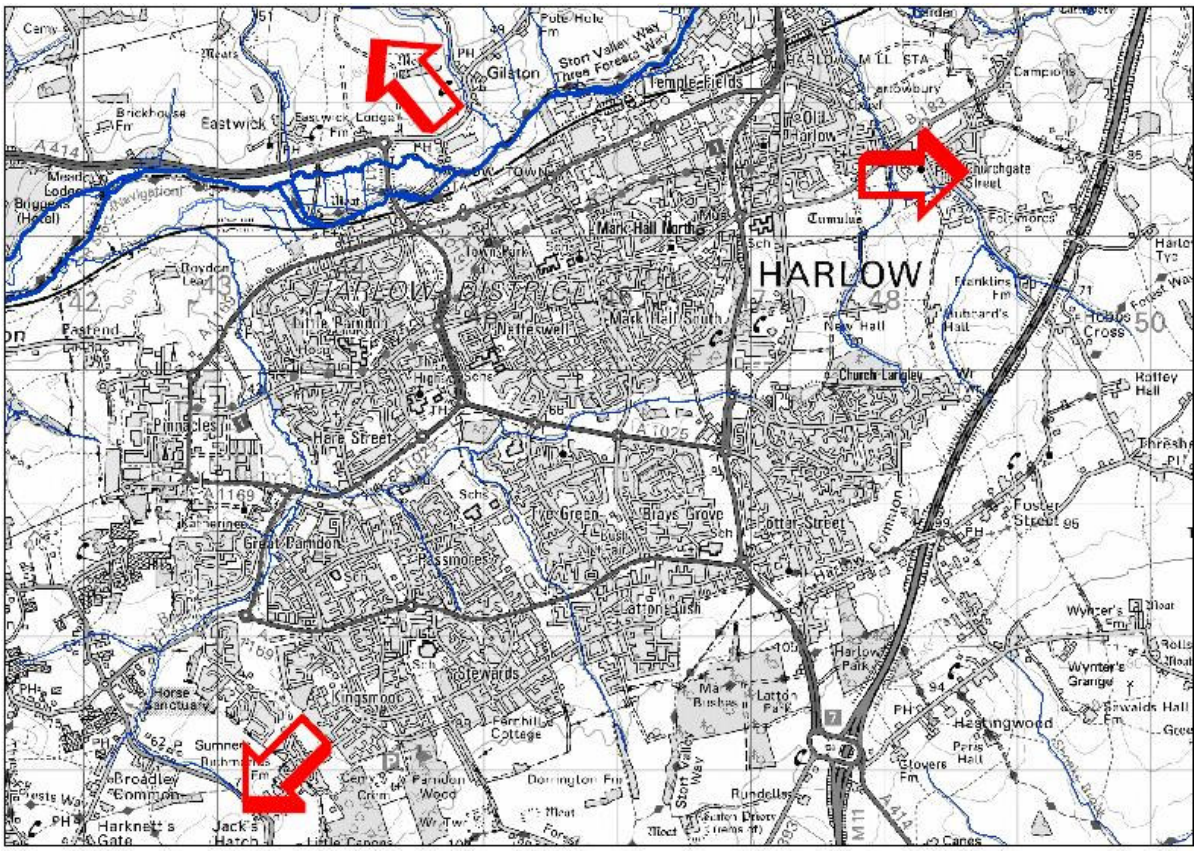


Figure 3-21 Possible growth directions for Harlow

Whilst these urban extensions have not yet been decided upon, they must be considered in this WCS, as the majority of RSS target cannot be accommodated within the existing urban boundary.

All wastewater from Harlow is currently treated at Rye Meads WwTW. The possibility of changing this regime, for new developments, is discussed in Section 6.

3.4.3 Welwyn Hatfield

WHDC are currently in the process of collecting information and evidence to inform their Core Strategy Issues and Options document. WHDC were able to provide details of approved planning applications within the existing urban areas, but strategic sites have not yet been located.

Welwyn Garden City is mostly contained within the Rye Meads WwTW catchment, whilst urban areas to the south, such as Hatfield, are treated at Mill Green WwTW or Maple Lodge WwTW.

Through consultation with WHDC, it was decided that two scenarios should be used when considering the impact of development within Welwyn Hatfield on Rye Meads WwTW. These are:

- 50% (likely approximate spread) of planned development is within / around Welwyn Garden City, hence treated at Rye Meads; and
- 80% (conservative worst case) of planned development is within / around Welwyn Garden City, hence treated at Rye Meads.

3.4.4 East Herts.

EHDC are also at an early stage in their LDF process. Percentage figures, with which to allocate the RSS targets to the larger settlements, were provided during consultation. These figures stemmed from the East Herts. Proportional Catchment Based Distribution (PCBD) method, utilised in their Local Plan consultations, which had aimed to create a sustainable and equitable distribution of dwellings across the District.

The numbers of dwellings required by the RSS targets surpass those required in the Local Plan. However, it was agreed with EHDC that the same PCBD percentages should be used to allocate the RSS dwellings around the District for the purpose of calculations within this WCS.

The distribution is described in Table 3-9 below.

Town	% of development	In Rye Meads WwTW catchment?
Bishops Stortford	48	No
Hertford	16	Yes
Ware	11	Yes
Sawbridgeworth	6	Yes
Buntingford	4	No
Stanstead Abbotts/ St. Margarets	5	Yes
Rural Villages	10	Partly

Table 3-9 Estimation of EHDC Development

For the purposes of water resource calculations in latter sections of this WCS, the worst case development for Rye Meads WwTW is defined as 48% of the RSS target for the East Herts District. This figure emerges from summing the proposed development in Hertford, Ware, Sawbridgeworth, Stanstead Abbotts/ St. Margarets and the rural villages, in keeping with Table 3-9 above.

It should be noted that the RSS target for East Herts is in addition to any development that occurs on the northern fringe of Harlow.

3.4.5 Broxbourne

Broxbourne Borough Council are currently consulting the public with regards to their Core Strategy Preferred Option. They have suggested one strategic site, with the remaining development happening on small sites as and when they become available. The strategic site is located outside the Rye Meads WwTW catchment. However, given the uncertainty around the remaining development it has been assumed for the purpose of calculations that 50% of the RSS development will fall within the catchment. This is in keeping with a similar high level assessment made by TWU.

3.4.6 North Herts. and Epping Forest

Small areas of Epping Forest and North Herts. currently fall within the Rye Meads WwTW catchment.

The NHDC Core Strategy Preferred Option document suggests that only a modest amount of development will occur in towns within the Rye Meads WwTW catchment, such as Knebworth. The search for larger strategic sites needed to meet the RSS targets will occur around the urban areas such as Royston, which is outside the study area for this WCS.

EFDC are at a very early stage in their LDF process. Their assessment of sites available over the next five years suggests the majority of developments will be in the towns of Epping and Loughton, which are outside the Rye Meads WwTW catchment. It is assumed that future development will continue in this manner. It should be noted that the RSS target for Epping Forest is in addition to any development that occurs as an extension Harlow.

It is therefore assumed that the effects of development from North Herts. and Epping Forest on Rye Meads WwTW are negligible. The only proposed growth that may be of concern would be in the Hitchin or Letchworth areas. This growth would increase the loading on their respective WwTW, which may prevent the diversion of some wastewater from the Stevenage development sites, should this become the preferred option.

3.5 Catchment Contribution Summary

In summary, when considering water infrastructure (particularly sewerage), a conservative worse case development scenario has been developed.

This is that Rye Meads WwTW receives wastewater from the following new developments:

- All of Stevenage (this is investigated further in subsequent sections);
- All of Harlow (including 16,000 dwellings in total to 2021, to be shared with East Herts and Epping Forest);
- Around 48% of proposed East Herts. development (as described in tables above, excluding the EHDC share of the 16, 000 dwellings around Harlow);
- 80% of development in Welwyn Hatfield;
- 50% of development in Broxbourne; and
- None of the development in North Herts. outside the area covered by SNAP or Epping Forest (excluding the Epping Forest share of the 16,000 around Harlow above).

This equates to just under 40,400 new dwellings in the catchment by 2021, and an additional 25,900 by 2031, therefore a total increase of 66,300 dwellings between 2007/08 and 2031.

4 Development Impact Calculations

4.1 Introduction

High level calculations are required to quantify the likely impacts of the proposed development on the existing water infrastructure. Critical to this assessment is the way in which existing properties are accounted for. Reductions in occupancy rate and Per Capita Consumption (PCC) in existing dwellings have the potential to unlock capacity for future development. Similarly, any increase in the consumption of existing customers can offset proposed efficiencies in new dwellings.

4.2 Variables

The variable factors within the water infrastructure calculations are:

- Occupancy rate;
- PCC for new and existing dwellings; and
- Infiltration rate, for sewerage calculations, which represents all unaccounted for flows into the network.

Also, in the case of sewerage and wastewater treatment, another key variable is the amount of development that actually occurs within the catchment.

Predictions of reductions in the occupancy rates in each Local Authority, produced by Anglia Polytechnic (now ***Anglia*** Ruskin University)[19], have been used to estimate changes in the study area population. These predictions are to 2021, so a linear extrapolation to 2031 was used.

This gives the following prediction of occupancy rates.

Council	2006	2011	2016	2021	2026	2031
Epping Forest	2.34	2.31	2.26	2.23	2.19	2.15
Harlow	2.36	2.32	2.28	2.26	2.23	2.2
Broxbourne	2.44	2.41	2.36	2.34	2.32	2.29
East Herts	2.38	2.33	2.29	2.26	2.23	2.2
North Herts	2.29	2.24	2.19	2.15	2.12	2.08
Stevenage	2.33	2.27	2.22	2.19	2.17	2.14
Welwyn Hatfield	2.34	2.31	2.27	2.25	2.23	2.21

Table 4-10 Occupancy Rate predictions for the Study Area

As illustrated in Section 3, different PCC target rates are proposed in various Government documents. In summary, these are:

- **125 l/p/d**, proposed 08/09 changes to the Building Regulations[20] (new houses);

[19] King et al, *Revised 2001-based Population and Household Growth in the East of England, 2001-2021,* APU, 2005

[20] DEFRA, *Action taken by Government to encourage the conservation of water,* 2008

- **105 l/p/d** by 2010, and **80 l/p/d** by 2016**,** Code for Sustainable Homes Levels 3/4 and 5/6[21] respectively (new houses). *Social housing required to meet Level 3 from April 2008*; and
- **130 l/p/d** by 2030, Defra's aspirational target[22] for average PCC of all properties.

It must be noted that conventional understanding within the water industry is that smaller households tend to have higher PCC rates, as there are less opportunities to 'share' demand for washing machines, dishwashers etc. The predicted trend of falling occupancy rates will therefore make the above PCC targets harder to achieve. However, it is essential that reductions in PCC are still achieved despite decreasing occupancy rates, to allow the study area to move towards **water neutrality**, as described in Section 5.2.3.

TVW have provided predictions of average PCC rates for their NWRZ that correspond to their draft WRMP, and the demand management options they are proposing, such as 90% meter penetration by 2030 for all properties.

TWU use 95% of the TVW PCC in calculations relating to wastewater received at Rye Meads. This percentage has been adopted for sewerage calculations in this WCS.

For the purpose of the following sewerage calculations, an unallocated flow rate (which includes infiltration and other unaccounted for flows) of 30% of domestic population x PCC has been used. This rate emerged from a TWU comparison of measured Dry Weather Flow (DWF) at Rye Meads against estimated DWF from population served in 2007/08.

4.3 Methodology

Through a review of current and planned policies, and consultations with water companies, the sets of variables described above were decided upon. Existing dwelling numbers were estimated using Office of National Statistics 2001 Census data and adding 2001—2006 net completions as reported in 06/07 AMRs.

Potable water demand was initially calculated using the entirety of the Local Authority areas, without apportioning to the Rye Meads catchment.

[21] CLG, *Greener Homes for the Future,* 2008

[22] DEFRA, *Future Water,* 2008

Local Authority	2001 Census Dwellings	2001—06/07 AMR Completions	2007 Dwellings for Potable Supply Calculations
Broxbourne	35,904	2,215	38,119
Epping Forest	51,814	1,627	53,441
East Herts.	53,316	3,386	56,702
Harlow	33,776	1,275	35,051
North Herts.	49,870	2,837	52,707
Stevenage	33,226	2,171	35,397
Welwyn Hatfield	40,678	3,383	44,061
Totals	**298,584**	**16,894**	**315,478**

Table 4-11 Calculation of existing dwellings (2007) for potable supply

Demands on the sewerage network and Rye Meads WwTW were then calculated by assessing the existing population in Super Output Areas (SOA) that coincided, as best as possible, with the Rye Meads catchment boundary. It is assumed that the higher definition of SOA, in relation to the overall catchment area, makes slight differences between their boundaries negligible in the context of this strategic study. 2001—2006 completions were apportioned to these SOA based on the percentage of existing dwellings that each super output area accounted for in 2001.

Local Authority	2001 Census Dwellings[1]	2001—06/07 AMR Completions[2]	2007 Dwellings for Wastewater Calculations
Broxbourne	14,044	866	14,910
Epping Forest	3,244	102	3,346
East Herts.	33,459	1,664	35,123
Harlow	33,776	1,275	35,051
North Herts.	4,169	237	4,406
Stevenage	33,226	2,171	35,397
Welwyn Hatfield	23,067	1,918	24,985
Totals	**144,985**	**7,979**	**152,964**

Table 4-12 Calculation of existing dwellings (2007) in Rye Meads WwTW catchment

Notes on Table 4-12

1: Estimation of total dwellings in super output areas that coincide with Rye Meads catchment boundary. Only Stevenage and Harlow are entirely within the catchment.

2: AMR completions are apportioned to the super output areas according to the percentage of the existing local authority dwellings they contained in 2001.

The 2007 total dwelling figure above compares well with estimations of current population loading (390,000 PE) made by TWU, once occupancy rates and trade flows are taken into account.

4.4 Scenarios

Following consultation, three scenarios were devised to assess the sensitivity and the possible impacts of the various policies described in Section 3, and the water companies' draft WRMPs and their water infrastructure. These scenarios are described in more detail below.

4.4.1 Best Case

This scenario assumes:

- Occupancy rates fall in line with APU predictions following the continuing downward trend;
- New buildings comply with the 2008/09 Building Regulations changes until 2010, and then follow the ambitious CSH targets and timetable (described in Appendix D); and
- Existing dwellings start at the 2007-2011 average PCC as predicted by TVW and then gradually fall to the DEFRA target of 130 l/p/d by 2031.

4.4.2 Worst Case

This scenario assumes:

- No change in occupancy rates from APU 2006 value;
- New buildings comply with 2008/2009 Building Regulations changes, but fail to comply with CSH levels 3/4 or 5/6; and
- Existing dwellings remain at 2007 TVW PCC

4.4.3 Base Case

Following consultation with stakeholders, it was agreed that a middle scenario was needed that incorporated the TVW business plan as detailed in their 2008 draft WRMP.

This scenario assumes:

- Occupancy rates fall in line with APU predictions as per Best Case Scenario above;
- New buildings comply with the 2008/09 Building Regulations changes until 2010, and then meet CSH Level 3/4 (105 l/p/d) after this; and
- PCC at existing dwellings follows the predictions of TVW.

Spreadsheets were created to calculate the effects of the above scenarios on the existing dwellings, and new dwellings required by the RSS.

The housing trajectories described in Section 3 were used in these calculations.

For ease of use, the changes in variables were assumed to coincide with the AMP periods, rather than vary yearly. Given the uncertainties involved with arriving at these variables, and the high level nature of these calculations, this assumption is deemed to have a negligible effect on the results.

Trade effluent received by the Rye Meads WwTW is included in the wastewater calculations. Following discussions with TWU, is has been assumed that the flow recorded in 06/07 remains constant for the foreseeable future. Intensification of existing employment areas is unlikely to result in a net increase in industrial demand, as it is predicted that companies with heavy water

use will be replaced with service orientated industry. In addition, TWU are under no obligation to accept new trade flows; any required upgrades would be planned and funded on an individual basis, following an agreement between TWU and the company in question.

The wastewater calculations assume the highest rates of new housing development within the Rye Meads WwTW catchment as described in Catchment Contribution Scenarios in Section 3, including all of the possible Stevenage development. This gives the most conservative view of net impact. If more of the development occurs outside the catchment, the strain on existing infrastructure will be less.

4.5 Development Impact Results

Full copies of the spreadsheets are available in Appendix E.

Key results are shown below to illustrate the difference between the scenarios.

4.5.1 Water Supply Results

Note that these results refer to the increase in domestic demand only. As discussed above, demand of potable water from industry is not expected to increase significantly by the WCS stakeholders.

Scenario	2031 Change in Demand of Existing Dwellings	2031 Total Demand Increase from New Dwellings	06/07 to 2031 Net Demand Increase
	m3/day	*m3/day*	*m3/day*
Best	-31,258	19,048	-12,209
Worst	0	26,820	26,820
Base	-17,383	22,306	4,923

Table 4-13 Calculation results for change in potable water demand by 2031

The base case total demand, broken down into existing and new dwellings, is illustrated in the graph below. As described in Section 4.3, this figure is based on existing demand and growth across all seven Local Authorities.

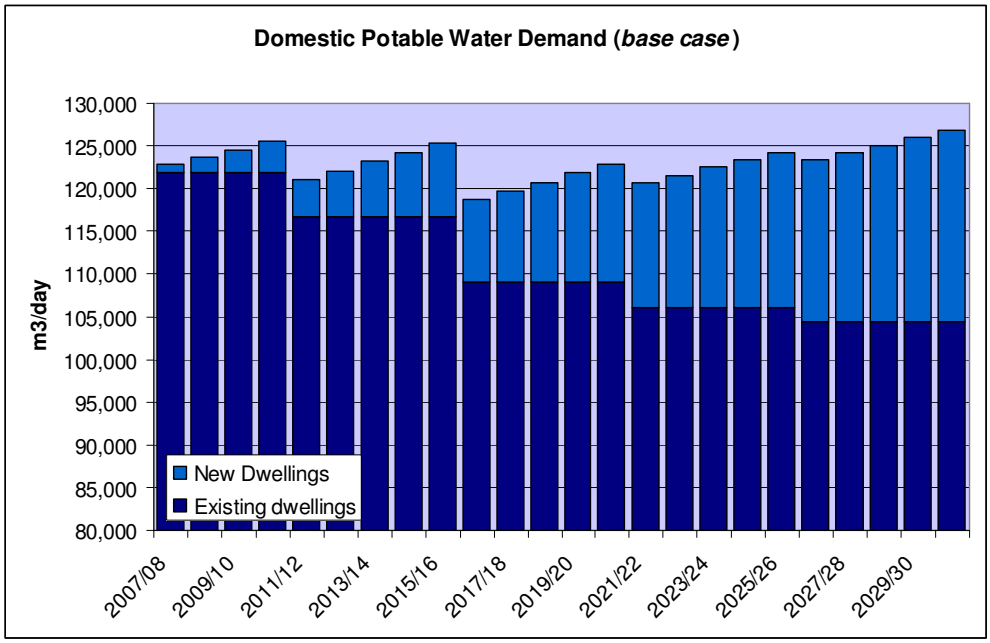


Figure 4-22 Components of domestic potable water demand for base case scenario*

As described previously, TVW are confident that their demand management programme will prevent the need for new resources to be developed in the Northern WRZ within the next 25 years. Also, TWU are proposing a number of schemes to eliminate a predicted future deficit in their London WRZ (see Section 2.6.1).

The supply and demand of potable water, including an assessment of all three scenarios, is discussed further in Section 5.2.

4.5.2 Wastewater Treatment Results

Note that these results refer to dwellings within the Rye Meads Catchment, and assume that the maximum possible development, as defined in the catchment contributions section, occurs within the catchment.

Scenario	2031 Change in DWF of Existing Dwellings	2031 Total DWF Increase from New Dwellings	06/07 to 2031 Net DWF Increase
	m3/day	*m3/day*	*m3/day*
Best	-15,816	17,902	2,086
Worst	0	25,332	25,332
Base	-10,329	21,007	10,677

Table 4-14 Calculation results for change in wastewater production by 2031

The base case total DWF is illustrated in the graph below. This includes infiltration as detailed above, and is broken down into flows from trade, new dwellings and existing dwellings.

* Note that high level calculation results have a stepped pattern due to five yearly intervals in PCC changes

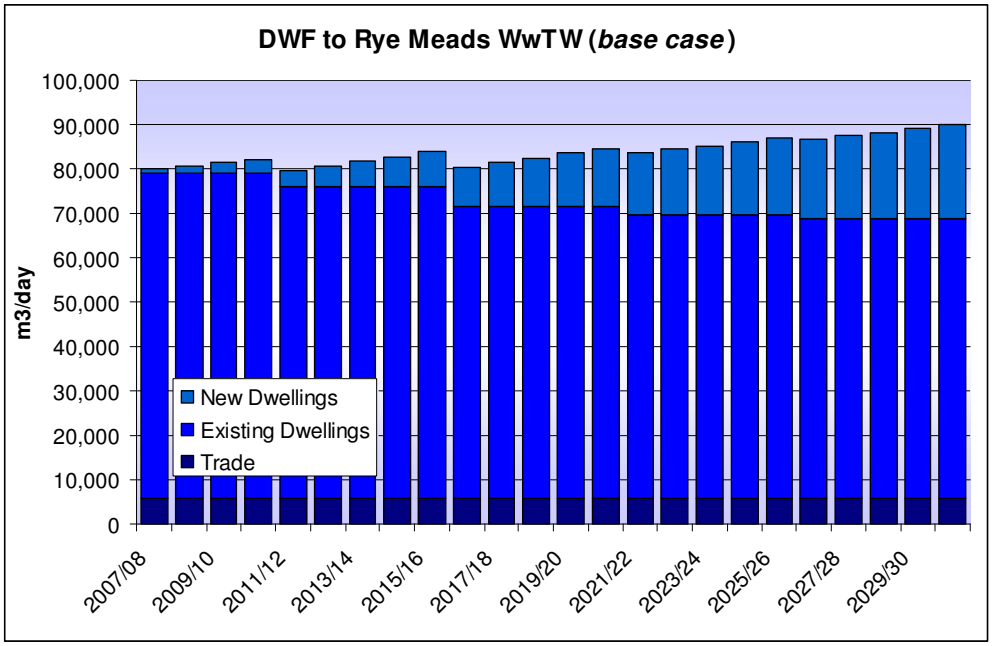


Figure 4-23 Components of wastewater received by Rye Meads WwTW for base case scenario

Figure 4-23 illustrates that future reductions in occupancy rate and PCC (in the base case scenario) will unlock some hydraulic capacity at Rye Meads WwTW, allowing the treatment of wastewater from new development to be accommodated.

The capacity of Rye Meads WwTW to accept these flows is described in more detail in subsequent sections.

5 Catchment Capacity

This section will assess the capacity of the various components of the water cycle and highlight the areas where no remaining environmental or infrastructure capacity remains.

5.1 The Water Cycle

The natural water cycle is the process by which water is transported throughout a region. The process commences with some sort of precipitation, be it rain, snow, sleet or hail. This is then intercepted by the ground and either travels overland through the process of surface runoff to rivers or lakes, or it percolates through the surface and into underground water aquifers.

The presence of vegetation can also intercept this precipitation through the natural processes that plants carry out, such as transpiration and evapo-transpiration.

The water will eventually travel through the catchment and will be evaporated back into the atmosphere along the way, or will enter the sea where a large amount will be evaporated from the surface. This evaporated water vapour then forms into clouds and falls as precipitation again to complete the cycle.

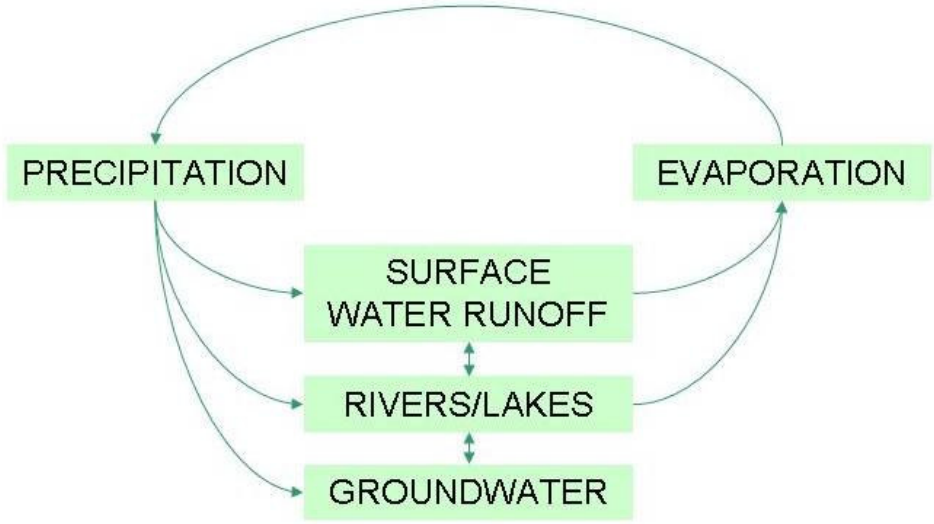


Figure 5-24 The natural Water Cycle

Urbanisation creates a number of interactions with the natural water cycle. Abstraction of water, from both surface water and groundwater sources for use by the local population, interacts with the water cycle by reducing the amount of water that is naturally held within the aquifers. This water is then transported via trunk mains and distribution pipes to the dwellings in the area, and then used by the population within the dwellings for a number of different purposes, which creates large volumes of wastewater.

The use of tarmac and other surfaces in this development also reduces the amount of water that is able to percolate through the ground to the groundwater aquifers. This therefore increases the rate of surface water runoff, which leads to flooding and increased peak discharges in rivers.

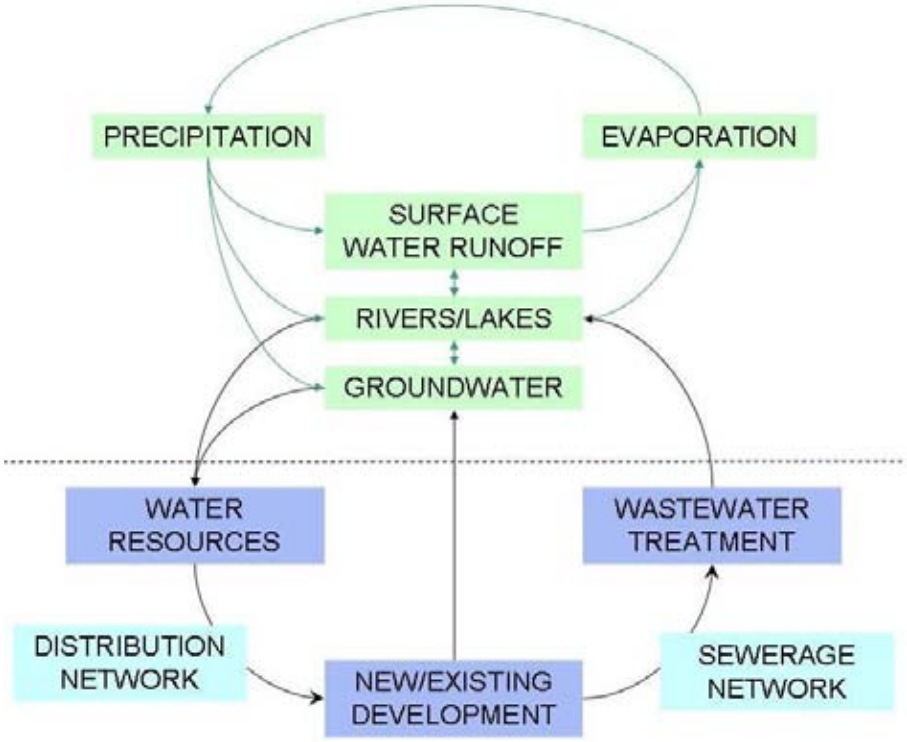


Figure 5-25 The wider Water Cycle

The wastewater from the developments is transported via the sewerage network to a wastewater treatment works, where the water is screened, treated, and then discharged back into the rivers.

The distance between where the water is abstracted and where it is later discharged as treated effluent has a large effect on the overall sustainability of a catchment. If large volumes of water are abstracted in the upper reaches of the catchment and not discharged until much further down the catchment, as is the case in the Rye Meads catchment, or into a different catchment, significant environmental implications such as low river flows become apparent.

5.2 Managing Potable Water Demand

5.2.1 Estimated Demand Increase

The calculations for the number of properties that have been allocated to the study area, and the variables that have been assumed, have been previously described in Section 4. A summary graph for total water demand from within the catchment can be found in Figure 5-26 below. The graph plots the results of the scenario testing that was carried out by varying the per capita consumption for both new and existing dwellings.

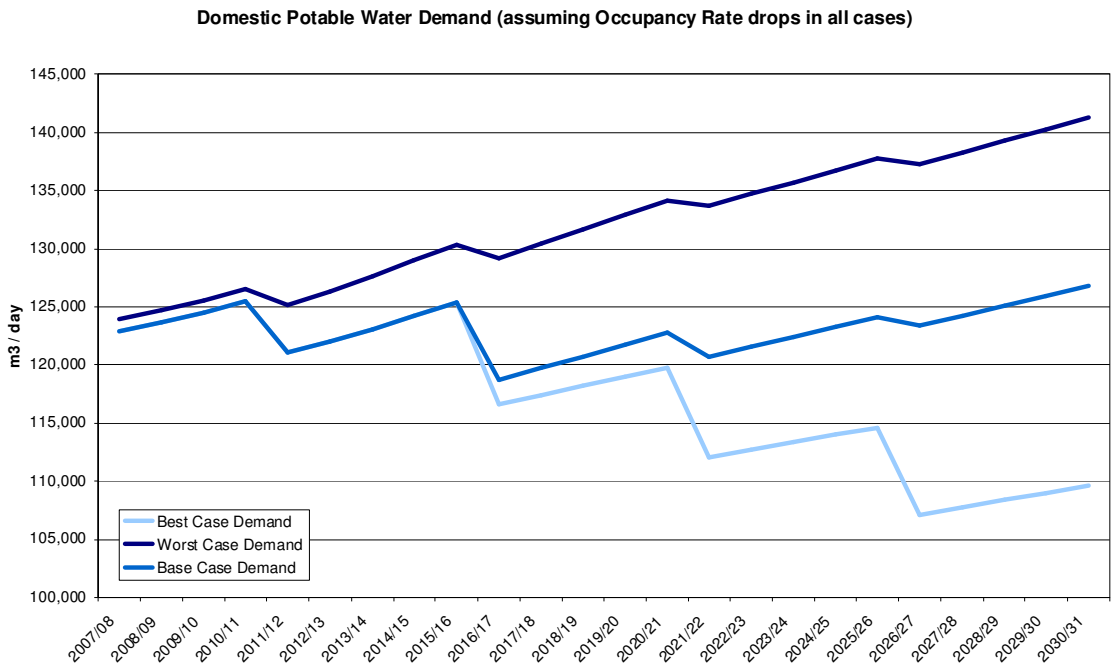


Figure 5-26 Estimated impacts of scenarios on potable water demand

Three scenarios are shown:

- **worst case** - where current consumption is taken forward to 2031;
- **base case** – where the minimum required consumption targets are taken to 2031, such as the expected change in building regulations and implementation of the level 3 code for sustainable homes (see Appendix D); and
- **best case** – where the consumption of all new developments is reduced in line with the code for sustainable homes level 6 (see Appendix D); and the consumption of existing properties is reduced to 130 l/p/d.

The graph shows that, for the base case, if all new developments are required to include some demand reducing measures, by 2031 around 14,000 m^3/day will be saved within the catchment compared to current consumption levels. If policies are included within certain LDF documents to reduce the consumption of new properties beyond current requirements, and if water companies reduce the consumption of their existing population base, additional savings at 2031 of 17,000 m^3/day will be seen. If a significant change is seen in the behaviour of the entire population of the catchment (and the best case consumption scenario is achieved), the total consumption of the catchment will actually reduce, despite the significant growth within the area.

This reiterates that **water efficiency and consumer education will be vital** in ensuring that the supply of water to the area will be sufficient for the long-term and that the surrounding environment will be protected against further increases in abstraction.

5.2.2 Demand Management Tools

In their new Water Resource Strategy, currently out for consultation, the EA recommends:

- Efficient use of water in all new homes with water efficiency set at 105 l/p/d (i.e. level 3/4 for water within Code for Sustainable Homes) or better;

- That all growth point plans liaise with water companies to ensure that company have the water resources and associated environmental infrastructure (such as new resources and adequate distribution) now, and in the future, to meet planned development;
- All new buildings, including flats, must be metered;
- Whenever possible developments should consider the benefits of rainwater harvesting and water recycling in new developments;
- Implementation of low water use landscaping and gardens; and
- Local Authorities to undertake their duties, as noted in the Water Act 2003 (part 3 sections 81 & 83), which states that 'the relevant authority must, where appropriate, take steps to encourage the conservation of water'.

Currently, 34% of TVW customers have water meters in their homes. By 2030, TVW have stated in their draft WRMP that they plan to accelerate the compulsory metering of the properties to 90% of their customer base. The draft WRMP also states that on average, once metered, customers use approximately 10-15% less water, although there is much debate within the water industry as to whether metering reduces consumption for all customers. Options such as seasonally adjustable charge rates, at times of water stress, have been deemed the fairest method of payment for water. This should raise the awareness of customers, by increasing the unit price of water during times of peak demand and reducing it correspondingly at all other times. The overall objective is that it would be cost neutral over the course of a year, but will have the effect of reducing peak demand, for uses such as garden watering, at times of greatest environmental stress.

5.2.3 Water Neutrality

The concept of offsetting the potable water demand from new development by increased water efficiency and reduced demand in existing buildings is referred to as water neutrality. This concept allows the new development to be served without impacting on water resources (and in some cases the strategic supply network).

Water neutrality allows water to remain in the environment for ecological and leisure purposes and negates the need for the development of new resources such as reservoirs. As the amount of water in the supply system is not increased, there are no increases in the energy (and hence carbon footprint) required to supply the water. Water neutrality also benefits sewerage and wastewater treatment, as the assets involved in these processes do not have to deal with increased flows from new development in the long term.

In 2007 the EA published a report[23] in partnership with Defra and Communities and Local Government on water neutrality in the Thames Gateway development area. The study showed it is possible to move towards water neutrality in the Thames Gateway by 2016 through a combination of measures including:

- Building new homes to higher standards of water efficiency;
- Improving the water efficiency of existing homes through retrofitting of water saving appliances;
- Metering of not only new but also existing homes;
- Introducing variable tariffs; and

[23] Towards water neutrality in the Thames Gateway, Environment Agency, November 2007

- Improving the water efficiency of non households.

Whilst there are differences between the Thames Gateway area and this study area, the demand management principles remain the same.

As illustrated in Section 5.2.1, if new properties achieve PCC equivalent to CSH Level 3 (105 l/p/d), existing properties achieve the reducing PCC rates predicted by TVW in their WRMP, and occupancy rates reduce as predicted, a significant amount of the new demand across all seven Local Authorities will be offset. However, water neutrality will not be achieved, as domestic demand will be nearly 4,000 m^3/day higher than 2007/08 levels by 2031.

Water neutrality would be achieved in the study area by a combination of new dwellings achieving PCC in line with CSH targets (i.e. 80 l/p/d by 2016) and existing properties achieving Defra's aspirational target of 130 l/p/d by 2030. As shown in Figure 5-26, if both of these efficiencies are fully achieved, the seven Local Authorities will go beyond water neutrality, with overall domestic demand reduced by over 13,000 m^3/day by 2031.

For this reason, water neutrality should always be an aim of Local Authorities, the water companies and developers. Fully achieving the CSH PCC targets, through measures such as rainwater harvesting and grey water reuse, and continuing to strive for Defra's aspirational target in existing properties of 130 l/p/d by 2031 will go a long way towards achieving water neutrality in the study area. Social housing, either under the management of the Local Authorities or Housing Associations, may present the best opportunity for the retrofitting of water efficient fittings. There may also be scope to make significant water savings at non-domestic premises under the management of the Local Authorities, other government organisations and water companies.

Using less water per person in this way will reduce the impact the new development has on the hydraulic capacity at Rye Meads WwTW, allowing more development to be catered for with the existing capacity, and preventing the need for a larger volumetric discharge consent prior to 2021. However, the WwTW may require additional treatment capacity to be constructed to ensure that the more concentrated incoming wastewater (from existing and new dwellings) is sufficiently treated to achieve the quality consent.]

The cost implications of achieving these ambitious PCC targets are discussed in the following section.

5.2.4 Cost Implications of the Code for Sustainable Homes

A study undertaken by the Environment Agency in 2007[24] assessed the cost implications of reducing consumption rates in line with the recommendations from the Code for Sustainable Homes. It highlighted that the costs of water saving measures only marginally increased through reducing consumption from the baseline of 150 l/p/d to 100 l/p/d. Further reductions to 80 l/p/d entail the installation of rainwater and grey water harvesting techniques, which significantly increased the overall expenditure. Also, these figures are based on the cost of installing the technologies at time of construction, rather than retrofitting to existing properties, which would be significantly more expensive.

The table below set out the broad costs per dwelling for each of the consumption rates that were assessed. The total costs and the difference between the consumption rate and the baseline were considered. The table also shows the reduced costs per dwelling that can be

[24] Assessing the cost of compliance with the Code for Sustainable Homes, Environment Agency, January 2007

achieved through VAT exclusion schemes, and through bulk purchasing discounts available to developers.

Scenario/Target level (litres/head/day)	Cost £ (inc VAT)	Extra over baseline	Cost £ (exc VAT)	Cost £ (exc VAT + 20% discount)
Baseline (150)	£508	£0	£432	£346
130	£677	£169	£576	£461
120	£697	£189	£593	£475
100	£792	£284	£674	£539
80	£3,737	£3,229	£3,180	£2,544

Figure 5-27 Extract from EA report (2007) estimating cost of achieving reduced PCC

The report also highlighted that over time, the capital cost of the fittings used to make such water savings is likely to reduce (as shown in Figure 5-28) due to the natural product life cycle and pricing strategies.

Scenario/Target level (litres/head/day)	Current cost of compliance (retail inc VAT)	Extra over baseline	2016 cost of compliance	
			Upper bound (best case)	Lower bound (worst case)
Baseline (150)	£508	£0	£406	£508
130	£677	£169	£406*	£615
120	£697	£189	£406*	£627
100	£792	£284	£406*	£687
80	£3,737	£3,229	£884	£2,543
*Upper bound meets discounted baseline				

Figure 5-28 Extract from EA report (2007) estimating cost reductions by 2016

The EA report demonstrates that in as little as 10 years, the costs of fitting devices (which will decrease the average household consumption rates to only 100 l/p/d) are likely to reduce to be the same as the current baseline case of 150 l/p/d. This shows that the cost of the water saving devices that can be installed into **new** properties are only slightly more expensive at present and are likely to significantly reduce in price in the coming years as the technology evolves and the uptake increases.

Also, these figures do not take into account the potential savings to customers due to reduced water bills. This additional benefit further reduces the long-term costs of introducing water efficiency measures.

The higher costs associated with retrofitting water efficiency measures to **existing** properties may be able to be met, either wholly or in part, by some form of grant scheme. Discussions between Central Government, Local Authorities and Water Companies will need to continue to determine the optimum methods to encourage water efficiency in existing properties.

5.2.5 Greenhouse Gas Implications of Water Resource Options

The carbon dioxide released from certain activities is becoming a key indicator of the sustainability of certain options. The Environment Agency have recently carried out a study[25] that looked into the greenhouse gas implications of a number of water resource options in line with the water companies draft water resource management plans. The study looked into both supply and demand options. The key outcomes of the study are that[25]:

- 89% of emissions in the water system can be attributed to 'water in the home'. This includes energy for heating water but excludes space/central heating. The remaining 11% of emissions originate from abstracting, treating and supplying water, and subsequent wastewater treatment;
- Simple demand management measures – particularly those that reduce hot water use – have significant potential to not only save water and save energy, but also to reduce the carbon footprint throughout the water system. Small actions by individuals could together result in a significant reduction in greenhouse gas emissions, with the added benefit of lower energy and water bills; and
- All new supply side infrastructure measures result in an increase in greenhouse gas emissions. Desalination has the greatest potential to increase emissions, followed by effluent re-use and reservoir options. However, a very wide range of emissions is associated with similar supply options, so to select the lowest carbon solution requires a scheme-by-scheme assessment.

5.3 Water Resources and Distribution Network

5.3.1 Resource Capacity

It is essential to consider whether the amount of water that is currently available will be sufficient following the period of sustained growth. TVW incorporate updated Source Reliable Output and Demand figures for the forecasting of water demand and resource availability at a Water Resource Zone level. These figures are continually updated to incorporate developments that may arise and are required to be published and consulted upon every five years. The draft WRMP indicates, that for the TVW Northern Water Resource Zone (with the current baseline water metering and water efficiency), there is likely to be **sufficient water to meet demand** for Stevenage, Harlow and other communities within the Rye Meads Catchment Water Cycle Strategy area, providing additional sustainability reductions for the current abstractions are not enforced. The implementation of further demand reductions or resource development options should not be required over the planning period (2010 – 2035).

The Supply-Demand balance for the Northern WRZ as set out in the draft WRMP for TVW for both Dry Year Annual Average and Dry Year Critical Period can be seen in Figure 5-29 and Figure 5-30. Both figures show the increase in Water Available for Use (WAFU) that TVW are expecting following the completion of a number of resource refurbishment schemes (within the conditions of existing licenses) towards the end of AMP 4.

Figure 5-29 shows that the target headroom at 2035 lies very close to the current baseline WAFU level based on annual average estimations.

[25] Greenhouse Gas Emissions of Water Supply and Demand Management Options, Environment Agency 2008

Both figures show a decrease in WAFU around 2015. This 15 Ml/d decrease is due to **sustainability reductions** that the EA have recently advised (following review of the draft WRMP 2008) will be required at two TVW abstraction points (on the Rivers Beane and Mimram). TVW are concerned that reductions in these abstractions will pass on higher costs to their customers as assets may be abandoned, other resources may need to be developed to ensure security of supply, and significant infrastructure will be required to maintain supplies. Also, more expensive water may have to imported further distances, further increasing costs.

The White Hall abstraction on the River Beane will have to be reduced by around 5 Ml/day. For this reason, TVW support further analysis into the effluent reuse on the River Beane, as discussed in the latter sections of this report.

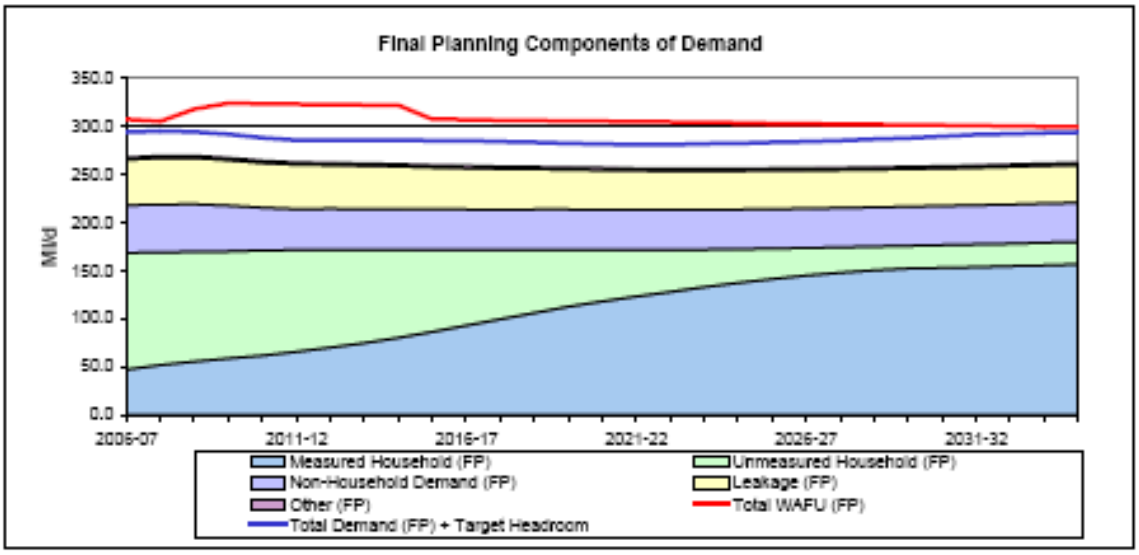


Figure 5-29 TVW Northern WRZ Dry Year Annual Average Supply-Demand Balance

(TVW Draft Water Resource Management Plan 2009)

The Dry Year Critical Period forecasts in Figure 5-30 show an improved availability of water against demand for the future of the WRZ until 2035.

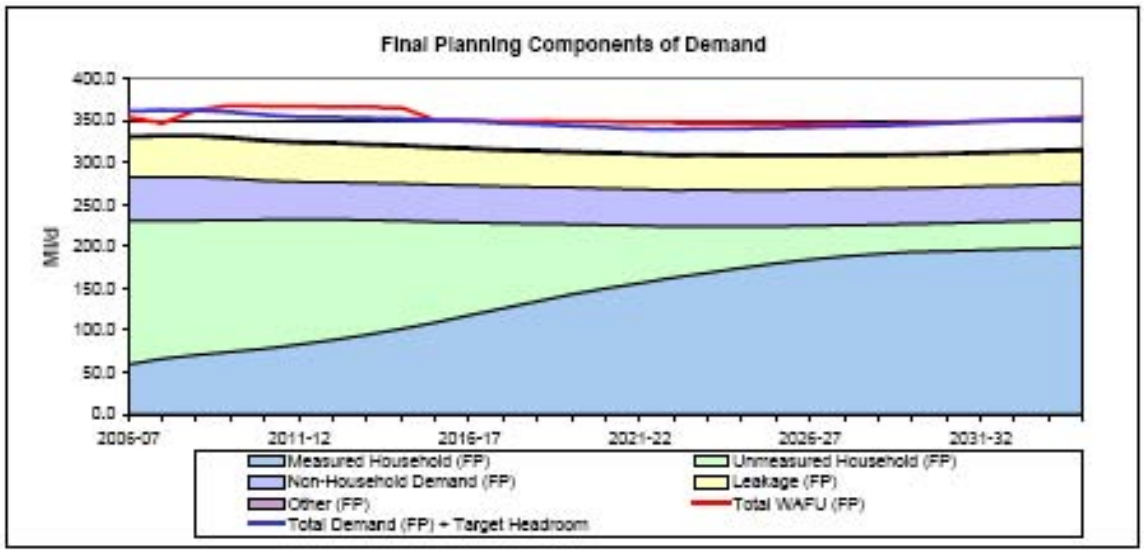


Figure 5-30 TVW Northern WRZ Dry Year Critical Period Supply-Demand Balance

(TVW Draft Water Resource Management Plan 2009)

The water supply will continue to be delivered from a combination of groundwater sources within the catchment as well as the import of surface water from Anglian Water Services.

The **validity of other current licence arrangements** within the catchment have been recently investigated by the EA as part of the Restoring Sustainable Abstraction programme. One investigation on the River Mimram concluded that the nearby TVW abstraction was having a detrimental effect on flows in the River Mimram. A series of further investigation were commissioned, including trial drilling and testing for alternative abstraction points in the area. The results so far have identified that there are few locations to which the abstraction source could be relocated, due to active quarrying in the region, historic landfilling and other land access issues. A site for a possible new source has been identified on the northern side of the valley near Tewin where land negotiations are nearing completion.

Sufficient time will be given to TVW to locate alternative sites if they are deemed to be contributing significantly to the low flows within the region, as these abstractions are for public water supply purposes.

The draft WRMP clearly states that the only further development of water resources within the TVW Northern WRZ is the confined chalk aquifer to the south east of Harlow. The amount of water available from this area is currently unknown, although studies are currently in hand to determine this. However, no additional water is envisaged to be available (or required) from this area until at least 2021.

However there is a risk to the WCS as the draft WRMP is currently out for consultation and it is possible that the final findings may be different from those highlighted within this report. TVW has assured that the supply demand balance will be maintained over the planning period as resource modeling factoring for the change in available resources is carried out. The water resources plan will be continually reviewed in 5 year periods to ensure the supply to customers without deterioration in levels of service.

The Upper Lee CAMS suggests, that due to the classification of the majority of the study area as **over-abstracted**, approximately 5 Ml/d is aimed to be recovered within the region during the first CAMS cycle by:

- Implementing the CAMS licensing policy alongside the existing policy;
- Carrying out investigations under AMP/RSAp schemes;
- Investigating the use of new powers granted under the Water Act 2003 for revoking unused licences; and
- Promoting water efficiency.

It is therefore highly unlikely that new licenses of significant volumes will be approved and any **new licenses will be given a time-limit** to promote the constant monitoring of abstraction within the area. TVW will have to take this into account when assessing the confined chalk aquifer mentioned above.

5.3.2 Water Supply Infrastructure Capacity

TVW has large diameter strategic mains that can be utilised to supply potable water to all development areas in the Rye Meads Catchment Water Cycle Strategy study area that falls within TVW's supply area. Provision of the necessary infrastructure to supply individual housing growth areas will be facilitated further by detailed network analysis to ensure that sufficient and suitable diameter mains extensions are provided from the strategic mains network to maintain minimum statutory flows and pressures at individual properties, both new and existing, at all times.

TVW have stated that there are no strategic water supply network restrictions that will prevent or defer the normal 'requisitioning' process beyond the length of time required to install and commission the necessary supply infrastructure utilising the current powers accorded to all water undertakers in England and Wales.

At a Water Resource Zone level, TVW have **no strategic supply network restrictions** that will prevent provision of suitable and sufficient water to existing properties whilst simultaneously providing for the growth in demand from the projected population and housing growth within the study area.

The provision of water supplies to new homes is subject to the requisitioning process described in sections 90 to 92 of the Water Act 2003 and will require the installation of new infrastructure to supply the new development. TVW have stated that their network modelling has identified the infrastructure required in the Northern WRZ and this includes distribution mains, boosters and a small covered treated water storage reservoir. TVW do not envisage any complications in funding these improvements through the developer requisition process. Depending on the size of the installation required, anything from one to five years will be needed for the planning and installation of connections for new strategic developments.

The difference between the costs of these upgrades (including reinforcement to the existing network to ensure adequate capacity) and the predicted revenue from the new customers can be passed onto developers using Requisitioning Agreements. The amount charged is referred to as the "relevant deficit", and can be paid over a 12 year period, or immediately following the work, one lump sum discounted to a net present value.

The provision of this infrastructure will be phased in accordance with the program of planning applications and subsequent requisitions recovered from developers. However, it is not envisaged from the information available that there are any significant engineering or planning issues, which may prevent the infrastructure being provided in a timely manner.

In conclusion, TVW should be consulted during the preliminary site selection process for those councils that have not yet selected their large strategic sites in order to ensure the supply of

water to these developments. This will enable TVW to plan upgrades in advance and decide whether the supply will be sustainable and achievable in the time required.

5.4 Sewerage Network and Wastewater Treatment

Table 5-15 below shows the consent requirements of the effluents from the main WwTWs within and surrounding the study catchment. There are a vast range of sizes of WwTW in the area, from very large works such as Deephams WwTW or Rye Meads WwTW, to small rural works such as Weston WwTW or Ashbrook WwTW.

	WwTW Name	Receiving Watercourse	2006 Population Equivalent	Consent SS/BOD/AMM/(P) (mg/l)	Consented Flow – Max or DWF (m^3/day)
Thames Water Utilities	Deephams	Salmons Brook	866,000	30/10/4	443,000 (max)
	Maple Lodge	Grand Union Canal/ Colne	495,000	15/15/1/1	390,000 (max)
	Rye Meads	**Toll House Stream**	**390,000**	**15/6/2/1**	**330,000 (max)**
	Blackbirds	Colne	102,000	10/7/1.4/1	122,000 (max)
	Bishops Stortford	Great Hallingbury Brook	56,200	22/9/2/	29,500
	Mill Green (Hatfield)	**Lee**	**19,670**	**20/10/5/2**	**11,450 (max)**
	Widford & Wareside	**Ash**	**3,071**	**20/10/3**	**1,569 (max)**
	Weston	**Weston Tributary**	**1,284**	**20/15**	**167**
	Little Hallingbury	**Little Hallingbury Brook**	**1,254**	**40/20/8**	**1,620 (max)**
	Whitwell	Mimram	976	20/20/10	399
	Thornwood	Cripsey Brook	742	45/20/6	666 (max)
	Chapmore End	Rib tributary	288	30/20	77
	Brickendon	Harmonds Brook West Arm	272	20/15	36
	Little Berkhamsted	Berkhamsted Brook	255	40/30/20	120 (max)
	Bramfield	Ground water	227	45/30/20	45
Anglian Water Services	Letchworth	Pix Brook	41,953	25/13/5/2	9,900
	Hitchin	Purwell	32,868	30/15/4/2	10,290
	Ashbrook	**Ash Brook**	**2,879**	**35/20/10**	**630**

Table 5-15 Volumetric and physio-chemical (numeric) discharge consents for WwTW in the Study Area

It has been assumed that a significant proportion of new developments within the study area will be drained to the Rye Meads WwTW; therefore, the volumetric capacity of the works has been considered. Deephams WwTW is further downstream in the catchment than Rye Meads

WwTW, and is therefore situated too far from the proposed development to be a viable alternative. The other treatment works within the catchment are unlikely to be able to accept significant additional flows from new developments due to their current size and consents.

Since late 2007, Rye Meads WwTW has also had to comply with upper tier limits on individual readings for some determinands. These are:

- BOD, 50 mg/l;
- Ammonia, as N, 20 mg/l (Nov—April); and
- Ammonia, as N, 12 mg/l (May—Oct).

Rye Meads WwTW operates a phosphorous removal process using chemical dosing, and is therefore subject to a consent limit of:

- 4 mg/l for iron; and
- 2 mg/l for aluminium.

5.4.1 Infrastructure Capacity (and Planned Upgrades)

Rye Meads WwTW

The Dry Weather Flow (DWF) received at the works is 77,582 m^3/day, based on 20 percentile flows from 2005 – 2007.

Throughout the winter months, Rye Meads WwTW receives contaminated surface water from Stansted airport, via a rising main and pumping station arrangement, often referred to as the Glycol main. This contaminated surface water originates from the de-icing processes undertaken at the airport. TWU have come to an agreement with BAA that the planned expansion at Stansted Airport will not result in a higher loading at the Rye Meads WwTW. A number of on site balancing ponds will continue to attenuate the contaminated surface water prior to it being conveyed to Rye Meads.

TWU constructed a wastewater transfer scheme from the Deephams WwTW catchment to Rye Meads WwTW, referred to as the Deephams Transfer Main (DTM) in 2004. The DTM delivers untreated wastewater from the Deephams catchment for treatment and discharge at Rye Meads WwTW. The purpose of the DTM is to increase available capacity at Deephams WwTW, and increase deployable output at surface water abstraction points further downstream on the River Lee, particularly during drought situations.

The DTM is planned to operate during times of drought, under a seasonal consent, delivering 25 Ml/d June to August, and 12.5 Ml/d September to May. An assumption is made by TWU that the reduced load from the DTM in the winter months is broadly equivalent to the additional load from the Glycol main. As this is a Regulatory Deployable Output, its potential partial or full close-down for whatever reason cannot be considered by TWU for the foreseeable future. The DTM discharges directly into the inlet works, rather than the inlet pumping station, and as such is not affected by the capacity issues at the inlet pumping station.

Best estimations, taking into account AMP 3 upgrades, indicate that the currently available domestic treatment capacity of the works is 404,815 PE plus an allowance of around 90,000 PE for the DTM and Glycol Main when operational. Therefore, compared with the current PE estimation of 390,000, the treatment capacity currently available for new development at Rye Meads WwTW is approximately 15,000 PE.

A rough calculation, assuming an average occupancy rate for the seven Local Authorities of 2.35 weighted by the proportion of remaining RSS allocations for each council, equates this 15,000 PE capacity to around **6,400 homes**. This assumes that none of the remaining capacity is taken up by an increase in infiltration or additional trade flows. Based on the predicted completion rates (within the Rye Meads catchment, see Appendix E), this equates to **less than 4 years** worth of residential development. However, by optimising the operational procedures at the WwTW the existing treatment capacity may be able to be extended further. The close down of a number of heavy water use businesses is anticipated by TWU in the catchment in locations such as Welwyn Hatfield and Stevenage. This will also serve to unlock some additional hydraulic and treatment capacity at the WwTW for future development.

However, it is **imperative** that TWU are successful in securing funds for capacity upgrades at Rye Meads in AMP5/ 6 to avoid the treatment capacity of the WwTW significantly constraining development. Any future reductions in PCC and occupancy rates in existing dwellings will release some hydraulic capacity at the WwTW, and therefore allow more new development to be connected to the Rye Meads network. Again, this highlights the importance of reducing water consumption in new and existing dwellings to optimise the capacity of existing water and wastewater infrastructure. However, decrease in flow volumes, whilst benefiting the components of the WwTW limited by hydraulics, such as the inlet works, do not affect the biological and chemical loading on the process components of the WwTW. Additional new population will increase the biological load and hence may require more treatment capacity to be constructed. In addition, the lower flows from existing dwellings will concentrate the wastewater, which may then require more rigorous treatment, again highlighting the importance of TWU securing funds for any necessary treatment upgrades.

Due to uncertainty over the definition of max flow, the volumetric discharge consent at Rye Meads WwTW will be expressed as DWF, from AMP 4 onwards. The new DWF consent is set by the EA as 110,000 m3/day, (one third of the original max flow consent).

Section 4.5.2 illustrated that; compared against the DWF consent of 110,000 m3/day, there appears to be **sufficient volumetric capacity** within the current consent for future growth, although this may be dependent on the operation of the DTM. The currently installed treatment capacity is significantly less than the current consent. The installed hydraulic capacity of the WwTW is currently limited by:

- The capacity of the inlet pumping station;
- Sizing of pipes between primary settlement tanks and the activated sludge process; and
- The actual capacity of the activated sludge process aeration lanes;

In addition, the robustness of the installed treatment capacity is reduced due to power supply issues (mains generation and standby) throughout the site.

TWU are currently in the process of finalising their business plan for the next AMP period. The proposals for **upgrades to Rye Meads** during AMP 5 are:

- Design effluent upgrades to increase capacity in AMP 6 and beyond;
- Upgrade power supply to address robustness issue and backup generator shortfall; and
- Investigate / implement more sustainable techniques for dealing with sludge (if prioritised by TWU Carbon Management Strategy)

Regarding possible upgrades to capacity in AMP 6, the schemes that TWU are suggesting will need to be investigated / designed during AMP 5 include:

- New inlet pumping station;

- New inlet works;
- A 5th (and possibly 6th) activated sludge stream, to be built on abandoned sludge drying area, to create additional capacity for 50,000 PE per stage, or 100,000 PE total by 2036;
- Additional storm and primary settlement tanks; and
- Thermal hydrolysis process for treating sludge.

These upgrades have the potential to increase the capacity of the works to allow for growth within the region however, the long-term sustainability of further upgrades to the system beyond 2021 and the potential ecological implications are of concern to the WCS stakeholder group. This is discussed further in Section 6.

Other Wastewater Treatment Works

An expansion of the **Mill Green WwTW** on the River Lee is currently being commissioned. TWU have advised that there is no additional capacity for further development remaining at Mill Green at present following the recent expansion and the transferral of a number of properties in Welwyn Garden City from the Rye Meads catchment. The removal of some of the properties in the south west of Welwyn Garden City alleviates the capacity issues along Boundary Lane/ Howlands as well as decreasing the number of properties connected to the Rye Meads network.

The potential to further upgrade existing WwTW within the study area is described in more detail in Section 6. A key concern of a number of WCS stakeholders is that the distance travelled by the wastewater through the sewerage system, in particular from Stevenage to Rye Meads WwTW, has unsustainable impacts on the environment, as it effectively removes water from the upper reaches of the river catchment. New, more localised WwTW should also be considered by this WCS, in addition to upgrading the existing WwTW, in order to mitigate this concern.

Sewerage Network

The sewerage network serving the Rye Meads catchment is known to be **close to capacity** at a number of locations such as in and around Stevenage and Harlow. TWU are aware of surcharging at some locations along the trunk sewers. Localised bottlenecks can also cause capacity issues within certain towns. In some cases, the local upgrades required to provide capacity in the network for new development sites will help alleviate local sewer flooding issues, although care must be taken to not pass the flooding issue downstream to other locations on the network.

Opportunities to combine sewerage upgrades for new development with the alleviation of current sewer flooding should be explored by the Local Authorities, water companies and developers during the planning process.

Figure 5-31 shows the utilisation of the existing sewer network. In simple terms, the darker the colour, the greater the relative usage of a particular sewer compared to one shown in a lighter colour. This figure illustrates that the local sewers in the built up areas tend to be more utilised on a frequent basis than the major trunk sewers, which by their nature are designed to carry much greater flows on a less frequent basis. The trunk sewers are also normally laid much deeper, which allows flow under surcharged conditions without causing physical flooding at the ground surface. It should be noted that the range of diurnal variation diminishes within the network as it gets closer to the WwTW and/or the further away from the source of the flow. Therefore, this figure illustrates the distribution of flow on frequency of pipe utilisation but is not an indication of the capacity of individual sewers to accept additional flow from new developments.

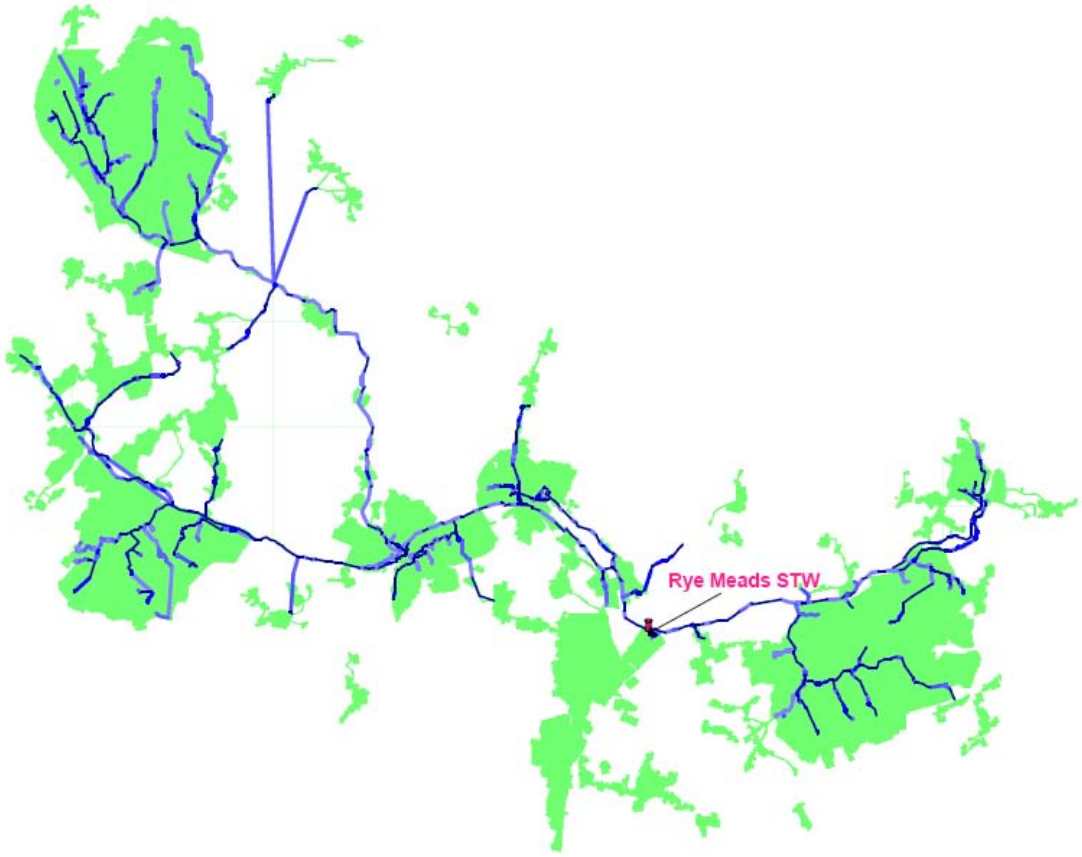


Figure 5-31 Utilisation of sewer network within the Rye Meads catchment

A number of upgrades to the current network have been completed by TWU, or are currently in the feasibility/ design stages.

TWU have recently completed and commissioned an upgrade to the sewerage network to the south east of **Welwyn Garden City**. This upgrade takes the wastewater from the south east of the urban area and routes it northeast to connect to the trunk sewer running from Welwyn to Hertford. The new outfall sewer has sufficient diameter and length to balance out the majority of flows from storm events. A flow control device is fitted at the intersection with the trunk main to allow further attenuation and reduce the impact on the trunk main. This upgrade has significantly increased the ability of the network to accept flows to the south east of Welwyn Garden City.

The feasibility of constructing a new storage tank has been assessed by TWU to alleviate local sewer capacity issues and potentially provide additional capacity for new development to the west of the town. This tank will balance storm surges from the western side of Stevenage and prevent flooding at the intersection between the western and eastern Stevenage outfall sewers. TWU have some flexibility to alter the size of this tank during the design stage to accommodate the flow from new developments to the north of Stevenage; however TWU state that due to uncertainty in the location and timing of developments no specific funding has been included in the PR09 business plan submission to Ofwat for the AMP5 planning period. The cross boundary issues, such as how TWU deal with sites within the AWS area will also need resolving as soon as possible to ensure that the appropriate funding is sought.

Network upgrades are planned in the east **Harlow** area in AMP 5, with more planned during AMP 6 to allow for further development to the north of Harlow. Network upgrades have been favoured over more localised treatment due to the proximity of the town to the Rye Meads WwTW as well as the poor quality of the receiving watercourses surrounding the town.

A new sewer is proposed running parallel to the existing sewer, but located south of the railway line. Once completed some existing flows will be re-connected to the new sewer and the two sewers will be used in combination to drain the catchment. This option has been planned with the known development locations in mind and therefore should, subject to further detailed discussions, be generally compatible with the phasing of developments. As well as the planned development within Harlow, this option will also increase the potential for some development within the town of Sawbridgeworth, as it is upstream of the trunk sewer.

Further details on options for development beyond the currently planned work by the water companies, and preferred strategy recommended by this WCS, are discussed in Sections 6 and 7.

5.4.2 Environmental Capacity

Increases in discharge can adversely impact downstream **water quality** and **flood risk**. However, as the base case scenario suggests that the increase in discharge at Rye Meads WwTW will be similar to the volumetric consent stipulated by the EA, it is considered that the discharge will not significantly alter flood risk downstream beyond that which is deemed acceptable under the current consent.

Providing the WwTW operates within the standards prescribed in its consent, for a discharge not exceeding its volumetric consent, the water quality of the River Lee at this point should not be significantly impacted.

However, the WFD, as described in 2.4.3, may require future changes in consent for the River Lee to achieve good status. This key risk is difficult to assess at this point, and will be further clarified in future cycles of the RBMP cycle. During consultations for this WCS, the EA advised TWU that; whilst they **cannot guarantee** consents would not become stricter, a new consent would not go beyond the best available technology (BAT) available to TWU at the time of consideration. The EA has indicated that any changes to the current volumetric and physio-chemical consent limits are unlikely before 2021, except for an administrative change in the near future to convert any maximum flow consents into DWF consents.

During storm events, the sewers in the catchment convey some storm water along with wastewater to Rye Meads WwTW. The works deals with this wastewater in the following way:

Wastewater Volume	Treatment
Up to 3 x DWF	Full treatment
Between 3 and 6 x DWF	Storage for full treatment after storm event
Above 6 x DWF	Screened and discharged to the River Stort

Table 5-16 Treatment of wastewater during storm events

To ensure that the proposed development does not increase the frequency and volume with which untreated wastewater is discharged to the Stort, sewage and storm water must be

separated at source. The utilisation of separate collection and drainage systems for new developments, incorporating SUDS, will prevent storm water entering the sewerage system.

5.5 Flood Risk

A **fundamental assumption** of this review for the Water Cycle Strategy is that; as requested in PPS25, new development will not increase or exacerbate flood risk across the region. This is especially important as the CFMP highlights the importance of a holistic approach to the management of surface water from new developments as the volumes and timings of contributions throughout the catchment are critical to the flood risk experienced further down the River Lee. The Environment Agency aspires to the achievement of Greenfield runoff rates for all developments, whether from Greenfield or Brownfield sites. This WCS fully supports this aspiration, and recommends that Local Authorities and developers take every opportunity to deal with surface water at source, and achieve runoff rates that are the same, (or preferably less) than before development.

5.5.1 Flood Risk Assessments

Each council when planning and designing new development must ensure that the development will not add to and should, where practicable, reduce flood risk. PPS25 should be adhered to in order that new development is steered to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers identifying locations for development and infrastructure, allocating land in spatial plans or determining applications for development at any particular location should consider sites in Flood Zone 2. This decision should take into account the flood risk vulnerability of land uses and apply the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3, again taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

Level 1 Strategic Flood Risk Assessments (SFRAs) have been completed by the respective councils for Stevenage, North Herts, East Herts, Welwyn Hatfield and Broxbourne areas. Harlow and Epping Forest are currently undertaking a sub-regional joint SFRA. A summary of the relevant key issues to the WCS study area is given below where SFRAs have been already completed.

Level 2 SFRAs will be required to apply the Exception Test should the Local Authorities choose to allocate residential development sites within areas of Flood Zone 3.

Stevenage SFRA

The Stevenage SFRA indicates two study areas where a detailed assessment of the implications of proposed development sites has been carried out.

The first of these study areas covers the **West of Stevenage** development site with approximately 5000 new dwellings in three interlinked villages. It indicates that the topography contains a ridge running through the centre of the area which marks the boundary of the Thames/Anglian catchments. The SFRA highlights that the geology is mainly impermeable glacial clay which causes high surface water runoff until the chalk strata is reached where the water is intercepted. The Eastern side of the site drains to the catchment of the Stevenage Brook on the other side of the motorway, which could create a significant obstruction to flow. The SFRA maintains that no part of the West of Stevenage area is subject to any significant risk of flooding or water logging but highlights the need for adequate surface water drainage systems that are designed to appropriate standards. It also states that temporary storage in public spaces may need to be required to attenuate peak runoff as substantial runoff from an

increase in impermeable surfaces has the potential to cause significant increases in flooding downstream. The Western side of the development area drains to Langley Brook which is a short channel that rises in Knebworth woods and flows North West. The main constriction of the Langley Brook is the swallow hole located to the south of Little Almshoe. The SFRA states that for the majority of its length, the Langley Brook has a well defined stream channel and that the swallow hole is capable of receiving all flows from Langley Brook. Overland flow downstream of the swallow hole occurred in July 2007 for the first time in 15 years and the SFRA states that unattenuated discharges could cause this to happen more frequently and also have the potential to impact the quality of the water in the downstream aquifer.

The **North of Stevenage** development site is the second of the two study areas in the Stevenage SFRA. It is also bisected by the Anglian/Thames catchment boundary. The geology of this site is predominantly exposed chalk. The Eastern half of the site drains to the Stevenage Brook. An increasing in urbanisation will lead to a reduction in infiltration and will also increase the amount of water in the surface water system. The Western half drains to the headwaters of the Ash Brook.

The key recommendations from the SFRA include:

- The need for Thames Water (in conjunction with asset owners and the EA) to undertake the comprehensive hydraulic modelling of Stevenage's surface water sewerage system at an early date;
- In those areas of the Borough where there appear to be significant surface water flooding issues, the Council, in conjunction with the Environment Agency, should consider the implementation of a Surface Water Management Plan for that area; and
- The Borough Council should adopt the flood risk alleviation measures described in the SFRA for dealing with applications for planning consent from prospective developers.

NHDC SFRA

The North Herts SFRA, published in 2008, raises some issues for the WCS study area. It describes the interconnectivity between the groundwater and surface water to the west of Stevenage as complex, and that as this area is the source of the Ash Brook/ River Purwell, monitoring should be undertaken as part of site specific FRA to ensure surface water runoff does not increase flood risk on the River Purwell.

The SFRA also details the current relatively high flood risk to properties on the southern periphery of Hitchin, due to road and railway culverts causing the River Purwell and Ash Brook to back up during storm events. Properties in this location are estimated to have a level of protection of between 1 in 20-50 years. Increases in the volume of discharged effluent from Ashbrook WwTW (possibly from the northern Stevenage development sites) would have to be carefully mitigated to ensure that this flood risk is not exacerbated.

EHDC SFRA

The East Herts SFRA, also published in 2008, illustrates a number of historic flood events arising from watercourses in the town of Hertford. These events are clustered around the confluence of the Rivers Beane and Lee. A similar cluster of events can be seen at Watton-at-Stone, near the confluence of the River Beane and Stevenage Brook. The towns of Hertford and Ware are particularly at risk due to the convergence of five rivers in their general vicinity.

Any increase of discharges to these watercourses, and the management of surface water from development in these areas, should be carefully managed by EHDC, (following guidance in their SFRA) to ensure that the flood risk is not exacerbated.

Broxbourne SFRA

The Broxbourne Borough SFRA (2007) has identified area at risk of flooding from watercourses and other causes. This document highlights the extensive culverting of watercourses (and lack of required maintenance to these culverts) as a primary source of risk within the Borough.

The SFRA should be used to steer development to areas with the lowest flood risk. The proposed growth within the Rye Meads catchment is unlikely to create a significant increase to flood risk in Broxbourne, as the River Lee (which receives the discharge from the Tollhouse Stream/ Rye Meads WwTW) has flood risk mitigated by a number of structures in this location, most notably the River Lee Flood Relief Channel and associated weirs/ sluices.

5.5.2 Surface Water Management

Surface water runoff arising from the new developments should be managed by SUDS systems that enable surface water to be controlled and re-introduced into the environment close to source. The type of SUDS systems adopted at each development area will depend upon local conditions and will range from infiltration systems to wetland areas and ponds draining to surface watercourses after attenuation. Storage of rainwater close to development will also enable water reuse options to be adopted, and an integrated water reuse and surface water management system could help reduce water demand whilst minimising environmental impacts.

The nature of the geology in the area indicates that infiltration systems will often be feasible and where this is so they should be encouraged as a means of reducing impacts on groundwater recharge. Declining recharge has already been identified as one of the issues causing low flows in watercourses maintained by groundwater, and is one measure by which the impact of transferring water out of the River Beane catchment via the formal drainage system can be avoided. The North Hertfordshire SFRA has identified the capacity for infiltration systems in the North Herts area (see Section 9.1.2 for relevant extracts).

In other areas infiltration may not be possible, either because of poor permeability of superficial deposits or concerns regarding groundwater quality impacts. In these areas SUDS will still be possible but will need to be based on surface water attenuation systems, supported by local reuse schemes, using green roofs for instance.

The widespread use of SUDS systems and construction of dedicated surface water drainage systems discharging to watercourses will reduce the discharge of rainwater to the sewerage system and hence reduce impacts on capacity at treatment works. Whilst Building Regulations should ensure that all new sewerage is separate, experience has shown that the impact of wet weather on foul water discharges cannot be completely eradicated: some rainwater will always gain access to the sewerage system either through wrongly made, or unauthorised connections, and infiltration through damaged/ deteriorated pipe work.

Whilst assumptions on treatment capacity will be based on dry weather flow, allowance for some increase above this as a result of surface water drainage will still be necessary, despite widespread use of SUDS.

5.5.3 Need for Surface Water Management Plans

A Surface Water Management Plan (SWMP) is recommended in PPS25 and Defra's Future Water consultation where drainage issues are critical.

Although surface drainage in most urban areas has not reached critical levels, the information collected for this report suggests that the extensive areas of Flood Zones 2 and 3 within urban

areas, in conjunction with the scale of planned city centre intensification proposals and urban extensions, would make the development of a SWMP beneficial.

A SWMP will assist in the assessment of flood risk across the study area to ensure that increased levels of development and also climate change do not have an adverse impact on flooding from surface water sources within the catchment. The SWMP may be produced as part of a Level 2 SFRA or WCS for each Local Authority or as a separate study, if this approach would be more appropriate or cost advantageous.

In addition, a SWMP would assist in maintaining, and improving water quality in the surrounding watercourses. With the advent of the WFD standards, this will become increasingly important, particularly for the following three Local Authorities.

Stevenage SWMP

There are a number of drivers within the information collected to date for Stevenage that suggest a SWMP would be a useful tool in addressing the potential risk of surface water flooding. These drivers include:

- The substantial amounts of urban and overland runoff into the storm (and inadvertently, the foul) sewer network, Stevenage Brook and the River Beane;
- The historical cases of localised flooding surrounding the Stevenage Brook;
- The large amounts of planned development and the effects of climate change which, unless managed appropriately, may cause increased surface runoff;
- The impacts of surface water across the catchment boundaries to the north of Stevenage; and
- The quality and efficiency of the aging network of surface water reservoirs around Stevenage, and the associated maintenance requirements.

Harlow SWMP

A SWMP for Harlow should be required to assess and manage the impacts of:

- Large developments on greenfield land that contain a number of small watercourses;
- The policies contained in the CFMP that highlight the need to further attenuate peak flows within the Middle Lee area in order to reduce flood risk downstream;
- Sporadic flash flooding of parts of Hunsdon Mead SSSI from surface water from Canon's Brook during the summer; and
- Development proposals and climate change on the existing storm and foul sewers within urban areas.

Flash flooding of a number of properties and streets in the southern area of Harlow occurred during the summer of 2006 due to extreme rainfall events overwhelming the drainage system. This highlights the need for a SWMP for Harlow (in partnership with EFDC), should development go ahead in this area (as an urban extension into Epping Forest District).

East Herts SWMP

Hertford and Ware are two major towns with significant areas within flood zones. A SWMP would enable a better understanding of how to manage the combined flood risk from urban runoff and the five rivers which converge in this area.

5.6 Environmental Opportunities

5.6.1 Green Infrastructure Strategy

A Green Infrastructure Strategy such as the one already completed in Harlow is recommended for each major urban settlement to ensure that growth is accompanied by the protection and provision of quality green infrastructure. From previous experiences, there are six guiding principles for the strategy:

- Connectivity;
- Multi-functionality;
- Extended access;
- Landscape character enhancement;
- Biodiversity enhancement; and
- Landmark projects.

A further recommendation, as described above, is that SUDS should be utilised in support of all aspects and opportunities for new developments. Active engagement in this by Local Authorities should be widely encouraged.

There are considerable opportunities to contribute to both the biodiversity and surface water management if development sites are planned accordingly and allow the connectivity of the green grid to existing green and blue (water related) corridors.

The full integration of water management needs within the emerging plan should be considered. Examples of such opportunities are rainwater and grey water recycling, incorporation of green roofs, permeable pavements and swales and seeking opportunities for floodplain restoration by setting back development. Retrofitting of such measures may also help to relieve some pressure on the overloaded foul sewer system (which is subject to an element of surface water inflow in times of storm) within the town centre areas whilst providing more resilience against future risks such as climate change.

5.6.2 River Beane Improvements

The river water quality of the River Beane varies along its length. Generally the physio-chemical and biological water quality results for the upper part of the river range between “good” and “fairly good” and the river is compliant with its RE target. However, there have been “significant failures” in the lower sections of the river, downstream of its confluence with Stevenage Brook.

The graph below is a representation of the flows within the River Beane at its confluence with the River Lee at Hartham Common and the respective water quality compliance at the same point. As can be seen the periods of lowest flow during 1997-1999 and 2005-2006 correspond to the periods where the quality of water within the river were lowest. The source of this deterioration is not clear at present, but it may be the lack of turbulence and therefore re-aeration, caused by the low flow resulting in reduced levels of dissolved oxygen in the watercourse. Also, when flows are low, the urban runoff from Stevenage is less diluted and may cause a greater reduction in river quality on the Beane than under average flow conditions.

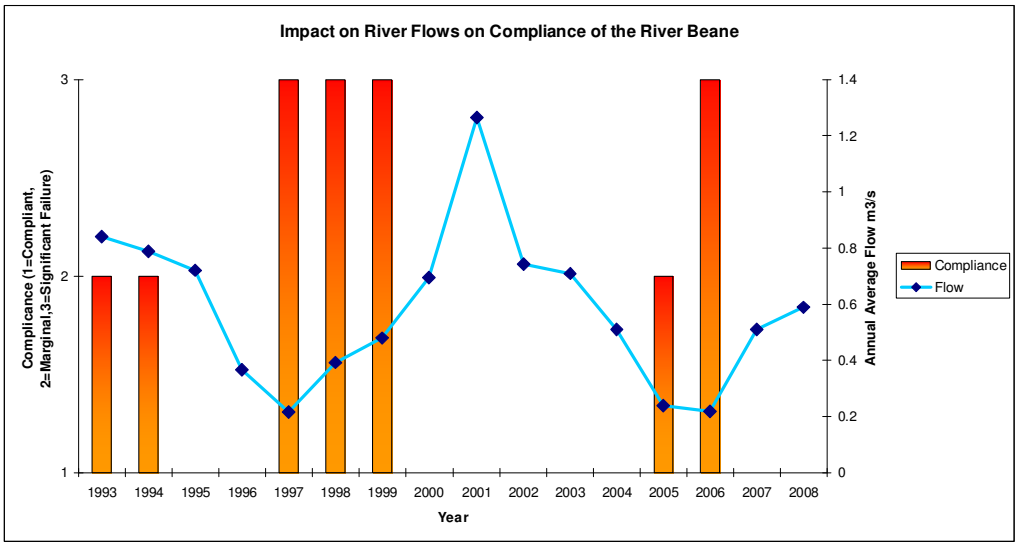


Figure 5-32 Relationship between flow and quality compliance for the River Beane

The graph implies that with an increase in water flow, the risk of the river failing its quality targets has the potential to be reduced, as long as the quality of the water being added to the river is sufficient enough to not cause a reduction in quality during periods where flows are naturally low.

5.7 Catchment Capacity Summary

Some locations within the study area are in areas of relatively high **flood risk**; however development should be planned in accordance with PPS25 and local SFRA. This will ensure that flood risk is not exacerbated. Whilst Rye Meads WwTW continues to operate within its existing volumetric discharge consent, it is considered that the new effluent flows (associated with new sewage from the additional development) will not significantly worsen downstream flood risk. Should Rye Meads WwTW require an increase in its consented discharge quantity, the impact of this on downstream flood risk should be assessed by the EA and TWU and mitigated accordingly.

Local Authorities within the Rye Meads study area should find that potable **water supply** does not significantly constrain development. This is mainly because TVW are confident that a twin track approach incorporating resource development and demand management should provide sufficient supply for existing and new customers. Localised upgrades may be required for specific sites, but the planning and funding of these will arise through the regular process (i.e. requisitions from developers). However, the security of supply does require ambitious increases in water efficiency in new and existing dwellings. Local Authorities should require all developers to install fittings to meet, as a minimum, the PCC rates described in the CSH Level 3.

Fully achieving the PCC targets in the CSH for new properties, and aiming for existing properties to meet Defra's aspirational PCC target of 130 l/p/d, would allow **water neutrality** to be achieved within the study area, although it is recognised that there are cost and behavioural issues (particularly in existing properties) associated with such reductions.

Consumer education, through either the water companies and/or the Local Authorities, will therefore be key to ensuring that these ambitious reductions in PCC are met.

Provided that these minimum efficiencies recommended (base case) are realised, Rye Meads WwTW should be capable of treating the **wastewater** from the majority of development (as quantified in Section 3.5), without requiring an amendment to its existing volumetric discharge

consent prior to **2021**. Upgrades to the works will be required in AMP 5 and AMP 6 to achieve the increased treatment capacity and ensure the required effluent standards, in terms of physio-chemical and biological determinands, continue to be met. TWU have already determined the upgrades required, and providing funding is made available, this should not constrain development.

Between 2021 and 2031 Rye Meads WwTW may be approaching its volumetric consent limit, although this will be dependent on future changes in occupancy rates, the operation of the DTM and the realisation, or not, of the development within the catchment. This will also be dependent on achieving the water efficiency targets and the water neutrality aspirations (i.e. better than base case) described in this WCS. However, there is still a risk that a stricter discharge consent may be imposed by the EA to achieve the higher water quality and ecological standards required by the WFD.

The **sewerage network** in the catchment is known to be at, or approaching, capacity in certain locations. TWU are proposing a range of upgrades during AMP 5 and subsequent AMP periods to address these issues. Providing funding is made available, the sewerage network upgrades can be phased and sized to take account of the proposed development, and as such should not cause a major constraint.

Low flows in the rivers within the study area are detrimental to the ecology. Opportunities exist to improve this situation, whilst reducing the affect of the development on the Rye Meads WwTW and sewerage network. These options are described in Section 6.

6 Preliminary Optioneering

6.1 Methodology

This section seeks to further investigate a solution, or combination of solutions, for the catchment that will not only solve the wastewater treatment and sewerage issues but attempt to improve the environmental constraints that have been identified. It predominantly discusses wastewater treatment and related sewerage issues, as previous sections highlighted that they are critical issues for the Rye Meads catchment that require a considerable amount of investigation.

The optioneering process will:

- Assess the available technologies for wastewater treatment;
- Identify locations where options could be situated; and
- Select the most feasible options that will contribute towards a positive overall effect.

This high level assessment aims to reduce the number of options in order to concentrate analysis on those options that have the largest positive effect on the catchment.

6.2 Wastewater Treatment Technologies

There are a number of available technologies for the treatment of wastewater. The choice of the treatment process is dependent on a number of factors; such as approximate population, required effluent consent and available funding. The following table provides a very brief overview of the available technologies and sets out the broad advantages and disadvantages of each of the solutions. Within the study area of this WCS there may be opportunities to upgrade or introduce new treatment processes.

Treatment Process	Description	Issues	Advantages
Reed beds	Screened wastewater flows through the root system of a bed of reeds PE <50 for wastewater treatment, PE <2000 for tertiary treatment	Significant land required Constant loading required Winter die-back can make the achievement of required consents inconsistent	Low capital investment required Can be used for tertiary treatment of effluents
Rotating Biological Contactor	Small scale treatment method where organic matter is aerobically digested on the surface of paddles PE = 100-2000	High maintenance required Only works within specified flow ranges	Multiple units can be used in parallel for phased upgrades
Aerated Lagoons	Oxygen provided to large ponds of screened wastewater to treat effluent PE ~<2000	Significant land required Reduced efficiency rates in winter Odour issues	Can be wind powered to reduce operating costs Little sludge produced Lower capital costs
Membrane Bio Reactor	Physical permeable barrier used to trap solids and nutrients PE = 50+ (can be upgraded in stages)	High operating costs High capital cost	High quality of effluent achievable Low tank volume required
Trickling Filter	Screened wastewater passed through filter media with biological film to digest organic matter PE = small-medium sized communities	Additional treatment may be required Risk of clogging Affected by cold weather Difficulty in achieving low ammonia loads	Simple, reliable biological process Low power requirements Relatively small land requirements
Activated Sludge Plant	Provides oxygen to bacteria that feed on organic matter within wastewater PE ~ medium-large communities	Large quantities of sludge produced Constant monitoring required High power costs	High quality treatment available Well established technology
Advanced Aeration	Liquids and solids treated in tandem through microbiological process and aeration; bubbles created in a partial vacuum, to have a higher surface area, which increases the performance of the aerobic bacteria PE = full range of applications and sizes	Power requirement may still be higher than other methods e.g. trickling filter	High quality treatment available Low odour Low sludge production Significant reduction in energy consumption compared to traditional ASP

Table 6-17 Methods of wastewater treatment

6.3 WwTW Location Options

This section will identify sites where potential upgrades, or new treatment works, could be located within the catchment, and will assess them against the current and future constraints on the environment and infrastructure. The broad locations of the various options in relation to the study area can be seen in Figure 2-3 (on page 12). The high level analysis of options has been carried out in the form the following matrix, which plots the options against the catchment constraints.

Key		**Constraints**								
Option Screening		*River Quality Issues*	*RSAp Low Flow Rivers*	*Sewerage Capacity Issues*	*Groundwater Levels*	*Designated Conservation Sites*	*Surface Water Flooding*	*River Flooding*	*Rye Meads WwTW capacity*	*Proximity to development and phasing*
	To be analysed further									
	Unfeasible options									
Constraints Analysis										
✓	Potential to have positive impact									
/	Mitigation Required									
✗	Potential to have negative impact									
●	Little/No Impact									
Options										
WwTW Upgrades										
Rye Meads WwTW		/	●	/	●	✗	●	/	✓	●
Ash Brook WwTW		/	●	✓	●	●	●	/	✓	✓
Letchworth/Hitchin WwTW		/	●	✓	●	●	●	/	✓	✗
Other Rural WwTWs*		/	✓	●	✓	●	●	/	✓	✗
New WwTW										
Beane		/	✓	✓	✓	●	●	/	✓	✓
Mimram		/	✓	✓	✓	✗	●	/	✓	✗
Lee		/	●	●	●	✗	●	✗	✓	●
Cripsey Brook		/	●	✓	●	●	●	/	✓	✗
Stort		✗	●	●	✓	✗	●	✗	✓	✓
Local Reed Bed Filters*		✓	●	●	✓	●	✓	✓	●	✗

** Upgrading the existing small rural WwTW, and providing small scale new development sites (around 50 PE) with reed bed filters are, by their nature, unfeasible solutions to the large amount of proposed growth. However, they may be suitable for isolated pockets of development, and should be considered by the Local Authorities and TWU should such sites be proposed.*

Table 6-18 Optioneering Matrix

The following text gives a description of the option followed by the key outcomes from the matrix analysis showing the:

✕ Critical constraints;

Areas where mitigation will be required; and

✔ Catchment benefits.

6.3.1 WwTW Upgrades

Rye Meads

This option considers a large-scale upgrade of the Rye Meads WwTW.

✕ As described previously, TWU are proposing that process upgrades are built on abandoned sludge drying areas, and as such, the upgrades will not adversely affect the neighbouring SSSI. However, HMWT propose that the floristic nature of the Rye Meads Nature Reserve (and SSSI) can be adversely impacted by backing up of the nutrient rich Tollhouse Stream during periods of high discharge from the works[26]. Increasing flows through the WwTW may increase the frequency of this happening.

Also, there is some concern from the WCS stakeholders that solely relying on the wastewater treatment at Rye Meads WwTW is not the most sustainable solution in the long term, especially given the low flow issues in the upper reaches of the rivers in this catchment.

This option will also require widespread network upgrades, with the associated social, economical and environmental costs, to solve local capacity issues.

In order to convey the wastewater to Rye Meads WwTW, upgrades will be needed to the existing sewerage network. The trunk sewers border, and in certain locations, pass through, SSSI and other sensitive areas, so the environmental impacts of these upgrade works must be mitigated. As the WwTW is unlikely to require an increase in volumetric consent prior to 2031, it is considered that the River Lee can accommodate the currently consented discharge without significantly increasing flood risk or decreasing water quality. However, as discussed previously, changes to consents following the implementation of the WFD cannot be ruled out completely. Should a higher rate of discharge be required in the future, detailed hydraulic modelling of the Toll House Stream siphon under the River Stort, and the downstream reaches of the River Lee, will be necessary to understand any possible increases in flood risk and ensure appropriate mitigation is put in place.

✔ Additional discharge at Rye Meads may allow increased abstraction further downstream on the River Lee.

Small upgrades to the WwTW are still likely to be required to meet short term increases in demand even if alternative wastewater treatment solutions are adopted in the longer term.

[26] Rye Meads Nature Reserve Management Plan, Herts and Middlesex Wildlife Trust, April 2008

Ashbrook

Located close to the planned urban extension to the West of Stevenage, Ashbrook WwTW has been highlighted as having the potential to be upgraded to accommodate wastewater from this development.

✗ Provided that it is technically/ economically viable for AWS to achieve the quality of discharge that the EA require at Ashbrook, and limit the effect of the increased discharge on the geomorphologic properties of the watercourse, there should be no other major constraints to this option.

/ Mitigation will be required against the risk of flooding and potential water quality concerns. Initial investigations have shown that the receiving watercourse has the capacity to receive additional flows and sufficient flood alleviation mechanisms can be put in place to attenuate flows in the Ash Brook.

✓ This option has the advantage of diverting new flows away from the “at capacity” Stevenage sewerage system and would prevent the need for significant pumping over the catchment threshold.

An upgrade to the Ashbrook WwTW could potentially be phased in line with the development but any work would require a significant amount of time to progress through planning and funding mechanisms.

Letchworth or Hitchin

This option deals with diverting flows from new developments to the existing treatment works at either Letchworth Garden City or Hitchin, which are managed by Anglian Water Services.

✗ Letchworth WwTW is approximately 13 km away from planned development to the north of Stevenage on the other side of Letchworth itself, and Hitchin WwTW is about 8 km away to the North West of Stevenage. Therefore, both would require significant lengths of trunk sewers and/or pumping mains to be constructed. The WCS stakeholders are concerned that the conveyance of wastewater over such long distances is not the most sustainable long-term solution for the catchment.

/ Mitigation will be required against the risk of flooding and potential water quality concerns.

✓ Both works have the capacity to receive some flows from development. However, septicity control would be required to mitigate against odour and corrosion to sewerage infrastructure due to the excessive pumping distances.

Rural WwTWs

There are a number of small-scale rural treatment works within the catchment that serve village communities. These treatment works have the potential for minor upgrades to increase capacity, providing an increase in consent can be established with the EA if required.

✗ Due to the nature of the villages that are served, large-scale housing developments are unlikely to be planned in many of the locations and therefore these do not play an important part in this study. Large increases in volumetric discharge consents would likely be accompanied by a tightening of the required consent standards, which may make some locations economically unachievable for the scale of development.

/ Mitigation will be required against the risk of flooding and potential water quality concerns

✔ These upgrades would increase the flows in local rivers and streams and ensure the availability of water resources downstream. Upgrading the smaller works with the latest technology may increase the quality of the discharged effluent, thus benefiting the ecology downstream.

6.3.2 New WwTW

River Beane

This option deals with a new WwTW on the River Beane. The location of the treatment works is still to be decided. A treatment works lower down the river would help less with the low flows upstream but has the potential to receive flows from a number of villages in East Herts as well as the development to the north of Stevenage. There is also the possibility of diverting flows from the eastern Stevenage outfall sewer to the new treatment works depending on capacity and flows.

✕ Provided that it is technically/ economically viable for TWU to achieve the quality of discharge that the EA require for a River Beane discharge, there should be no major constraints to this option, although acquiring suitable land and planning permission is a risk faced by TWU.

/ Mitigation will be required against the risk of flooding and potential water quality concerns. Further work would be required to ensure groundwater quality is not compromised by such a discharge.

✔ This option would introduce water back to the catchment locally rather than transporting it downstream to the Rye Meads WwTW, improving river flows in known low-flow stretches and potentially enhancing biodiversity. The treatment works, or associated discharge point, could lie upstream of a groundwater abstraction point that is used for public supply and so increase the availability of water.

River Mimram

This option could accommodate some growth within Welwyn Garden City and the surrounding areas.

✕ This option would be located close to the Tewinbury SSSI and could potentially have an impact on the wildlife there. Also, the River Mimram has the highest quality water (RE1) in the study area. Additional discharges into this watercourse would have to meet strict quality standards which may not be economically viable. It is likely that a WwTW located here would only treat a small proportion of the development, which may make the costs of achieving the high quality discharge standards appear disproportionate.

/ Mitigation will be required against the risk of flooding and potential water quality concerns. Natural England would need considerable reassurances that any such scheme would not adversely affect water levels and quality through the SSSI.

✔ This option would also introduce water back to the catchment locally rather than transporting it downstream to the Rye Meads WwTW, improving river flows in known low-flow stretches and potentially enhancing biodiversity. The treatment works could lie upstream of a groundwater abstraction point that is used for public supply and so increase the availability of water.

There is also a treatment works adjacent to Welwyn Garden City already on the River Lee and therefore this option is not as sustainable as improving the situation elsewhere in the catchment

River Lee

The option for a new WwTW on the River Lee close to the towns of Hertford and Ware has also been considered.

✗ Due to the complexity of the sewerage network, the proximity to existing developments and the significant areas of flooding within the area, this option was deemed to be unfeasible at reasonable cost.

Mitigation will be required against the risk of flooding and potential water quality concerns.

✓ This option will help to solve localised sewer flooding issues along the River Lee. It also has the potential to reduce the existing load at Rye Meads WwTW and hence release additional capacity to treat wastewater from future development.

Cripsey Brook

This option has the potential to divert flows from development around Harlow away from the Rye Meads catchment.

✗ It has been suggested that the quality of the receiving watercourse is not adequate enough for further effluent discharges due to the number of treatment works presently discharging to the river. Pumping would almost certainly be required to take flows from the planned development locations and therefore this option may entail a higher carbon cost than other options which rely solely on gravity. Any development to the north of Harlow would be costly to connect to a WwTW in this location, as new sewers would most likely be required around the periphery of the town.

Mitigation will be required against the risk of flooding and potential water quality concerns.

✓ This option will help to solve localised sewer flooding issues within Harlow and prevent future flooding occurrences. It also has the potential to reduce the existing load on the Rye Meads WwTW, but not significantly.

The locality of Harlow to the treatment works also lends itself naturally to being treated at Rye Meads; a new treatment works to the south of Harlow will not help to remedy any of the other problems within the catchment e.g. significant upgrades would still be required to the sewerage network around Stevenage.

River Stort

The River Stort to the north of Harlow is a divide between any proposed development to the north of Harlow and the town itself. A new treatment works has been considered on the River Stort due to this locality being close to the development.

✗ The River Stort currently receives effluent discharges upstream from WwTW in Bishops Stortford, Little Hallingbury, Takeley, Hatfield Heath, Stansted Mountfitchet, Clavering and Manuden, and a number of private WwTW. This has resulted in a reduction in quality standards and increased risk of RQO failure. Additional loading is expected at Bishops Stortford WwTW from the proposed expansion of Stansted airport, and from EHDC housing development. Also, a large proportion of the land close to the river and developments is within the flood plain and would therefore not be suitable for a new WwTW.

Mitigation will be required against the risk of flooding and potential water quality concerns, as some units of Hunsdon Mead SSSI are know to be adversely impacted by flooding with nutrient

rich water. Natural England would need considerable reassurances that any such scheme would not adversely affect water levels and quality through the SSSI.

✔ This option will help to solve localised sewer flooding issues within Harlow and prevent future flooding occurrences. It also has the potential to reduce the existing load on Rye Meads WwTW, but not significantly.

Rural Reed Bed Filters

This option considers the wide-spread use of reed beds as the main method of wastewater treatment for development sites within the catchment.

✘ The scope for the use of reed beds for the treatment of screened wastewater is fairly limited, as they are mostly suited to relatively small developments. Land availability will be an important issue with this option as the treatment works will need to be located with enough surrounding land available. Consistently achieving the required effluent consents can be impeded by winter die-back.

✔ This option will help to locally discharge to watercourses or groundwater, thus increasing the availability of water within the catchment. If used appropriately, reed beds can also help to reduce the risk of river and surface water flooding from new developments.

There is potential to incorporate reed beds as tertiary treatment systems for the new treatment works in the Beane valley in order to improve the effluent quality and attenuate the flood risk. Reed bed filters may be suitable for individual small (less than 50 PE) development sites, although the availability of land for a solution such as this would need to be assessed on a site-by-site basis.

6.4 WwTW Options Screening

The following options have been selected for further analysis, and the outcome of this assessment is presented in Section 7. It is essential that the options development process and the recommended detailed strategy should consider:

- The capacity of the quality of the receiving water to accept an increase in effluent discharges, (or the impact on water quality from extra effluent discharges);
- The hydraulic capacity of the receiving watercourse;
- The potential increase in downstream flood risk from the increased flows;
- The potential ecological and geomorphological impacts on the receiving watercourses;
- The likely timescale for upgrades to commence;
- The approximate capital investment required; and
- The overall sustainability.

Ashbrook WwTW Upgrade

An upgrade to the Ashbrook WwTW has been selected as a potential solution because it:

- Is located close to planned major developments;
- Would minimise the need for pumping wastewater;
- Has sufficient land for upgrade works;
- Would not directly affect any SSSI; and

- Has the potential to significantly reduce the pressure on the sewerage system in Stevenage.

New WwTW on the River Beane

A new WwTW on the River Beane has been selected as a potential solution because it:

- Would increase the sustainability of infrastructure within the catchment through localised discharges;
- Is located close to planned major developments;
- Has sufficient land for upgrade works outside of the flood plain; although ownership of the land has to be considered;
- Would not directly affect any SSSI; and
- Has the potential to significantly reduce the pressure on the sewerage system in Stevenage.

Hitchin/ Letchworth WwTW upgrade

The creation of new trunk sewer from the Stevenage development areas to the AWS WwTW at either Hitchin or Letchworth has been selected as a potential solution because it:

- Is located closer (than Rye Meads WwTW) to planned major developments around Stevenage;
- May allow some synergy between development in Stevenage and North Herts, as NHDC are considering both locations for development;
- May require less stringent discharge quality than the Ashbrook option, due to the higher dilution available from the watercourses;
- Would not directly affect any SSSI; and
- Has the potential to significantly reduce the pressure on the sewerage system in Stevenage.

Rye Meads WwTW upgrade

Upgrading the existing WwTW, and associated sewerage network, has been selected as a potential solution because it:

- Allows some development to be connected in the short to medium term;
- Will require a shorter planning period than a new WwTW;
- Does not rely on suitable land becoming available to either TWU or AWS; and
- Utilises an existing discharge consent, which provides more certainty when compared with other options.

6.5 Other Catchment Wide Strategic Opportunities

The following options consider the other strategic solutions for the catchment that are not related to wastewater treatment directly, but have the potential to influence the constraints within the catchment.

6.5.1 Reduce Abstraction

Ongoing studies are being carried out as part of the EA's Restoring Sustainable Abstraction programme to look into changing the quantity and location of abstraction points on the rivers Beane and Mimram. Trial boreholes are planned to consider the effects of reducing abstractions. Increased flows in the watercourses should help to achieve good status as required under the WFD.

6.5.2 Develop Outside of Catchment

The councils that are still considering the preferred options for development locations have the opportunity to promote locations outside of the Rye Meads WwTW catchment (most notably Welwyn Hatfield and East Herts). This will help to reduce the increase needed in treatment capacity at Rye Meads, as well as relieving the potential network capacity issues. The extent to which development can be located outside the catchment will depend on a range of planning factors, such as the availability of sites, and critical infrastructure (including water). By definition, considering the implications of this development on water infrastructure outside of the catchment is outside of the scope of the Rye Meads WCS. However, the implications of the WFD and other pressures on development will apply to all WwTW catchment areas, so an integrated approach will be required between this WCS and those completed for other catchments bordering the study area in the future.

The relatively large size of the Rye Meads works compared to other WwTW in the surrounding area means that the impact of development may be less. For any given development site the increase in loading, as a percentage of total load already received, will be less at Rye Meads when compared to a smaller WwTW.

Therefore, EHDC and WHDC should continue to consult with the water companies and EA to ensure the most sustainable development options are taken forward in their respective areas, whilst taking account of the water infrastructure capacity of all the catchments that could potentially serve their areas.

6.5.3 SUDS (new/retrofit)

Local Authorities and developers should aim for SUDS to be integrated into all developments. Surface water drainage should not be connected to the sewer network. This will reduce the amount of surface water and sewer flooding, as runoff will be better attenuated. SUDS also have the potential to locally discharge good quality surface water into either the river system or the groundwater aquifer rather than the current system of discharging surface water into rivers (such as the Stevenage Brook) or conveying the flow to treatment works via the existing sewer system. The retrofitting of SUDS elements to existing developments should also be considered in order to attenuate the flashy runoff that is generally experienced through discharges from urban areas.

7 Development of the Preferred Strategy to address Key Strategic Constraints

7.1 Strategy context

Given that the optioneering process described in Section 6.3 ruled out a new WwTW in or around Welwyn Garden City, Hertford, Ware and Harlow, it is has been recognised that **Rye Meads WwTW** will continue to treat wastewater from these settlements, including that from new development sites (although upgrades to the works and associate sewerage network will be required). Strategies such as the CSH and the implementation of SUDS can reduce the amount of wastewater transported to Rye Meads, essentially unlocking the remaining treatment capacity for new development.

The other key options that remain for analysis concern the treatment of wastewater from the development in and around **Stevenage**, due to the limitations of the strategic sewers that convey flows from the town to Rye Meads WwTW. Altering the current regime, by treating this wastewater in a different location, such as in the Beane Valley or Anglian Water operational area, also unlocks capacity at Rye Meads WwTW (and in the sewer network) for development in the other Local Authority areas in addition to Stevenage. The discharge from this new treatment works (in the case of the Beane Valley) could be used to supplement low flows in the upper reaches of the Upper Lee catchment, providing that the quality of the discharge, and the dilution available, are sufficient to comply with the WFD whilst not significantly increasing flood risk during extreme weather conditions.

As described in Section 3.4.1, the required development in and around Stevenage, is around 23,500 new dwellings by 2031. Figure 7-33 below shows the AWS/ TWU boundary and the Stevenage development sites.

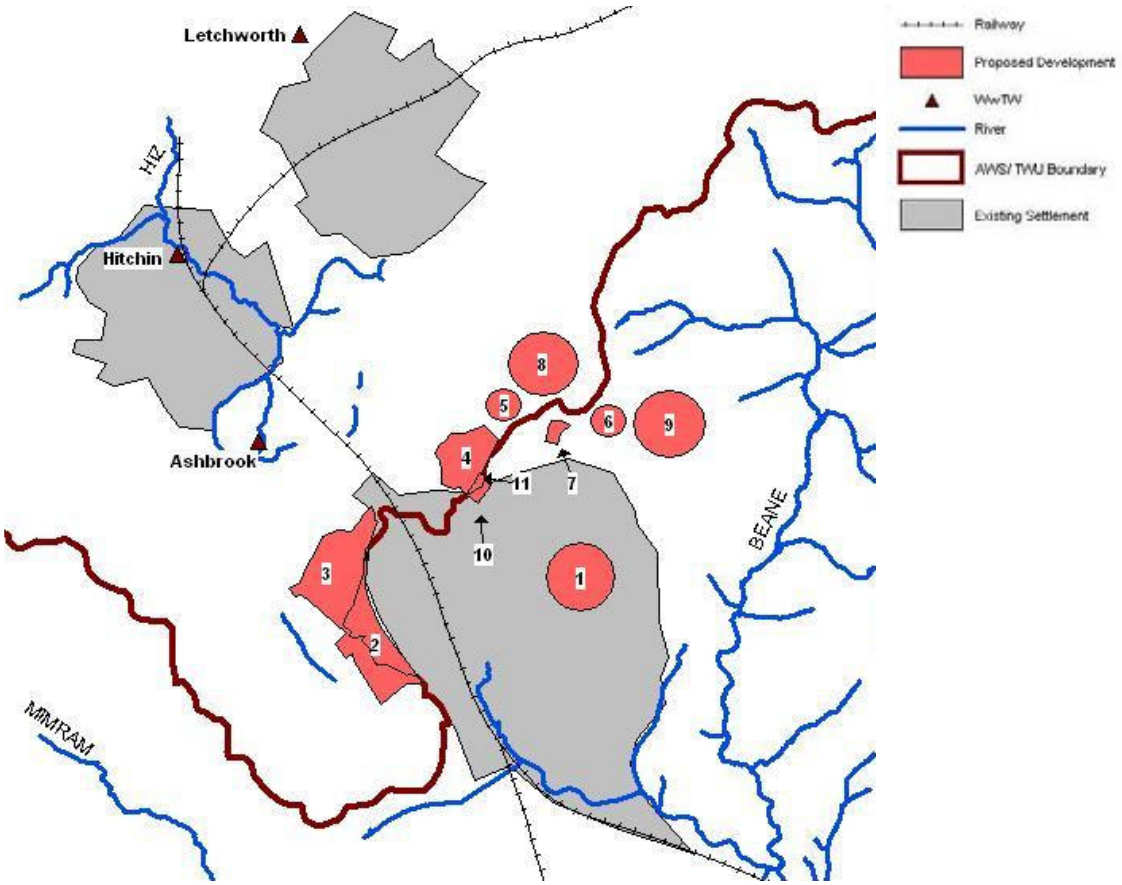


Figure 7-33 Development sites in and around Stevenage

Table 7-19 below illustrates the approximate number of dwellings envisioned in each area, following extensive consultation with SBC, AWS and TWU.

Site No	No of Dwellings	Period of development	Comments
1	5,422	Pre 2021	*Indicative location; development is required within urban area*
2	1,247	Pre 2021	*Proportion of 5,000 Stevenage West development in TWU area*
3	3,753	Pre 2021	*Proportion of 5,000 Stevenage West development in AWS area*
4	1,800	Pre 2021	
5	770	Pre 2021	*Indicative location; proportion of additional 1,540 required by 2021 in AWS area*
6	770	Pre 2021	*Indicative location; proportion of additional 1,540 required by 2021 in TWU area*
7	300	Pre 2021	
8	4,550	Post 2021	*Indicative location; proportion of additional 9,300 required by 2021 in AWS area*
9	4,750	Post 2021	*Indicative location; proportion of additional 9,300 required by 2021 in TWU area*
10	197	Post 2021	
11	103	Post 2021	

Table 7-19 Explanation of Stevenage development sites

The information presented above can be used to illustrate the distribution of development for the treatment and network options to be considered.

7.2 Thames Water Options

TWU have assessed the issue of the Stevenage development site using three separate scenarios. These scenarios describe the various combinations of development sites from which TWU may have to collect and treat wastewater.

The scenarios are:

Scenario Reference	Development Site Reference	Description
T1	1, 2, 6, 7, 9, 10	Sites which only lie within the TWU boundary
T2	1, 2, **3**, 6, 7, 9, 10	The above + all of **Stevenage West**
T3	All	All Stevenage development

Table 7-20 Scenarios considered by TWU

TWU have put forward a variety of possible solutions to collect and treat the wastewater from the above scenarios, as explained in subsequent sections

7.2.1 Upgrade Rye Meads WwTW

Proposed growth

The **worst case** growth scenario considered within this WCS, which includes Stevenage development in keeping with Scenario T3, predicts that the increase in DWF by 2031 will be around 25,000 m^3/day. This is without any reductions in per capita consumption in existing properties, and assumes that new buildings will only achieve a reduction to 125 l/p/d.

Under the expected **base case** variables, Rye Meads WwTW will be able to accommodate the flows from existing customers, the proposed growth, and the DTM, up to **2021**. However, the WwTW may just breach its DWF consent of 110,000 m3/day by 2031. (see Table 7-21)

Scenarios (see Section 4.4)	Existing DWF in 2008	2021 DWF net Increase	2031 DWF net Increase	DTM Summer Flow	Total DWF in 2021	Total DWF in 2031
	m3/day	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
Best		4,198	2,086		106,780	104,668
Base	77,582	5,384	10,677	25,000	107,966	113,259
Worse		15,439	25,332		118,021	127,914

Table 7-21 Impacts of growth on Rye Meads WwTW (with T3)

(Based on worst case catchment contribution, including TWU scenario T3)

The need for an increased DWF consent to account for additional growth to 2031 is a risk, as there can be no guarantees that such a consent would be granted, or that the quality of the discharge required would not be cost prohibitive, particularly given the emerging requirements of the WFD.

This risk can be mitigated during the full study period up to 2031 if less of the development is connected to the Rye Meads network, such as in TWU scenario T1, as demonstrated in Table 7-22 below. This will also result in significantly less network upgrade requirements within the Rye Meads catchment compared with scenario T3 above.

Scenarios (see Section 4.4)	Existing DWF in 2008	2021 DWF net Increase	2031 DWF net Increase	DTM Summer Flow	Total DWF in 2021	Total DWF in 2031
	m3/day	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
Best		2,570	-597		105,152	101,985
Base	77,582	3,454	7,362	25,000	106,036	109,724
Worse		13,045	21,176		115,627	123,758

Table 7-22 Impacts of growth on Rye Meads WwTW (with T1)

(Based on worst case catchment contribution, including TWU scenario T1)

Local Authorities who have not yet determined the location of development, such as Welwyn Hatfield and EHDC, can have a similar effect by choosing to develop outside the Rye Meads WwTW catchment, should the capacity of neighbouring catchments permit.

During the finalisation of this WCS, TVW revised the average PCC predictions for customers in their northern WRZ, however the calculations in this report were based on the 2008 figures. Whilst the revised PCC figures are higher than those used previously, the predicted decrease over the planning period (to 2031 and beyond) is larger. This results in an additional increase of approximately 500 m3/day by 2021, but an additional decrease of approximately 1,570 m3/day by 2031, in the DWF figures in Table 7-21 (worst case). As these differences do not significantly affect how the proposed flow relates to the consent at the two time intervals, they are deemed negligible.

Upgrades Required

TWU are proposing that Rye Meads WwTW can be suitably upgraded to accept flows from the development in the whole catchment, including the worst case contribution scenarios from all the Local Authorities as described in Section 3.5, by utilising existing land within the site boundary (without encroaching upon the SSSI area).

The process and network upgrades currently planned have been described in Section 5.4.1 of this report. Further potential upgrade options that have been investigated during the WCS development are described below. It should be noted that TWU anticipate having to construct some of the network upgrades, such as the Elder Way storage tank, and upsizing of the western Stevenage sewer, to accommodate the development within the urban areas of Stevenage (site 1), however these network upgrades have not been specifically included in Thames Water's PR09. Upgrading Rye Meads WwTW does not help to solve the low flow issues in the Upper Lee catchment. However, it is likely that the increased discharge on the River Lee, where dilution capacity is relatively high, will have less water quality and ecological impacts compared to discharging to rivers in the Anglian catchment, or the River Beane.

The network upgrade requirements and potential TWU options are further discussed in Section 8.

Also, TWU should continue to liaise with HMWT and NE to ensure that the interest of Rye Meads SSSI is not adversely impacted by the backing up of the Toll House Stream during storm events. As the discharge flow from Rye Meads WwTW approaches its consented volumetric limit, and given the implications of climate change, there is a risk that the backing up will occur more frequently and with higher severity. An assessment of the mitigation measures required in the future should be undertaken. This assessment should also consider the implications of a higher discharge on the water quality, and hence the ecology, within the lagoons.

7.2.2 New WwTW on River Beane

Current Proposal

At present it is anticipated that any Stevenage development site within the TWU boundary will be connected to the TWU network draining to Rye Meads WwTW. As stated previously, a key concern of the WCS stakeholders is the long distances travelled by wastewater to Rye Meads, given the low flows in upstream rivers in the catchment. A new WwTW on the River Beane has the potential to address this issue by supplementing the low flows with treated effluent, although it must be noted that some of the potable water, which results in this wastewater, is still transported long distances from the AWS Ruthamford WRZ.

Proposed growth

In order to assess the feasibility of this option, the proposed growth to be accepted at the Beane WwTW is assumed to be from all northern Stevenage sites. This corresponds with scenarios T3, as described in Table 7-20 equating to an approximate PE of 26,655.

Using variables from the **worst case scenario**, as described in Section 4.4.2, leads to the following results:

Scale of development for Beane WwTW	Stevenage Development Sites	New dwellings by 2031	PE at WwTW by 2031	DWF at WwTW by 2031
	Site No		*Based on 2.33 occupancy rate*	*m^3/day*
All northern Stevenage Sites *(see scenario T3)*	5, 6, 7, 8, 9, 10, 11	11,440	26,655	5,440

Table 7-23 Predicted worst case loading at a new WwTW on the River Beane

Benefits

This option localises discharge of treated effluent to the upper reaches of the Upper Lee catchment, addressing a key concern over low flows, which are known to negatively impact the ecology of the rivers.

As discussed previously, treating effluent from the development sites at this new WwTW will lessen the impact of the development on the existing TWU network and Rye Meads WwTW. The proposed discharge is similar to the sustainability reduction that the EA have imposed upon the TVW White Hall abstraction. The indirect reuse of this effluent for potable supply could mean that security of supply is not adversely affected by the proposed sustainability reductions.

Flood Risk

Historic flooding events, caused by occasional high flows in the River Beane, are recorded as affecting the villages of Walkern and Watton at Stone. Whilst the Beane is considered to be suffering low flows, extreme rainfall events can still lead to an increase in flood risk. This problem is intensified where the Bean converges with the Stevenage Brook, which is conveying runoff from the urban areas. If a new WwTW discharging into the Beane is constructed, mitigation will be required to control, and where possible reduce, flood risk.

Water Quality

Due to the low flows in the upper reaches of the River Beane; stringent consent limits may need to be applied to the WwTW in order to ensure the watercourse is able to achieve good status under the WFD. Through consultation with the EA, a set of indicative consent limits have been developed for a WwTW discharging to the River Beane upstream of its confluence with the Stevenage Brook.

Biochemical Oxygen Demand	Ammoniacal Nitrogen	Phosphorous
mg/l (95%ile)	*mg/l (95%ile)*	*mg/l (Annual Average)*
5	1	0.15

Table 7-24 Indicative consent for increased Beane WwTW discharge

It should be noted that this consent is indicative only, and further detailed investigation by the EA would be required prior to a Beane WwTW being approved. Achieving the 0.15 mg/l of phosphate as suggested in Table 7-24 may be disproportionately expensive when compared with the relatively small amount of PE at the works, and the alternative of using the Rye Meads system. TWU are concerned that the high costs may prevent funds being made available

through Ofwat. This option is also likely to have more planning risks and lead time implications for its implementation, resulting in a significant constraint to the proposed growth in Stevenage compared with other TWU options above.

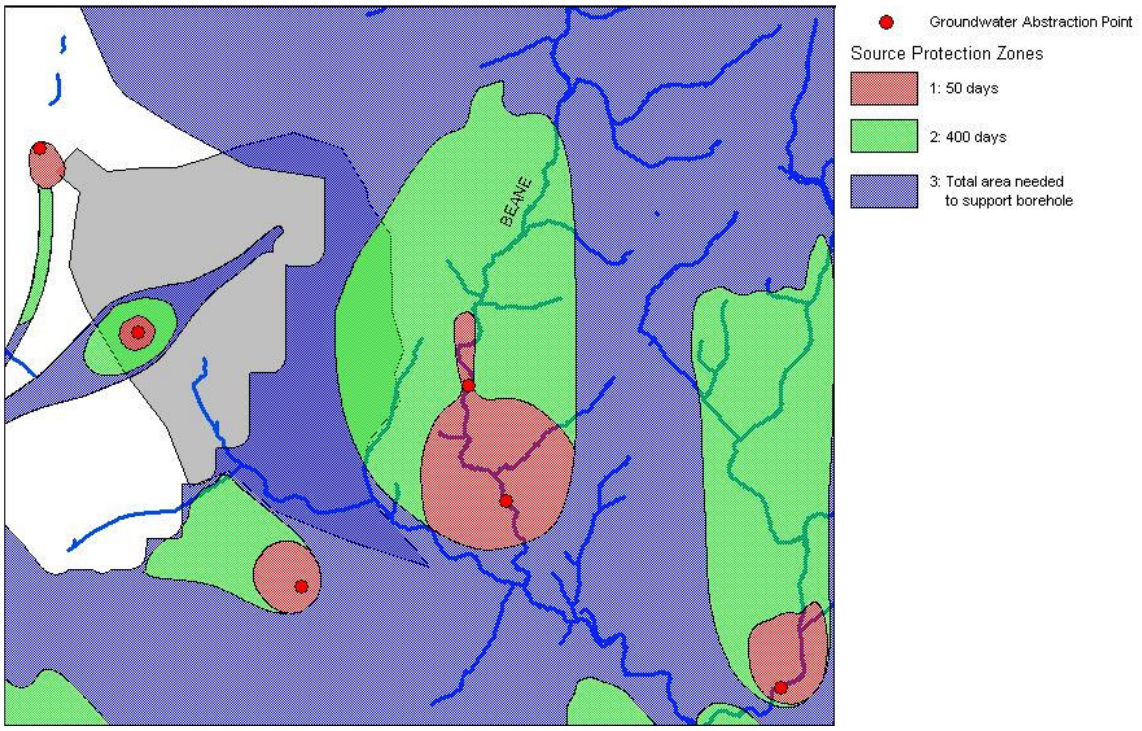


Figure 7-34 SPZ in and around Stevenage

As shown in Figure 7-34, there are source protection zones on the River Beane surrounding the TVW White Hall and Aston groundwater abstraction points. The interaction between the surface and groundwater in a chalk river such as the Beane may be complex, and the risk of contaminating the groundwater must be carefully mitigated. Supplementing flows in the Beane with treated effluent may detriment groundwater quality, thereby requiring TVW to include additional processes at abstraction points.

Planning

The Beane valley is a rural area that is renowned across the county for its aesthetic quality. Securing planning permission for a new WwTW in this location may prove problematic for TWU.

Costs and Phasing

TWU estimate that the planning, approval and construction of a new WwTW in the Beane valley will take seven to ten years. Initial estimations of cost were provided by TWU. Compared to the cost of just upgrading the existing Rye Meads network to take scenario T1, a new WwTW will be:

- 217% more expensive for scenario T1;
- 230% more expensive for scenario T2; and
- 242% more expensive for scenario T3.

This assessment does not include the additional costs incurred by Anglian Water to collect and convey wastewater from their operational area to the TWU network, or any costs that may be incurred by TVW to maintain quality at the Whitehall abstraction, or mitigate any increases in flood risk due to the increased discharge.

New Beane WwTW Conclusion

The cost of achieving the required high quality of effluent discharge may be prohibitive for TWU, particularly as initial assessments suggest that other solutions will incur significantly less cost.

The stringent discharge consent required for a WwTW in this location could not be met using conventional technology at a works of the size required. This could mean the use of unconventional technologies, not tried and tested as part of the wastewater treatment process, are required, with the risk of introducing high capital and operational costs, and associated carbon impacts.

Furthermore, in order to achieve the 2021 RSS targets, some development must continue in Stevenage during the next decade. The lead in time of around ten years for the Beane WwTW would significantly constrain this growth. TWU would most likely be required to upgrade parts of the existing sewerage network before then to accommodate current commitments and early phases of future sites. These interim upgrades have the potential to create disruption and incur costs similar in magnitude to the option that solely relies on Rye Meads WwTW for treatment.

Following extensive consultation with the EA, it is still unclear at this time if supplementing flows, or maintaining the highest water quality, should take precedence on the River Beane. Both factors can be detrimental to the ecology of the watercourse, and place pressure on existing abstractions. Whilst the EA acknowledge that the Beane is severely impacted by low flows, and that supplementing flows with treated effluent may be a solution, it is unclear at present how to balance this against the requirements of the WFD in respect to water quality. Resolving this issue will depend on how the WFD is implemented within this catchment, and therefore depends on the contents of the final RBMP (Thames Region).

Ongoing research to understand the effects of low flow on ecology is being undertaken by the EA, and until such a time as the benefits can be clearly quantified, it is unlikely that a WwTW on the Beane would be approved. Whilst the WCS stakeholders maintain the aspiration of supplementing low flows to benefit ecology and abstraction, a new WwTW on the Beane cannot be recommended at this time unless additional funding and definitive standards can be made available. Even if the new WwTW is viable, both technically and economically, only approximately 20% of the existing Stevenage catchment can be drained by gravity to this works, leaving the need to continue sewering wastewater from the remainder of Stevenage to Rye Meads WwTW for the foreseeable future.

Details of the further work required by the stakeholders to fully assess this option is included in Section 10.2.

7.3 Anglian Water Options

7.3.1 Ashbrook WwTW upgrade

Current Process

Ashbrook WwTW currently uses biological filters to treat a PE of around 3,000 from the North Herts villages of St Ippollitts, Little Wymondley and Todd's Green.

The current consent applied to the discharge is as follows:

Consented DWF	Suspended Solids	Biochemical Oxygen Demand	Ammoniacal Nitrogen
m^3/day	*mg/l*	*mg/l*	*mg/l*
630	35	20	10
	Upper Tier Limits:	56	37

Table 7-25 Current Ashbrook WwTW discharge consent

The WwTW currently discharges treated effluent into the River Purwell, a tributary of the river Hiz, via the Ash Brook. As described in Section 2.4.3, these watercourses will fail to meet WFD good status due to high phosphate levels. AWS is proposing that a tertiary treatment process, to reduce phosphate levels in the Ash Brook discharge to 1 mg/l, is constructed during AMP 5 to achieve the required phosphate levels in the watercourse.

Proposed growth

The possibility of treating some or all of the wastewater from the Stevenage development has been discussed throughout the course of the consultations for this WCS, and the following worst case scenario was arrived upon.

Initial calculations are to be based on the assumption that Ashbrook WwTW would be used to treat wastewater from the development sites that lie within the AWS area, excluding the small 103 unit development to the north (site 11), which would likely be included in the TWU network. The proximity of the works to the Stevenage West development (sites 2 and 3) led to AWS also considering accepting wastewater from site 2.

Using variables from the worst case scenario, as described in Section 4.4.2, leads to the following results:

Sites to Ashbrook WwTW	New dwellings by 2031	Increase in PE by 2031	Increase in DWF by 2031
Site No		*Based on 2.33 occupancy rate*	*m^3/day*
2, 3, 4, 5, 8	12,120	28,240	5,764

Table 7-26 Predicted worst case increase in wastewater at Ashbrook WwTW

This increase in DWF equates to more than a ten fold increase in volumetric discharge to the Ash Brook/ River Purwell. Therefore, **flood risk**, **water quality and ecology** are the key concerns.

Benefits

Along with the advantages described at the start of Section 7, this option has a number of other benefits.

As illustrated in Figure 7-35, Ashbrook WwTW is located in a rural area with adequate land available for possible future upgrades. Landscaping would be possible to further reduce the visual impact of the works.

Figure 7-35 Existing settlement tank at Ashbrook WwTW

The location of Ashbrook WwTW means that odour from the works would be transported away from the development sites, and Hitchin, by the prevailing south-westerly wind. The topography of the WwTW site and surrounding area would suggest that gravity could be utilised to convey wastewater from site 3 to the WwTW. Pumping may be required for other development sites, although the Corey's Mill pumping station and existing AWS network could be modified to allow this.

Discharging an increased flow of treated effluent to the Ash Brook could help alleviate low flows in the River Purwell which, as described in Section 2.4.3, may be preventing the watercourse achieving 'good ecological potential' under the WFD.

Flood Risk

The NHDC SFRA identified an area of south Hitchin prone to flooding from the River Purwell; where some properties are at risk of flooding during a 1 in 20 year flood event. Increased discharges upstream from Ashbrook WwTW risk exacerbating this problem.

Through outline proposals and consultations with the EA, Hyder Consulting were able to demonstrate that slight modifications to the topography, where the Ash Brook converges with the Ippollitts Brook to form the River Purwell, would allow a flood storage area to be created. It is possible to create sufficient storage volume to better attenuate the flooding, mitigate the risk from the increased discharge, and reduce the overall flood risk.

The EA agreed with this solution in principle, although further detailed investigation and modelling would be required by AWS should this option be taken forward. Maintenance of such an asset would also be an important consideration, with responsibility having to be adopted by either AWS or SBC/ NHDC.

Water Quality

The relatively low dilution available due to the low flows in the Ash Brook/ River Purwell require extremely stringent consent limits to be applied to the WwTW, in order to ensure the watercourse is able to achieve good status under the WFD. Through consultation with the EA, a set of indicative consent limits have been developed.

Suspended Solids	Biochemical Oxygen Demand	Ammoniacal Nitrogen	Phosphorous
mg/l (95%ile)	*mg/l (95%ile)*	*mg/l (95%ile)*	*mg/l (Annual Average)*
16	8	1	0.12 (WFD requirement) 1 (BAT)

Table 7-27 Indicative consent for increased Ash Brook discharge

It should be noted that this consent is indicative only, and further detailed investigation by the EA would be required prior to the Ashbrook WwTW consent being altered. A phosphorous limit of 1 mg/l is understood to be achievable with BAT, as discussed between the water companies and EA during the WCS consultation. To achieve the 0.12 mg/l of phosphate in the watercourse as required under the WFD, it is likely that the consent would have to be significantly lower than 1 mg/l. There is therefore a risk that this option will result in the water quality in the river not meeting the phosphate levels required by the WFD, even with the proposed AMP 5 scheme.

As this activity precluded the confirmation of the worst case variables, a slightly lower discharge, (around 5,000 m^3/day compared to the 5,764 m^3/day mentioned above) has been used when assessing indicative consents. However, it is considered that this is a conservative approach, as consent standards would likely be more stringent for a higher discharge.

Phasing

AWS has suggested that Ashbrook WwTW would need to be extended and converted to an activated sludge works. This work, which may take five or more years to plan, approve and construct, could ultimately be phased in line with the development. Before then, SBC would have to steer development towards the Rye Meads catchment (i.e. existing TWU network in Stevenage).

Ashbrook Conclusion

Ashbrook WwTW is the closest WwTW (approx. 2-3 km) to the Stevenage development sites, and is in a rural location, with available land, where planning issues may be relatively uncomplicated.

However, the ten-fold increase in discharge to the Ash Brook from upgrading the WwTW will require comprehensive mitigation to address **flood risk** and **water quality** concerns. Achieving the required phosphorous concentration in this discharge to comply with WFD phosphate limits would require treatment to a level lower than BAT, or more specifically BATNEEC.

The effects of the proposed additional flows on the **geomophological** properties, and hence the **ecology**, of the watercourse are of significant concern to the EA. The possibility of mitigating these issues by accepting a smaller amount of development at Ashbrook provides little benefit, as the remaining development in the Anglian region may still have to be treated elsewhere, such as Hitchin or Letchworth, which would require significant lengths of new infrastructure and pumping arrangements.

For the above reasons, the WCS stakeholders **do not** prefer this option. However, upgrading Ashbrook WwTW and pumping the treated effluent further downstream to be discharged to either the River Hiz or Pix Brook has been discussed as an option by the WCS stakeholders, and is described in more detail in Section 7.3.3.

7.3.2 Hitchin/ Letchworth WwTW Upgrade

Current Process

Hitchin WwTW currently serves a PE of approximately 33,000, whilst Letchworth WwTW serves a PE of approximately 42,000. The current consents applied to the discharges are as follows:

WwTW	Consented DWF	Suspended Solids	Biochemical Oxygen Demand	Ammoniacal Nitrogen
	m^3/day	*mg/l*	*mg/l*	*mg/l*
Hitchin	10,290	30	15	4
		Upper Tier Limits:	50	16
Letchworth	9,900	25	13	5
		Upper Tier Limits:	50	20

Table 7-28 Current Letchworth and Hitchin WwTW discharge consent

Hitchin WwTW discharges into the River Hiz, whilst Letchworth WwTW discharges into the Pix Brook. As discussed previously, both these watercourses will fail to comply with the WFD as they exhibit high concentrations of phosphate. The phosphorous removal that AWS is planning to implement in AMP 5 at Ashbrook WwTW should remedy this situation for the River Hiz upstream of Hitchin WwTW, although AWS suggests that this will not provide the capacity for increased discharges from Hitchin WwTW, unless the phosphorous concentrations in the Hitchin discharge are reduced.

Proposed growth

Hitchin WwTW was extended in 2004 and has capacity to treat predicted demand in the Hitchin area for the foreseeable RSS period. Any discharge of wastewater from Stevenage growth areas into Hitchin WwTW will require a further substantial extension of the works.

Letchworth WwTW is planned to be extended in AMP 5 (2011) and after this should have the capacity to treat predicted demand in the Letchworth and Baldock area for the foreseeable RSS period.

As previously described in the Ashbrook option, AWS has assessed accepting wastewater from sites 2, 3, 4, 5 and 8 to either Hitchin or Letchworth WwTWs, which will produce an estimated DWF of 5,764 m^3/day.

Benefits

AWS is proposing to upgrade **Letchworth** WwTW in AMP 5 to solve issues with ammonia concentration and provide sufficient capacity for the Letchworth and Baldock catchment for the duration of the RSS period. Additional upgrades to accept effluent from the Stevenage development sites could be included in this process.

Both **Hitchin** and **Letchworth** WwTW have the advantage of discharging into watercourses with higher flows, and therefore a higher capacity of dilution, than the Ash Brook.

Flood Risk

Downstream of this **Hitchin** WwTW discharge, the River Hiz flows through a built up area of the town for around 2 km, before entering a predominantly rural area. Mitigation would be required to ensure that an increase in discharge does not increase flood risk to the properties in either the urban, or the rural, areas.

The Pix Brook, downstream of the **Letchworth** WwTW discharge, flows through a predominantly rural area for around 2 km before it enters the village of Stotfold. Some properties here are shown to be at risk of flooding from less than 1 in 100 yr flood events. Mitigation will be required to ensure increased discharges from the WwTW do not exacerbate this flood risk.

Water Quality

In order to account for the highest possible flows, and hence the greatest possible detriment to water quality, an increase in DWF at Hitchin WwTW of approximately 83% has been considered. This is equivalent to the flows from all Stevenage growth sites, including those in the TWU area (see Figure 7-33), but excluding site 1, and including the projected increase in flow from proposed development within Hitchin.

The EA have identified that the consent limits described in Table 7-29 would apply to the Hitchin WwTW discharge, should the flow increase by the above amount.

Biochemical Oxygen Demand	Ammoniacal Nitrogen	Phosphorous
mg/l (95%ile)	*mg/l (95%ile)*	*mg/l (Annual Average)*
8	1	1

Table 7-29 Indicative consent for increased Hitchin WwTW discharge

As previously, it should be noted that this consent is indicative only, and further detailed investigation by the EA would be required prior to the Hitchin WwTW consent being altered.

Planning

Letchworth WwTW does not have sufficient land to accommodate the substantial upgrades needed to accept wastewater from the Stevenage sites. Additional land will be required; although the works appears to be surrounded by predominantly undeveloped land, which could be suitable providing planning issues are resolved.

AWS suggests that **Hitchin** WwTW has sufficient land available within the site boundary to accommodate the upgrades required. However, the works was upgraded in 2004, and now has sufficient capacity for growth proposed in this RSS period. AWS considers Hitchin to be unsuitable for treating potential West Stevenage flows due to the difficulty of connecting the development area to the WwTW inlet, which is close to the centre of the town.

Phasing

The trunk sewer/ rising main needed to convey wastewater from the Stevenage sites to Hitchin WwTW, round the eastern periphery of the town, would be in excess of 9 km long. Any such route would have to cross the railway line and River Purwell/ Hiz on a number of occasions (complicating any future extensions of the railway network in this area), and would require pumping for much of the length due to the topography. It is estimated that such a scheme would take around five years to plan and construct, including the necessary WwTW upgrades and pumping arrangement. The trunk sewer could be duplicated at a later date to increase capacity, as required by the development phasing.

A similar connection to Letchworth WwTW would involve around 14 km of trunk sewer/ rising main, and involve similar pumping requirements and difficulties in crossing the East Coast railway near the WwTW. Regarding cost, whilst there would be no need for the pumping station and rising main near Hitchin, alongside the River Hiz, this would be offset in part by the requirement for longer stretches of gravity sewer.

Pumping wastewater over distances such as those above causes long retention times in the rising mains. Wastewater can then become septic, causing odour and treatment issues at the receiving WwTW. This can be overcome, but will require an increase in capital and operational costs, energy consumption and hence carbon footprint.

Hitchin/ Letchworth WwTW Upgrade Conclusion

When compared with discharging into the Ash Brook, these options may impact the water quality of the receiving watercourses less, due to the higher dilution available. However, a more detailed assessment would have to be conducted by the EA to ensure that WFD quality targets could still be achieved before an increase in volumetric discharge would be consented to.

Also, the risks of odour and treatment difficulties, due to long retention times of raw wastewater, are key concerns for AWS. The distances and complexity of the possible routes, the scale of upgrades required at the WwTW, overall sustainability concerns and the high risks result in neither of these options being favoured by Hyder Consulting, AWS and the other WCS stakeholders.

7.3.3 Hybrid Anglian Water Option

AWS has proposed a combination of the above options as its preferred solution. This option utilises the proximity to the development sites, and the land available, of Ashbrook WwTW. It is envisaged that wastewater from the Stevenage development sites in the Anglian catchment is collected and treated at Ashbrook WwTW, with the treated effluent then pumped to the River Hiz downstream of Hitchin for discharge. Pumping treated effluent, rather than raw wastewater, will mitigate the odour and septicity issues described previously. However, this option should only be considered if the Environment Agency is unable to grant an increase in the existing flow consent at Ashbrook WwTW.

It is proposed that the new discharge in the River Hiz will be downstream of the urbanised area of Hitchin, so flood risk mitigation will only be required for a relatively limited number of rural properties. The higher dilution available in the River Hiz, compared to the Ash Brook, makes it more likely that the watercourse can accept the discharge and still achieve Good Ecological Potential under the WFD, although a detailed assessment of such a proposal would need to be undertaken by the EA to ensure this was in fact achievable. This would require AWS and the EA to decide upon the most suitable discharge location, which may be subject to negotiations with landowners.

The consent limits for such a discharge would need to be carefully considered and an assessment made to ensure that the combined discharges (as Hitchin WwTW will continue to discharge to the River Hiz) would not cause a breach of water quality targets.

Details of the further work required by the stakeholders to fully assess this option is included in Section 10.2.

7.3.4 Routing of Anglian wastewater options

A summary of the potential routes, based on consultation with AWS, for the all the Anglian options described previously is presented in Figure 7-36 below.

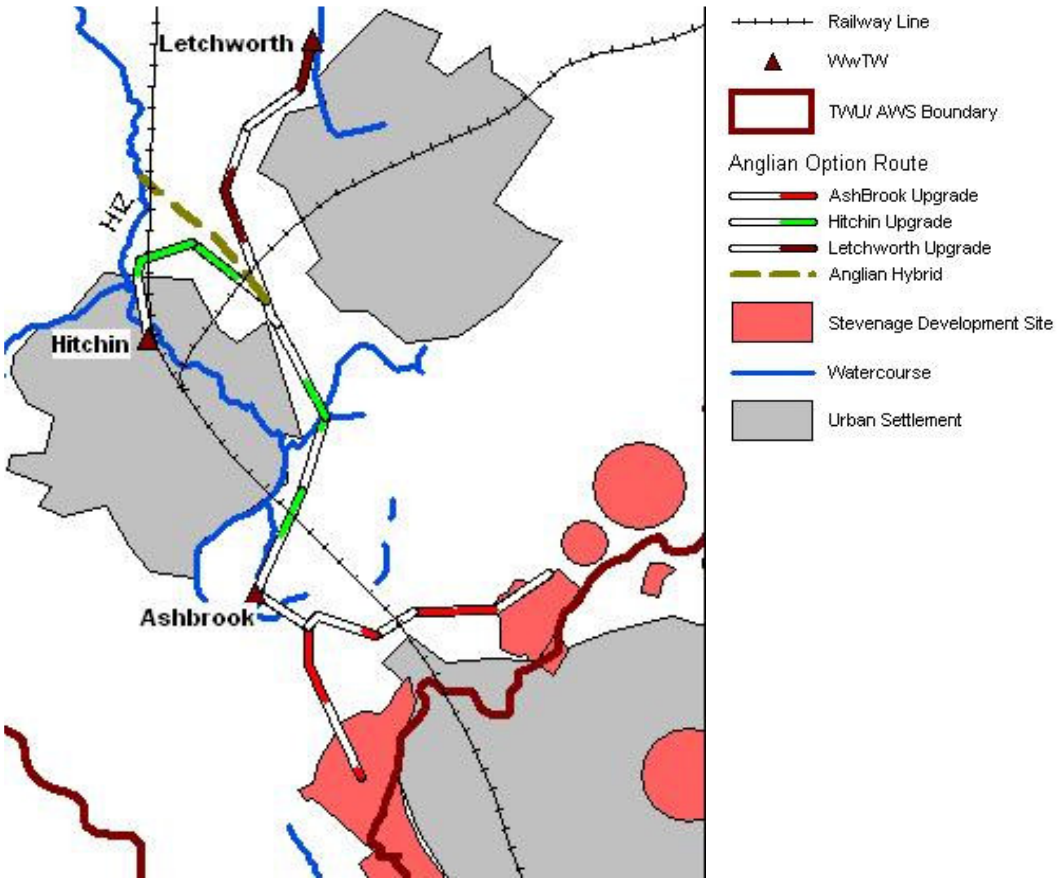


Figure 7-36 Indicative routes for Anglian wastewater options

The sewers from Stevenage to Ashbrook WwTW would be able to use gravity as the driver for the majority of the route. However, the topography between Ashbrook and Hitchin/ Letchworth/ the Hiz, would mean that pumping would be required for significant lengths of the route. Regardless of whether the flow conveyed is treated effluent or untreated wastewater, these latter options will be subject to large operating costs and energy demands.

7.4 Preferred Strategy Conclusion

The issue of collecting and treating wastewater from the Stevenage development has been a key concern of all WCS stakeholders as it has a significant influence on the overall catchment, including a number of cross-boundary issues.

Upgrades to the Rye Meads network and WwTW are unavoidable, and for the majority of the Local Authorities there are no viable alternatives to this, except developing in other catchments. Stevenage is a special case with several cross-boundary issues, and presents the WCS stakeholders with an opportunity to change the current system.

Supplementing flows on the River Beane with treated effluent should remain a topic of discussion during future iterations of the WCS process, in line with future RSS and River Basin Management Plan reviews. However, at present there is limited information with which to fully justify the benefits of this solution, and high risk in achieving practical implementation due to a

number of issues including planning and funding. These barriers may be overcome if additional funds and advanced technology are used beyond the current operating regime of the water companies, for the benefit of wider environmental gains.

Two options for this part of the strategy (for Stevenage wastewater treatment) have emerged:

- Inclusion of new Stevenage sites that are within either the TWU area only, or all sites regardless of operational area, into the existing Rye Meads WwTW catchment; and
- Treatment of some Stevenage sites at Ashbrook WwTW, with the treated effluent pumped to the River Hiz.

The Rye Meads option correlates better with the initial phasing of development, although some of the required upgrades are not confirmed by TWU for AMP 5. TWU have also been able to provide additional modelling information to demonstrate the feasibility of achieving additional network upgrades in future AMP periods. However, both options appear technically feasible and would be suitable for the latter phases of development, which would most likely be to the north of Stevenage. Both options are also likely to require significant capital investment, and securing the necessary funding will be a key challenge to the two water companies and affected Local Authorities, although it is likely that developer contributions would significantly facilitate this process.

An initial assessment of the lengths of sewers needed to construct either the Anglian Hybrid option, or the TWU upgrades to the Stevenage network (T3), is included in Table 7-30 below. This table gives an indication as to the amount of materials required and key constraints that would contribute to the environmental and social impact of both options.

Wastewater Option	Total length of new sewer/ upgrade	Construction work in urban area	A road/ motorway crossings	Railway crossings	River crossings	Significant Additional Pumping required?
	(m)	(m)	(No.)	(No.)	(No.)	Y/N
Anglian Hybrid	*11200*	*0*	*4*	*4*	*4*	*Y*
T3 (Rye Meads network)	*9800*	*2300*	*2*	*3*	*0*	*N*

Table 7-30 Initial assessment of impacts arising from sewerage options

These lengths are initial estimates based on consultations with AWS and TWU, and the indicative routes, which can be seen in Figure 7-36 for the Anglian option and Figure 8-40 (page 117) for the T3 option.

All of the above options would result in increased flows in receiving watercourses. Any flood risk management/ mitigation measures that are required because of these increases should seek to maximise the environment/ ecological gain wherever possible.

It is still to be confirmed which of the options would incur the highest environmental and social costs. Upgrading the Rye Meads network is likely to have a smaller overall carbon footprint, due to the smaller length of new sewers required, and the use of gravity rather than pumping to convey the majority of the wastewater flow. The Anglian option would also involve undertaking substantial upgrade works to the existing Ashbrook WwTW by effectively constructing a new works. The Rye Meads option will involve laying new sewers through built up urban areas and is therefore likely to cause significant social disruption. Both options are unlikely to cause direct significant impact on environmentally sensitive areas, although the construction works will have

to be carefully managed to ensure the interest of nearby sites is not affected. A detailed assessment of the required construction work and associated emissions/ disruption would be required to fully understand the sustainability of the possible solutions.

To date, without undertaking further studies it is impossible to reliably assess the benefit of increasing river flows against maintaining the highest quality, in particular with regard to the River Beane and Ashbrook options considered and ruled out previously. Waiting for this information to become available may cause an unacceptable delay to the development in Stevenage, and could compromise the achievement of its RSS targets. Details of the further work required by the stakeholders to determine the most sustainable solution is included in Section 10.2.

TWU estimates that it is possible to drain the entire Stevenage West development area to the Rye Meads network for a comparatively smaller additional cost of 26% over scenario T1 (the TWU sites only case). The required upgrade works could be completed during the latter stages of the AMP 5 period, or the early stages of the AMP 6 period. However, no specific funding at present has been included in the TWU PR09 business plan. Contributions coming forward from developer requisitions would aid the successful implementation of future capital schemes. **For these reasons, it is recommended that the Stevenage development should be initially located within the urban area, and to the West, and should coincide with TWU's planned upgrades.** However, should development to the west be unduly delayed by the current economic climate or other planning issues, the proposed upgrades to the west of the network may allow for some development in the north (such as sites 4, 10 and 11) to be connected instead. This is discussed in more detail in Section 8.2.2.

Discussions between water companies, developers and the EA should continue as to the treatment of wastewater from the additional development to the North. This should work in tandem with the SNAP programme and PR14 process, as the water companies will need confirmation of the sites being considered. Both AWS and TWU options described above are feasible, subject to the outcome of future consultations and studies as part of the preparation process for PR14. There may be also opportunities for TWU to submit an interim submission to Ofwat ahead of PR14 depending on the actual speed of economic recovery and new house build rate.

TWU has sought funding in PR09 for upgrades to parts of the Rye Meads network and wastewater treatment works in the catchment. This funding is to serve development within its operational boundary but the scale of these improvements will be determined by Ofwat. This in turn will dictate the number of houses that can be built. Where infrastructure needs to be provided to serve future development, suitable phasing will be required to ensure that the infrastructure is in place ahead of the development.

A high certainty in the development being delivered within a defined time period is required for water companies to either:

- Include investment in periodic review business plans to Ofwat or;
- Fund infrastructure upgrades until the end of the AMP period whereby they can log-up the additional cost with the regulator. This is required when funding is not included in the most recent regulator determination.

Therefore, it is recommended that a further review of the WCS or Sustainability Appraisal be completed within the next four years to compare the economic, environmental and social costs and benefits associated with the preferred Anglian option and Thames option T3. This will allow a strategic decision to be made on the best way forward for Stevenage North developments, and future RSS allocations around the Stevenage area beyond 2021. However, it is important to note that current RSS allocations and the delivery of LDFs should not be unnecessarily delayed

in the short term, as this WCS has clearly demonstrated that TWU and AWS can propose technical options to deal with Stevenage North growth, provided that necessary funding and subsequent studies are undertaken immediately in accordance with an agreed timescale.

This preferred strategy allows short term growth aspirations to be met, whilst ensuring that the most sustainable option (which strategically addresses any cross-boundary issues) is selected in the future for the long term.

Further details of the preferred strategy for the entire Rye Meads catchment, covering all remaining aspects of the WCS, are given in Section 8.

8 Recommended Strategy

Taking into account the capacity of the catchment, as described in Section 5, and the preferred solution to the cross-boundary wastewater issues described in Section 7, the following strategy has been developed for the Rye Meads study area. This strategy has evolved through an iterative consultation process between Hyder Consulting and the WCS stakeholders, and lays out the key infrastructure, changes in behaviour and guidance that will be required to accommodate the ambitious RSS targets within the Rye Meads Catchment until 2021 and beyond.

8.1 Potable Water

Regarding **water supply**, there are no specific key strategic constraints to development within the study area. As described previously, the proposed development locations are in close proximity to the TVW strategic main network, and TVW are confident that a supply demand deficit can be avoided within the Northern WRZ. When current usage, growth and headroom are considered, the Ruthamford WRZ link provides adequate supplies for all future developments planned in the Northern WRZ at this present time. TVW and AWS have confirmed that the bulk transfer of water from Ruthamford WRZ to the TVW Northern WRZ is not at risk in the future, as AWS take the full amount of this export into account when planning for future supply in the Ruthamford WRZ.

Local Authorities should continue to consult with water companies on a frequent basis, particularly concerning large strategic sites, to ensure the effective planning and funding of the required local network upgrades.

Working jointly with the water companies to inform and educate the public on fittings and techniques to reduce end user demand should be a priority. Reducing demand in this manner increases the security of supply and can avoid the need to develop new resources.

Local Authorities should require all developers to build to at least CSH Level 3 (105 l/p/d) with regard to **water efficiency**. Effective discussions with developers and water companies regarding higher levels of efficiency than this in the future should begin now, as the rainwater harvesting or grey water reuse required will need to be strategically planned across the larger sites. It is only by embracing technologies such as these in both new and existing dwellings that **water neutrality** can be achieved in the study area to overcome some of the identified environmental constraints in the long-term. Similarly, Local Authorities, water companies and other government organisations should explore the opportunities, where possible, to gradually retrofit water efficiency measures within non-residential buildings and premises that they manage such as offices, schools, hospitals and leisure facilities through their annual maintenance plans. They should also work together to make the necessary behavioural changes of their customers and stakeholders to reduce the overall water demand.

Local Authorities should also consider the retrofit of water efficient fittings to all their existing housing stock.

More detailed guidance for water companies and developers, regarding demand management and water efficiency, is included in Section 9.

8.2 Wastewater Treatment and Sewerage network

The provision of wastewater treatment and sewerage has been identified as a key constraint throughout this WCS. Following the option development process in Sections 6 and 7, it is recommended that the upgrades of the Rye Meads WwTW and sewerage network proposed by TWU are further assessed and constructed without delay.

8.2.1 Rye Meads WwTW upgrades

Figure 8-37 below illustrates the WwTW upgrades which have been identified, and how the phasing of these upgrades through the AMP process will be required to accommodate the increasing development within the catchment. However, it must be noted that this figure is for guidance only; it is based on the assumptions detailed within this report, and certain variables being achieved such as the required annual dwelling completion rates. As these may be subject to change in the future, it is vital that good communication is maintained between the Local Authorities and TWU, to update and amend the development proposals and infrastructure requirements as more information becomes available.

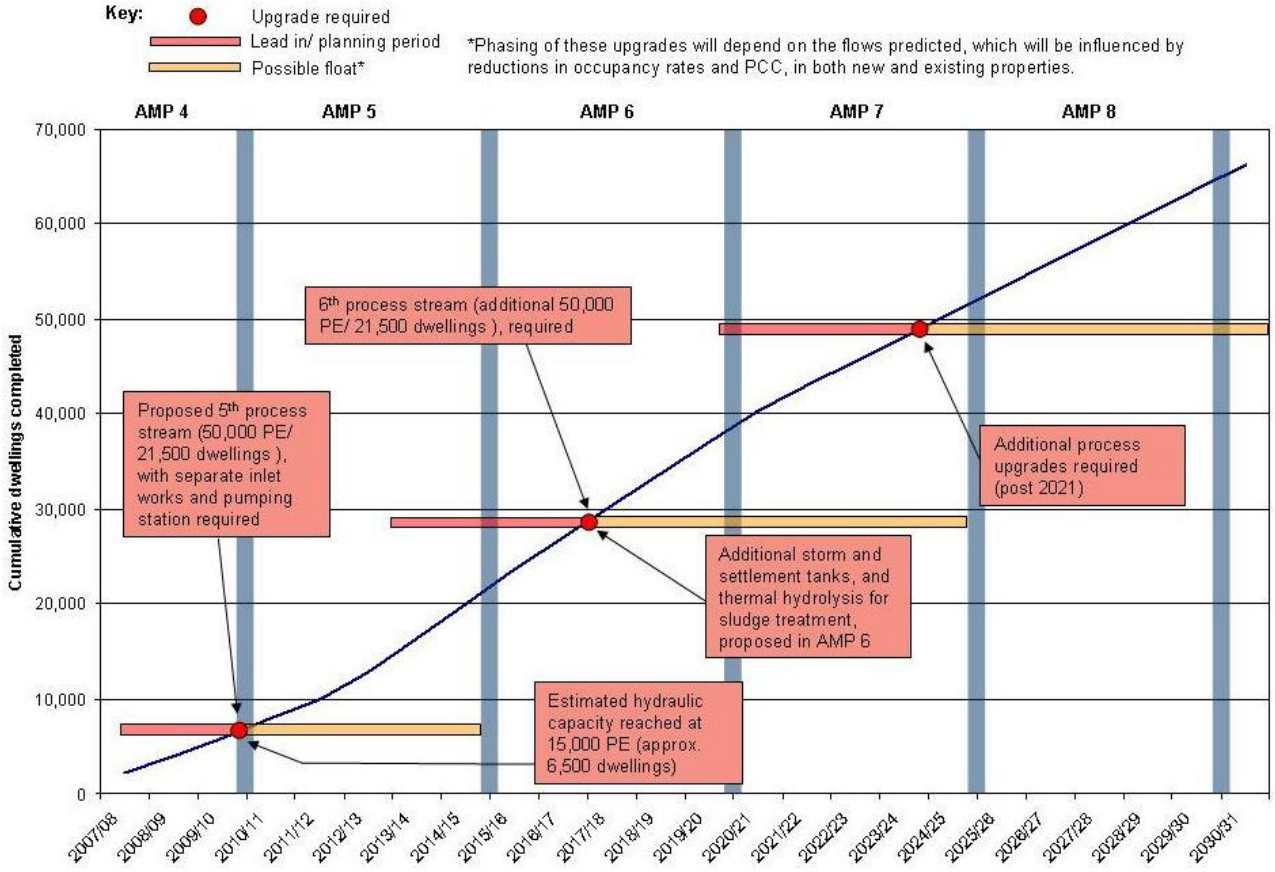


Figure 8-37 Rye Meads Intervention Graph

It must be noted for clarity that the PE values illustrated for the various upgrades will not sum and convert to the total dwellings expected in the Rye Meads catchment. This is because the base case variables effectively predict reductions in occupancy and PCC in new and existing dwellings, so the wastewater flow associated with a new dwelling is reduced in the future. Also, the loading from the existing properties (including trade flows) is predicted to reduce, effectively unlocking some hydraulic capacity at the WwTW (similar to the concept of water neutrality).

The exact dates at which these upgrades are required will depend upon the actual development rates and the flows observed by TWU at the WwTW. This will be heavily influenced by the future performance of the study area, in terms of variables such as PCC and occupancy rate. The need for upgrades may also be delayed by the **economic climate**. Funding approval for these upgrades from Ofwat may be restricted until there is a greater certainty of the growth being delivered.

In order that future development is not constrained, Local Authorities must continue to communicate with TWU as the phasing and location of this development becomes more certain. This increased certainty will allow TWU to ensure that the appropriate funding is in place, to provide suitable capacity as and when it is required. This may even enable TWU to submit an interim submission to Ofwat ahead of the normal PR14 and AMP 6 process, depending on the actual speed of economic recovery and associated growth. TWU should closely monitor the development rates and actual flows from Rye Meads whilst optimising the operational strategy at the works through the planned AMP5 upgrades. It is also imperative that the detailed design of the proposed 5th process stream starts as soon as the outcome of the PR09 submission is determined by Ofwat.

Additional flood risk mitigation and water quality improvement needs arising after 2021 due to a potentially increased discharge consent and tighter WFD targets should be factored in the development of Rye Meads upgrade proposals through close consultation between TWU and EA. Similarly, the impact on Rye Meads SSSI due to the planned upgrade works should be avoided through negotiations with Natural England.

As discussed previously, it is **critical** that the appropriate funding is made available by Ofwat to ensure that development is not constrained once the economic climate begins to improve, as the current spare capacity of Rye Meads WwTW translates to roughly 6,400 homes.

8.2.2 Strategic Sewer Network Upgrades

The layout of the network, and the location of the proposed development, requires that the majority of urgent upgrades are in the towns of Harlow and Stevenage. The following figures illustrate the critical strategic network upgrades that will be required in order that development is not constrained.

Harlow

As described in Section 3.4, the development locations around Harlow have not yet been decided upon, however development to the North must be considered by this WCS in order to achieve the RSS requirement.

The network upgrades proposed by TWU to accommodate future growth around Harlow are illustrated in Figure 8-38. HDC and TWU should begin discussions now as to how the required infrastructure will be funded (contributions from developers may be required), and the actual locations and likely phasing of the key development sites.

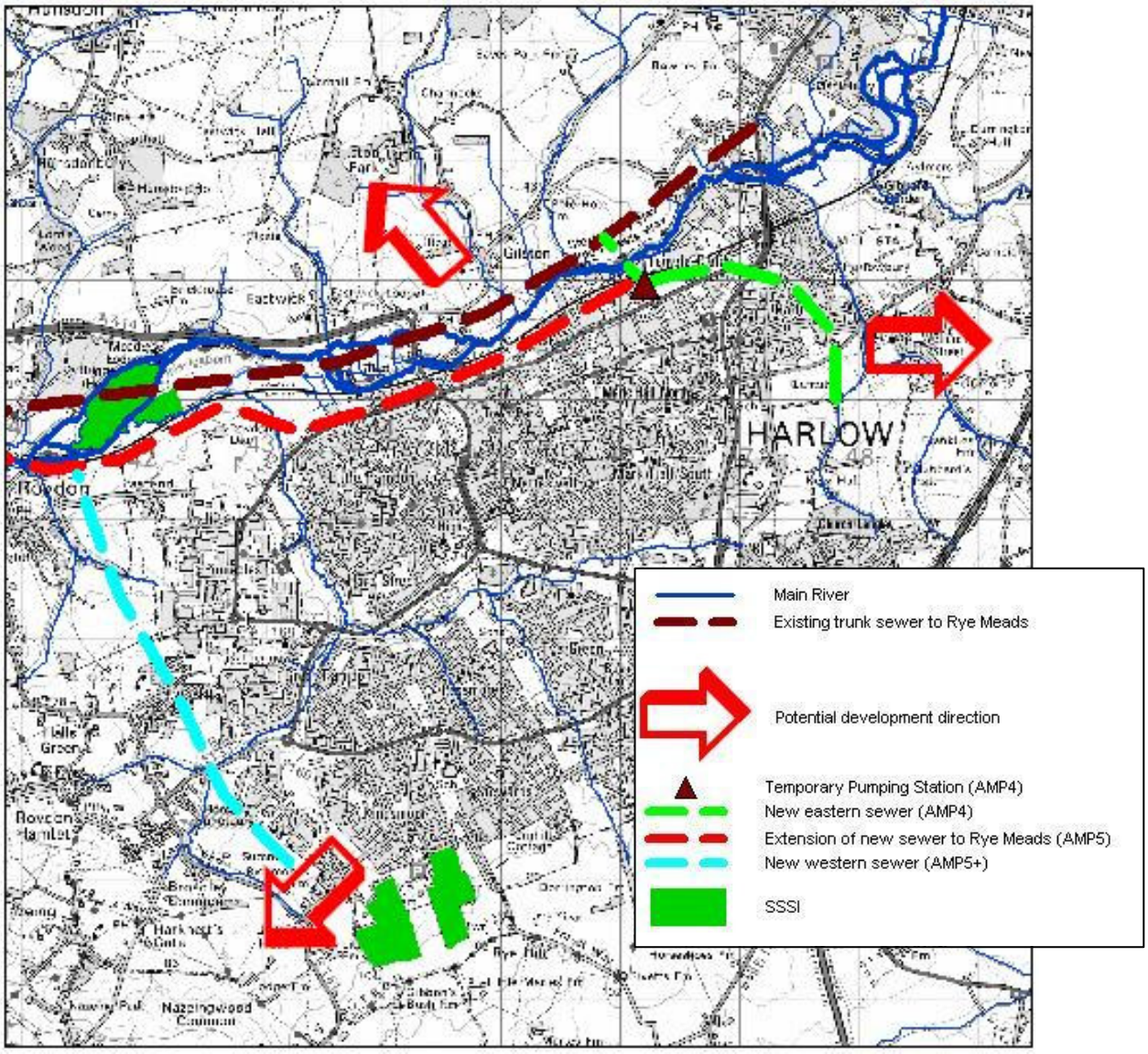


Figure 8-38 Proposed Harlow sewerage network upgrades

The new eastern outfall sewer (Phase 1) is likely to primarily be a tunnel and will run from the Newhall Farm development site, across Gilden Way, along Priory Avenue then along Edinburgh Way to the River Way junction. At this point a temporary pumping station will lift the flows across to the existing trunk sewer. The temporary pumping station will regulate the flows into the existing trunk sewer and the oversized pipelines will operate as storage tanks to balance flows.

The extension to the eastern outfall sewer (Phase 2) will run along Edinburgh Way and then follow a line parallel to (and to the south of) the railway line to Roydon. It will then cross the railway and River Stort to connect to Rye Meads WwTW. Once this sewer extension has been built the temporary pumping station will be abandoned and the existing branch outfall sewers will be connected to the new sewer. This will free up capacity in the existing trunk sewer for any development areas to the north of Harlow.

Any development areas to the south west of Harlow could be served by a new independent outfall connecting direct to the new trunk outfall sewer that may possibly be constructed in late AMP 6 once the eastern outfall extension to Rye Meads has been completed. These proposed upgrades will result in the sewerage network not constraining development around Harlow. It is stressed however that due consideration to the timing and risk of construction of network

infrastructure upgrades be set against the proposed timing and location of new development sites.

The figure above also highlights Hunsdon Mead SSSI (on the River Stort) and Harlow Woods SSSI (to the south west) in relation to the proposed upgrade locations. The upgrade (and duplication) to the trunk sewer parallel to the Stort has the potential to impact upon Hunsdon Mead unless carefully managed.

Hunsdon Mead SSSI contains area of meadow, fen, and floodplain grazing marsh, all of which are UK BAP Priority Habitats. As illustrated in Figure 8-38, the route of the new sewer can be designed to avoid a direct impact on the SSSI. Whilst the proposed upgrades will not affect water levels through the site, there is a possibility that polluted run-off from the construction phases (of both the network upgrade and the housing development) may detriment the water quality of the site. The poor quality of urban and agricultural runoff into the River Stort is already known to be causing the northern unit of the site to be in an unfavourable condition. Opportunities to include some form of surface water attenuation and treatment, such as an integrated wetland area, in conjunction with the proposed works should be investigated by TWU and HDC in partnership with the EA and Natural England.

There is a risk that development to the south of the urban area may require the proposed western sewer to be routed in proximity to, or through, the Harlow Woods SSSI site. This risk has to considered and mitigated during the feasibility and design stages.

Table 8-31 below illustrated the constraints that must be overcome when TWU complete the required Harlow sewerage network upgrades, and gives an indication as to the likely disruption that may be caused by such works.

Harlow Upgrade Phase	Total length of new sewer/ upgrade	Construction work in residential area	Construction work in industrial area	Construction work in rural area	A road/ motorway crossings	Railway crossings	River crossings
	(m)	(m)	(No.)	(No.)	(No.)	(No.)	(No.)
Phase 1	*3100*	*2000*	*1100*	*0*	*0*	*0*	*0*
Phase 2	*7600*	*1000*	*1500*	*5100*	*0*	*1*	*1*

Table 8-31 Initial assessment of impacts arising from Harlow trunk strategic sewerage network upgrades

TWU plan to utilise trenchless technologies, such as tunnelling, to install certain lengths of the proposed upgrades, due to practical construction issues within the built up areas and environmentally sensitive areas. This will significantly reduce the disruption to their customers within the existing urban area, and may also be used to mitigate any adverse impacts of the upgrades on Harlow Woods.

Figure 8-39 below shows the major milestones, in terms of development areas and network upgrades, for Harlow. Again, it must be noted that this figure is for guidance only; it is based on the assumptions detailed within this report, and certain variables being achieved such as the required annual dwelling completion rates. As these may be subject to change in the future, it is vital that good communication is maintained between the Local Authorities and TWU, to update and amend the development proposals and infrastructure requirements as more information becomes available.

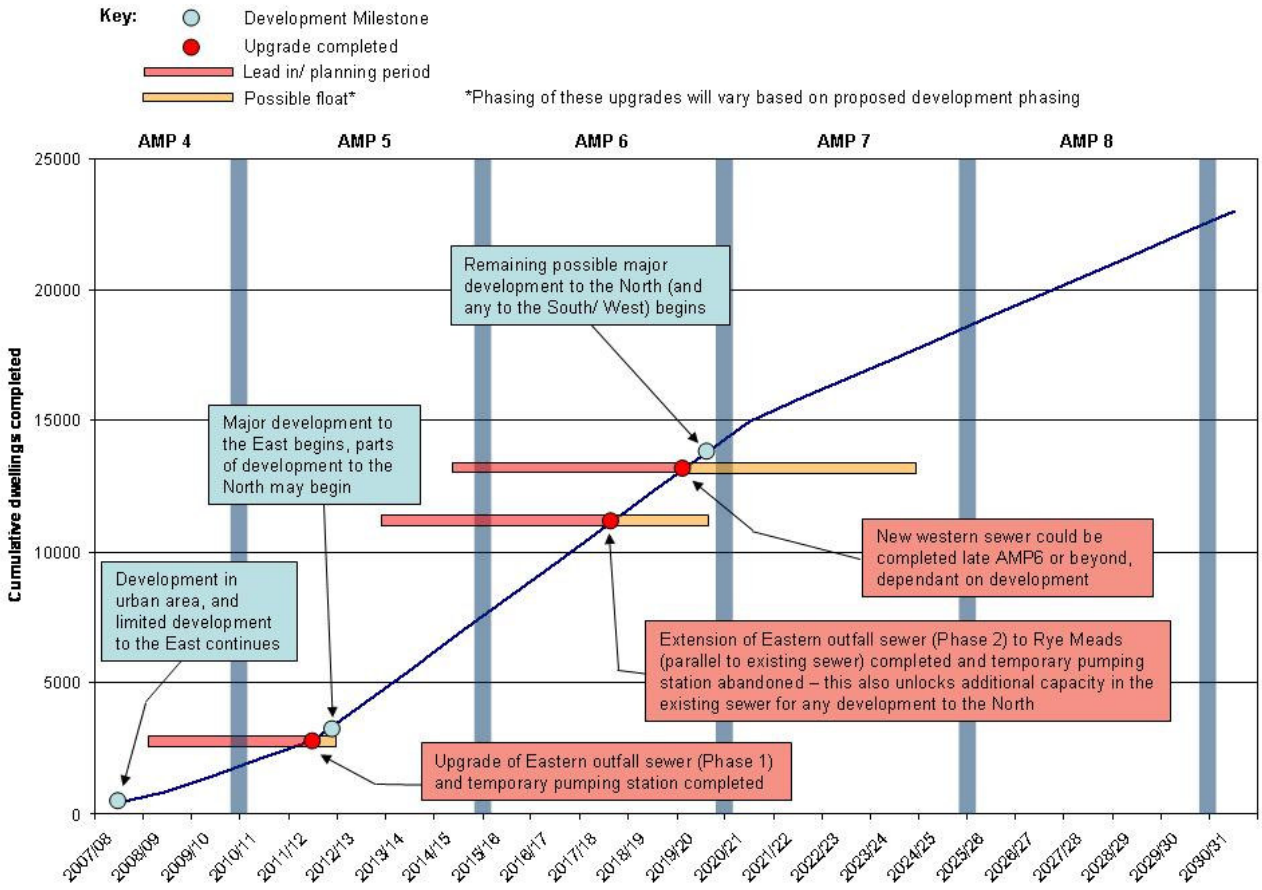


Figure 8-39 Harlow Intervention Graph

In the short term, development around Harlow is best steered towards the east, where TWU are planning to provide additional capacity by constructing a new outfall sewer. The completion date for this is currently forecast for 2012. The purpose of this sewer (Phase 1) is to ultimately drain all the new development sites to the east of Harlow, once it has been extended (Phase 2) to Rye Meads WwTW. However, in the short term the new sewer will serve the Newhall Farm and Gilden Way sites by balancing flows and regulating discharge to the existing trunk sewer (via a temporary pumping station).

The connection of some existing flows from the Old Harlow area to the new sewer will release some capacity in the existing trunk sewer, which could then be made available for possible development sites to the north of the River Stort. In this respect, development to the north of Harlow will not be constrained from 2012 onwards, as it is not reliant on the Phase 2 sewer extension. However, continued discussion will be required with TWU to control the phasing of any development to the north.

Development to the west of Harlow will be reliant on the completion of the Phase 2 outfall sewer extension to Rye Meads WwTW. TWU initially forecast a completion date for this upgrade in 2018. Again, further discussions will be required to ensure that any development in this area is phased accordingly.

Developer contributions through the requisition process and/or a community infrastructure levy based scheme could facilitate any future upgrades to accelerate the delivery of new development.

Stevenage

TWU have undertaken an initial modelling assessment based on the WCS growth data and consultation with the WCS stakeholders to ascertain the network reinforcement that would be required for the Stevenage network to convey wastewater from the proposed development sites.

As described in Section 7.2, TWU have considered a range of scenarios based upon the development sites from which they would ultimately be responsible for collecting wastewater. Figure 8-40 illustrates the major network upgrades that would be required to accommodate the development solely within the TWU area (scenario T1). This figure can also be used in conjunction with the additional text given below to illustrate the nature of the works required for scenarios T2 and T3.

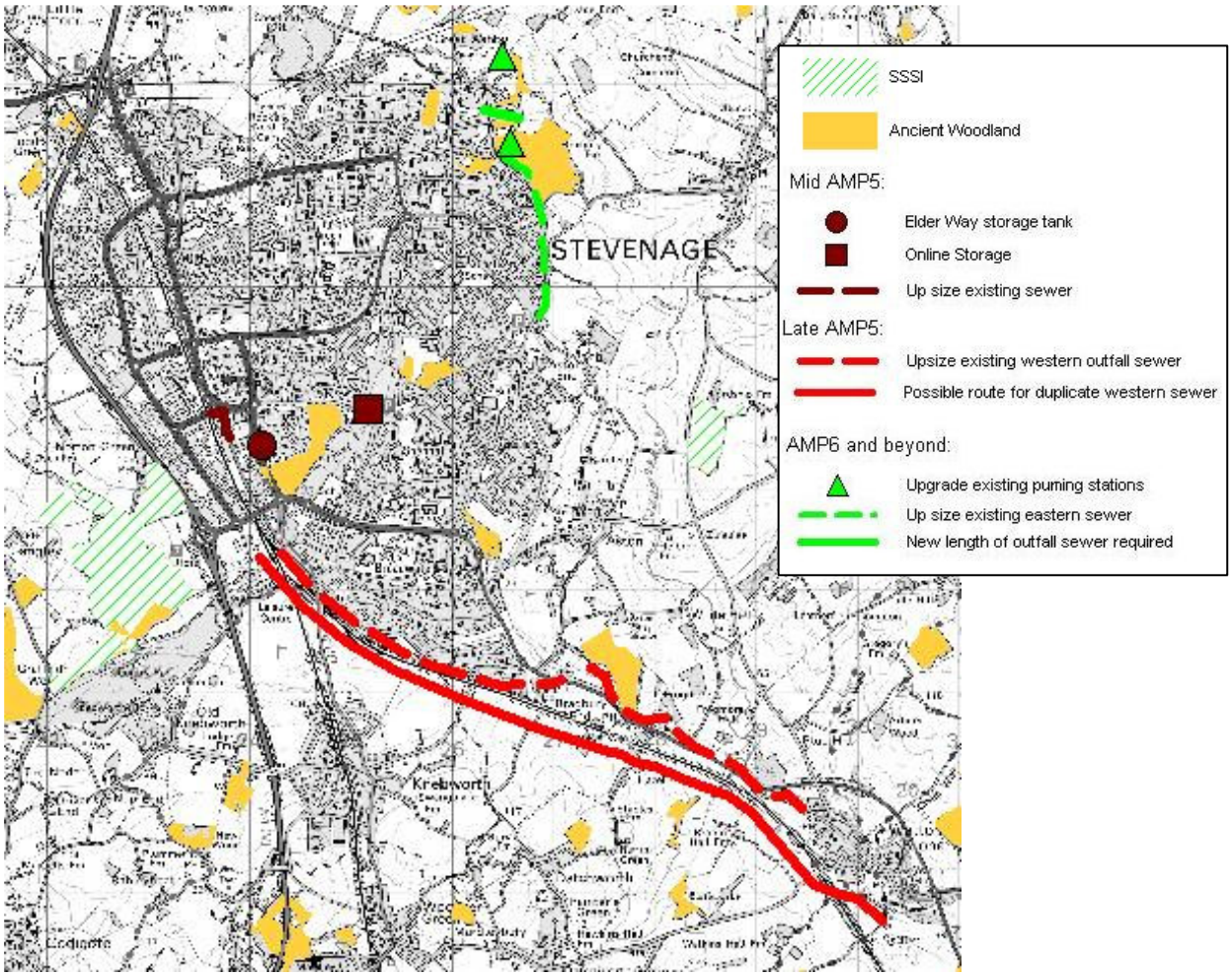


Figure 8-40 Proposed Stevenage network upgrades

The scale and phasing of the upgrades required will depend heavily upon the location and phasing of the future development. The above figure only highlights major upgrades, but additional smaller localised upgrades, and some form of attenuation on the eastern outfall sewer, may also be required, depending on future development.

Upgrades such as the Elder Way tank were originally proposed to provide additional capacity for the entire Stevenage West development. It may be more sustainable to size the required sewerage upgrades to also accommodate the T3 scenario, to avoid the economic, environmental and social costs associated with further upgrades in the same location in the future to cater for the remaining Stevenage development. Equally, should development not go ahead in this location, different solutions may become more preferable to TWU, particularly as

there are concerns over the maintenance requirement for an underground storage tank of the scale proposed. Furthermore, there is a risk of wasted capital expenditure and unnecessary burden to the existing TWU customers.

The duplication, or not, of the western outfall sewer will be heavily dependant on the certainty with which development locations are proposed by SBC and mechanism for addressing cross boundary issues with AWS, as TWU are only proposing that it is essential for growth scenario T3. Another deciding factor would be the construction difficulties such as over-pumping and traffic diversions that need overcoming if the existing sewer has to be upsized within the urban area. The need for the duplication will ultimately be an internal decision for TWU, based on their assessments of possible revenues and funding mechanisms, and the economic, social and environmental costs. This is all influenced by certainty in the location and timing of new development locations. Particular consideration will need to be given to the fact that the existing outfall sewer runs underneath areas of private property and close to existing dwellings.

In addition to the duplication of the western trunk sewer, another key remaining infrastructure requirement associated with T3 (compared to T1 and T2) would be the continuation of a new western ring main through the Stevenage West development. This would serve the northern development areas (e.g. sites 5 and 8 and possibly 4), has and would have to be planned and funded in conjunction with the developers involved.

As illustrated in Figure 8-40, the proposed network upgrades will be in close proximity to areas of ancient woodland. These areas contain UK BAP priority habitats, hence careful management of the construction phases will be required to ensure these important areas are not adversely affected. The design and construction should also carefully assess and mitigate any issues related to working adjacent to the floodplain and existing railway line. TWU have advised that any proposed duplication of the outfall sewer would be routed outside the floodplain as much as practicable.

Figure 8-41 below illustrates the major milestones, in terms of development areas and required network upgrades, for Stevenage. Again, this figure is based on the assumptions contained within this report; the exact phasing of these upgrades will depend on the development rate achieved by SBC and security of funding. The SNAP programme should strive to finalise the north Stevenage development locations, in consultation with AWS and TWU.

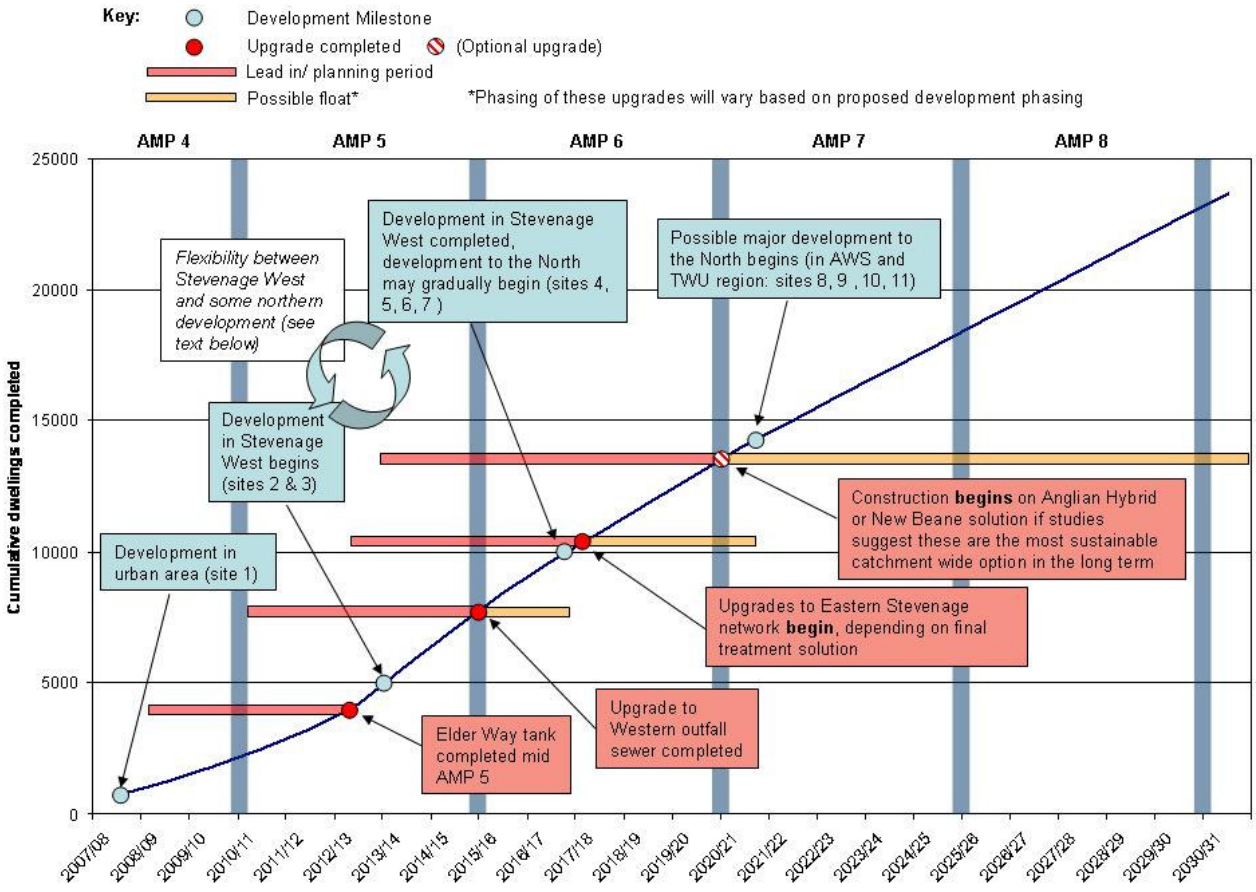


Figure 8-41 Stevenage Intervention Graph

The proposed network upgrades (in part to relieve existing capacity issues) result in development within the existing urban area (site 1), and to the west (sites 2 and 3) being achievable in the short to medium term. The detailed design of such upgrades relies on the individual site location and phasing being confirmed by SBC.

However, sites in the vicinity of the AWS network, such as site 4, (and possibly 10, 11 and 5) can also be developed in the short term, as sewerage can be pumped to the western Stevenage network via the Corey's Mill pumping station. This allows some **flexibility** should development in the urban area (site 1) or Stevenage West (sites 2 and 3) be delayed for any reason. As this wastewater would be conveyed down the western side of the Stevenage network, the Elder Way tank would still be required to attenuate flows.

Providing adequate funding is made available for the above upgrades and cross boundary issues are resolved with AWS, the sewerage network will not constrain development in and around Stevenage before 2021. The long term (past 2021) solution for collecting and treating wastewater in and around Stevenage can only be determined following further assessment by the WCS stakeholders.

However, it should be noted that TWU are able to propose network upgrades to accept wastewater from all Stevenage development (scenario T3). Therefore, whilst the long term treatment solution is not yet confirmed, development from 2021 onwards will not be constrained by the sewerage network providing SBC, NHDC and developers continue to liaise with AWS and TWU, to confirm development locations and secure funding for the required upgrades in a timely fashion.

To allow the most informed decisions to be made, and minimise delivery risk regarding the Elder Way tank and western outfall sewer upgrades, TWU require more certainty from SBC as to the phasing of the Stevenage West development.

Other Local Authorities

Further guidance for all Local Authorities within the Rye Meads catchment regarding the location and phasing of development, in respect to wastewater infrastructure provision, is presented in Section 9.1.1.

8.3 Flood Risk

North Herts, Stevenage and East Herts should continue to refer to their respective SFRAs for the most up to date flood risk information. The remaining Local Authorities should refer to their SFRAs as and when they are completed. Development should continue to be steered away from areas of high flood risk, and should be planned and constructed in such a way as to decrease flood risk downstream where possible. Greenfield (i.e. pre development) runoff rates should be required on all sites. A key measure to achieve this will be the use of **Sustainable Drainage Systems** (SUDS).

Surface Water Management Plans are recommended as a tool to better manage and mitigate flood risk from all sources. Opportunities to combine biodiversity enhancement with flood risk mitigation should be considered for every development.

Green Infrastructure Strategies are recommended as a tool to plan and implement biodiversity improvements alongside flood risk mitigation.

8.3.1 Widespread use of Sustainable Drainage Systems (SUDS)

Previous sections have mentioned the importance of successfully managing surface water from new developments through the adoption of SUDS elements. This section will look more closely at the application of SUDS within each of the Local Authority areas within the study catchment. For the purposes of this assessment, it has been assumed that all new development proposals will adhere to PPS25 and the recently published (June 2008) Practice Guide. More information can be found in the Stage 1 SFRAs that have been completed by the majority of councils within the catchment.

New development can affect the quantity and quality of the receiving water systems in several ways:

- Altering the natural surface water runoff rate and quality;
- Passing more wastewater to the treatment works and hence discharging more treated effluent to receiving watercourses;
- Discharging un-attenuated or poorly attenuated storm water runoff into storm sewers or receiving watercourses; and
- Discharging storm flows into existing network with the associated risk of Combined Sewer Overflows (CSOs) on existing sewers.

The sustainable management of surface water will therefore ensure that:

- The risk of surface water flooding is reduced through the attenuation or infiltration of surface water;
- The quality of the runoff is improved, to lessen the effect of poor quality surface water draining to watercourses; and
- The environmental biodiversity of the development is increased through the allocation of more green areas and techniques such as reed beds and wetlands.

Fully developed SUDS schemes should ensure that all three of these elements are considered thoroughly during the early stages of design.

The EA currently suggest that the SUDS hierarchy is adopted when considering SUDS techniques for new development, showing the preferred order in which different SUDS

techniques should be considered for a site. SUDS techniques at the top of the hierarchy are preferable for their potential ecological and water quality benefits, as illustrated by Figure 8-42

	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
Most Sustainable	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	Tanked systems - over-sized pipes/tanks - storms cells	✔		

Figure 8-42 SUDS Hierarchy

(SUDS: A Practice Guide, EA 2006)

It is the responsibility of Local Authorities to promote the use of SUDS for the management of runoff. The successful implementation of SUDS requires the early consideration of a wide range of issues surrounding their management, long term adoption and maintenance. The designers and stakeholders should take every available chance to discuss SUDS early in the development phase. It is essential that responsibility for future adoption, management and maintenance is established in the use of any SUDS in any development in order to ensure that it is successful and worthwhile.

The common method of developing SUDS schemes is through the concept of a 'management train'. A conceptualisation of this can be seen in Figure 8-43. It shows that a combination of individual SUDS elements is required to contribute to the overall effectiveness of the SUDS scheme. Single elements such as a soak away or infiltration basin may not be suitable in a number of circumstances due to, for example, the potential to contaminate groundwater sources.

The Interim Code of Practice[27] for SUDS, which was published by CIRIA in 2004, sets out the management and adoption of SUDS elements within the context of urban planning policy. CIRIA have also produced three model agreements[28] that have been designed as a binding agreement between the organisation involved in developing the SUDS scheme, the local authority and the Water Company. Defra have recently carried out a consultation on the future management of surface water as a follow on leading to the publication of Future Water earlier this year.

[27] Interim Code of Practice for SUDS, CIRIA. July 2004

[28] C625 Model agreements for SUDS, CIRIA

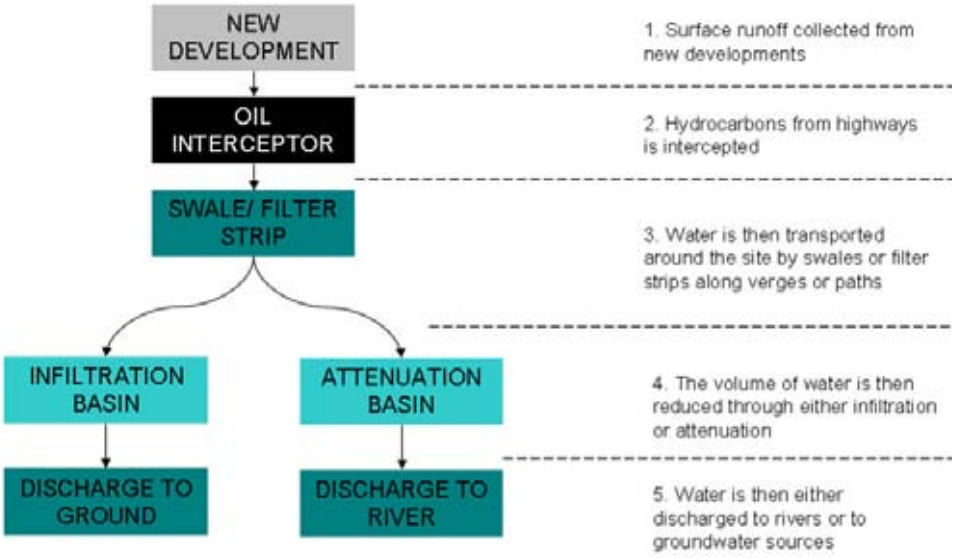


Figure 8-43 Example of SUDS management train

SUDS elements can also be retrofitted to existing developments or to the current urban fabric. One simple example of an element that has the potential to reduce urban runoff from existing developments is the use of rainwater harvesting techniques such as a simple water butt. A water butt collects a proportion of the rainwater that falls onto the roof of a property, which subsequently can be used, for example, to water the garden. Although legislation cannot oblige residents to fit rainwater harvesting solutions to their property, the promotion of these elements through guidance such as this is vital in increasing the uptake within the community.

Another example of a retrofit SUDS element is a traffic calming measure that also acts as an attenuation and infiltration basin. These elements are widely used in Germany and create an ideal way to introduce local storm water attenuation within urban areas. Local councils could adopt such elements as a standard when putting in traffic calming measures throughout urban areas.

An opportunity exists to link the design of SUDS with Green Infrastructure Strategies, to provide an integrated network that relieves flood risk whilst enhancing biodiversity. Attenuation basins and wetlands can provide valuable habitats for wildlife, as well as forming parts of green corridors between environmentally important sites. Local Authorities should encourage developers to incorporate SUDS from the higher levels of the SUDS hierarchy (Figure 8-42) into development sites wherever possible.

9 Strategy Guidance

In addition to the overall catchment strategy described in Section 8, additional guidance is provided in this section on select topics.

This guidance in intended for Local Authorities, water companies and developers, and is presented on a more localised level where appropriate.

Adhering to this guidance will be an essential component in achieving the strategic objectives for the overall catchment, and as such, will ensure that development is not constrained in the short to medium term.

9.1 Local Authorities

This section provides more localised guidance for Local Authorities; specifically on the topics of wastewater and SUDS.

9.1.1 Wastewater

Small isolated development sites, in the rural areas of the District, may be viable locations to utilise localised treatment options such as reed beds or biological contactors (see Table 6-17 for suitable population sizes for localised wastewater treatment methods). This should be explored further by the Local Authorities and TWU, as it may be preferable to connecting to the Rye Meads network.

Following consultation with the water companies and EA, the following advice is given to each of the Local Authorities regarding the compatibility of their proposed development with the wastewater infrastructure in the catchment.

Broxbourne

The network of pumping stations and rising mains that convey wastewater from the northern half of Broxbourne to Rye Meads WwTW may require upgrading to allow development to proceed in the future. However, as the location of this development is not yet confirmed, BBC will have to advise TWU as and when more information is known. TWU will prefer to locate sites close to strategic sewers, or with clear routes from the site to the strategic sewer, to limit costly and disruptive local upgrades within the urban area.

Broxbourne is one of the closest Local Authorities to Rye Meads, and some connections on the catchment border may be connected to the Rye Meads network in the future. The one strategic site identified so far by BBC, to the west of Hoddesdon, is outside the extents of both the Rye Meads WwTW and Deephams WwTW sewerage network. It is preferable, with regards to capacity at Rye Meads, to develop outside the catchment. However, TWU have advised that, due to concerns over network and WwTW capacity at Deephams, it would be likely that the development site in question would be connected to the Rye Meads network.

As information on development sites becomes more certain, BBC should consult with TWU to assess capacity of the existing local network and pumping regime, to enable the most sustainable sewerage solution to be devised for each site.

East Herts.

As East Herts. have not yet confirmed development locations, they are in a position to reduce their potential impact on the capacity of the Rye Meads WwTW and the sewerage network by **developing outside the catchment** where this is feasible.

An indicative distribution of development is provided from the percentages suggested from EHDC's PCBD method. This indicates that a large proportion of growth is expected in **Bishops Stortford**. This town has its own WwTW discharging into the River Stort. It is outside the scope of this WCS to assess the suitability of this, although TWU have advised that they have recently upgraded the WwTW, and that some network upgrades are planned. Bishops Stortford WwTW has been upgraded, in part, to allow for an increased loading from the development of Stansted airport. EHDC and TWU should continue to consult in the future regarding the capacity of the Bishops Stortford WwTW to accept flows from new development. Treating wastewater from development at Bishops Stortford results in discharges higher up the catchment, and is therefore a more sustainable solution than Rye Meads, providing water quality is not compromised.

TWU have also suggested to EHDC that the small town of **Buntingford** may be a suitable location to steer some development towards. During consultations on this WCS, TWU advised that some spare capacity exists at the WwTW in this location, with the potential to upgrade the works post 2015 if required. The sewerage network however may be close to capacity. Therefore, beyond what is within the current Local Plan, a strategic development site of 2-300 dwellings post 2017, built to the south or west of the town, linked directly to the WwTW would be acceptable. This would avoid the need to upgrade the existing network in the town.

EHDC should continue to investigate development in and around **Sawbridgeworth**, as the planned upgrades to the existing Harlow trunk sewer will allow additional capacity in this area of the network, although local upgrades could still be required. Again, connection of a strategic site directly to the main outfall sewers is preferred by TWU, as it avoids the need for extensive upgrades of the local network. It is anticipated that the second phase of the duplication of the trunk sewer to the north of Harlow is unlikely to commence before 2015, so development at Sawbridgeworth may have to be postponed until then, as the network near Harlow is at capacity in a number of places.

Development in **Hertford** and **Ware** will not be constrained by the capacity of the trunk sewer, as the new flows will only be a small proportion of the existing flows at this point in the network. Disruptive local network upgrades can be avoided by choosing strategic sites with clear access to the trunk main network. These sites may be limited to the east of Ware, to the west of Hertford or to sites within the valley close to the River Lee and therefore the trunk sewer.

Development in **Puckeridge**/ **Standon** would be possible. The existing sewers and pumping station to the WwTW are running at capacity however by selecting an appropriate site with a new pumped connection directly to the WwTW, this would not be an issue. Potential sites include the area between Standon and Puckeridge. TWU anticipate that the new pumped connection would be requisitioned by the developers. The site would have to be of a size to make the required connection cost viable, and an upgrade to Standon WwTW would be required.

Development along the **Thundridge**/ **Wadesmill**/ **A10 corridor** is likely to give rise to major drainage issues. A number of small sites of up to 30 dwellings each, with a maximum of 100 in total, could be accommodated. If higher levels are proposed there would be a need to upgrade a number of pumping stations, rising mains and sewers right through to Ware. As well as costly, this would be highly disruptive.

It is also possible that flood risk may be more of a constraint to development than sewerage. The East Herts. SFRA will provide the most up to date information on flooding, from all sources, and this will need to be a key consideration when locating development sites.

Epping Forest

Very few of the existing properties within Epping Forest are connected to Rye Meads WwTW. It is anticipated that the majority of development will occur **outside the catchment**.

Local network upgrades would be required if development is located within the catchment, although the small amount of development that would presumably be achieved in this area would have a negligible effect on Rye Meads WwTW and trunk sewer network.

However, if a major step change occurs in the catchment so that flows to Rye Meads from Stevenage and other areas are drastically reduced, it may be preferable to locate future Epping Forest development within the catchment to maintain flows in this stretch of the River Lee.

EFDC should consult with TWU at all stages of their LDF to ensure there is an adequate provision of wastewater treatment and sewerage network for their proposed sites.

Harlow

Due to a history of good communication between HDC and TWU, upgrades to the trunk **sewers** serving Harlow are already planned to the east of the urban area.

HDC should **continue to liaise** with TWU to ensure that appropriate network upgrades are in place for when the proposed development comes online. Providing HDC keep TWU informed of the most likely development phasing, TWU should be able to provide adequate capacity in both the network and Rye Meads WwTW itself.

As a large development to the north (as identified in the RSS) may be part of HDC's preferred solution, HDC should ensure that TWU are kept informed of any emerging dwelling numbers and phasing as soon as reasonably practicable, so additional capacity can be built in when upgrading/ duplicating the sewer that runs parallel to the River Stort. Significant upgrades of the sewerage infrastructure can involve long lead in and implementation times (up to 5 years) and therefore effective communication regarding the timing and location of development will reduce the risk of these upgrades becoming the critical path.

Development sites to the south of the urban area may be more problematic, as they will be further from the outfall sewer. This may require either extensive upgrades to the town centre network, or routing of wastewater around the south-western periphery of the town. As mentioned previously, consideration will need to be given to **Harlow Woods SSSI**, which may obstruct the route of new sewers from southern development sites.

North Herts.

The majority of development in North Herts is unlikely to be within the Rye Meads WwTW catchment. Regarding sewerage, localised network upgrades may be required in villages such as Knebworth, although it is acknowledged that NHDC are proposing very modest development in these locations. It is unlikely that WwTW and network capacity will be major constraints on development of this scale.

NHDC should avoid large development sites within the Rye Meads catchment, as the distance to the WwTW, and the current capacity issues being addressed near Stevenage, suggest that this is not the most sustainable option.

As described previously, flood risk in the town of Hitchin, and the water quality downstream of the Hitchin WwTW, may constrain development in this location.

Any decisions on strategic sites made by NHDC should take account of the development in and around Stevenage. This is best achieved by continuing to focus on the SNAP programme jointly with SBC and WCS stakeholders.

Stevenage

As described in detail in Section 7, SBC should promote the development of sites within the existing urban area and to the west, although the network upgrades identified may allow for some development to commence to the north should Stevenage West be delayed. Firming up these development proposals soon allows TWU a better evidence base with which to plan and secure funding for upgrades with Ofwat, although the opportunity for the potential inclusion of these sites in PR09 has been missed.

SBC and NHDC should continue to liaise through the SNAP programme to identify the likely sites for development to the north of Stevenage.

This process should run in parallel with a further review of the recommendations in this WCS and/ or Sustainability Appraisals as part of the LDF process, which should be conducted with input from the EA, TVW, AWS and TWU. This should quantify the economic, environmental and social benefits and costs of continuing to connect to the Rye Meads WwTW network, upgrading Ashbrook WwTW or the construction of a new WwTW on the Beane Valley. Alternatively, the water companies may decide to do their own investigations in accordance with their business plans and provide the relevant information to the WCS stakeholders but this may be dependant on the normal developer requisitioning process and likely to be too late to inform ongoing LDF documents and RSS review.

Welwyn Hatfield

Recent upgrades by TWU to the sewerage network on the outskirts of Welwyn Garden City provide WHDC with an opportunity. A new sewer, which runs along the eastern periphery of the urban area to the trunk main, has capacity to take the wastewater from a large strategic site.

TWU have advised WHDC that a large strategic development site on the southeast margin of the urban area can be connected to this sewer.

WHDC have not yet confirmed locations for their development, but the phasing of a site in the location above would not be constrained by the sewerage network.

Likewise, development to the northeast (in the Panshanger Aerodrome area) would not be unduly constrained by the sewerage network, as it could either be connected into the new sewer (to the east), or the wastewater could be attenuated on site before being discharged into the existing outfall sewer (to the north).

However, significant development north of Welwyn Garden City, in the Digswell area, would have to be connected to the existing outfall sewer. If a large strategic site is proposed in this area, this outfall sewer would need upsizing.

TWU have also advised that a diversion from the southwestern areas of Welwyn Garden City to Mill Green WwTW is awaiting commissioning. This reduces flow in the existing local network along Howlands and could provide the opportunity for further growth in this area. The diverted sewer has capacity for further growth at Chequers, although if this is an area selected for development, some further upgrades of Mill Green WwTW would be required.

There may be a possibility of upgrading Mill Green WwTW within its existing boundaries to accept more development, however, major development connected to this works would lead to a need for a change of treatment process, incurring significant cost, and an increased consent to discharge into the River Lee may be required. WHDC should liaise with TWU (and the EA regarding possible consent implications) to assess the feasibility of connecting some development to the Mill Green WwTW.

It is therefore proposed that, apart from the strategic sites mentioned above and smaller infill development within Welwyn Garden City, WHDC should locate around 50% of development towards Hatfield, in the Maple Lodge/ Blackbirds WwTW catchment, although the water infrastructure capacity here has not yet been assessed by a WCS. Therefore, TWU and WHDC should continue to consult on feasible development locations outside the Rye Meads catchment.

9.1.2 Localised SUDS Appraisal

The design of SUDS measures should be undertaken as part of the drainage strategy and design for a development site. A ground investigation should be undertaken to assess the suitability of using infiltration measures, with this information being used to assess the required volume of on-site storage. Hydrological analysis should be undertaken using industry approved procedures such as the Flood Estimation Handbook to ensure a robust design.

The appropriate application of a SUDS scheme to a specific development is heavily dependent upon a number of issues:

- Underlying geology and results of on-site Geo-Environmental investigations;
- Proximity of groundwater table; and
- Local criteria for protection of underlying groundwater, surface water and contaminated land issues.

Careful consideration of the site characteristics is necessary to ensure the future sustainability of the adopted drainage system.

Broxbourne

Much of the Borough contains permeable soil characteristics such as sand, gravel and silt. In these locations it is recommended that infiltration drainage techniques are implemented (e.g. soakaways, permeable surfaces). Where impermeable soil characteristics exist or the water table is high, techniques that focus on storing water above the ground should be implemented. It is important to note that the majority of the underlying geology across the Borough is mudstone which is impermeable, hence the depth of the soil to the under lying rock must also be taken into consideration when selecting the SUDS types.

There are a number of groundwater source protection zones within the Borough. These zones are defined in terms of how groundwater behaves and are designed to protect against the transmission of toxic chemicals and water-borne diseases.

Park Plaza is identified as a key employment area with ancillary uses such as a hotel with conference and training facilities. The site geology consists of brickearth, an irregular rock type spread mainly across southern and southeast England; in places, under engineering loads, it is prone to rapid ‘collapse’ settlement when saturated. Due to the nature of the geology, it would be recommended to incorporate SUDS solutions that do not infiltrate into the soil in order to reduce the increase risk of rapid collapse settlement within the site area.

The SFRA has provided advice and guidance for developers for SUDS considerations and has highlighted that all future developments should provide for SUDS within the development including the identification of a SUDS design strategy. This could and should include options that are not reliant on infiltration into ground for example:

- Green Roofs: Vegetated roofs that reduce the volume and rate of run off and can reduce contaminants in the runoff;
- Filter Drains: Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist with drainage, to store and conduct water;
- Basins and Ponds: Where water may be stored on the surface. (Basins are free from water during dry weather flow conditions, whilst ponds are permanently wet); and
- Water harvesting, for example the use of water butts to collect rainwater, which in turn can be recycled for various uses.

East Herts

Generally, the District is predominantly comprised of calcareous pelosols associated with stagnogley soils and argillic brown earths. The parent material is chalky glacial drift and has a slowly permeable character with well structured, calcareous clayey soils associated with impeded drainage, or less clayey better drained soils, which are often stony. The suitability of infiltration SUDS here will need to be assessed on a site by site basis. The western parts of the District can contain paleo argillic brown earths with glacial, glaciofluvial or river-terrace drift and associated brick earth.

In the western areas of the District, around Hertford and the lower Beane valley, the soil is generally freely draining and as such may be suitable for infiltration SUDS techniques, although pollution of the underlying chalk aquifer should be carefully mitigated against. Similarly, there are freely draining areas surrounding the Rivers Rib and Ash.

Within Hertford there are certain areas, predominantly near the river confluences, where groundwater levels are high, which will impact upon the detailed design of any SUDS at a site level.

An area of waterlogged impermeable soils exists in the south west of the District and as such, infiltration SUDS will not be suitable in this location.

Maps of the drift geology in the District are included in the East Herts SFRA, which should be consulted by developers, along with CIRIA guidance, to assess the suitability of SUDS options.

East Herts Council is actively promoting the use of SUDS within the District in accordance with guidance as described in PPS25 and the Thames CFMP. Where possible above ground SUDS would be encouraged as these are acknowledged to emulate natural drainage features and tend to be easier to maintain. However, below ground SUDS and tanks could be beneficial for some situations, particularly where used as part of domestic or commercial grey water recycling systems.

North Hertfordshire

The BGS 1:50,000 Solid and Drift edition (sheet 221) provides a geological summary of the site area. The area is underlain by the Upper, Middle and Lower Chalk formations with several areas to the northwest of the study area having the Lower and Middle Chalk formations exposed. The Upper Chalk is exposed in the centre of the site just north of Stevenage, and locally to the south-west.

The drift deposits are more varied across the site and are dominantly deposits from the Anglian Glaciation. These predominantly comprise chalky sand and gravels and chalky sandy, gravelly clay.

Several channel features run through the area, predominantly running northwest to southeast, approximately through Hitchin town centre. These channels are recorded as being up to 100+ m deep in certain locations and a maximum of 2 km and minimum of 100 m across and are comprised of a combination of glaciolacustrine, glaciofluvial and till deposits.

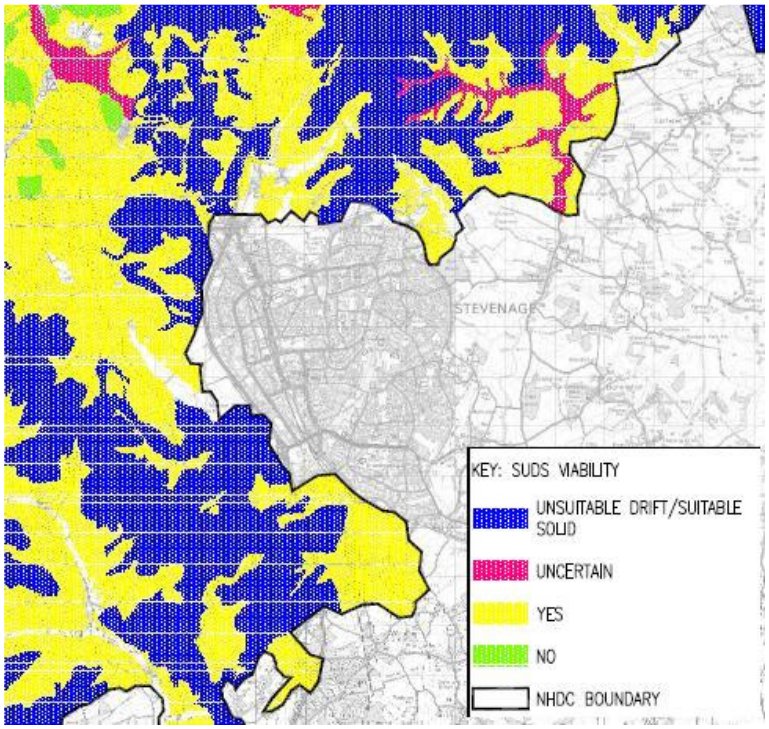


Figure 9-44 North Herts SUDS Viability Map

(NHDC SFRA, WSP 2008)

The area to the west and north of Stevenage is identified as the area in which the majority of the new residential development within the Borough will occur. The geology consists of Upper and Middle Chalk formations. Infiltration SUDS options are considered suitable for these areas, due to the Upper and Middle Chalk consisting of white chalk with beds of flint, nodular chalks, and marl seams and flaser marls, all of which hold soakaway potential.

Some areas are shown to have a grey marly chalk with no flint, which comprises glauconitic marl and is overlain by typical lower chalk sequence and hard band. This creates impermeable layers and therefore other more suitable SUDS options should be looked at for these areas.

In order to provide the most sustainable SUDS techniques throughout the area, and considering the type of geology across the site, the most effective SUDS recommendation would be to incorporate the use of green roofs, basin and ponds (balancing, detention, retention, and wetlands) filter strips and swales and infiltration devices such as soakaways, trenches and basins. All of these provide flood risk reduction, water quality improvement and can benefit wildlife and the landscape.

Stevenage

Surface water runoff is collected and attenuated in Stevenage via a network of TWU storm sewers and 12 flood storage reservoirs (FSR), planned and built at the same time as the town (know locally as water meadows).

The rapid growth of Stevenage over the past 40 years has created a significant risk of pluvial flooding, particularly from heavy, intense storms larger than that for which the drainage system was designed.

The recent Stage 1 SFRA commented that *'In Stevenage the generally permeable nature of the soil, subsoil and underlying strata makes the disposal of runoff to groundwater by means of SUDS incorporating soil infiltration processes a desirable and potentially* ***feasible option****. There should therefore be an* ***initial presumption*** *within Stevenage in favour of using these types of SUDS in preference to those that merely attenuate peak discharges to sewers or watercourses by the retention of runoff in temporary storage facilities. Since chalk is the dominant stratum in the Stevenage area, developers should be made aware of the presence of a number of groundwater source protection zones in the area and it is essential that the quality of the runoff disposed of by infiltration is fully taken into account.'*

Box 16: Stevenage SFRA extract

The use of a chalk aquifer for public water supply purposes will necessitate the use of oil interceptors and/or the separation of roof drainage from the runoff from road surfaces and vehicle parking areas to reduce the risk of pollution.

Although the permeable local geology will make the use of infiltration SUDS highly effective, even the widespread use of SUDS may not prevent the need for the provision of a substantial volume of additional runoff storage in the form of a new FSR, or extension of an existing FSR .

The retrofitting of SUDS elements to the existing urban area should be considered in Stevenage to reduce the rate of surface runoff that is discharged into the surface water sewers and FSRs.

Epping Forest

The geology throughout Epping and Waltham Abbey consists of Older Head and Claygate Beds in Epping, and London Clay within Waltham Abbey. Older Head consists of up to 5 m of orcheous brown, pale grey and red mottled clays with some sand and rounded black flint pebbles. Claygate Beds are sandy passage beds between London Clay and Bagshot Beds and consist of brown, orange and lilac molted mottled silts. The Claygate Beds vary in thickness from 14 m to 24 m.

The geologic formation of Older Head and London Clay may not be suitable for a soakaway SUDS option, therefore the most suitable options from the above list would be attenuation measures, rather than infiltration.

Harlow

Harlow District has a substantial aquifer capped by London Clay, and is part of the main chalk aquifer of the London Basin. Sustainable drainage within Harlow should focus on the control of surface water run-off **as close to the origin as possible**, before it discharges to a watercourse or to the ground, in order to protect the underlying aquifer.

The geology of Harlow District has been the result of a number of key events that have taken place over time. The River Thames once flowed to the north of its current path passing through or just north of the current administrative boundaries of Harlow District. This resulted in the

Thames river terrace gravels that are found in the surrounding region. East Anglia was also covered by an ice sheet (the Anglian Ice Age 472 – 428 thousand years ago) which has left a layer of boulder clay, till and glacial sediments over much of the area, except where the ice has exposed the London Clay.

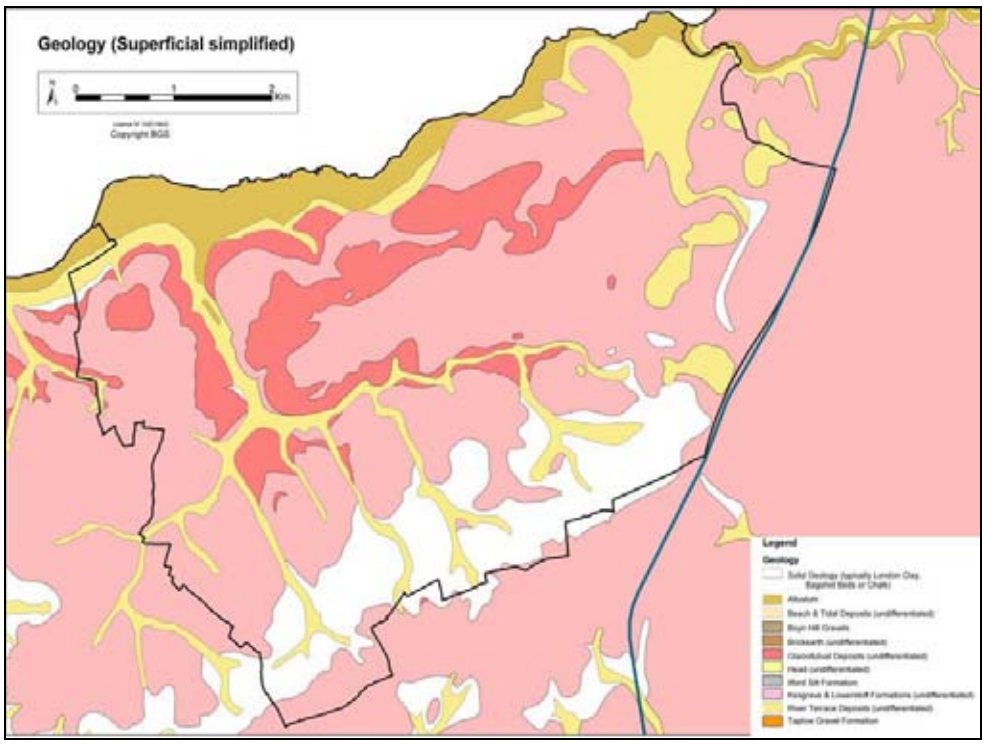


Figure 9-45 Surface Geology of Harlow District

(Harlow Strategic Environmental Assessment, 2005)

The prevailing geological conditions in this area are likely to constrain the use of infiltration based SUDS techniques in most cases. However, where flood risks are identified, appropriate flow attenuation facilities or mitigation measures may be a prerequisite for development.

Therefore, the SUDS options throughout the residential and employment areas proposed in Harlow, taking into account the geological land formation, should consist of source control and attenuation measures such as:

- Green roofs;
- Rainwater harvesting;
- Swales;
- Detention basins;
- Retention ponds; and
- Wetlands.

Welwyn Hatfield

Glacial gravels, clays and barns cover a great deal of the whole Borough, and overlay the Chalk aquifer. Groundwater feeds into the surface water system by means of springs and river flows. Pollution of ground and surface water can result from activities such as the disposal of effluent in soakaways, contaminated land, landfilling of unsealed sites over permeable bedrock and other industrial processes.

WHDC should continue to resist development sites until clarification is made that the aquifer and surface water quality will not be adversely affected.

If proposals are acceptable then the use of SUDS (to reduce the concentration of pollutants) should be encouraged, which in turn will lead to the enhancement of ground water quality.

9.2 Developer Guidance

Developers will continue to be required to comply with emerging Local Authority and regional policies, in addition to statutory national policies such as PPS25.

The following checklist is provided as outline guidance for developers, to enable developments to be planned whilst taking account of best practice, and conforming to the strategy and aspirations discussed throughout this WCS.

Meeting the “actively encouraged” requirements will minimise the negative impacts of any development on the water infrastructure within the study area, and the wider water environment.

Topic	Strategic Requirement/ Aspiration	Minimum Requirement	Actively Encouraged
Flood Risk	*Has the development been approved following an assessment under PPS25, utilising the sequential and exception tests, a FRA and LA SFRA where appropriate?*	ⓘ	
	Does the FRA for the development site propose measures to reduce downstream flood risk, particularly from surface water runoff following WCS guidance?		✔
SUDS	*Has the developer provided details of how surface water runoff will be separated from foul drainage systems and limited to the rate prior to development (the equivalent greenfield rate for brownfield sites), in line with EA guidance, CFMP, WCS and SFRA?*	ⓘ	
	Can the developer demonstrate that any planned SUDS are appropriate for the site geology, taking into account Groundwater Vulnerability and SPZ, as detailed in this WCS. Previous land use should be considered, and localised permeability tests will also be required, potentially as part of the site FRA?	ⓘ	
	Has the developer consulted with the Local Authority regarding who will be responsible for maintenance of any SUDS features, and how this will be funded?	ⓘ	
	Is the developer proposing to integrate biodiversity features such as wetlands and green corridors into any proposed SUDS, as recommended in this WCS guidance and any Green Infrastructure Strategies?		✔
Demand Management	*Has the developer provided evidence of how calculated whole building performance will be 105 l/p/d or less, as recommended in this WCS?*	ⓘ	
	Has the developer provided details of any rainwater harvesting/ grey water reuse systems to achieve PCC between 80-105 l/p/d?		✔
	Has the developer provided details of any schemes/ measures to raise the occupiers'/ community's awareness of the importance of water efficiency, such as integrating smart meters into dwellings?		✔
Potable Supply	*Has the developer liaised with TVW to ascertain if supply can be provided, and ensured that appropriate funding mechanisms are in place?*	ⓘ	
	Is the development part of a strategic site within close proximity to TVW assets?		✔
Sewerage	*Has the developer provided evidence (following liaison with AWS/ TWU) that network capacity can be provided, the receiving WwTW has adequate capacity to receive the flows, and that appropriate funding mechanisms are in place?*	ⓘ	
	Is the development location and phasing in keeping with the catchment (and localised) strategy recommended in this WCS		✔

Topic	Strategic Requirement/ Aspiration	Minimum Requirement	Actively Encouraged
Conservation	*Has the developer completed all relevant ecological surveys and impact assessments, and complied with all relevant planning conditions, as directed by UK/ EC law, PPS9 and the latest LA policies?*	ⓘ	
	Has the developer provided details of integrated site specific solutions to enhance biodiversity in the water environment?		✔

Table 9-32 WCS Developer Checklist

9.3 Water Companies

As described in Sections 2 and 5, it is expected that no new abstraction resources will become available within the study area after 2010. Over-abstraction of existing resources may lead to reductions in existing abstraction licenses in the future to provide environmental benefits.

This WCS has also demonstrated throughout the importance of reducing consumer water use, to lessen the impact of development on the capacity of existing infrastructure.

For these reasons water companies (or more specifically the water companies responsible for potable supply; TVW and TWU) must seek to maximise efficiencies, by continuing to reduce leakage, increase meter penetration and inform customers of the environmental and financial benefits of conserving water.

Water companies should continue to engage in a programme of active leakage detection/ control and pressure management to reduce leakage from the supply network.

As the study area is within an area of serious water stress, TVW should continue to aim to achieve 90% meter penetration by 2030 (as proposed in their draft WRMP), if not before. Metering sends the right price message to customers, and can act as a financial incentive to reduce consumption. However, consideration must be given to those vulnerable groups in society where affordability may be an issue.

TVW are already proposing to build upon their existing customer education programme throughout the next AMP period, and introduce variable water tariffs by 2015 to further influence customer behaviour.

All water companies should continue to liaise with the WCS stakeholders involved in this study and engage proactively to identify and deliver sustainable solutions for the entire catchment. Water companies should work in partnership with the Local Authorities and the EA to aim towards water neutrality.

All of the above activities should help to reduce the impact of existing customers, and the proposed development, on the water supply and sewerage network (including treatment).

10 Conclusions and Recommendations

This section summarises the main conclusions that have emerged whilst developing the Water Cycle Strategy for the Rye Meads catchment, and brings together the recommendations for further work that have been identified.

10.1 Conclusions

This WCS has identified the possible constraints to development within the catchment through reviewing existing strategies and documents and consulting with the key stakeholders.

The main conclusions that have been incorporated into the strategy are summarised by topic below:

Water Quality

The water quality of rivers within the study area is generally compliant with objectives set by the EA, however under the emerging WFD the majority of watercourses will fail to meet the required quality, mainly due to excessive concentrations of nutrients.

As stated above, the WFD is a key risk, as Rye Meads WwTW may be required to produce a discharge with a much higher quality in the future than at present, which may even lead to a possible reduction of current maximum volumetric flow consent if the specified chemical and biological quality improvements are not achievable through improved treatment and financial investment. This has the potential to constrain development, but only after 2021. Before then, the EA have advised TWU that they are unlikely to tighten consent standards. Water efficiency measures, aspiring to achieve water neutrality, and routing flows from future development into other WwTW catchments where feasible, will allow the management of this risk to some extent. The EA have also advised that any required improvements would not be beyond best available technology, although the cost implications of this will have to be assessed internally by TWU.

Utilising surface runoff attenuation and treatment (in both urban and rural locales), such as source control measures and integrated wetlands, can help to reduce the nutrient concentrations in the watercourses.

Flood Risk and SUDS

Providing that development is planned in accordance with national policies such as PPS25, there is no reason for flood risk to constrain development. Adequate land is available outside areas of high flood risk.

Guidance has been provided as to the general SUDS applications that may be most appropriate for the Local Authorities. The importance of incorporating biodiversity conservation and enhancement features into SUDS applications has been also been highlighted.

The additional flood risk due to increased effluent discharge from new or upgraded WwTWs will require further assessment and mitigation in close consultation with the EA.

Water Resources and Supply Network

- TVW are responsible for potable water supply in the study area, which is located in their northern water resource zone;

- Broxbourne and some southern areas of Epping Forest and East Herts lie within TWU's London Resource Zone;
- TVW have strategic mains in the vicinity of all proposed development areas and do not envision that supply infrastructure capacity will constrain growth;
- TVW are confident that planned AMP 4 resource development, and continued demand management and leakage reduction will prevent a deficit in this water resource zone between supply and demand before 2035;
- In order to achieve this, all new properties will be metered, overall meter penetration will be 90% of households by 2030, and new ways of charging for water will be assessed and implemented;
- The effects of climate change, possible pollution events and the requirement to protect the environment can reduce resources available for supply, however the above measures will provide adequate headroom against this risk;
- The importance of water efficient fittings in households and other business premises (new and retrofit) and the need to further educate consumers with regards to water conservation has been highlighted; and
- It has been shown that these measures must be actively encouraged throughout the planning process, as they will significantly reduce the impact of the proposed growth on the existing resources and network, and can help the study area move towards water neutrality.

As such, water resources and supply infrastructure should not significantly constrain development. Continued liaison between TVW, TWU and the Local Authorities is required as soon as development sites become more certain. This will allow the appropriate planning and funding mechanisms to be put in place.

Wastewater Treatment

- It is envisaged that the highest amount of growth in the Rye Meads WwTW catchment will be around 40,400 new dwellings in the catchment by 2021, or a total of 66,300 by 2031, to meet RSS targets;
- Rye Meads WwTW will require substantial upgrades in the future to ensure capacity can be provided for the proposed growth;
- Land is available within the existing site to accommodate these upgrades, without encroaching on the adjacent SSSI;
- Securing funding for the required upgrades via Ofwat will be a challenge, particularly due to the current economic climate and lack of house building;
- There is sufficient headroom within the Rye Meads WwTW volumetric discharge consent to accommodate the proposed development to 2021. However, the works may require an increase in this consent before 2031, depending on the growth in the catchment, PCC and occupancy rates and future operation of the DTM. This is a key risk (given the potential water quality implications of the WFD), although the risk can be reduced if planned reductions in PCC are realised and development outside the Rye Meads catchment is maximised;
- There is an opportunity to further reduce this risk in the long-term, and perhaps supplement low flows in rivers higher in the catchment, by changing how wastewater is treated in and around Stevenage with either a new WwTW on the River Beane, or a hybrid of options in the Anglian catchment;

- The benefits of such solutions cannot yet be fully quantified, but Rye Meads WwTW is an acceptable substitute, as it can accommodate the proposed growth whilst these options are further assessed according to the guidance given in this WCS;and
- As stated throughout the report, increased efficiencies (achieving the 'best case') means that wastewater treatment and water resources will not constrain development before 2031.

In conclusion, wastewater treatment capability should not significantly constrain development prior to 2021 providing that there is continued liaison between TWU, AWS and the Local Authorities to ensure planning and funding for the required upgrades are in place. There is still a risk that future water quality implications on the River Lee following implementation of the WFD, and the ability to meet these in an economical and sustainable way, may constrain development before 2031.

Sewerage Infrastructure

- The sewer network is known to be at capacity in places, increasing the risk of sewer flooding impacting people and the environment due to the planned growth and potential climate change impacts;
- The towns of Harlow and Stevenage are where major network upgrades will be required, as development in towns further down the network (such as Hertford and Ware) have a lesser effect on overall flows in the trunk sewers;
- TWU are proposing network upgrades in Harlow for future AMP periods, based on their interpretation of the realisation of RSS figures. Potential upgrade requirements also based on RSS figures have been assessed for Stevenage;
- It is important that a long term wastewater strategy for the development in and around Stevenage is progressed as soon as possible (see Section 10.2). Otherwise, there is a significant risk that the water companies will invest heavily in sewerage infrastructure, which may then become redundant if the wastewater treatment solution changes in the future; and
- Providing that the appropriate funding can be obtained for these upgrades to match with likely development phasing and cross boundary issues are resolved, the proposed growth should be able to be accommodated. It is stressed that significant infrastructure upgrades could be required; to reduce the risk that this becomes the critical path to delivering planned growth, early communication detailing high confidence on timing and location of developments is required.

Therefore, the capacity of the sewerage network should not considerably constrain development, as known capacity issues have already been identified and plans can be investigated to address these, whilst also providing for the additional growth. Securing funds to deliver substantial sewer upgrades in a timely fashion ahead of the planned development, given the uncertainty of the development locations and their phasing, is a key risk to this process at a local level, although this can be mitigated through constant discussions between TWU, AWS, the Local Authorities and developers. Overcoming the cross boundary issues related to Stevenage development is also a significant consideration in this process.

Arriving at a decision as to the best long-term treatment solution for wastewater from the Stevenage development as soon as possible will allow TWU and AWS to confirm their network development plans accordingly, and ensure that the major upgrades constructed can support the development to 2021 and beyond in the most efficient fashion.

10.2 Recommendations

Following the completion of this WCS, the following recommendations are made regarding policies and further studies:

- Developers, water companies and Local Authorities should use this WCS report (and associated guidance) as a tool to inform their existing and future decisions and policies, to ensure that new development and major water infrastructure upgrades are in accordance with the strategy suggested herein;
- The Local Authorities and water companies should consult with national and regional government (including Ofwat) to ensure that the current economic climate does not constrain growth plans, and that appropriate funds for water infrastructure improvements continue to be made available as highlighted in this WCS report and water company business plans.
- The significant lead in time involved in planning, securing funds, designing and construction of substantial water infrastructure upgrades within the Rye Meads catchment should be factored in to deliver the ambitious RSS targets within the Rye Meads catchment, which clearly highlights the need for making timely decisions throughout this process;
- TWU have advised that if appropriate funds are not allocated by Ofwat in PR09 for the required infrastructure upgrades due to the current uncertainty in the housing market then it is strongly recommended that TWU, at their discretion, consider making an interim submission to Ofwat ahead of the PR14 process when the rate of economic recovery is better understood. This will reduce the lead time associated with the planning and delivery of major infrastructure and ensure that growth plans are not further constrained due to lack of infrastructure. Key to the success of this recommendation will be documented support to Ofwat from the relevant LA;
- Detailed assessments for Stevenage and Harlow sewerage upgrades and increasing Rye Meads treatment capacity should commence soon after the publication of the WCS report;
- In addition, a detailed assessment of the Beane WwTW and Anglian upgrade options should be undertaken to quantify the economic, social and environmental benefits and costs of such solutions, to ensure the most sustainable long term solution is achieved for collection and wastewater treatment. This will require the input of the EA, TWU, TVW, and AWS, to determine the most sustainable balance between river flows, abstraction, water quality and ecology that best suits the needs of society and the environment (see below);
- Further assessment of the implications of the WFD, the actions that emerge from the finalised RBMP and what these mean for the forward planning of AWS, TVW and TWU will be required. Water companies should continue to actively engage with the EA during RBMP consultation periods and when implementing the resultant programme of measures;
- Surface Water Management Plans should be completed by SBC, HDC and EHDC to further understand and mitigate against flood risk from surface water; and
- Green Infrastructure Strategies should form part of the Local Authorities' LDFs, to investigate and identify opportunities to enhance the biodiversity of the water (and wider) environment across the entire study area. SUDS design should be linked to these strategies to create an integrated network of flood risk mitigation, pollution control and biodiversity enhancement.

Whilst this WCS satisfies the original brief that was primarily originated as a requirement of the RSS, further work is required to ensure the optimum combination of development and environmental protection/ climate change resilience in the long-term and to provide the additional detailed evidence base for the preparation of ongoing and future LDF documents. The required involvement of the stakeholders in this work is displayed in Table 10-33 below. This table highlights the recommended indicative dates by which these important studies should be completed, and suggests the possible consequences of any delays.

A part of this work should be undertaken immediately through independent / parallel studies funded by the WCS stakeholders. The work regarding wastewater treatment options should consider that all current and future wastewater discharges from the Harlow area would be treated at Rye Meads WwTW. Thames Water should conduct a detailed cost benefit analysis for both the likely upgrades to the sewerage network from Stevenage to Rye Meads and a new WwTW on the Beane Valley. Thames Water, in close consultation with the Environment Agency, should also assess the water quality, flood risk and ecological effects of any increase in discharge from Rye Meads on the water environment and how to mitigate such impacts.

Anglian Water should also work together with the Environment Agency to conduct a similar study to assess the suitability of the Anglian Hybrid Option. The water companies, in consultation with WCS stakeholders, should then determine the most sustainable and cost effective long-term solution for the collection and treatment of wastewater in the Stevenage and North Herts area. The process of identifying this solution must be transparent, and should also maintain the presence of a third party in order to clearly demonstrate that it is not anti-competitive in any way.

Planning applications and/ or permissions for large scale strategic developments are likely in the Stevenage area within the next year, so the detailed or initial feasibility stages of the above work should be carried out within the next 9 to 12 months subject to development locations, dwelling numbers and likely phasing being confirmed by Stevenage Borough Council.

In any case, it is important to consolidate this work and present the key outcomes so that it can be easily understood and used as an evidence base to inform the preparation of the ongoing and future LDF documents, and associated infrastructure investment strategies. Therefore, a full review of this WCS is recommended within the next four years.

Topic	Timeframe		Task	Local Authorities generic tasks	*Stevenage and North Herts specific tasks*	Thames Water tasks	Three Valleys Water tasks	Anglian Water tasks	Environment Agency tasks	Natural England	Consequences if not completed
	Begin	**Complete**									
Potable water	Now	Ongoing initiative	**Reduce potable water demand, and consequently loading on sewerage network, within the catchment, with the aim of moving towards water neutrality**	Work with water companies to identify affordability solutions for vulnerable groups. Work with water companies to develop consumer education schemes to reduce water use. Determine who is best placed to fund and promote retrofit of water efficient devices into existing properties. Follow WCS strategy regarding minimum PCC requirements for all new dwellings and exceed these standards to achieve water neutrality where possible.		Investigate if lower flows will impact the function of existing and new gravity sewers. Increase meter penetration inline with WRMP or faster. Develop tariffs for water.	Increase meter penetration inline with WRMP or faster. Develop tariffs for water.	Investigate if lower flows will impact function of existing and new gravity sewers.	Work with water companies and Central Government to ensure regulations incentivise water companies to reduce PCC	-	Water neutrality will not be achieved. New development puts strain on existing supply and sewerage systems, reducing resilience to climate change. More water is abstracted from sources, and more effluent is discharged, putting the environment and meeting future consent needs at risk
	Now	2015	**Further assess the security of supply and resource options in the study area**	-		Work with the EA to investigate effluent reuse and the relocation of sources following any sustainability reductions	Work with the EA to investigate effluent reuse and the relocation of sources following any sustainability reductions	Continue with demand management and resource development, to ensure bulk transfer from Ruthamford WRZ does not compromise the security of supply for other areas.	Work with the water companies to relocate abstractions within existing licenses and assess the merits of effluent reuse	Work with the water companies to understand the biodiversity implications of relocating abstractions within existing licenses and assess the merits of effluent reuse	Water supply will be less resilient to climate change. Drought situations may cause supply shortages. If additional resources such as reservoirs are needed, long term development may be constrained until solutions are found

Topic	Timeframe		Task	Local Authorities generic tasks	*Stevenage and North Herts specific tasks*	Thames Water tasks	Three Valleys Water tasks	Anglian Water tasks	Environment Agency tasks	Natural England	Consequences if not completed
	Begin	**Complete**									
Water and wastewater infrastructure planning	Now	As soon as practicable (ideally before 2011)	**Confirm strategic sites and individual development locations, dwelling numbers and phasing**	Use WCS, other planning policies and liaise with water companies to inform LDF	*Work with TWU and AWS regarding suitability of sites in SNAP area*	Use strategic site allocations as evidence for submissions to Ofwat, comment on suitability of sites Confirm phasing and funding needs.	Use strategic site allocations as evidence for submissions to Ofwat, comment on suitability of sites. Confirm phasing and funding needs	Use strategic site allocations as evidence for submissions to Ofwat, comment on suitability of sites. Confirm phasing and funding needs	Comment on specific allocations and sites regarding flood risk and water quality	Comment on specific allocations and sites regarding biodiversity concerns	Water companies will not be able to secure funding through Ofwat. Development cannot commence as suitable infrastructure will not be in place
Wastewater collection and treatment solutions development	Now	As soon as practicable (ideally before 2010)	**Assess suitability of a new Beane WwTW through a detailed Cost Benefit Analysis**	Firm up site allocations through LDF process using WCS and subsequent studies		Liaise with TVW and EA/ NE to understand costs and benefits (and responsibilities) of Beane solution.	Liaise with TWU ad EA to understand costs and benefits (and responsibilities) of Beane solution, including effects on treatment requirements at downstream abstractions	Confirm with TWU how development in the Anglian area can be drained to the sewerage new works	Complete studies regarding effluent reuse and the effects of low flow on ecology. Confirm consent limits to meet future WFD needs, and provide guidance on flood risk mitigation and the interaction between river and groundwater	Comment on suitability of solutions with regards to protected sites and biodiversity	Opportunity to change current wastewater treatment setup is missed. Also opportunities to restore low flow issues and maximise ecological benefits on the River Beane may be missed. Rye Meads WwTW more likely to breach consent before 2031. Sustainability reductions on TVW Beane abstractions may detriment supply from 2015 onwards, consumers bills may rise considerably to provide the security of supply needed for the new development

Topic	Timeframe		Task	Local Authorities generic tasks	*Stevenage and North Herts specific tasks*	Thames Water tasks	Three Valleys Water tasks	Anglian Water tasks	Environment Agency tasks	Natural England	Consequences if not completed
	Begin	**Complete**									
	Now	As soon as practicable (ideally before 2010)	**Assess suitability of the Anglian Hybrid Option through a detailed Cost Benefit Analysis**	Firm up site allocations through LDF process using WCS and subsequent studies		Liaise with AWS to understand which sites will be connected to which network	Consider effects on treatment requirements at any surrounding abstractions	Liaise with TWU to understand which sites will be connected to which network. Work with EA to determine optimum discharge location and treatment required	Confirm consent limits to meet future WFD needs, including the implications of hydro-morphological factors and flood risk mitigation needs	Comment on suitability of solutions with regards to protected sites and biodiversity	Opportunity to change current wastewater treatment setup is missed, Rye Meads WwTW more likely to breach consent before 2031. Loss of customers and the need for agreeing bulk transfer agreements beyond normal practice.
	Following the above (before 2011)	Before 2012	**Determine best sustainable and cost-effective long-term solution for Stevenage/ North Herts. wastewater collection and disposal through improved and new sewerage network and wastewater treatment facilities, based on the clear evidence from above studies and further investigations**	-	*Keep abreast of development of studies to help steer future development sites*	Confirm details of preferred solution and funding with Ofwat/ Local Authorities	-	Confirm details of preferred solution and funding with Ofwat/ Local Authorities/ Developers	Work with water companies and others to determine most sustainable solution, indicate likely future discharge consent limits for Rye Meads beyond 2021, taking account water quality and flood risk on the River Lee	Work with water companies and others to determine most sustainable solution	Funding is not approved by Ofwat in PR14. The most sustainable solution does not come online by 2021. Development is either constrained, or connected to Rye Meads WwTW network, with the same consequences as above

Topic	Timeframe		Task	Local Authorities generic tasks	*Stevenage and North Herts specific tasks*	Thames Water tasks	Three Valleys Water tasks	Anglian Water tasks	Environment Agency tasks	Natural England	Consequences if not completed
	Begin	**Complete**									
	AMP5	Before 2015	**Assess the effects of increased discharge from Rye Meads WwTW on the environment. Determine the possibility of an increased volumetric discharge consent. Confirm the required upgrades to Rye Meads WwTW and associated environmental mitigation measures**	Provide TWU with aspirations for growth beyond the current RSS period		Work with HMWT and NE to mitigate risks to Rye Meads SSSI. Work with EA to assess capacity of Tollhouse Stream siphon. Work with EA to determine possible changes to discharge consent and associated environmental mitigation measures. Decide on the future role of the DTM.	-	-	Work with TWU to confirm possible changes to discharge consent after 2021, taking account water quality, flood risk and ecological impacts on the River Lee	Work with TWU and HMWT to ensure interest of Rye Meads SSSI is not affected	Increased discharge from Rye Meads WwTW due to development may detriment the SSSI, increase downstream flood risk and compromise the water quality

Table 10-33 Further Work requirements to inform future Rye Meads WCS review

It is recommended that the study into the feasibility of the Beane and hybrid Anglian WwTW options would need to be led by the water companies, with significant input from the EA, and a firm commitment of development locations and phasing from SBC and NHDC through the emerging SNAP process.

TVW are particularly keen to instigate the investigation into the Bean WwTW, due to future sustainability reductions they may have to allow on their downstream abstractions. The study could either be undertaken separately for these two options, with the results compared at the end, or combined into one project if desired, for example as an extension to this WCS, with all three water companies contributing.

The study should take account of the following considerations:

- The environmental, social and financial costs (and future risks) of solely relying on the Rye Meads sewerage network and WwTW;
- The environmental, social and financial costs (and future risks) of constructing a new WwTW to discharge into the River Beane; sewerage network and WwTW, including topics such as:
  - *Emerging research from the EA on the indirect reuse of effluent for potable abstraction;*
  - *Emerging EA research on the link between ecology and river flows;*
  - *Ecological and low flow mitigation benefits on the river flows whilst meeting other WFD requirements;*
  - *Mitigation requirements to avoid additional flood risk in the downstream reaches during peak river flooding events due to new effluent discharge;*
  - *Detailed study of the interaction between the surface water and the groundwater, to better understand contamination risk and flood risk in the local area;*
  - *The network (and energy for pumping) required to convey flows from the Anglian region and possible diversion of parts of TWU Stevenage network to the new works;*
  - *The costs incurred by TWU and/ or TVW if extra treatment is required at the new works and/or the existing Whitehall abstraction (and effects the proposed sustainability reductions will have on TVW customers with and without the new Beane works);*
  - *An assessment of whether the forthcoming Community Infrastructure Levy can be used to part fund such an upgrade*
- The environmental, social and financial costs (and future risks) of upgrading Ash Brook WwTW to discharge into the River Hiz, including topics such as:
  - *Possible discharge locations and the associated flood risk and water quality concerns;*
  - *The network (and energy for pumping) required to convey the flows;*
  - *The effects of the increased flow with regards to the nutrient levels and hydromorphological factors as required by the WFD;*
  - *Mitigation requirements to avoid additional flood risk in the downstream reaches during peak river flooding events due to additional effluent discharge; and*
  - *An assessment of whether the forthcoming Community Infrastructure Levy can be used to part fund such an upgrade.*

As Section 8 shows, the potential lead in time of up to ten years, for a new WwTW or significant WwTW expansion, means that the detailed design should have been commenced by the end of AMP 5 (2015) for it to come online when required after 2021. A delay to these studies will jeopardise the chances of the water companies securing funding for the works in PR14 in AMP6.

In addition, if a new wastewater treatment solution is not in the development pipeline before 2015, the only option that will allow development will be TWU upgrading the network to accept all the proposed development at Rye Meads (scenario T3) subject to overcoming environmental constraints, and funding and cross boundary issues with AWS and Ofwat. However, the opportunity to change the current set up in the catchment and maximise possible wider sustainability measures will then have been missed, coupled with continuing reliance, and associated risk, on Rye Meads WwTW to accommodate the wastewater demands from future growth.

Therefore, it is imperative that the recommended studies above be started imminently and completed as soon as possible. In addition, strategic scale new developments should be subject to appropriate planning conditions where sewerage infrastructure constraints and upgrade requirements have been highlighted, unless sufficient capacity can be demonstrated through further investigations and consultations with the water companies.

Glossary of Terms

Acronym	Term
AMP	Asset Management Period
AMR	Annual Monitoring Report
AWS	Anglian Water Services
BAP/ (L)BAP	(Local) Biodiversity Action Plan
BAT	Best Available Technology
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BBC	Broxbourne Borough Council
BOD	Biochemical Oxygen Demand
CAMS	Catchment Abstraction Management Strategies
CFMP	Catchment Flood Management Plans
CSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
DEFRA	Department for Environment, Food and Rural Affairs
DO	Deployable Output
DPD	Development Plan Documents
DTM	Deephams Transfer Main
DWF	Dry Weather Flow
DYCP	Dry Year Critical Period
EA	Environment Agency
EFDC	Epping Forest District Council
EHDC	East Hertfordshire District Council
FFD	Freshwater Fish Directive
FSR	Flood Storage Reservoir
GEP	Good Ecological Potential
GQA	General Quality Assessment
HBRC	Hertfordshire Biological Records Centre
HCC	Hertfordshire County Council
HDC	Harlow District Council
HMWB	Heavily Modified Water Body
HMWT	Hertfordshire and Middlesex Wildlife Trust
LDD	Local Development Documents
LDF	Local Development Framework
LDS	Local development Scheme
LNR	Local Nature Reserve
NE	Natural England
NHDC	North Hertfordshire District Council
NNR	National Nature Reserve
OFWAT	The Water Services Regulation Authority
PCC	Per Capita Consumption
PE	Population Equivalent
PPS	Planning Policy Statement
PR09/ 14	Price Review 2009/ 2014
RBMP	River Basement Management Plan
RE Target	River Ecosystem Target
RQO	River Quality Objective
RSAp	Restoring Sustainable Abstraction programme
RSS	Regional Spatial Strategy
SAC	Special Area of Conservation
SBC	Stevenage Borough Council
SFRA	Strategic Flood Risk Assessment

SOA	Super Output Area
SPA	Special Protection Area
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TVW	Three Valleys Water
TWU	Thames Water Utilities
UKTAG	United Kingdom Technical Advisory Group
UWWTD	Urban Wastewater Treatment Directive
WAFU	Water Available for Use
WFD	Water Framework Directive
WHBC	Welwyn Hatfield Borough Council
WRZ	Water Resource Zone
WwTW	Wastewater Treatment Works

Technical Glossary

- **Asset Management Period (AMP)** - A period of five years in which water companies implement planned upgrades and improvements to their asset base. For example, AMP4 is 2005-2010 and AMP5 is 2010-2015.
- **Best Available Technology (BAT) –** in this context refers to the most advanced methods (that have been proven in the industry) that a water company can utilise to obtain the best result from a process.
- **Best Available Technology Not Entailing Excessive Cost (BATNEEC) –** similar to the above, but taking account of the whole life cycle costs. BATNEEC is often applied by water companies because they pass on costs to customers through the Price Review process, and this funding regime requires that the optimum balance between benefits and costs is therefore achieved.
- **Biochemical Oxygen Demand –** a measure of the oxygen demand that results from bacteria breaking down organic carbon compounds in water. High levels of BOD can use up oxygen in a watercourse, to the detriment of the ecology.
- **Catchment Abstraction Management Strategies (CAMS)** - the production of a strategy by the EA to assess and improve the amount of water that is available on a catchment scale. The first cycle of CAMS have recently been produced and are currently being reviewed. An interim update of the CAMS process can be viewed at http://publications.environment-agency.gov.uk/pdf/GEH00508BOAH-e-e.pdf?lang=_e. *Additional CAMS information, specific to the study area, is included in Appendix B.*
- **Code for Sustainable Homes (CSH)** - released in 2007 and aims to make newly built homes more efficient in the future. The code gives a star rating (between 1 and 6) for a home based on nine different categories including water, waste and energy. In May 2008 the government announced a timetable to ensure the implementation of the CSH through the tightening up of building regulations. At present all new homes are required to be assessed for a CSH star rating. Details and technical guidance for the CSH can be found at; http://www.communities.gov.uk/planningandbuilding/buildingregulations/legislation/englandwales/codesustainable/.
- **Combined Sewer Overflow (CSO) –** a point on the sewerage network where untreated wastewater is discharged during storm events to relieve pressure on the network and prevent sewer flooding. Sewerage systems that are not influenced by storm water should not require a CSO.
- **Deployable Output –** the amount of water that can be abstracted from a source (or bulk supply) as constrained by environment, license, pumping plant and well/aquifer properties, raw water mains, transfer, treatment and water quality.
- **Discharge Consent –** a consent issued and reviewed by the EA which permits an organisation or individual to discharge sewage or trade effluent into surface water, groundwater or the sea. Volume and quality levels are set to protect water quality, the environment and human health.
- **Draft Water Resource Management Plan (WRMP)** - Currently in their draft stages awaiting approval by OFWAT later this year, the Water Resource Management Plans are studies undertaken by every water company in England to determine the availability of water resources for the next 25 years. WRMPs can be found on most water company websites.
- **Dry Weather Flow (DWF)** – an estimation of the flow of wastewater to a WwTW during a period of dry weather. This is based on the 20th percentile of daily flow through the works over a rolling three year period.
- **Dry Year Critical Period (DYCP) –** the period of time during which the customer experiences the greatest risk of loss of potable water supply, during a year of rainfall below long-term average (characterised with high summer temperatures and high demand).
- **Eutrophication –** higher than natural levels of nutrients in a watercourse, which may lead to the excessive build up of plant life (especially algae). Excessive algal blooms remove valuable oxygen from the watercourse, block filters at water treatment works, affect the taste and smell of water, and can be toxic to other wildlife.
- **Freshwater Fish Directive (FFD) 1978** – A European Union directive (2006/44/EC), adopted in 1978 and consolidated in 2006, to protect and improve the quality of rivers and lakes to encourage healthy fish populations. The Directive will be repealed in 2013 by the Water Framework Directive.

- **General Quality Assessment (GQA)** – The current assessment method used by the EA to describe the chemical and biological quality of watercourses, along with nutrient levels and aesthetic quality. *More information is included in Appendix C.*
- **Habitats Directive -** promotes biodiversity by requiring measures to be taken to maintain or restore natural habitats and wild species to a favourable conservation status, introducing robust protection for those habitats and species of European importance.
- **Local Development Framework (LDF)** – A folder of development documents outlining the spatial planning strategy for each local authority. The LDF will contain a number of statutory Local Development Documents (LDDs), such as a Statement of Community Involvement, Annual Monitoring Reports, Core Strategy, Local Development Scheme as well as a number of optional Supplementary Planning Documents. More information can be found at: http://www.planningportal.gov.uk/uploads/ldf/ldfguide.html.
- **Local Nature Reserve (LNR) –** are areas with wildlife or geological features that are of special interest locally. Details of LNR can be found at http://www.natureonthemap.org.uk/.
- **National Nature Reserve (NNR) –** are areas of national importance, protected because they are amongst the best examples of a particular habitat in the country. Details of NNR can be found at http://www.natureonthemap.org.uk/.
- **Per Capita Consumption (PCC) –** the volume of water used by one person over a day, expressed in units of litres per person per day (l/p/d).
- **Planning Policy Statement (PPS)** - set out the Government's national policies on different aspect of planning. The policies in these statements apply throughout England and focus on procedural policy and the process of preparing local development documents. One of the Statements, PPS 25, deals with the impacts of Flood Risk on development. More information can be found at http://www.planningportal.gov.uk/england/professionals/en/1020432881271.html.
- **Population Equivalent –** is a method of measuring the loading on a WwTW, and is based on a notional population comprising; resident population, a percentage of transient population, cessed liquor input expressed in population, and trade effluent expressed in population.
- **Potable Water –** is water that is fit for drinking, being free of harmful chemicals and pathogens. Raw water can be potable in some instances, although it usually requires treatment of some kind to bring it up to this level.
- **Price Review –** the process with which Ofwat reviews water company business plans and subsequently sets limits on the prices the companies can charge their customers for the following AMP. The business plan submissions are often referred to as the Price Review submission, e.g. business plan submitted in 2009 for AMP5 (2010–2015) is referred to as the PR09 submission.
- **Ramsar Sites -** are wetlands of international importance designated under the Ramsar Convention, 1971. More information is available at http://www.jncc.gov.uk/page-161.
- **Raw Water -** is water taken from the environment, which is subsequently treated or purified to produce potable water.
- **Regional Spatial Strategy (RSS)** - a broad development strategy for a region for a 15 to 20 year period prepared by the Regional Planning Body. The Regional Spatial Strategy for the East of England is currently under review. Once issued, it will establish the broad development strategy for the region, and provide a framework within which local development documents and local transport plans can be prepared for the period to 2021. The Government Office has submitted representations on the draft Plan on behalf of Ministers.
- **Restoring Sustainable Abstraction Programme (RSAp)** - identifies abstraction licences causing problems, and reviews them with the purpose of rectifying the problems by reducing the volume extracted, altering licence conditions, and relocating abstraction points.
- **River Basin Management Plans (RBMP)** – documents being produced for consultation by each of the EA regions to catalogue the water quality of all watercourses and set out actions to ensure they achieve the ecological targets stipulated in the WFD.
- **River Ecosystem (RE) Targets** – are the targets uses to assess quality against the above mentioned RQO. *More information is included in Appendix C.*

- **River Quality Objective (RQO)** - targets for all rivers in England and Wales that specify the water quality needed in rivers if we are to be able to rely on them for water supplies, recreation and conservation. *More information is included in Appendix C.*
- **Site of Special Scientific Interest (SSSI) -** an area of special interest by reason of any of its flora, fauna, geological or physiographical features (basically, plants, animals, and natural features relating to the Earth's structure). A map showing all SSSI sites can be found at http://www.natureonthemap.org.uk/**.**
- **Source Protection Zones (SPZ)** - zones designated around public drinking water abstractions and sensitive receptors which detail risk to the groundwater zone they protect.
- **Special Area for Conservation (SAC) -** a site designated under the European Community Habitats Directive, 1991, to protect internationally important natural habitats and species. A map showing all SAC sites can be found at http://www.natureonthemap.org.uk/.
- **Special Protection Area (SPA) -** sites classified under the European Community Directive on Wild Birds to protect internationally important bird species. A map showing all SPA sites can be found at http://www.natureonthemap.org.uk/.
- **Strategic Flood Risk Assessment (SFRA)** – document required by PPS25 that informs the planning process of flood risk and provides information on future risk over a wide spatial area. It is also used as a planning tool to examine the sustainability of the proposed development allocations.
- **Super Output Areas (SOA)** – are the basic areas used for publishing data from the 2001 census. They are geographic hierarchy created to improve the reporting of small area statistics, and are primarily based on ward boundaries. Further details are available on the National Statistics website.
- **Surface Water Management Plans (SWMP)** – assist in the assessment of flood risk to ensure that increased levels of development, and climate change, do not have an adverse impact on flooding from surface water sources within the catchment. SWMP were introduced following he severe flooding in 2007, as means for Local Authorities to take the lead in reducing flood risk.
- **Sustainable Drainage Systems (SUDS)** – a combination of physical structures and management techniques designed to drain, attenuate, and in some cases treat, runoff from urban (and in some cases rural) areas.
- **Target Headroom -** the threshold of minimum acceptable headroom, which would trigger the need for water management options to increase water available for use or decrease demand.
- **UK Biodiversity Action Plan (BAP) –** is the Government's response to the Convention on Biological Diversity 1992. It describes the UK's biological resources, both species and habitats, and details a plan to protect them. UK BAP habitats are often encompassed within the other sites listed above, however smaller pockets of UK BAP habitat may also exist outside these sites. More information can be found at ~~http://www.ukbap.org.uk/~~.
- **Urban Wastewater Treatment Directive (UWWTD) 1991** – A European Union directive (91/271/EEC) which sets treatment levels on the basis of sizes of wastewater discharges and the sensitivity of waters receiving the discharges. Under the Directive the UK is required to review environmental waters at four-yearly intervals to determine whether they are sensitive to the effects of wastewater discharges.
- **Water Available for Use (WAFU) –** the amount of water remaining after allowable outages and planning allowances are deducted from deployable output in a WRZ.
- **Water Framework Directive (WFD) 2000** - A European Union directive (2000/60/EC) which commits member states to make all water bodies of good qualitative and quantitative status by 2015. The WFD could have significant implications on water quality and abstraction. Important dates for the WFD are:
    - 2008 Draft River Basin Management Plans for each river basin district completed;
    - 2009 Final River Basin Management Plans completed;
    - 2012 Programs of measures for improvements to be fully operational; and
    - 2015 Achieve the first set of water body objectives.
- **Water Neutrality –** the concept of offsetting demand from new developments by making existing homes and buildings more water efficient.

- **Water Resource Zone (WRZ) –** are areas based on the existing potable water supply network and represent the largest area in which water resources can be shared.
- **Wastewater -** is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture.
- **Wastewater Treatment Works (WwTW)** – facility which treats wastewater through a combination of physical, biological and chemical processes.

Appendix A

WCS PARTICIPANTS

The participants in this WCS are listed below:

- Anglian Water Services
- Broxbourne Borough Council
- East Hertfordshire District Council
- Environment Agency (Thames Region and Anglian Region)
- Epping Forest District Council
- Harlow District Council
- Hertfordshire and Middlesex Wildlife Trust
- Hertfordshire Biological Records Centre
- Hertfordshire County Council
- Natural England
- North Hertfordshire District Council
- Stevenage Borough Council
- Thames Water
- Three Valleys Water
- Welwyn Hatfield Borough Council

Appendix B

ENVIRONMENTAL POLICIES

1 Catchment Abstraction Management Strategies (CAMS)

CAMS are EA strategies for the management of water resources. They provide information on water resources and licensing practice and allow the balance between the needs of abstractors, other water users and the aquatic environment to be considered in consultation with the local community. This study crosses a number of river catchment boundaries and as such could influence a number of relevant CAMS:

- Thames Region - Upper Lee Catchment Abstraction Management Strategy;
- Thames Region - London CAMS;
- Anglian Region - Upper Ouse and Bedford Ouse CAMS

The boundaries for the respective CAMS areas in relation to the study area can be seen in Figure B-1 below.

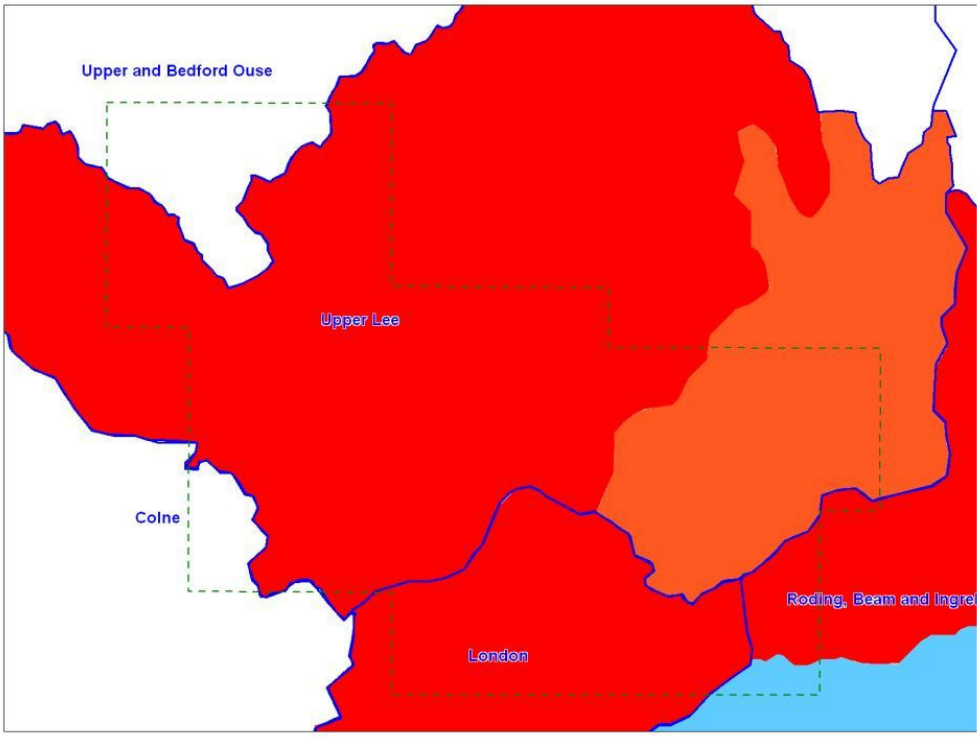


Figure B-1 CAMS areas within the Rye Meads WCS study area

This “resource availability status” indicates the relative balance between committed and available resources and the relationship with the environmental requirements for the water. The status category shows whether licences are likely to be available and highlighting areas where abstraction needs to be reduced. There are four categories of resource availability status, as shown in Table B-1.

Indicative Resource Availability Status	Definition
Water available	Water likely to be available at all flows including low flows. Restrictions may apply
No water available	No water available for further licensing at low flows although water may be available at higher flows with appropriate restrictions.
Over-licensed	Current actual abstraction is resulting in no water available at low flows. If existing licenses were used to their full allocation they would have the potential to cause unacceptable environmental impact at low flows. Water may be available at high flows with appropriate restrictions.
Over-abstracted	Existing abstraction is causing unacceptable environmental impact at low flows. Water may still be available at high flows with appropriate restrictions

Table B-1 Definition of CAMS availability status

The resonant issue throughout all of the CAMS documents is that the majority of the rivers and groundwater sources within the region are identified as being over–abstracted and over–licensed, as shown in Figure B-1.

The EA are continuously monitoring the CAMS process over five year cycles and during the first period of review, it is likely that steps will be taken in the future to restrict the allocation of abstraction licences where the resultant removal of water could have a negative impact on the environment. Presently over 85% of the abstraction licences within the Upper Lee CAMS area are used for Public Water Supply.

Unused licences are also likely to be reviewed and potentially removed following a period of consultation. Regular monitoring of abstractions will be maintained by issuing fixed period licenses (usually 12 years).

The Upper Lee Cams recognises that the development targets proposed by the RSS, particularly around Stevenage and Harlow, will place pressure on existing abstractions. It suggests that the increase in demand may have to be met from outside the catchment, whilst emphasising water efficiency at every stage.

2 Catchment Flood Management Plan (CFMP)

CFMPs present what is considered to be the most sustainable direction for managing fluvial flood risk within a region for the next 50 to 100 years. The CFMP is based on extensive research into the catchment characteristics of the region and the options available for managing the risk to people, properties and the environment. It takes into account the likely impacts of climate change and the plans for future development.

The study catchment lies predominantly within the Thames CFMP Middle and Upper Lee Policy Units as well as partially being included in the Thames CFMP Lower Lee Policy Unit and the draft Great Ouse CFMP Bedford Ouse Policy Unit.

Specific approaches may develop for different areas, which should be incorporated into future planning by Local Authorities within the study area.

The resounding themes throughout the policy units are:

- the need to maintain and protect the natural floodplains from development;
- increased storage within the upper reaches of the rivers will help in maintaining or reducing the risk of flooding in lower policy units; and
- recognition that individual action will play an important role in ensuring the sustainability of flood protection for the future.

Policy Unit	Opportunities and Constraints	Policy	Objectives	Actions
Middle Lee and Stort	Redevelopment within urban areas to reduce the consequences of flooding BAP creation within natural floodplain Increase attenuation to reduce downstream risk	P6 – Increase frequency of flooding to deliver benefits locally or elsewhere	Safeguard possible sites for future flood storage Re-establishing river corridors in urban areas Manage runoff from new development Maintain and enhance floodplain capacity	Safeguard open space Appropriate LDF policies and SFRA recommendations Application of Making Space for Water principles Carry out more detailed investigations (e.g. Hertford)
Upper Lee	Small scale river restoration in urban areas e.g. Stevenage Brook or culvert removal	P3 – Continue with existing or alternative actions to manage flood risk at the current level	No single strategic solution	Future responsibilities for urban drainage Land use planning

Table B-2 Summary of CFMP

Through the mechanisms of SFRAs, LDF policies and planning applications, Local Authorities should ensure that both short term and long term land-use planning aims to:

- Create safe and sustainable development that positively reduces flood risk in the middle Lee in line with PPS25;
- Retain the remaining floodplain for flood risk management compatible uses;
- Encourage partners to develop policies, strategies and initiatives that seek to increase the resistance and resilience of existing development at risk of flooding;

- Adopt and apply policies that ensure that all new properties built in the floodplain are resistant and resilient to flooding;
- Seek greenfield runoff discharge rates, and a reduction in runoff volumes, in new greenfield and brownfield development, and encourage initiatives to reduce run-off rates and volumes for existing development;
- Encourage refurbishment of existing buildings that increases resilience and resistance to flooding;
- Identify opportunities to recreate river corridors and wetland habitats in urban areas. Encourage new development and any redevelopment of these areas to acknowledge these opportunities in their site layouts and set development back, allowing space for water, habitat, wildlife and recreation; and
- Assess the viability of future land swapping opportunities in those areas where there is a risk of flooding.

There should also be LDF policies in place to assess the viability of those locations where it may be possible to reduce the probability of flooding in a more sustainable way, including Hertford. Those sites that are most likely to be viable and are in areas where little redevelopment is expected, should be prioritised and the land safeguarded as appropriate.

2.1 CFMP Policy Unit Commentaries

2.1.1 Middle Lee and Stort

The following characteristics explain this policy approach;

- Floodplains towards the downstream end of this policy unit are quite extensive and flooding tends to occur following more prolonged rainfall;
- These wide and extensive floodplains provide a degree of natural storage to reduce risks to local urban areas such as Hertford and Ware;
- There are environmentally designated sites where both water level and flow management are important in maintaining their condition; and
- Immediately downstream of this policy unit are large numbers of properties at risk from flooding in the Lower Lee. Interventions in the Middle Lee and Stort will have an impact on flood risk downstream and need to be considered alongside managing the risk locally.

There are clusters of properties at risk within this policy unit; notably in Hertford, Ware, Bishops Stortford and Sawbridgeworth. In Bishops Stortford the cluster of properties at risk from flooding are stretched out along the River Stort. They tend to be very close to the watercourse; therefore raised flood defences are unlikely. There is however a lot of redevelopment of the river corridor and many other industrial and commercial premises may be redeveloped over the forthcoming decades.

In Hertford four rivers run through Hertford forming a complicated system for flood risk management. The four rivers include sections of natural channel, canalised river, navigations and diverted watercourses. There are some sluices on the River Lee in the centre of Hertford which are currently not operated. The current standard of flood protection within Hertford is uncertain and unlikely to be within the indicative standard of protection for built up areas. Within Hertford there may be technically viable means of providing a flood defence to some of these properties.

Upstream of the confluence of the Rivers Lee and Stort are a number of sites that could provide flood storage in the future. The main justification for ever developing these flood storage areas

would be to provide further protection to properties at risk further downstream in the Lower Lee, but many would also provide local benefits to Hertford and Ware should they ever be developed. In the Lower Lee the preferred approach to managing the flood risk is to maintain the existing defences to benefit from another life cycle from the existing defences and at the same time ensure that all new development in the floodplain is flood resilient. When this CFMP is reviewed in five years time, there will be a much clearer indication of whether flood risk management is really moving to a more sustainable footing. If it is, and the approach for the Lower Lee is staring to be progressed, it is highly unlikely that these flood storage areas would ever be developed on a large scale.

The main messages for the rural parts of this policy unit emphasise the value of the natural floodplain in reducing flood risk to people and property. The focus of the policy is about maintaining the natural characteristics of the catchments to manage flood risk. To increase the capacity of the natural floodplain to attenuate water would require wide spread interventions across the policy unit. To make more use of the floodplain will require significant planning, engineering works and operations. This will need a close collaboration between land and water management. Even at this scale of intervention the majority of the benefits are likely to be local. However there could prove to be cumulative benefits, particularly in the long term.

The examples below show how the different scales of intervention that could be used to deliver the flood risk policy. In broad terms the cost of measures and the amount of benefit increases moving down the list.

- Change the operation of the existing water level control structures to retain more water on the land;
- Removal or modification of structures that prevent inundation of the natural floodplain. e.g. Kings Meads, Hertford;
- Restore channels;
- Re-establish water meadows e.g. [Kings Meads, Hertford.];
- Alter land use and management;
- Bunds across floodplain to provide increased flood water storage within the natural floodplain e.g. Stort catchment upstream of Bishops Stortford; and
- Engineered storage reservoirs of significant volume on main rivers.

As flood risk increases or the contribution from the wider Lee catchment increases (from climate change), some form of additional attenuation in the Middle Lee or Stort may become viable. The EA may be safeguarding possible sites where this attenuation could be carried out.

2.1.2 Upper Lee

The following characteristics explain this policy approach;

- Narrow floodplains towards the headwaters of the catchment with wide downstream floodplains;
- Relatively few properties at risk from flooding across a wide area. Under 2000 properties are at risk from a 0.1% AEP fluvial flood;
- Generally, the properties at risk from flooding are widely distributed and changes made to river flows and levels in the Upper Lee have a negligible effect on the areas of greater flood risk in the Lower Lee; and
- Changes in flow and level do impact greatly on the number of properties flooded above a certain threshold (typically 10% to 2.5% AEP flood).

Flood risk management will need to be based on managing a sustainable river system and influencing the wider management of the catchment. There does not need to be a radical change in the way risk is managed in these areas; the EA will continue to maintain watercourses, increase flood awareness and provide appropriate flood warnings.

The River Lee is a principal tributary of the River Thames in Greater London and essentially flows in a southerly direction from its source in Bedfordshire through North London before joining the River Thames on the east side of London, near Bow Creek. The Upper Lee comprises the rivers in the Lee Basin upstream of the confluence of the Lee and the Stort. Along this route it is joined from the north by the tributaries, Mimram, Beane, Rib, Ash and Stort. Towards the headwaters of all of the rivers across the Upper Lee flood risk area, there is a rolling landscape with narrow rivers valleys and narrow floodplains.

Within the Upper Lee there are 1,080 properties at risk from a flood with a 1% AEP, which is less than 1% of all properties within the 1% AEP flood extent in Thames Region. The scale of flood risk at any one location is small in the regional context; typically there are less than 100 properties at risk of flooding in any one location. The Mimram, Ash and Rib catchments are predominantly rural tributaries, and any flood risk is very dispersed.

Flooding in the Upper Lee results mainly from fluvial or groundwater sources. The risk of fluvial flooding is currently managed using the existing river network to convey flows through the catchment. These watercourses can accommodate the more frequent fluvial events. However, the watercourse system is fragile, and any blockages or constrictions can quickly result in localised flooding.

Historically many of the river channels have been modified through built up areas for flood defence, power or bridging the watercourse. These are typically the locations where fluvial flooding occurs, from blockage or channel capacity being exceeded. In addition, the geology of this area makes it susceptible to groundwater flooding. This tends to occur after long periods of rainfall, and can often happen away from watercourses.

In these headwaters of the Lee basin, there are no opportunities for strategic-scale flood risk intervention. Many of the flood risks in this part of the Upper Lee are localised and therefore lend themselves more to localised options.

There are some localised schemes for specific clusters of property that may be technically viable to protect properties from fluvial flooding. This would most likely involve the construction of raised defences around these properties and the provision of compensatory flood storage. However, the scale of intervention is significant compared to the scale of flooding, and hence these schemes are a long way from attracting funding.

A delivery plan for spatial planning could be developed. At this stage, it should focus on utilising the SFRA process to establish policies within LDFs. These use the flood management messages particularly about the limitations on delivering built defences and the benefits on watercourse and floodplain management. This will inform the spatial planning options.

The characteristics of this area mean that flood probability will not be reduced to all property. Measures to manage the consequences of flooding such as flood resilience will be increasingly important, for both existing and new development. Investigating this type of intervention and how to apply it in this area could form a delivery plan in conjunction with flood warning and awareness.

A delivery plan for wider catchment management may also be required. It should assess the existing land management and land use and establish opportunities for localised flood management throughout the catchments.

A full flood risk management strategy will not be needed in these areas. The character of the flood risk is such that:

- Local solutions should be pursued where they are justified;
- Wider interventions (spatial planning, land management) can be pursued through alternative appraisal and funding mechanisms.

3 Restoring Sustainable Abstraction Programme (RSAp)

Low flows in rivers can detriment ecology. The RSA Programme is an umbrella for work required under the Habitats Directive, PSA3 (Sites of Special Scientific Interest), Biodiversity Action Plans and undesignated sites of local importance.

Figure B-2 Watercourses in the study area being considered under the RSAp

As illustrated in Figure B-2, the EA are concerned about flows in a number of rivers in the Upper Lee catchment (red triangles indicate low flow investigations). These include the Rivers Mimram, Beane, Rib, Stort and mid sections of the River Lee. The EA have not granted any new abstraction licenses for public water supply in this area for many years. Nonetheless, the area is over-abstracted due to abstraction licenses granted in the past, many of them being licenses of right (i.e. without time-limits or other government means of withdrawing the licenses).

There has been concern about low flows on the Rivers Beane & Mimram for a number of years. Initial Investigations found that the river was suffering from a history of low flows and that this was primarily due to groundwater abstraction. Further studies have looked at various alleviation scenarios for both rivers, and the EA are currently undertaking to drill test boreholes to see whether it is feasible to relocate these abstractions. There is however concern that moving these abstractions may cause environmental degradation at downstream sites.

The EA are very keen to pursue the idea of water re-use for the Beane and a number of rivers within the Upper Lee catchment. Water is currently abstracted from within river catchments and then discharged at sites downstream and outside of the catchment. Therefore these unsustainable abstractions are impacting on flows. Redirecting water to be discharged within the same catchment as it was abstracted from we will improve flows and result in a more sustainable abstraction regime.

Licensed abstraction in Hertfordshire and other parts of South East England, for all purposes including public water supply, should be reduced. The EA are determined to refuse any applications for increased abstraction for public water supply in the area. However, they may agree to the relocation of abstractions within the overall limits, if that would benefit local rivers.

4 EA Water for People and the Environment: Developing a Water Resource Strategy

The EA are currently developing a new Water Resource Strategy following a consulting stage during 2007[1]. Its aims are to:

- Improve the quality of life so that people value and enjoy their water environment;
- Create a better water environment to restore key biodiversity and wildlife sites;
- Ensure sustainable development is achieved;
- Ensure water is valued and is priced properly; and
- Reduce the impact on climate change.

They have set out some preliminary guidelines for the policy of water supply for the region. Due to the specific pressures within the WCS region, future housing development should go further than Sustainable Homes Code Level 1, and as such the EA recommends:

- *Efficient use of water in all new homes with water efficiency set at 105 litres per head per day (i.e. level 3/4 for water within Code for Sustainable Homes) or better;*
- *That all growth point plans liaise with water companies to ensure that company have the water resources and associated environmental infrastructure (such as new resources and adequate distribution) now, and in the future, to meet planned development;*
- *All new buildings, including flats, must be metered;*
- *Whenever possible developments should consider the benefits of rainwater harvesting and water recycling in new developments;*
- *Use of low water use landscaping and gardens; and*
- *Local authorities to follow their duties, as noted in the Water Act 2003 (part 3 sections 81 & 83), that 'the relevant authority must, where appropriate, take steps to encourage the conservation of water'.*

[1] Water for People and Environment, Environment Agency, 2008

Appendix C

WATER QUALITY MONITORING

1 General Quality Assessment (GQA)

Measurements to determine GQA grades, for a particular stretch of river, are taken at least 12 times a year for chemical quality. Table H1 below describes the chemical levels required to attain each grade. The GQA chemical grade is based on the lowest individual detrimand for a particular sample.

Table C-2 also shows a description for each biological grade. Biology in a river is assessed by monitoring the amounts of 83 taxa of macro-invertebrates. The presence of taxa sensitive to pollution suggests better water quality than for sites where only pollution-tolerant taxa are found.

Water Quality (Chemical)	GQA Grade	Dissolved Oxygen	Biochemical Oxygen Demand	Ammonia	Biological
		(% saturation)	*(mgl-1)*	*(mgNl-1)*	*Description*
		10th percentile	*90th percentile*	*90th percentile*	
Very Good	A	80	2.5	0.25	Similar to that expected of unpolluted river
Good	B	70	4	0.6	As expected for unpolluted river
Fairly Good	C	60	6	1.3	Worse than expected for a unpolluted river
Fair	D	50	8	2.5	Several pollution tolerant species present
Poor	E	20	15	9	Restricted to pollution tolerant species
Bad	F	<20	-	-	Small number of very tolerant species

Table C-1 GQA Summary

2 Nutrient Grading

Rivers in different parts of the country have different concentrations of nutrients. 'Very low' nutrient concentrations, for example, are not necessarily good or bad; the classification merely states that concentrations in this river are very low relative to other rivers.

Samples are analysed for their concentrations of two nutrients, nitrate and phosphate. Data collected over three years are used to determine average nutrient concentrations.

Table C-2 illustrates the numeric grading system used to describe the nutrient concentrations in watercourses.

Grade	Nutrient Description	
	Phosphorous	Nitrate
1	Very low	Very low
2	Low	Low
3	Moderate	Moderately low
4	High	Moderate
5	Very high	High
6	Excessively high	Very high

Table C-2 GQA Nitrate and Phosphorous grading

3 River Quality Objectives (RQO) and River Ecosystem (RE) Targets

River Quality Objectives (RQOs) are planned targets for water quality. The Environment Agency uses RQOs to plan improvements to river quality and ensure that river quality is checked against all the standards needed to support uses.

River Ecosystem is a use-orientated scheme of environmental objectives. Depending on the particular use of a river it will require a particular level of environmental protection and need to be of a certain standard of water quality.

The River Ecosystem (RE) Classification comprises five hierarchical classes in order of decreasing quality. The five classes and how they relate to uses are illustrated in Table H3, below.

RQO (RE)	Ecological status	GQA Equivalent Grade	Fisheries Suitability
RE1	Excellent	A	All fish species
RE2	Good	B	All fish species
RE3	Moderate	C	Good Cyprinid fisheries
RE4	Poor	D	Cyprinid fisheries
RE5	Unsustainable	E	Limited fisheries

Table C-3 RE Category Descriptions

4 WFD Classification

Details of the classification components that make up surface water status under the WFD are displayed below.

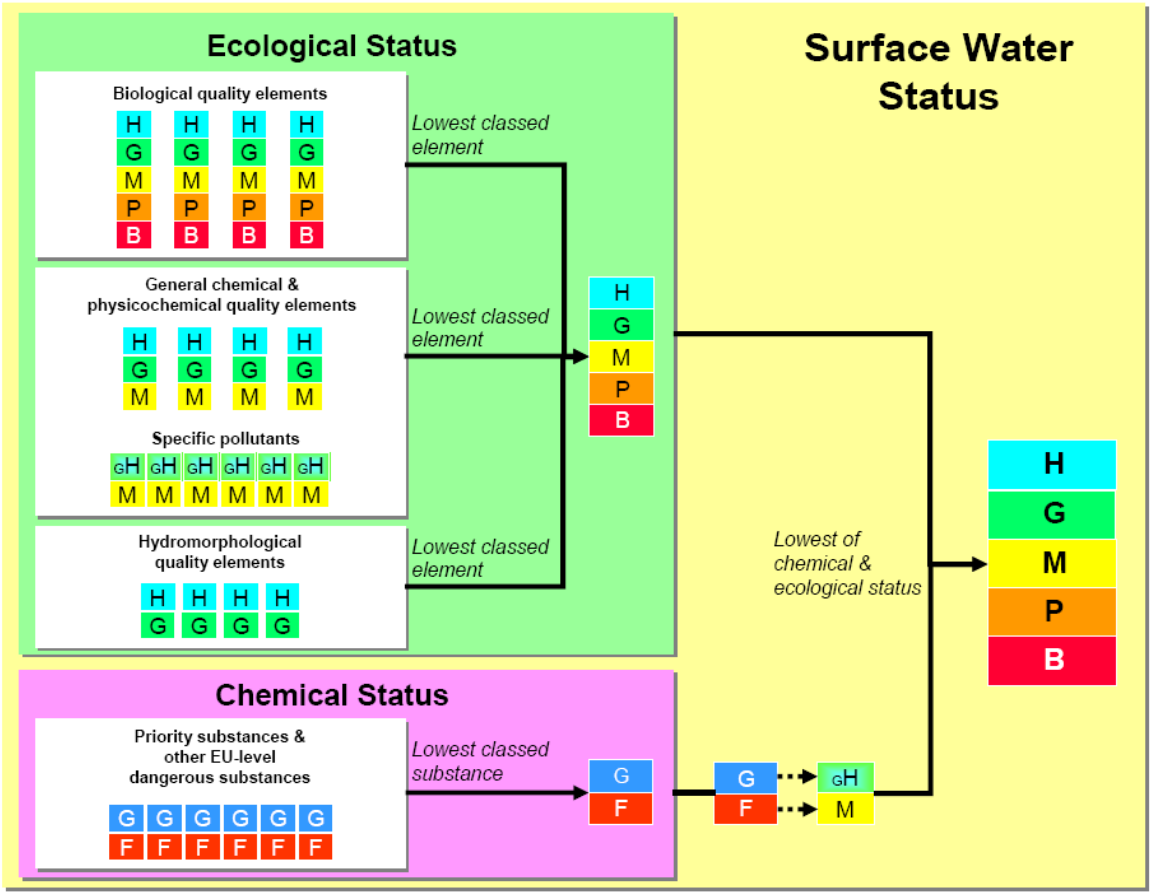


Figure C-1 WFD classification

(UKTAG Recommendations on Surface Water Classification Schemes for the purposes of the Water Framework Directive, 2007)

Further details on the WFD are available from the EA RBMPs, Defra and http://www.wfduk.org/

Appendix D

PLANNING POLICIES

1 National Policy

National policy for development and planning is set by the Government. The planning system has changed significantly in recent years due to the Governments planning reform. This reform has included the introduction of the 'Planning for a Sustainable Future: White Paper' and the 'Planning and Compulsory Purchase Act' which has lead to the need for local authorities to develop unified Local Development Frameworks. The planning reform has also lead to the revision of a number of planning policy documents. Extracts from the most relevant Planning Policy Statement (PPS) documents is set out below. This is not and exhaustive list but include the key areas where Local Authorities are required to contribute to the water environment. Information will also be given on the emerging policies that will affect the planning system in the future such as the Code for Sustainable Homes and the proposed changes to the Building Regulations with regard to water conservation.

1.1 Planning Policy Statement (PPS)

1.1.1 PPS 1: Delivering Sustainable Development[2]

PPS1 sets out the overarching planning policies on the delivery of sustainable development through the planning system. Regional planning authorities and local authorities should promote… *the sustainable use of water resources; and the use of sustainable drainage systems in the management of run-off.*

Development plan policies should take account of environmental issues such as:

- the protection of groundwater from contamination;
- the conservation and enhancement of wildlife species and habitats and the promotion of biodiversity; and
- the potential impact of the environment on proposed developments.

The Government is committed to promoting a strong, stable, and productive economy that aims to bring jobs and prosperity for all. Planning authorities should…ensure that infrastructure and services are provided to support new and existing economic development and housing.

In preparing development plans, planning authorities should seek to…*address, on the basis of sound science, the causes and impacts of climate change, the management of pollution and natural hazards, the safeguarding of natural resources, and the minimisation of impacts from the management and use of resources.*

1.1.2 PPS Planning and Climate Change: Supplement to PPS1[3]

This PPS on climate change supplements PPS1 by setting out how planning should contribute to reducing emissions and stabilising climate change and take into account the unavoidable consequences. In deciding which areas and sites are suitable, and for what type and intensity of development, planning authorities should assess their consistency with the policies in this PPS. In doing so, planning authorities should take into account:

[2] Planning Policy Statement 1: Delivering Sustainable Development, Office of the Deputy Prime Minister. 2005

[3] Planning Policy Statement: Planning and Climate Change. Supplement to Planning Policy Statement 1, Office of the Deputy Prime Minister. December 2007

- the capacity of existing and potential infrastructure (including for water supply, sewage and sewerage, waste management and community infrastructure such as schools and hospitals) to service the site or area in ways consistent with cutting carbon dioxide emissions and successfully adapting to likely changes in the local climate;
- the effect of development on biodiversity and its capacity to adapt to likely changes in the climate;
- the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity; and
- known physical and environmental constraints on the development of land such as sea level rises, flood risk and stability, and take a precautionary approach to increases in risk that could arise as a result of likely changes to the climate.

In their consideration of the environmental performance of proposed development, taking particular account of the climate the development is likely to experience over its expected lifetime, planning authorities should expect new development to…*give priority to the use of sustainable drainage systems, paying attention to the potential contribution to be gained from water harvesting from impermeable surfaces, and encourage layouts that accommodate waste water recycling.*

1.1.3 PPS 3: Housing[4]

PPS3 sets out the national planning policy framework for delivering the Government's housing objectives. Local Planning Authorities should encourage applicants to bring forward sustainable and environmentally friendly new housing developments, including affordable housing developments, and in doing so should reflect the approach set out in the forthcoming PPS on climate change, including on the Code for Sustainable Homes.

1.1.4 PPS 9: Biodiversity and Geological Conservation[5]

PPS9 sets out planning policies on protection of biodiversity and geological conservation through the planning system. Regional planning bodies and local planning authorities should adhere to the following key principles to ensure that the potential impacts of planning decisions on biodiversity and geological conservation are fully considered.

Development plan policies and planning decisions should be based upon up-to-date information about the environmental characteristics of their areas. These characteristics should include the relevant biodiversity and geological resources of the area. In reviewing environmental characteristics local authorities should assess the potential to sustain and enhance those resources.

Plan policies and planning decisions should aim to maintain, and enhance, restore or add to biodiversity and geological conservation interests. In taking decisions, local planning authorities should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; and to biodiversity and geological interests within the wider environment.

[4] Planning Policy Statement 3: Housing, Office of the Deputy Prime Minister. November 2006

[5] Planning Policy Statement 9: Biodiversity and Geological Conservation, Office of the Deputy Prime Minister. August 2005

Plan policies on the form and location of development should take a strategic approach to the conservation, enhancement and restoration of biodiversity and geology, and recognise the contributions that sites, areas and features, both individually and in combination, make to conserving these resources.

Plan policies should promote opportunities for the incorporation of beneficial biodiversity and geological features within the design of development.

Development proposals where the principal objective is to conserve or enhance biodiversity and geological conservation interests should be permitted.

The aim of planning decisions should be to prevent harm to biodiversity and geological conservation interests. Where granting planning permission would result in significant harm to those interests, local planning authorities will need to be satisfied that the development cannot reasonably be located on any alternative sites that would result in less or no harm. In the absence of any such alternatives, local planning authorities should ensure that, before planning permission is granted, adequate mitigation measures are put in place. Where a planning decision would result in significant harm to biodiversity and geological interests which cannot be prevented or adequately mitigated against, appropriate compensation measures should be sought. If that significant harm cannot be prevented, adequately mitigated against, or compensated for, then planning permission should be refused.

Local development frameworks should indicate the location of designated sites of importance for biodiversity and geodiversity, making clear distinctions between the hierarchy of international, national, regional and locally designated sites. They should also identify any areas or sites for the restoration or creation of new priority habitats, which contribute to regional targets, and support this restoration or creation through appropriate policies.

1.1.5 PPS 12: Local Spatial Planning[6]

PPS 12 sets out government policy on local development frameworks. The core strategy should be supported by evidence of what physical, social and green infrastructure is needed to enable the amount of development proposed for the area, taking account of its type and distribution. This evidence should cover who will provide the infrastructure and when it will be provided. The core strategy should draw on and in parallel influence any strategies and investment plans of the local authority and other organisations.

Good infrastructure planning considers the infrastructure required to support development, costs, sources of funding, timescales for delivery and gaps in funding. This allows for the identified infrastructure to be prioritised in discussions with key local partners. This has been a major theme highlighted and considered via HM Treasury's CSR07 Policy Review on Supporting Housing Growth. The infrastructure planning process should identify, as far as possible:

- infrastructure needs and costs;
- phasing of development;
- funding sources; and
- responsibilities for delivery.

[6] Planning Policy Statement 12: Local Spatial Planning, Office of the Deputy Prime Minister. 2008

The need for infrastructure to support housing growth and the associated need for an infrastructure delivery planning process has been highlighted further in the Government's recent Housing Green Paper. The outcome of the infrastructure planning process should inform the core strategy and should be part of a robust evidence base. It will greatly assist the overall planning process for all participants if the agencies responsible for infrastructure delivery and the local authority producing the core strategy were to align their planning processes. Local authorities should undertake timely, effective and conclusive discussion with key infrastructure providers when preparing a core strategy. Key infrastructure stakeholders are encouraged to engage in such discussions and to reflect the core strategy within their own future planning. However the Government recognises that the budgeting processes of different agencies may mean that less information may be available when the core strategy is being prepared than would be ideal. It is important therefore that the core strategy makes proper provision for such uncertainty and does not place undue reliance on critical elements of infrastructure whose funding is unknown. The test should be whether there is a reasonable prospect of provision. Contingency planning – showing how the objectives will be achieved under different scenarios – may be necessary in circumstances where provision is uncertain.

Many issues critical to spatial planning do not respect local planning authority boundaries. Housing markets and commuting catchments often cover larger areas, which makes planning an individual district in isolation a difficult task, even where the Regional Spatial Strategy gives a strong steer. Critical discussions on infrastructure capacity and planning may be more effectively and efficiently carried out over a larger area than a single local planning authority area. Joint working between local planning authorities can address these issues properly, and also make the best use of scarce skills and capacity in different authorities. The production of one core strategy instead of two or more may save resources. Joint working also resonates with approaches to sub-regional working as set out in the Sub-national review and supports the development and implementation of Multi Area Agreements.

1.1.6 PPS 23: Planning and Pollution Control[7]

The following matters (not in any order of importance) should be considered in the preparation of development plan documents and may also be material in the consideration of individual planning applications where pollution considerations arise:

- the potential sensitivity of the area to adverse effects from pollution, in particular reflected in landscape, the quality of soil, air, and ground and surface waters, nature conservation (including Sites of Special Scientific Interest (SSSIs), National Parks, Areas of Outstanding Natural Beauty (AONBs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs),Wetland of International Importance (RAMSAR sites), agricultural land quality, water supply (Source Protection Zones), archaeological designations and the need to protect natural resources;
- the possible adverse impacts on water quality and the impact of any possible discharge of effluent or leachates which may pose a threat to surface or underground water resources directly or indirectly through surrounding soils;
- the need to make suitable provision for the drainage of surface water; and
- the provision of sewerage and sewage treatment and the availability of existing sewage infrastructure.

[7] Planning Policy Statement 23: Pollution Control, Office of the Deputy Prime Minister. 2004

1.1.7 PPS 25: Development and Flood Risk[8]

RPBs and LPAs should adhere to the following principles in preparing planning strategies:

- LPAs should prepare Local Development Documents (LDDs) that set out policies for the allocation of sites and the control of development which avoid flood risk to people and property where possible and manage it elsewhere, reflecting the approach to managing flood risk in this PPS and in the RSS for their region;
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, LPAs should consider whether there are opportunities in the preparation of LDDs to facilitate the relocation of development, including housing to more sustainable locations at less risk from flooding;

In addition, LPAs should in determining planning applications:

- give priority to the use of SUDS; and
- ensure that all new development in flood risk areas is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed.

1.2 Code for Sustainable Homes

Released in 2007, the CSH aims to make newly built homes more efficient in the future. The code gives a star rating (between 1 and 6) for a home based on nine different categories including water, waste and energy. In May 2008 the government announced a timetable to ensure the implementation of the CSH through the tightening up of building regulations. At present all new homes are required to be assessed for a CSH star rating. Details and technical guidance for the CSH can be found at:

http://www.communities.gov.uk/planningandbuilding/buildingregulations/legislation/englandwales/codesustainable/.

Maximum water consumption (litres/person/day)	Mandatory levels
120	Levels 1 and 2
110	
105	Levels 3 and 4
90	
80	Levels 5 and 6

Table D-1 Code for Sustainable Homes – Internal water consumptions for Levels

[8] Planning Policy Statement 25: Development and Flood Risk, CLG, 2006

Year	2010	2013	2016
Energy efficiency improvement of the dwelling compared to 2006 (Part L Building Regulations)	25%	44%	Zero Carbon
Equivalent standard within the Code	Code level 3	Code level 4	Code level 6

Table D-2 Code for Sustainable Homes enforcement timetable

2 Regional Policy: The East of England Plan

The East of England Plan is the revision to the RSS for the East of England and is intended to complement national planning policy and provide policy and strategy guidance to local authorities until 2021. It is also responsible for setting a vision, objectives and core strategy for the longer term.

Policy SS1: Achieving Sustainable Development

The spatial strategy seeks to ensure that development:

Respects environmental limits by seeking net environmental gains wherever possible, or at least avoiding harm, or (where harm is justified within an integrated approach to the guiding principles set out above) minimising, mitigating and/or compensating for that harm.

Policy WAT1: Water Efficiency

The Government will work with the Environment Agency, water companies, OFWAT, and regional stakeholders to ensure that development in the spatial strategy is matched with improvements in water efficiency delivered through a progressive, year on year, and reduction in per capita consumption rates. Savings will be monitored against the per capita per day consumption target set out in the Regional Assembly's monitoring framework.

Policy WAT2: Water Infrastructure

The Environment Agency and water companies should work with OFWAT, EERA and the neighbouring regional assemblies, local authorities, delivery agencies and others to ensure timely provision of the appropriate additional infrastructure for water supply and waste water treatment to cater for the levels of development provided through this plan, whilst meeting surface and groundwater quality standards, and avoiding adverse impact on sites of European or international importance for wildlife.

A co-ordinated approach to plan making should be developed through a programme of water cycle and river cycle studies to address the issues of water supply, water quality, wastewater treatment and flood risk in receiving water courses relating to development proposed in this RSS.

Complementing this approach, Local Development Documents should plan to site new development so as to maximise the potential of existing water/waste water treatment infrastructure and minimise the need for new/improved infrastructure.

Recent studies of wastewater infrastructure and watercourses indicate the degree of challenge in reconciling timely delivery of growth with environmental limits at the different growth locations within the region. Work on options for expanding sewage treatment capacity for the Rye Meads catchment area, which includes Stevenage, Harlow, and Welwyn, is a priority. Restrictions in capacity at Rye Meads will need to be overcome without harm to the adjacent Lee Valley Special Protection Area or its qualifying features. A strategic review of the options is required, looking beyond incremental expansion to new facilities or other possible works. Depending on the necessary lead in times, this may bear on the rate of delivery.

Where capacity limits have been identified and additional infrastructure is required, development may need to be phased to ensure it does not exceed the capacity and/ or environmental limits of the infrastructure. Additional capacity for wastewater treatment will need to be included in water company investment plans, unless proposed by alternative providers working within the

regulatory framework provided by OFWAT and the Environment Agency. The scale of investment required suggests this will be a critical delivery issue for the region.

Policy WAT3: Integrated Water Management

Local planning authorities should work with partners to ensure their plans, policies, programmes and proposals take account of the environmental consequences of river basin management plans, catchment abstraction management strategies, groundwater vulnerability maps, groundwater source protection zone maps, proposals for water abstraction and storage and the need to avoid adverse impacts on sites of European importance for wildlife.

The Environment Agency and water industry should work with local authorities and other partners to develop an integrated approach to the management of the water environment.

Policy WAT4: Flood Risk Management

Coastal and river flooding is a significant risk in parts of the East of the England. The priorities are to defend existing properties from flooding and locate new development where there is little or no risk of flooding.

Local Development Documents should:

- Only propose departures from the above principles in exceptional cases where suitable land at lower risk of flooding is not available, the benefits of development outweigh the risks from flooding, and appropriate mitigation measures are incorporated; and
- Require that sustainable drainage systems are incorporated in all appropriate developments.

3 Local Policy

Within the currently adopted Local Plans for each of the Local Authorities within the study area there are a number of policies that are related to environmental protection and the Water Cycle. Extracts of these policies can be found below.

3.1 Stevenage Local Plan 2004

Policy EN32 - River corridors and Water Meadows

Development Proposals, including culverting of watercourses, will not be permitted unless satisfactory mitigation measures are implemented if they are liable to have an adverse impact on the town's river corridors and water meadows as identified below

River Corridors:

- Stevenage Brook and its tributaries;
- Aston End Brook and its tributaries; and
- Fairlands valley and its tributaries

Water Meadows:

Ridlins Wood, Aston Valley, Wychdell, Valley Park. Failands valley. Industrial Area Pond, Meadway, Corey's Mill, Elder Way, Burymead, Bragbury End and Campshill.

Development proposals will also be encouraged to incorporate measures to maintain and enhance the quality of any river corridors or water meadows that they are liable to have an adverse impact on.

Policy EN33 - Flood Risk and Drainage

Developers will be required to provide a flood risk assessment where a proposed development is likely to:

- Be at risk from flooding;
- Increase the risk of flooding elsewhere; or
- Prejudice the effectiveness of the drainage system or flood defences.

Where the flood risk assessment shows an increase in the risk of flooding or a reduction in the effectiveness of the drainage system of flood defences, development proposals will not be permitted unless appropriate flood protection and mitigation measures are implemented.

Developments will be required to incorporate appropriate surface water management techniques which will seek to maintain existing hydrological conditions and which will not have material adverse effects upon the aquifer and the existing natural water cycle.

Where appropriate, developers will be encouraged to incorporate suitable sustainable drainage systems.

Policy EN35 - Water supply and Infrastructure

Development proposals will only be permitted where the existing water supply and sewerage infrastructure is adequate to meet the needs of a development or where necessary improvements are undertaken in advance of the development becoming operational.

Water supply and sewerage infrastructure required to meet the operational needs of the water companies will be permitted unless this would have an unacceptable adverse impact on the environment or residential amenity.

Policy EN36 - Water Conservation

Development proposals will be encouraged to reduce water consumption and run-off by using suitable water conservation and storage measures such as the use of rainwater, water efficient devices and by recycling water.

3.2 Welwyn Hatfield District Plan 2005

Policy SD1 - Sustainable Development

Development proposals will be permitted where it can be demonstrated that the principles of sustainable development are satisfied and that they accord with the objectives and policies of this plan. To assist the Council in determining this, applicants will be expected to submit a statement with their planning application demonstrating how their proposals address the sustainability criteria in the checklist contained in the Supplementary Design Guidance.

Policy R6 - River Corridors

Initiatives to protect and enhance the river environment for biodiversity, including proposals for deculverting and naturalisation of the river channel, will be supported. Suitable public access and informal water based or waterside recreation within main river corridors will also be supported where it is appropriate, provided that there is no conflict with the biodiversity of the site. Development will not be permitted which would involve the culverting or diverting of any watercourse, and/or the siting of buildings in close proximity to the river channel, unless the Council is satisfied that there would be no detriment to the river corridor.

Policy R7 - Protection of Ground and Surface Water

Planning permission will not be granted for development which poses a threat to the quality of both surface and/or groundwater. Where proposals are acceptable the use of sustainable drainage systems will be encouraged, dependent on local site and underlying groundwater considerations.

Policy R8 - Floodplains and Flood Prevention

Within the floodplains identified on the Proposal Map, planning permission for development will not be granted where proposals would;

- Decrease the capacity of the floodplain to store flood water;
- Impede the flow of water; or
- Increase the number of people and properties at risk from flooding.

Planning permission for new development outside floodplains will not be granted where the proposals would result in an increase in flooding downstream because of increased run-off. The use of sustainable drainage systems will be encouraged, dependent on local site and underlying groundwater considerations. Proposals for development necessary to prevent an increase in flooding will be considered in terms of their impact on biodiversity, the landscape and recreation.

Policy R9 - Water Supply and Disposal

Permission will not be granted for proposals that:

- Would be detrimental to existing water abstractions, fisheries, amenity and nature conservation; and
- Would cause adverse change in flows or levels in the groundwater, or any rivers, streams, ditches, springs, lakes or ponds in the vicinity.

Proposals should be consistent with the long-term management of, and co-ordinated with, the provision of new water supply and disposal infrastructure.

Policy R10 - Water Conservation Measures

New development will be expected to incorporate water conservation measures wherever applicable, including sustainable drainage systems, water storage systems, soft landscaping and permeable surfaces to help reduce surface water run-off.

Policy R11- Biodiversity and Development

All new development will be required to demonstrate how it would contribute positively to the biodiversity of the site by;

- The retention and enhancement of the natural features of the site;
- The promotion of natural areas and wildlife corridors where appropriate as part of the design;
- The translocation of habitats where necessary, where it can be demonstrated that the habitat or species concerned cannot be successfully accommodated within the development;
- The use of locally native species in planting in accordance with Policy D8 Landscaping; and
- Helping meet priorities/targets set out in the Local Biodiversity Action Plan.

Policy R12 - Special Area of Conservation

Proposals for development or land use which may affect a designated or candidate special area of conservation will be subject to the most rigorous examination. Development or land use change not directly connected with or necessary to the management of the site and which is likely to have significant effects on the site (either individually or in combination with other plans or projects) and which would affect the integrity of the site will not be permitted unless the Council is satisfied that:

- There is no alternative solution; or
- There are imperative reasons of overriding public interest for the development or land use change.

Where the site concerned hosts a priority natural habitat type and /or a priority species, development or land use change will not be permitted unless the Council is satisfied that it is necessary for reasons of human health or public safety or for the beneficial consequences of primary importance for nature conservation.

3.3 Harlow Local Plan 2006

Policy NE13 - Water Environment

In considering applications for new development affecting the quality of the water environment the Council:

- Will oppose any adverse effect on watercourses and their corridors, or on groundwater quality or levels;
- Will require the protection, maintenance and where possible enhancement of the River Stort, ponds, watercourses and field meadows;
- May require the reinstatement and management of ponds; and
- May require the creation of new water areas, and the inclusion of schemes to enhance biodiversity.

All management schemes, including funding, must be agreed with the Council.

Policy NE15 - Biodiversity

Planning permission will not be granted for development that would harm habitats or other features of the landscape identified as priorities in the UK, or the Local Biodiversity Action Plan, or are of significant importance for wildlife, unless it can be demonstrated that the reason for the proposal outweighs the need to protect the habitat or feature.

If granted, planning permission may be subject to conditions, obligations or management agreements for the provision of appropriate mitigation and/or compensatory measures.

Policy CP8 - Public Utilities

The development of land for the requirements of the statutory undertakers is supported, provided that the need for such facilities outweighs any adverse land use or environmental impact or that any such adverse impact is minimised.

Policy CP9 - Public Utilities

To allow for the proper provision of public utility services, planning permission for development that increases the demand for off-site service infrastructure will only be granted if sufficient capacity already exists or extra capacity can be provided in time to serve the proposed development. Where sufficient capacity does not exist, planning permission may be granted conditionally requiring the phasing of development to coincide with provision.

Policy CP12 - Public Utilities – Flood Risk

Development that will be at risk of flooding, or will contribute to flood risk or has an adverse impact on the river corridor will be resisted.

3.4 East Herts Local Plan 2007

Policy SD4 - Sustainable Development and Nature Conservation

Development proposals are required to safeguard the integrity and continuity of landscape features of major importance for wild flora and fauna, and to include opportunities for encouraging habitat protection, enhancement and management.

Policy ENV13 - Development and SSSI's

Proposals for development in, or likely to affect, Sites of Special Scientific Interest will be subject to special scrutiny. Where such development may have an adverse effect, directly or indirectly, on the SSSI it will not be permitted unless the reasons for the development clearly outweigh the nature conservation value of the site itself and the national policy to safeguard the national network of such sites.

Where the site concerned is a National Nature Reserve (NNR), or a site identified under the Nature Conservation Review (NCR) or Geological Conservation Review (GCR), particular regard will be paid to the individual site's national importance.

Where development is permitted the District Council will impose conditions or use planning obligations (or as subsequently revised), to ensure the protection and enhancement of the site's nature conservation interest.

Policy ENV17 - Wildlife Habitats

The District Council will:

- support the work of the Hertfordshire Environmental Forum in achieving the actions and targets contained within the Hertfordshire Local Biodiversity Action Plan;
- work with landowners and other agencies to encourage the management of features of the landscape which are of major importance for wildlife, particularly those of a linear or continuous structure, and those which function as 'stepping stones' enabling individuals, species, and ecosystems to 'migrate, spread, and mix';
- seek to realise opportunities for habitat creation as part of appropriate development schemes in land reclamation schemes, public open spaces, and on other land held by the local authority;
- actively pursue the designation of Local Nature Reserves;
- seek, in the river valleys, to ensure that river and transport network improvements and other public utility maintenance schemes are appropriately designed and effected. Support will be given to schemes encouraging the restoration of traditional agricultural land use patterns;
- promote nature conservation in urban areas by encouraging appropriate management of recreational, amenity, and disused land, and where possible providing nature trails and other interpretative and environmental education facilities; and
- seek improvements to nature conservation wherever possible as development is granted and if necessary enter into relevant legal agreements.

Policy ENV18 Water Environment

Development or change of use of land will be required to preserve and enhance the water environment in one or more of the following ways:

- improvements in surface water quality and the ecological value of watercourses and their margins;
- deculverting and naturalisation of the river channel;
- promotion of nature conservation centred on water habitats;
- river corridor landscape enhancements; and
- sustainable improvements in public access and leisure use of water features.

With regard to watercourses, development of the following types will only be acceptable if there is no harm caused to the water environment: culverting, diversion, artificial reinforcement of beds/banks using 'hard' materials, buildings and hard surfaces in close proximity (within 10 metres).

Such developments in close proximity to watercourses will also normally be expected to retain or (re) establish open river corridors on one or both sides of river channels, with appropriate retention/planting of indigenous species.

ENV19 Development in Areas Liable to Flood

Proposals for development, including raising of land, in the flood plains and washlands will not be permitted if they would:

- materially impede the flow of flood water;
- increase the risk of flooding elsewhere;
- reduce the capacity of floodplains/washlands; or
- increase the risk to people or property from flooding.

Applicants will be required to submit a Flood Risk Assessment in conjunction with their planning application where the Council deems this necessary.

ENV21 Surface Water Drainage

Where appropriate and relevant, all development proposals will be expected to take into consideration Best Management Practices to surface water drainage, as advocated by the Environment Agency. Where applicable, planning obligations (or as subsequently revised) may be sought to ensure the on-going maintenance of such practices, including off-site provision.

Proposals that do not take sufficient account of such techniques and/or are detrimental to the effectiveness of existing schemes based on such techniques, will be refused.

Appendix E

DEVELOPMENT IMPACT RESULTS

Potable Supply Variables

Best Case

New Dwelling PCC	
	l/p/day
to 2011	125 (1)
to 2016	105 (2)
to 2021	80
to 2026	80
to 2031	80

Existing Dwelling PCC	
	l/p/day
to 2011	164.22 (3)
to 2016	160.14
to 2021	150
to 2026	140
to 2031	130 (4)

Occupancy Rate* (5)							
	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.32	2.33	2.41	2.27	2.31	2.24	2.31
to 2021	2.28	2.29	2.36	2.22	2.27	2.19	2.26
to 2026	2.26	2.26	2.34	2.19	2.25	2.15	2.23
to 2031	2.23	2.23	2.32	2.17	2.23	2.12	2.19

% Increase in PG	
Percentage of PG	0
Decimal	0

Was infiltration % in DWF spreadsheet, set to 0 for potable demand

Worst Case

New Dwelling PCC	
	l/p/day
to 2011	125 (7)
to 2016	125
to 2021	125
to 2026	125
to 2031	125

Existing Dwelling PCC	
	l/p/day
to 2011	165.64 (8)
to 2016	165.64
to 2021	165.64
to 2026	165.64
to 2031	165.64

assumes constant 2007 rate

Occupancy Rate* (6)							
	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.32	2.33	2.41	2.27	2.31	2.24	2.31
to 2021	2.28	2.29	2.36	2.22	2.27	2.19	2.26
to 2026	2.26	2.26	2.34	2.19	2.25	2.15	2.23
to 2031	2.23	2.23	2.32	2.17	2.23	2.12	2.19

*based on 2006 rate remaining constant

% Increase in PG	
Percentage of PG	0
Decimal	0

Base Case

New Dwelling PCC	
	l/p/day
to 2011	125 (1)
to 2016	105 (10)
to 2021	105
to 2026	105
to 2031	105

Existing Dwelling PCC	
	l/p/day
to 2011	164.22 (9)
to 2016	160.14
to 2021	152.53
to 2026	150.27
to 2031	149.91

assumes constant 2007 rate

Occupancy Rate* (6)							
	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.32	2.33	2.41	2.27	2.31	2.24	2.31
to 2021	2.28	2.29	2.36	2.22	2.27	2.19	2.26
to 2026	2.26	2.26	2.34	2.19	2.25	2.15	2.23
to 2031	2.23	2.23	2.32	2.17	2.23	2.12	2.19

*based on 2006 rate remaining constant

% Increase in PG	
Percentage of PG	0
Decimal	0

(1) Assumes new homes built in accordance with forthcoming changes to building regs
http://www.defra.gov.uk/environment/water/conserve/what.htm#progress
(2) Assumes all new homes reaching CSH targets 3/4 and 5/6 by 2011 and 2016
(3) Based on average PCC predicted by TVW for Northern WRZ for 2007-2011, and 2011-2016
(4) Aspirational target for all houses from Future Water
(5) Based on ODPM 2002 based interim household projections of average household size 2001 - 2021, APU, and extrapolated to 2031
(6) Based on 2006 rate remaining constant, ODPM 2002 based interim household projections of average household size 2001 - 2021, APU
(7) Assumes CSH water efficiency targets not enforced, but building regs changes go ahead
(8) Assumes no drop in average PCC due to meter penetration, PCC stays at 2007 Northern WRZ level
(9) Based on TVW NWRZ average PCC for every 5 year block
(10) Assumes new dwellings built to CHS Level 3/4 but not Level 5/6

Supply Calculations

Best Case

Harlow

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	35,051	419	13,584.34	123.61	123.61	13,707.94
2008/09	35,051	465	13,584.34	137.18	260.78	13,845.12
2009/10	35,051	621	13,584.34	183.20	443.98	14,028.31
2010/11	35,051	679	13,584.34	200.31	644.28	14,228.62
2011/12	35,051	612	13,022.32	149.08	793.36	13,815.68
2012/13	35,051	1,354	13,022.32	329.83	1,123.20	14,145.51
2013/14	35,051	1,354	13,022.32	329.83	1,453.03	14,475.35
2014/15	35,051	1,354	13,022.32	329.83	1,782.87	14,805.18
2015/16	35,051	1,354	13,022.32	329.83	2,112.70	15,135.02
2016/17	35,051	1,354	11,987.44	246.97	2,359.67	14,347.11
2017/18	35,051	1,354	11,987.44	246.97	2,606.64	14,594.08
2018/19	35,051	1,354	11,987.44	246.97	2,853.61	14,841.05
2019/20	35,051	1,354	11,987.44	246.97	3,100.58	15,088.02
2020/21	35,051	1,354	11,987.44	246.97	3,347.55	15,334.99
2021/22	35,051	800	11,090.14	144.64	3,492.19	14,582.33
2022/23	35,051	800	11,090.14	144.64	3,636.83	14,726.97
2023/24	35,051	800	11,090.14	144.64	3,781.47	14,871.61
2024/25	35,051	800	11,090.14	144.64	3,926.11	15,016.25
2025/26	35,051	800	11,090.14	144.64	4,070.75	15,160.89
2026/27	35,051	800	10,161.28	142.72	4,213.47	14,374.75
2027/28	35,051	800	10,161.28	142.72	4,356.19	14,517.47
2028/29	35,051	800	10,161.28	142.72	4,498.91	14,660.19
2029/30	35,051	800	10,161.28	142.72	4,641.63	14,802.91
2030/31	35,051	800	10,161.28	142.72	4,784.35	14,945.63

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-3,423.05	4,784.35	1,361.30

East Herts.

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	56,702	873	22,161.61	259.72	259.72	22,421.33
2008/09	56,702	489	22,161.61	145.48	405.20	22,566.81
2009/10	56,702	433	22,161.61	128.82	534.01	22,695.63
2010/11	56,702	181	22,161.61	53.85	587.86	22,749.47
2011/12	56,702	710	21,157.00	173.70	761.56	21,918.56
2012/13	56,702	710	21,157.00	173.70	935.26	22,092.26
2013/14	56,702	710	21,157.00	173.70	1,108.96	22,265.97
2014/15	56,702	710	21,157.00	173.70	1,282.67	22,439.67
2015/16	56,702	710	21,157.00	173.70	1,456.37	22,613.37
2016/17	56,702	710	19,477.14	130.07	1,586.44	21,063.58
2017/18	56,702	710	19,477.14	130.07	1,716.51	21,193.65
2018/19	56,702	710	19,477.14	130.07	1,846.58	21,323.72
2019/20	56,702	710	19,477.14	130.07	1,976.66	21,453.79
2020/21	56,702	710	19,477.14	130.07	2,106.73	21,583.86
2021/22	56,702	600	17,940.51	108.48	2,215.21	20,155.72
2022/23	56,702	600	17,940.51	108.48	2,323.69	20,264.20
2023/24	56,702	600	17,940.51	108.48	2,432.17	20,372.68
2024/25	56,702	600	17,940.51	108.48	2,540.65	20,481.16
2025/26	56,702	600	17,940.51	108.48	2,649.13	20,589.64
2026/27	56,702	600	16,437.91	107.04	2,756.17	19,194.08
2027/28	56,702	600	16,437.91	107.04	2,863.21	19,301.12
2028/29	56,702	600	16,437.91	107.04	2,970.25	19,408.16
2029/30	56,702	600	16,437.91	107.04	3,077.29	19,515.20
2030/31	56,702	600	16,437.91	107.04	3,184.33	19,622.24

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-5,723.70	3,184.33	-2,539.38

Broxbourne

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	38,119	296	15,274.16	90.28	90.28	15,364.44
2008/09	38,119	235	15,274.16	71.68	161.96	15,436.12
2009/10	38,119	389	15,274.16	118.65	280.60	15,554.76
2010/11	38,119	311	15,274.16	94.86	375.46	15,649.62
2011/12	38,119	212	14,711.55	53.65	429.10	15,140.65
2012/13	38,119	216	14,711.55	54.66	483.76	15,195.31
2013/14	38,119	216	14,711.55	54.66	538.42	15,249.97
2014/15	38,119	216	14,711.55	54.66	593.08	15,304.63
2015/16	38,119	216	14,711.55	54.66	647.74	15,359.28
2016/17	38,119	216	13,494.13	40.78	688.52	14,182.64
2017/18	38,119	216	13,494.13	40.78	729.30	14,223.42
2018/19	38,119	216	13,494.13	40.78	770.08	14,264.21
2019/20	38,119	216	13,494.13	40.78	810.86	14,304.99
2020/21	38,119	216	13,494.13	40.78	851.64	14,345.77
2021/22	38,119	280	12,487.78	52.42	904.06	13,391.84
2022/23	38,119	280	12,487.78	52.42	956.47	13,444.26
2023/24	38,119	280	12,487.78	52.42	1,008.89	13,496.67
2024/25	38,119	280	12,487.78	52.42	1,061.30	13,549.09
2025/26	38,119	280	12,487.78	52.42	1,113.72	13,601.51
2026/27	38,119	280	11,496.69	51.97	1,165.69	12,662.38
2027/28	38,119	280	11,496.69	51.97	1,217.66	12,714.35
2028/29	38,119	280	11,496.69	51.97	1,269.62	12,766.32
2029/30	38,119	280	11,496.69	51.97	1,321.59	12,818.28
2030/31	38,119	280	11,496.69	51.97	1,373.56	12,870.25

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-3,777.47	1,373.56	-2,403.91

Stevenage

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	35,397	692	13,544.05	201.55	201.55	13,745.59
2008/09	35,397	543	13,544.05	158.15	359.69	13,903.74
2009/10	35,397	581	13,544.05	169.22	528.91	14,072.96
2010/11	35,397	685	13,544.05	199.51	728.42	14,272.46
2011/12	35,397	722	12,867.44	172.09	900.50	13,767.94
2012/13	35,397	970	12,867.44	231.20	1,131.70	13,999.14
2013/14	35,397	1,480	12,867.44	352.76	1,484.46	14,351.90
2014/15	35,397	1,380	12,867.44	328.92	1,813.39	14,680.83
2015/16	35,397	1,380	12,867.44	328.92	2,142.31	15,009.75
2016/17	35,397	1,190	11,787.20	211.34	2,353.65	14,140.85
2017/18	35,397	1,110	11,787.20	197.14	2,550.79	14,337.99
2018/19	35,397	1,110	11,787.20	197.14	2,747.92	14,535.13
2019/20	35,397	1,110	11,787.20	197.14	2,945.06	14,732.26
2020/21	35,397	1,110	11,787.20	197.14	3,142.20	14,929.40
2021/22	35,397	960	10,852.72	168.19	3,310.39	14,163.11
2022/23	35,397	960	10,852.72	168.19	3,478.58	14,331.30
2023/24	35,397	960	10,852.72	168.19	3,646.77	14,499.49
2024/25	35,397	960	10,852.72	168.19	3,814.96	14,667.68
2025/26	35,397	960	10,852.72	168.19	3,983.16	14,835.88
2026/27	35,397	960	9,985.49	166.66	4,149.81	14,135.31
2027/28	35,397	960	9,985.49	166.66	4,316.47	14,301.96
2028/29	35,397	960	9,985.49	166.66	4,483.12	14,468.62
2029/30	35,397	960	9,985.49	166.66	4,649.78	14,635.27
2030/31	35,397	960	9,985.49	166.66	4,816.44	14,801.93

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-3,558.55	4,816.44	1,257.88

Welwyn Hatfield

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	44,061	732	16,931.53	214.11	214.11	17,145.64
2008/09	44,061	460	16,931.53	134.55	348.66	17,280.19
2009/10	44,061	372	16,931.53	108.81	457.47	17,389.00
2010/11	44,061	538	16,931.53	157.37	614.84	17,546.37
2011/12	44,061	283	16,299.19	68.64	683.48	16,982.67
2012/13	44,061	214	16,299.19	51.91	735.38	17,034.58
2013/14	44,061	300	16,299.19	72.77	808.15	17,107.34
2014/15	44,061	531	16,299.19	128.79	936.94	17,236.14
2015/16	44,061	531	16,299.19	128.79	1,065.74	17,364.93
2016/17	44,061	531	15,002.77	96.43	1,162.17	16,164.94
2017/18	44,061	531	15,002.77	96.43	1,258.59	16,261.37
2018/19	44,061	531	15,002.77	96.43	1,355.02	16,357.79
2019/20	44,061	531	15,002.77	96.43	1,451.45	16,454.22
2020/21	44,061	531	15,002.77	96.43	1,547.88	16,550.65
2021/22	44,061	500	13,879.22	90.00	1,637.88	15,517.10
2022/23	44,061	500	13,879.22	90.00	1,727.88	15,607.10
2023/24	44,061	500	13,879.22	90.00	1,817.88	15,697.10
2024/25	44,061	500	13,879.22	90.00	1,907.88	15,787.10
2025/26	44,061	500	13,879.22	90.00	1,997.88	15,877.10
2026/27	44,061	500	12,773.28	89.20	2,087.08	14,860.37
2027/28	44,061	500	12,773.28	89.20	2,176.28	14,949.57
2028/29	44,061	500	12,773.28	89.20	2,265.48	15,038.77
2029/30	44,061	500	12,773.28	89.20	2,354.68	15,127.97
2030/31	44,061	500	12,773.28	89.20	2,443.88	15,217.17

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-4,158.25	2,443.88	-1,714.36

North Herts.

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	52,707	407	19,821.19	116.50	116.50	19,937.70
2008/09	52,707	259	19,821.19	74.14	190.64	20,011.84
2009/10	52,707	259	19,821.19	74.14	264.78	20,085.98
2010/11	52,707	259	19,821.19	74.14	338.92	20,160.11
2011/12	52,707	259	18,906.72	60.92	399.84	19,306.55
2012/13	52,707	259	18,906.72	60.92	460.75	19,367.47
2013/14	52,707	259	18,906.72	60.92	521.67	19,428.39
2014/15	52,707	259	18,906.72	60.92	582.59	19,489.30
2015/16	52,707	259	18,906.72	60.92	643.50	19,550.22
2016/17	52,707	259	17,314.25	45.38	688.88	18,003.13
2017/18	52,707	259	17,314.25	45.38	734.26	18,048.51
2018/19	52,707	259	17,314.25	45.38	779.63	18,093.88
2019/20	52,707	259	17,314.25	45.38	825.01	18,139.26
2020/21	52,707	259	17,314.25	45.38	870.39	18,184.64
2021/22	52,707	310	15,864.81	53.32	923.71	16,788.52
2022/23	52,707	310	15,864.81	53.32	977.03	16,841.84
2023/24	52,707	310	15,864.81	53.32	1,030.35	16,895.16
2024/25	52,707	310	15,864.81	53.32	1,083.67	16,948.48
2025/26	52,707	310	15,864.81	53.32	1,136.99	17,001.80
2026/27	52,707	310	14,526.05	52.58	1,189.56	15,715.61
2027/28	52,707	310	14,526.05	52.58	1,242.14	15,768.19
2028/29	52,707	310	14,526.05	52.58	1,294.72	15,820.77
2029/30	52,707	310	14,526.05	52.58	1,347.29	15,873.34
2030/31	52,707	310	14,526.05	52.58	1,399.87	15,925.92

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-5,295.15	1,399.87	-3,895.28

Epping Forest

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	53,441	108	20,536.03	31.59	31.59	20,567.62
2008/09	53,441	144	20,536.03	42.12	73.71	20,609.74
2009/10	53,441	434	20,536.03	126.95	200.66	20,736.68
2010/11	53,441	366	20,536.03	107.06	307.71	20,843.74
2011/12	53,441	275	19,769.08	66.70	374.41	20,143.49
2012/13	53,441	148	19,769.08	35.90	410.31	20,179.39
2013/14	53,441	200	19,769.08	48.51	458.82	20,227.90
2014/15	53,441	200	19,769.08	48.51	507.33	20,276.41
2015/16	53,441	200	19,769.08	48.51	555.84	20,324.92
2016/17	53,441	200	18,116.50	36.16	592.00	18,708.50
2017/18	53,441	200	18,116.50	36.16	628.16	18,744.66
2018/19	53,441	200	18,116.50	36.16	664.32	18,780.82
2019/20	53,441	200	18,116.50	36.16	700.48	18,816.98
2020/21	53,441	200	18,116.50	36.16	736.64	18,853.14
2021/22	53,441	175	16,684.28	31.22	767.86	17,452.14
2022/23	53,441	175	16,684.28	31.22	799.08	17,483.36
2023/24	53,441	175	16,684.28	31.22	830.30	17,514.58
2024/25	53,441	175	16,684.28	31.22	861.52	17,545.80
2025/26	53,441	175	16,684.28	31.22	892.74	17,577.02
2026/27	53,441	175	15,214.65	30.66	923.40	16,138.05
2027/28	53,441	175	15,214.65	30.66	954.06	16,168.71
2028/29	53,441	175	15,214.65	30.66	984.72	16,199.37
2029/30	53,441	175	15,214.65	30.66	1,015.38	16,230.03
2030/31	53,441	175	15,214.65	30.66	1,046.04	16,260.69

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-5,321.38	1,046.04	-4,275.34

Total

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total Domestic demand
			m3/day	m3/day	m3/day	m3/day
2007/08	315,478	3,527	121,853	1,037	1,037	122,890
2008/09	315,478	2,595	121,853	763	1,801	123,654
2009/10	315,478	3,089	121,853	910	2,710	124,563
2010/11	315,478	3,019	121,853	887	3,597	125,450
2011/12	315,478	3,073	116,733	745	4,342	121,076
2012/13	315,478	3,871	116,733	938	5,280	122,014
2013/14	315,478	4,519	116,733	1,093	6,374	123,107
2014/15	315,478	4,650	116,733	1,125	7,499	124,232
2015/16	315,478	4,650	116,733	1,125	8,624	125,357
2016/17	315,478	4,460	107,179	807	9,431	116,611
2017/18	315,478	4,380	107,179	793	10,224	117,404
2018/19	315,478	4,380	107,179	793	11,017	118,197
2019/20	315,478	4,380	107,179	793	11,810	118,990
2020/21	315,478	4,380	107,179	793	12,603	119,782
2021/22	315,478	3,625	98,799	648	13,251	112,051
2022/23	315,478	3,625	98,799	648	13,900	112,699
2023/24	315,478	3,625	98,799	648	14,548	113,347
2024/25	315,478	3,625	98,799	648	15,196	113,996
2025/26	315,478	3,625	98,799	648	15,844	114,644
2026/27	315,478	3,625	90,595	641	16,485	107,081
2027/28	315,478	3,625	90,595	641	17,126	107,721
2028/29	315,478	3,625	90,595	641	17,767	108,362
2029/30	315,478	3,625	90,595	641	18,408	109,003
2030/31	315,478	3,625	90,595	641	19,048	109,644

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-31,257.55	19,048.46	-12,209.09

Worst Case

Harlow

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	35,051	419	13,701.80	123.61	123.61	13,825.41
2008/09	35,051	465	13,701.80	137.18	260.78	13,962.58
2009/10	35,051	621	13,701.80	183.20	443.98	14,145.78
2010/11	35,051	679	13,701.80	200.31	644.28	14,346.08
2011/12	35,051	612	13,469.57	177.48	821.76	14,291.33
2012/13	35,051	1,354	13,469.57	392.66	1,214.42	14,683.99
2013/14	35,051	1,354	13,469.57	392.66	1,607.08	15,076.65
2014/15	35,051	1,354	13,469.57	392.66	1,999.74	15,469.31
2015/16	35,051	1,354	13,469.57	392.66	2,392.40	15,861.97
2016/17	35,051	1,354	13,237.33	385.89	2,778.29	16,015.62
2017/18	35,051	1,354	13,237.33	385.89	3,164.18	16,401.51
2018/19	35,051	1,354	13,237.33	385.89	3,550.07	16,787.40
2019/20	35,051	1,354	13,237.33	385.89	3,935.96	17,173.29
2020/21	35,051	1,354	13,237.33	385.89	4,321.85	17,559.18
2021/22	35,051	800	13,121.22	226.00	4,547.85	17,669.07
2022/23	35,051	800	13,121.22	226.00	4,773.85	17,895.07
2023/24	35,051	800	13,121.22	226.00	4,999.85	18,121.07
2024/25	35,051	800	13,121.22	226.00	5,225.85	18,347.07
2025/26	35,051	800	13,121.22	226.00	5,451.85	18,573.07
2026/27	35,051	800	12,947.04	223.00	5,674.85	18,621.89
2027/28	35,051	800	12,947.04	223.00	5,897.85	18,844.89
2028/29	35,051	800	12,947.04	223.00	6,120.85	19,067.89
2029/30	35,051	800	12,947.04	223.00	6,343.85	19,290.89
2030/31	35,051	800	12,947.04	223.00	6,566.85	19,513.89

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-754.76	6,566.85	5,812.09

East Herts.

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	56,702	873	22,353.24	259.72	259.72	22,612.96
2008/09	56,702	489	22,353.24	145.48	405.20	22,758.44
2009/10	56,702	433	22,353.24	128.82	534.01	22,887.26
2010/11	56,702	181	22,353.24	53.85	587.86	22,941.10
2011/12	56,702	710	21,883.64	206.79	794.65	22,678.29
2012/13	56,702	710	21,883.64	206.79	1,001.44	22,885.07
2013/14	56,702	710	21,883.64	206.79	1,208.22	23,091.86
2014/15	56,702	710	21,883.64	206.79	1,415.01	23,298.65
2015/16	56,702	710	21,883.64	206.79	1,621.80	23,505.44
2016/17	56,702	710	21,507.95	203.24	1,825.04	23,332.99
2017/18	56,702	710	21,507.95	203.24	2,028.27	23,536.23
2018/19	56,702	710	21,507.95	203.24	2,231.51	23,739.46
2019/20	56,702	710	21,507.95	203.24	2,434.75	23,942.70
2020/21	56,702	710	21,507.95	203.24	2,637.99	24,145.94
2021/22	56,702	600	21,226.19	169.50	2,807.49	24,033.67
2022/23	56,702	600	21,226.19	169.50	2,976.99	24,203.17
2023/24	56,702	600	21,226.19	169.50	3,146.49	24,372.67
2024/25	56,702	600	21,226.19	169.50	3,315.99	24,542.17
2025/26	56,702	600	21,226.19	169.50	3,485.49	24,711.67
2026/27	56,702	600	20,944.43	167.25	3,652.74	24,597.16
2027/28	56,702	600	20,944.43	167.25	3,819.99	24,764.41
2028/29	56,702	600	20,944.43	167.25	3,987.24	24,931.66
2029/30	56,702	600	20,944.43	167.25	4,154.49	25,098.91
2030/31	56,702	600	20,944.43	167.25	4,321.74	25,266.16

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-1,408.82	4,321.74	2,912.92

Broxbourne

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	38,119	296	15,406.24	90.28	90.28	15,496.52
2008/09	38,119	235	15,406.24	71.68	161.96	15,568.19
2009/10	38,119	389	15,406.24	118.65	280.60	15,686.84
2010/11	38,119	311	15,406.24	94.86	375.46	15,781.69
2011/12	38,119	212	15,216.82	63.87	439.32	15,656.14
2012/13	38,119	216	15,216.82	65.07	504.39	15,721.21
2013/14	38,119	216	15,216.82	65.07	569.46	15,786.28
2014/15	38,119	216	15,216.82	65.07	634.53	15,851.35
2015/16	38,119	216	15,216.82	65.07	699.60	15,916.42
2016/17	38,119	216	14,901.11	63.72	763.32	15,664.43
2017/18	38,119	216	14,901.11	63.72	827.04	15,728.15
2018/19	38,119	216	14,901.11	63.72	890.76	15,791.87
2019/20	38,119	216	14,901.11	63.72	954.48	15,855.59
2020/21	38,119	216	14,901.11	63.72	1,018.20	15,919.31
2021/22	38,119	280	14,774.83	81.90	1,100.10	15,874.93
2022/23	38,119	280	14,774.83	81.90	1,182.00	15,956.83
2023/24	38,119	280	14,774.83	81.90	1,263.90	16,038.73
2024/25	38,119	280	14,774.83	81.90	1,345.80	16,120.63
2025/26	38,119	280	14,774.83	81.90	1,427.70	16,202.53
2026/27	38,119	280	14,648.55	81.20	1,508.90	16,157.45
2027/28	38,119	280	14,648.55	81.20	1,590.10	16,238.65
2028/29	38,119	280	14,648.55	81.20	1,671.30	16,319.85
2029/30	38,119	280	14,648.55	81.20	1,752.50	16,401.05
2030/31	38,119	280	14,648.55	81.20	1,833.70	16,482.25

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-757.68	1,833.70	1,076.02

Stevenage

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	35,397	692	13,661.16	201.55	201.55	13,862.71
2008/09	35,397	543	13,661.16	158.15	359.69	14,020.85
2009/10	35,397	581	13,661.16	169.22	528.91	14,190.07
2010/11	35,397	685	13,661.16	199.51	728.42	14,389.58
2011/12	35,397	722	13,309.37	204.87	933.28	14,242.65
2012/13	35,397	970	13,309.37	275.24	1,208.52	14,517.89
2013/14	35,397	1,480	13,309.37	419.95	1,628.47	14,937.84
2014/15	35,397	1,380	13,309.37	391.58	2,020.05	15,329.42
2015/16	35,397	1,380	13,309.37	391.58	2,411.62	15,720.99
2016/17	35,397	1,190	13,016.21	330.23	2,741.85	15,758.06
2017/18	35,397	1,110	13,016.21	308.03	3,049.87	16,066.08
2018/19	35,397	1,110	13,016.21	308.03	3,357.90	16,374.11
2019/20	35,397	1,110	13,016.21	308.03	3,665.92	16,682.13
2020/21	35,397	1,110	13,016.21	308.03	3,973.95	16,990.16
2021/22	35,397	960	12,840.32	262.80	4,236.75	17,077.06
2022/23	35,397	960	12,840.32	262.80	4,499.55	17,339.86
2023/24	35,397	960	12,840.32	262.80	4,762.35	17,602.66
2024/25	35,397	960	12,840.32	262.80	5,025.15	17,865.46
2025/26	35,397	960	12,840.32	262.80	5,287.95	18,128.26
2026/27	35,397	960	12,723.06	260.40	5,548.35	18,271.40
2027/28	35,397	960	12,723.06	260.40	5,808.75	18,531.80
2028/29	35,397	960	12,723.06	260.40	6,069.15	18,792.20
2029/30	35,397	960	12,723.06	260.40	6,329.55	19,052.60
2030/31	35,397	960	12,723.06	260.40	6,589.95	19,313.00

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-938.11	6,589.95	5,651.84

Welwyn Hatfield

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	44,061	732	17,077.94	214.11	214.11	17,292.05
2008/09	44,061	460	17,077.94	134.55	348.66	17,426.60
2009/10	44,061	372	17,077.94	108.81	457.47	17,535.41
2010/11	44,061	538	17,077.94	157.37	614.84	17,692.77
2011/12	44,061	283	16,858.99	81.72	696.55	17,555.54
2012/13	44,061	214	16,858.99	61.79	758.34	17,617.33
2013/14	44,061	300	16,858.99	86.63	844.97	17,703.96
2014/15	44,061	531	16,858.99	153.33	998.30	17,857.28
2015/16	44,061	531	16,858.99	153.33	1,151.62	18,010.61
2016/17	44,061	531	16,567.06	150.67	1,302.29	17,869.35
2017/18	44,061	531	16,567.06	150.67	1,452.96	18,020.02
2018/19	44,061	531	16,567.06	150.67	1,603.64	18,170.69
2019/20	44,061	531	16,567.06	150.67	1,754.31	18,321.37
2020/21	44,061	531	16,567.06	150.67	1,904.98	18,472.04
2021/22	44,061	500	16,421.09	140.63	2,045.60	18,466.70
2022/23	44,061	500	16,421.09	140.63	2,186.23	18,607.32
2023/24	44,061	500	16,421.09	140.63	2,326.85	18,747.95
2024/25	44,061	500	16,421.09	140.63	2,467.48	18,888.57
2025/26	44,061	500	16,421.09	140.63	2,608.10	19,029.20
2026/27	44,061	500	16,275.13	139.38	2,747.48	19,022.61
2027/28	44,061	500	16,275.13	139.38	2,886.85	19,161.98
2028/29	44,061	500	16,275.13	139.38	3,026.23	19,301.36
2029/30	44,061	500	16,275.13	139.38	3,165.60	19,440.73
2030/31	44,061	500	16,275.13	139.38	3,304.98	19,580.11

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-802.81	3,304.98	2,502.17

North Herts.

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	52,707	407	19,992.59	116.50	116.50	20,109.09
2008/09	52,707	259	19,992.59	74.14	190.64	20,183.23
2009/10	52,707	259	19,992.59	74.14	264.78	20,257.37
2010/11	52,707	259	19,992.59	74.14	338.92	20,331.51
2011/12	52,707	259	19,556.07	72.52	411.44	19,967.51
2012/13	52,707	259	19,556.07	72.52	483.96	20,040.03
2013/14	52,707	259	19,556.07	72.52	556.48	20,112.55
2014/15	52,707	259	19,556.07	72.52	629.00	20,185.07
2015/16	52,707	259	19,556.07	72.52	701.52	20,257.59
2016/17	52,707	259	19,119.55	70.90	772.42	19,891.97
2017/18	52,707	259	19,119.55	70.90	843.32	19,962.87
2018/19	52,707	259	19,119.55	70.90	914.22	20,033.77
2019/20	52,707	259	19,119.55	70.90	985.13	20,104.67
2020/21	52,707	259	19,119.55	70.90	1,056.03	20,175.57
2021/22	52,707	310	18,770.33	83.31	1,139.34	19,909.67
2022/23	52,707	310	18,770.33	83.31	1,222.65	19,992.98
2023/24	52,707	310	18,770.33	83.31	1,305.96	20,076.30
2024/25	52,707	310	18,770.33	83.31	1,389.28	20,159.61
2025/26	52,707	310	18,770.33	83.31	1,472.59	20,242.92
2026/27	52,707	310	18,508.42	82.15	1,554.74	20,063.16
2027/28	52,707	310	18,508.42	82.15	1,636.89	20,145.31
2028/29	52,707	310	18,508.42	82.15	1,719.04	20,227.46
2029/30	52,707	310	18,508.42	82.15	1,801.19	20,309.61
2030/31	52,707	310	18,508.42	82.15	1,883.34	20,391.76

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-1,484.17	1,883.34	399.17

Epping Forest

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total demand
			m3/day	m3/day	m3/day	m3/day
2007/08	53,441	108	20,713.60	31.59	31.59	20,745.19
2008/09	53,441	144	20,713.60	42.12	73.71	20,787.31
2009/10	53,441	434	20,713.60	126.95	200.66	20,914.26
2010/11	53,441	366	20,713.60	107.06	307.71	21,021.31
2011/12	53,441	275	20,448.04	79.41	387.12	20,835.16
2012/13	53,441	148	20,448.04	42.74	429.85	20,877.90
2013/14	53,441	200	20,448.04	57.75	487.60	20,935.65
2014/15	53,441	200	20,448.04	57.75	545.35	20,993.40
2015/16	53,441	200	20,448.04	57.75	603.10	21,051.15
2016/17	53,441	200	20,005.45	56.50	659.60	20,665.05
2017/18	53,441	200	20,005.45	56.50	716.10	20,721.55
2018/19	53,441	200	20,005.45	56.50	772.60	20,778.05
2019/20	53,441	200	20,005.45	56.50	829.10	20,834.55
2020/21	53,441	200	20,005.45	56.50	885.60	20,891.05
2021/22	53,441	175	19,739.89	48.78	934.38	20,674.27
2022/23	53,441	175	19,739.89	48.78	983.16	20,723.05
2023/24	53,441	175	19,739.89	48.78	1,031.95	20,771.83
2024/25	53,441	175	19,739.89	48.78	1,080.73	20,820.61
2025/26	53,441	175	19,739.89	48.78	1,129.51	20,869.39
2026/27	53,441	175	19,385.81	47.91	1,177.41	20,563.22
2027/28	53,441	175	19,385.81	47.91	1,225.32	20,611.13
2028/29	53,441	175	19,385.81	47.91	1,273.23	20,659.03
2029/30	53,441	175	19,385.81	47.91	1,321.13	20,706.94
2030/31	53,441	175	19,385.81	47.91	1,369.04	20,754.85

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-1,327.80	1,369.04	41.24

Rye Meads Catchment Total

	06/07 Existing Dwellings	Yearly Dwelling Increase	Demand from 06/07 dwellings	Annual demand increase from new dwellings	Cum. Increase from new dwellings	Total Domestic demand
			m3/day	m3/day	m3/day	m3/day
2007/08	315,478	3,527	122,907	1,037	1,037	123,944
2008/09	315,478	2,595	122,907	763	1,801	124,707
2009/10	315,478	3,089	122,907	910	2,710	125,617
2010/11	315,478	3,019	122,907	887	3,597	126,504
2011/12	315,478	3,073	120,742	887	4,484	125,227
2012/13	315,478	3,871	120,742	1,117	5,601	126,343
2013/14	315,478	4,519	120,742	1,301	6,902	127,645
2014/15	315,478	4,650	120,742	1,340	8,242	128,984
2015/16	315,478	4,650	120,742	1,340	9,582	130,324
2016/17	315,478	4,460	118,355	1,261	10,843	129,197
2017/18	315,478	4,380	118,355	1,239	12,082	130,436
2018/19	315,478	4,380	118,355	1,239	13,321	131,675
2019/20	315,478	4,380	118,355	1,239	14,560	132,914
2020/21	315,478	4,380	118,355	1,239	15,799	134,153
2021/22	315,478	3,625	116,894	1,013	16,812	133,705
2022/23	315,478	3,625	116,894	1,013	17,824	134,718
2023/24	315,478	3,625	116,894	1,013	18,837	135,731
2024/25	315,478	3,625	116,894	1,013	19,850	136,744
2025/26	315,478	3,625	116,894	1,013	20,863	137,757
2026/27	315,478	3,625	115,432	1,001	21,864	137,297
2027/28	315,478	3,625	115,432	1,001	22,866	138,298
2028/29	315,478	3,625	115,432	1,001	23,867	139,299
2029/30	315,478	3,625	115,432	1,001	24,868	140,301
2030/31	315,478	3,625	115,432	1,001	25,870	141,302

2031 Change in demand of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total demand Increase
m3/day	m3/day	m3/day
-7,474.14	25,869.59	18,395.45

Base Case

	Harlow					East Herts.					Broxbourne					Stevenage					Welwyn Hatfield					North Herts.					Epping Forest				
	06/07 Existing Dwellings	Yearly Dwelling	Demand from 06/07 dwellings	Annual demand increase from	Cum. Increase from new	Total demand	06/07 Existing Dwellings	Yearly Dwelling	Demand from 06/07 dwellings	Annual demand increase from	Cum. Increase from new	Total demand	06/07 Existing Dwellings	Yearly Dwelling	Demand from 06/07 dwellings	Annual demand increase from	Cum. Increase from new	Total demand	06/07 Existing	Yearly Dwelling	Demand from 06/07	Annual demand increase from	Cum. Increase from new	Total demand	06/07 Existing	Yearly Dwelling	Demand from 06/07	Annual demand increase from	Cum. Increase from new	Total demand	06/07 Existing	Yearly Dwelling	Demand from 06/07 dwellings	Annual demand increase from	Cum. Increase from new	Total demand
			m3/day	m3/day	m3/day	m3/day			m3/day	m3/day	m3/day	m3/day			m3/day	m3/day	m3/day	m3/day			m3/day	m3/day	m3/day	m3/day			m3/day	m3/day	m3/day	m3/day			m3/day	m3/day	m3/day	m3/day
2007/08	35,051	419	13,584.19	123.61	123.61	13,707.80	56,702	873	22,161.38	259.72	259.72	22,421.10	38,119	296	15,274.00	90.28	90.28	15,364.28	35,397	692	13,543.90	201.55	201.55	13,745.45	44,061	732	16,931.35	214.11	214.11	17,145.46	52,707	407	19,820.99	116.50	116.50	19,937.49	53,441	108	20,535.81	31.59	31.59	20,567.40
2008/09	35,051	465	13,584.19	137.18	260.78	13,844.97	56,702	489	22,161.38	145.48	405.20	22,566.58	38,119	235	15,274.00	71.68	161.96	15,435.96	35,397	543	13,543.90	158.15	359.69	13,903.60	44,061	460	16,931.35	134.55	348.66	17,280.01	52,707	259	19,820.99	74.14	190.64	20,011.63	53,441	144	20,535.81	42.12	73.71	20,609.52
2009/10	35,051	621	13,584.19	183.20	443.98	14,028.17	56,702	433	22,161.38	128.82	534.01	22,695.39	38,119	389	15,274.00	118.65	280.60	15,554.60	35,397	581	13,543.90	169.22	528.91	14,072.81	44,061	372	16,931.35	108.81	457.47	17,388.82	52,707	259	19,820.99	74.14	264.78	20,085.77	53,441	434	20,535.81	126.95	200.66	20,736.47
2010/11	35,051	679	13,584.19	200.31	644.28	14,228.47	56,702	181	22,161.38	53.85	587.86	22,749.24	38,119	311	15,274.00	94.86	375.46	15,649.46	35,397	685	13,543.90	199.51	728.42	14,272.32	44,061	538	16,931.35	157.37	614.84	17,546.19	52,707	259	19,820.99	74.14	338.92	20,159.91	53,441	366	20,535.81	107.06	307.71	20,843.52
2011/12	35,051	612	13,022.31	149.08	793.36	13,815.67	56,702	710	21,156.99	173.70	761.56	21,918.55	38,119	212	14,711.54	53.65	429.10	15,140.64	35,397	722	12,867.43	172.09	900.50	13,767.94	44,061	283	16,299.18	68.64	683.48	16,982.66	52,707	259	18,906.70	60.92	399.84	19,306.54	53,441	275	19,769.06	66.70	374.41	20,143.47
2012/13	35,051	1,354	13,022.31	329.83	1,123.20	14,145.50	56,702	710	21,156.99	173.70	935.26	22,092.25	38,119	216	14,711.54	54.66	483.76	15,195.30	35,397	970	12,867.43	231.20	1,131.70	13,999.13	44,061	214	16,299.18	51.91	735.38	17,034.57	52,707	259	18,906.70	60.92	460.75	19,367.46	53,441	148	19,769.06	35.90	410.31	20,179.37
2013/14	35,051	1,354	13,022.31	329.83	1,453.03	14,475.34	56,702	710	21,156.99	173.70	1,108.96	22,265.95	38,119	216	14,711.54	54.66	538.42	15,249.96	35,397	1,480	12,867.43	352.76	1,484.46	14,351.89	44,061	300	16,299.18	72.77	808.15	17,107.33	52,707	259	18,906.70	60.92	521.67	19,428.37	53,441	200	19,769.06	48.51	458.82	20,227.88
2014/15	35,051	1,354	13,022.31	329.83	1,782.87	14,805.17	56,702	710	21,156.99	173.70	1,282.67	22,439.65	38,119	216	14,711.54	54.66	593.08	15,304.62	35,397	1,380	12,867.43	328.92	1,813.39	14,680.82	44,061	531	16,299.18	128.79	936.94	17,236.12	52,707	259	18,906.70	60.92	582.59	19,489.29	53,441	200	19,769.06	48.51	507.33	20,276.39
2015/16	35,051	1,354	13,022.31	329.83	2,112.70	15,135.01	56,702	710	21,156.99	173.70	1,456.37	22,613.35	38,119	216	14,711.54	54.66	647.74	15,359.27	35,397	1,380	12,867.43	328.92	2,142.31	15,009.74	44,061	531	16,299.18	128.79	1,065.74	17,364.92	52,707	259	18,906.70	60.92	643.50	19,550.21	53,441	200	19,769.06	48.51	555.84	20,324.90
2016/17	35,051	1,354	12,189.79	324.15	2,436.85	14,626.63	56,702	710	19,805.90	170.72	1,627.09	21,432.99	38,119	216	13,721.90	53.52	701.26	14,423.16	35,397	1,190	11,986.16	277.39	2,419.70	14,405.86	44,061	531	15,256.01	126.56	1,192.30	16,448.31	52,707	259	17,606.51	59.56	703.06	18,309.57	53,441	200	18,422.30	47.46	603.30	19,025.60
2017/18	35,051	1,354	12,189.79	324.15	2,761.00	14,950.78	56,702	710	19,805.90	170.72	1,797.81	21,603.71	38,119	216	13,721.90	53.52	754.79	14,476.69	35,397	1,110	11,986.16	258.74	2,678.44	14,664.60	44,061	531	15,256.01	126.56	1,318.86	16,574.88	52,707	259	17,606.51	59.56	762.62	18,369.13	53,441	200	18,422.30	47.46	650.76	19,073.06
2018/19	35,051	1,354	12,189.79	324.15	3,085.14	15,274.93	56,702	710	19,805.90	170.72	1,968.53	21,774.43	38,119	216	13,721.90	53.52	808.31	14,530.21	35,397	1,110	11,986.16	258.74	2,937.18	14,923.34	44,061	531	15,256.01	126.56	1,445.43	16,701.44	52,707	259	17,606.51	59.56	822.18	18,428.68	53,441	200	18,422.30	47.46	698.22	19,120.52
2019/20	35,051	1,354	12,189.79	324.15	3,409.29	15,599.08	56,702	710	19,805.90	170.72	2,139.25	21,945.15	38,119	216	13,721.90	53.52	861.84	14,583.74	35,397	1,110	11,986.16	258.74	3,195.92	15,182.09	44,061	531	15,256.01	126.56	1,571.99	16,828.00	52,707	259	17,606.51	59.56	881.73	18,488.24	53,441	200	18,422.30	47.46	745.68	19,167.98
2020/21	35,051	1,354	12,189.79	324.15	3,733.44	15,923.22	56,702	710	19,805.90	170.72	2,309.97	22,115.87	38,119	216	13,721.90	53.52	915.36	14,637.26	35,397	1,110	11,986.16	258.74	3,454.66	15,440.83	44,061	531	15,256.01	126.56	1,698.55	16,954.57	52,707	259	17,606.51	59.56	941.29	18,547.80	53,441	200	18,422.30	47.46	793.14	19,215.44
2021/22	35,051	800	11,903.66	189.84	3,923.28	15,826.94	56,702	600	19,256.55	142.38	2,452.35	21,708.89	38,119	280	13,403.83	68.80	984.16	14,387.99	35,397	960	11,648.83	220.75	3,675.41	15,324.24	44,061	500	14,897.33	118.13	1,816.68	16,714.01	52,707	310	17,028.58	69.98	1,011.27	18,039.85	53,441	175	17,908.16	40.98	834.11	18,742.28
2022/23	35,051	800	11,903.66	189.84	4,113.12	16,016.78	56,702	600	19,256.55	142.38	2,594.73	21,851.27	38,119	280	13,403.83	68.80	1,052.95	14,456.79	35,397	960	11,648.83	220.75	3,896.17	15,544.99	44,061	500	14,897.33	118.13	1,934.80	16,832.14	52,707	310	17,028.58	69.98	1,081.25	18,109.83	53,441	175	17,908.16	40.98	875.09	18,783.26
2023/24	35,051	800	11,903.66	189.84	4,302.96	16,206.62	56,702	600	19,256.55	142.38	2,737.11	21,993.65	38,119	280	13,403.83	68.80	1,121.75	14,525.58	35,397	960	11,648.83	220.75	4,116.92	15,765.74	44,061	500	14,897.33	118.13	2,052.93	16,950.26	52,707	310	17,028.58	69.98	1,151.24	18,179.81	53,441	175	17,908.16	40.98	916.07	18,824.23
2024/25	35,051	800	11,903.66	189.84	4,492.80	16,396.46	56,702	600	19,256.55	142.38	2,879.49	22,136.03	38,119	280	13,403.83	68.80	1,190.54	14,594.38	35,397	960	11,648.83	220.75	4,337.67	15,986.50	44,061	500	14,897.33	118.13	2,171.05	17,068.39	52,707	310	17,028.58	69.98	1,221.22	18,249.80	53,441	175	17,908.16	40.98	957.04	18,865.21
2025/26	35,051	800	11,903.66	189.84	4,682.64	16,586.30	56,702	600	19,256.55	142.38	3,021.87	22,278.41	38,119	280	13,403.83	68.80	1,259.34	14,663.17	35,397	960	11,648.83	220.75	4,558.42	16,207.25	44,061	500	14,897.33	118.13	2,289.18	17,186.51	52,707	310	17,028.58	69.98	1,291.20	18,319.78	53,441	175	17,908.16	40.98	998.02	18,906.18
2026/27	35,051	800	11,717.34	187.32	4,869.96	16,587.30	56,702	600	18,955.14	140.49	3,162.36	22,117.50	38,119	280	13,257.24	68.21	1,327.55	14,584.79	35,397	960	11,514.63	218.74	4,777.16	16,291.79	44,061	500	14,729.33	117.08	2,406.25	17,135.58	52,707	310	16,750.51	69.01	1,360.21	18,110.71	53,441	175	17,544.56	40.24	1,038.26	18,582.82
2027/28	35,051	800	11,717.34	187.32	5,057.28	16,774.62	56,702	600	18,955.14	140.49	3,302.85	22,257.99	38,119	280	13,257.24	68.21	1,395.76	14,653.00	35,397	960	11,514.63	218.74	4,995.89	16,510.52	44,061	500	14,729.33	117.08	2,523.33	17,252.66	52,707	310	16,750.51	69.01	1,429.21	18,179.72	53,441	175	17,544.56	40.24	1,078.50	18,623.06
2028/29	35,051	800	11,717.34	187.32	5,244.60	16,961.94	56,702	600	18,955.14	140.49	3,443.34	22,398.48	38,119	280	13,257.24	68.21	1,463.96	14,721.21	35,397	960	11,514.63	218.74	5,214.63	16,729.26	44,061	500	14,729.33	117.08	2,640.40	17,369.73	52,707	310	16,750.51	69.01	1,498.22	18,248.73	53,441	175	17,544.56	40.24	1,118.74	18,663.30
2029/30	35,051	800	11,717.34	187.32	5,431.92	17,149.26	56,702	600	18,955.14	140.49	3,583.83	22,538.97	38,119	280	13,257.24	68.21	1,532.17	14,789.42	35,397	960	11,514.63	218.74	5,433.37	16,947.99	44,061	500	14,729.33	117.08	2,757.48	17,486.81	52,707	310	16,750.51	69.01	1,567.23	18,317.73	53,441	175	17,544.56	40.24	1,158.98	18,703.54
2030/31	35,051	800	11,717.34	187.32	5,619.24	17,336.58	56,702	600	18,955.14	140.49	3,724.32	22,679.46	38,119	280	13,257.24	68.21	1,600.38	14,857.63	35,397	960	11,514.63	218.74	5,652.10	17,166.73	44,061	500	14,729.33	117.08	2,874.55	17,603.88	52,707	310	16,750.51	69.01	1,636.23	18,386.74	53,441	175	17,544.56	40.24	1,199.23	18,743.79

2031 Change in demand of existing	2031 Total Increase from new	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-1,866.85	5,619.24	3,752.38

2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-3,206.24	3,724.32	518.08

2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand Increasy
m3/day	m3/day	m3/day
-2,016.76	1,600.38	-416.38

2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-2,029.27	5,652.10	3,622.83

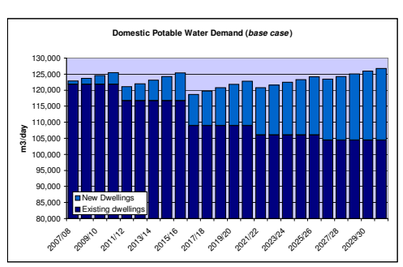
2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-2,202.02	2,874.55	672.53

2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-3,070.48	1,636.23	-1,434.25

2031 Change in demand of	2031 Total Increase from	06/07 to 2031 total demand Increasy
m3/day	m3/day	m3/day
-2,991.25	1,199.23	-1,792.03

	Rye Meads Catchment Total					
	06/07 Existing Dwellings	Yearly Dwelling	Demand from 06/07 dwellings	Annual demand increase from	Cum. Increase from new	Total Domestic
			m3/day	m3/day	m3/day	m3/day
2007/08	315,478	3,527	121,852	1,037	1,037	122,889
2008/09	315,478	2,595	121,852	763	1,801	123,652
2009/10	315,478	3,089	121,852	910	2,710	124,562
2010/11	315,478	3,019	121,852	887	3,597	125,449
2011/12	315,478	3,073	116,733	745	4,342	121,075
2012/13	315,478	3,871	116,733	939	5,280	122,014
2013/14	315,478	4,519	116,733	1,093	6,374	123,107
2014/15	315,478	4,650	116,733	1,125	7,499	124,232
2015/16	315,478	4,650	116,733	1,125	8,624	125,357
2016/17	315,478	4,460	108,989	1,059	9,684	118,672
2017/18	315,478	4,380	108,989	1,041	10,724	119,713
2018/19	315,478	4,380	108,989	1,041	11,765	120,754
2019/20	315,478	4,380	108,989	1,041	12,806	121,794
2020/21	315,478	4,380	108,989	1,041	13,846	122,835
2021/22	315,478	3,625	106,047	851	14,697	120,744
2022/23	315,478	3,625	106,047	851	15,548	121,595
2023/24	315,478	3,625	106,047	851	16,399	122,446
2024/25	315,478	3,625	106,047	851	17,250	123,297
2025/26	315,478	3,625	106,047	851	18,101	124,148
2026/27	315,478	3,625	104,469	841	18,942	123,410
2027/28	315,478	3,625	104,469	841	19,783	124,252
2028/29	315,478	3,625	104,469	841	20,624	125,093
2029/30	315,478	3,625	104,469	841	21,465	125,934
2030/31	315,478	3,625	104,469	841	22,306	126,775

2031 Change in demand of existing	2031 Total Increase from new	06/07 to 2031 total demand
m3/day	m3/day	m3/day
-17,382.88	22,306.05	4,923.17



Sewage Variables

Best Case

New Dwelling PCC		
	l/p/day	
to 2011	125	(1)
to 2016	105	(2)
to 2021	80	
to 2026	80	
to 2031	80	

Existing Dwelling PCC		
	l/p/day	
to 2011	156	(3)
to 2016	152	
to 2021	145	
to 2026	138	
to 2031	130	(4)

Occupancy Rate*							
(5)	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.32	2.33	2.41	2.27	2.31	2.24	2.31
to 2021	2.28	2.29	2.36	2.22	2.27	2.19	2.26
to 2026	2.26	2.26	2.34	2.19	2.25	2.15	2.23
to 2031	2.23	2.23	2.32	2.17	2.23	2.12	2.19

Infiltration	
Percentage of PG	30
Decimal	0.3

Worst Case

New Dwelling PCC		
	l/p/day	
to 2011	125	(7)
to 2016	125	
to 2021	125	
to 2026	125	
to 2031	125	

Existing Dwelling PCC		
	l/p/day	
to 2011	157.358	(8)
to 2016	157.358	
to 2021	157.358	
to 2026	157.358	
to 2031	157.358	

assumes constant 2007 rate

Occupancy Rate*							
(6)	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2021	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2026	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2031	2.36	2.38	2.44	2.33	2.34	2.29	2.34

*based on 2006 rate remaining constant

Infiltration	
Percentage of PG	30
Decimal	0.3

Base Case

New Dwelling PCC		
	l/p/day	
to 2011	125	(1)
to 2016	105	(10)
to 2021	105	
to 2026	105	
to 2031	105	

Existing Dwelling PCC		
	l/p/day	
to 2011	156	(9)
to 2016	152	
to 2021	145	
to 2026	143	
to 2031	142	

Occupancy Rate*							
(5)	Harlow	East Herts.	Broxbourne	Stevenage	Welwyn Hatfield	North Herts.	Epping Forest
to 2011	2.36	2.38	2.44	2.33	2.34	2.29	2.34
to 2016	2.32	2.33	2.41	2.27	2.31	2.24	2.31
to 2021	2.28	2.29	2.36	2.22	2.27	2.19	2.26
to 2026	2.26	2.26	2.34	2.19	2.25	2.15	2.23
to 2031	2.23	2.23	2.32	2.17	2.23	2.12	2.19

Infiltration	
Percentage of PG	30
Decimal	0.3

(1) Assumes new homes built in accordance with forthcoming changes to building regs
http://www.defra.gov.uk/environment/water/conserve/what.htm#progress
(2) Assumes all new homes reaching CSH targets 3/4 and 5/6 by 2011 and 2016
(3) Based on average 95% PCC predicted by TVW for Northern WRZ for 2007-2011, and 2011-2016
(4) Aspirational target for all houses from Future Water
(5) Based on ODPM 2002 based interim household projections of average household size 2001 - 2021, APU, and extrapolated to 2031
(6) Based on 2006 rate remaining constant, ODPM 2002 based interim household projections of average household size 2001 - 2021, APU
(7) Assumes CSH water efficiency targets not enforced, but building reg changes go ahead
(8) Assumes no drop in average PCC due to meter penetration, PCC stays at 95% of 2007 Northern WRZ level
(9) Based on 95% of TVW NWRZ PCC for every 5 year block
(10) Assumes new dwellings built to CHS Level 3/4 but not Level 5/6

Best Case

Type East Herts Option:	e2
E1	Least
E2	Most

Choose Stevenage Option	sx
	s1
	s2
	s3
	sx

Choose Welwyn Option	w1
W1	Most
W2	Least

	Harlow						East Herts.					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*			*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	35,051	419	16,775.69	160.69	160.69	16,936.38	35,123	419	16,952.61	162.06	162.06	17,114.67
2008/09	35,051	465	16,775.69	178.33	339.01	17,114.70	35,123	235	16,952.61	90.78	252.84	17,205.45
2009/10	35,051	621	16,775.69	238.15	577.17	17,352.86	35,123	208	16,952.61	80.38	333.22	17,285.83
2010/11	35,051	679	16,775.69	260.40	837.56	17,613.25	35,123	87	16,952.61	33.60	366.82	17,319.43
2011/12	35,051	612	16,068.50	193.81	1,031.37	17,099.87	35,123	341	16,170.91	108.39	475.21	16,646.12
2012/13	35,051	1,354	16,068.50	428.78	1,460.16	17,528.66	35,123	341	16,170.91	108.39	583.60	16,754.51
2013/14	35,051	1,354	16,068.50	428.78	1,888.94	17,957.44	35,123	341	16,170.91	108.39	691.99	16,862.90
2014/15	35,051	1,354	16,068.50	428.78	2,317.73	18,386.23	35,123	341	16,170.91	108.39	800.38	16,971.29
2015/16	35,051	1,354	16,068.50	428.78	2,746.51	18,815.01	35,123	341	16,170.91	108.39	908.77	17,079.68
2016/17	35,051	1,354	15,064.22	321.06	3,067.57	18,131.79	35,123	341	15,161.37	81.16	989.94	16,151.31
2017/18	35,051	1,354	15,064.22	321.06	3,388.63	18,452.85	35,123	341	15,161.37	81.16	1,071.10	16,232.47
2018/19	35,051	1,354	15,064.22	321.06	3,709.69	18,773.91	35,123	341	15,161.37	81.16	1,152.27	16,313.64
2019/20	35,051	1,354	15,064.22	321.06	4,030.75	19,094.97	35,123	341	15,161.37	81.16	1,233.43	16,394.80
2020/21	35,051	1,354	15,064.22	321.06	4,351.81	19,416.03	35,123	341	15,161.37	81.16	1,314.60	16,475.97
2021/22	35,051	800	14,211.22	188.03	4,539.85	18,751.06	35,123	288	14,240.41	67.69	1,382.29	15,622.70
2022/23	35,051	800	14,211.22	188.03	4,727.88	18,939.10	35,123	288	14,240.41	67.69	1,449.98	15,690.39
2023/24	35,051	800	14,211.22	188.03	4,915.91	19,127.13	35,123	288	14,240.41	67.69	1,517.67	15,758.08
2024/25	35,051	800	14,211.22	188.03	5,103.94	19,315.16	35,123	288	14,240.41	67.69	1,585.36	15,825.77
2025/26	35,051	800	14,211.22	188.03	5,291.97	19,503.19	35,123	288	14,240.41	67.69	1,653.06	15,893.47
2026/27	35,051	800	13,209.67	185.54	5,477.51	18,687.18	35,123	288	13,236.81	66.79	1,719.85	14,956.65
2027/28	35,051	800	13,209.67	185.54	5,663.05	18,872.72	35,123	288	13,236.81	66.79	1,786.64	15,023.45
2028/29	35,051	800	13,209.67	185.54	5,848.58	19,058.25	35,123	288	13,236.81	66.79	1,853.43	15,090.24
2029/30	35,051	800	13,209.67	185.54	6,034.12	19,243.79	35,123	288	13,236.81	66.79	1,920.23	15,157.03
2030/31	35,051	800	13,209.67	185.54	6,219.65	19,429.32	35,123	288	13,236.81	66.79	1,987.02	15,223.83

	Broxbourne						Stevenage					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*			*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	14,910	148	7,377.95	58.68	58.68	7,436.63	35,397	692	16,725.93	262.01	262.01	16,987.94
2008/09	14,910	118	7,377.95	46.59	105.27	7,483.22	35,397	543	16,725.93	205.59	467.60	17,193.53
2009/10	14,910	195	7,377.95	77.12	182.39	7,560.34	35,397	581	16,725.93	219.98	687.58	17,413.52
2010/11	14,910	156	7,377.95	61.66	244.05	7,621.99	35,397	685	16,725.93	259.36	946.94	17,672.87
2011/12	14,910	106	7,100.38	34.87	278.92	7,379.30	35,397	722	15,877.40	223.72	1,170.66	17,048.05
2012/13	14,910	108	7,100.38	35.53	314.44	7,414.82	35,397	970	15,877.40	300.56	1,471.22	17,348.61
2013/14	14,910	108	7,100.38	35.53	349.97	7,450.35	35,397	1,480	15,877.40	458.59	1,929.80	17,807.20
2014/15	14,910	108	7,100.38	35.53	385.50	7,485.88	35,397	1,380	15,877.40	427.60	2,357.40	18,234.80
2015/16	14,910	108	7,100.38	35.53	421.03	7,521.41	35,397	1,380	15,877.40	427.60	2,785.00	18,662.40
2016/17	14,910	108	6,632.86	26.51	447.54	7,080.40	35,397	1,190	14,812.58	274.75	3,059.75	17,872.33
2017/18	14,910	108	6,632.86	26.51	474.04	7,106.91	35,397	1,110	14,812.58	256.28	3,316.02	18,128.61
2018/19	14,910	108	6,632.86	26.51	500.55	7,133.41	35,397	1,110	14,812.58	256.28	3,572.30	18,384.88
2019/20	14,910	108	6,632.86	26.51	527.06	7,159.92	35,397	1,110	14,812.58	256.28	3,828.58	18,641.16
2020/21	14,910	108	6,632.86	26.51	553.57	7,186.43	35,397	1,110	14,812.58	256.28	4,084.86	18,897.44
2021/22	14,910	140	6,259.16	34.07	587.64	6,846.80	35,397	960	13,906.99	218.65	4,303.50	18,210.49
2022/23	14,910	140	6,259.16	34.07	621.71	6,880.87	35,397	960	13,906.99	218.65	4,522.15	18,429.14
2023/24	14,910	140	6,259.16	34.07	655.78	6,914.94	35,397	960	13,906.99	218.65	4,740.80	18,647.79
2024/25	14,910	140	6,259.16	34.07	689.85	6,949.01	35,397	960	13,906.99	218.65	4,959.45	18,866.44
2025/26	14,910	140	6,259.16	34.07	723.92	6,983.08	35,397	960	13,906.99	218.65	5,178.10	19,085.09
2026/27	14,910	140	5,845.91	33.78	757.70	6,603.61	35,397	960	12,981.14	216.65	5,394.76	18,375.90
2027/28	14,910	140	5,845.91	33.78	791.48	6,637.39	35,397	960	12,981.14	216.65	5,611.41	18,592.55
2028/29	14,910	140	5,845.91	33.78	825.26	6,671.17	35,397	960	12,981.14	216.65	5,828.06	18,809.20
2029/30	14,910	140	5,845.91	33.78	859.04	6,704.95	35,397	960	12,981.14	216.65	6,044.71	19,025.86
2030/31	14,910	140	5,845.91	33.78	892.81	6,738.73	35,397	960	12,981.14	216.65	6,261.37	19,242.51

	Welwyn Hatfield						North Herts.		Epping Forest	
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	DWF from 06/07 dwellings	06/07 Existing Dwellings	DWF from 06/07 dwellings
			m3/day	*m3/day*	*m3/day*	*m3/day*		*m3/day*		*m3/day*
2007/08	24,985	586	11,856.68	222.67	222.67	12,079.36	4,406	2,046.20	3,346	1,587.85
2008/09	24,985	368	11,856.68	139.93	362.61	12,219.29	4,406	2,046.20	3,346	1,587.85
2009/10	24,985	298	11,856.68	113.16	475.77	12,332.45	4,406	2,046.20	3,346	1,587.85
2010/11	24,985	430	11,856.68	163.66	639.43	12,496.11	4,406	2,046.20	3,346	1,587.85
2011/12	24,985	226	11,404.55	71.39	710.82	12,115.37	4,406	1,950.20	3,346	1,527.30
2012/13	24,985	171	11,404.55	53.98	764.80	12,169.35	4,406	1,950.20	3,346	1,527.30
2013/14	24,985	240	11,404.55	75.68	840.47	12,245.03	4,406	1,950.20	3,346	1,527.30
2014/15	24,985	425	11,404.55	133.95	974.42	12,378.97	4,406	1,950.20	3,346	1,527.30
2015/16	24,985	425	11,404.55	133.95	1,108.36	12,512.92	4,406	1,950.20	3,346	1,527.30
2016/17	24,985	425	10,690.96	100.29	1,208.65	11,899.61	4,406	1,818.86	3,346	1,425.43
2017/18	24,985	425	10,690.96	100.29	1,308.94	11,999.90	4,406	1,818.86	3,346	1,425.43
2018/19	24,985	425	10,690.96	100.29	1,409.23	12,100.18	4,406	1,818.86	3,346	1,425.43
2019/20	24,985	425	10,690.96	100.29	1,509.51	12,200.47	4,406	1,818.86	3,346	1,425.43
2020/21	24,985	425	10,690.96	100.29	1,609.80	12,300.76	4,406	1,818.86	3,346	1,425.43
2021/22	24,985	400	10,085.20	93.60	1,703.40	11,788.59	4,406	1,699.44	3,346	1,338.61
2022/23	24,985	400	10,085.20	93.60	1,797.00	11,882.19	4,406	1,699.44	3,346	1,338.61
2023/24	24,985	400	10,085.20	93.60	1,890.60	11,975.79	4,406	1,699.44	3,346	1,338.61
2024/25	24,985	400	10,085.20	93.60	1,984.20	12,069.39	4,406	1,699.44	3,346	1,338.61
2025/26	24,985	400	10,085.20	93.60	2,077.80	12,162.99	4,406	1,699.44	3,346	1,338.61
2026/27	24,985	400	9,416.10	92.77	2,170.57	11,586.66	4,406	1,578.58	3,346	1,238.39
2027/28	24,985	400	9,416.10	92.77	2,263.33	11,679.43	4,406	1,578.58	3,346	1,238.39
2028/29	24,985	400	9,416.10	92.77	2,356.10	11,772.20	4,406	1,578.58	3,346	1,238.39
2029/30	24,985	400	9,416.10	92.77	2,448.87	11,864.97	4,406	1,578.58	3,346	1,238.39
2030/31	24,985	400	9,416.10	92.77	2,541.64	11,957.74	4,406	1,578.58	3,346	1,238.39

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-3,566.02	6,219.65	2,653.63

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-3,715.80	1,987.02	-1,728.78

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-1,532.03	892.81	-639.22

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-3,744.79	6,261.37	2,516.58

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-2,440.58	2,541.64	101.05

2031 Change in DWF of existing dwellings
m3/day
-467.62

2031 Change in DWF of existing dwellings
m3/day
-349.46

	Rye Meads Catchment Total							
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total Domestic DWF	Trade Flow*	Total DWF (including trade)
			m3/day	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	153,218	2,264	73,323	866	866	74,189	5,861	80,050
2008/09	153,218	1,728	73,323	661	1,527	74,850	5,861	80,711
2009/10	153,218	1,902	73,323	729	2,256	75,579	5,861	81,440
2010/11	153,218	2,037	73,323	779	3,035	76,358	5,861	82,218
2011/12	153,218	2,007	70,099	632	3,667	73,766	5,861	79,627
2012/13	153,218	2,944	70,099	927	4,594	74,693	5,861	80,554
2013/14	153,218	3,523	70,099	1,107	5,701	75,800	5,861	81,661
2014/15	153,218	3,608	70,099	1,134	6,835	76,935	5,861	82,795
2015/16	153,218	3,608	70,099	1,134	7,970	78,069	5,861	83,929
2016/17	153,218	3,418	65,606	804	8,773	74,380	5,861	80,240
2017/18	153,218	3,338	65,606	785	9,559	75,165	5,861	81,026
2018/19	153,218	3,338	65,606	785	10,344	75,950	5,861	81,811
2019/20	153,218	3,338	65,606	785	11,129	76,736	5,861	82,596
2020/21	153,218	3,338	65,606	785	11,915	77,521	5,861	83,381
2021/22	153,218	2,588	61,741	602	12,517	74,258	5,861	80,118
2022/23	153,218	2,588	61,741	602	13,119	74,860	5,861	80,720
2023/24	153,218	2,588	61,741	602	13,721	75,462	5,861	81,322
2024/25	153,218	2,588	61,741	602	14,323	76,064	5,861	81,924
2025/26	153,218	2,588	61,741	602	14,925	76,666	5,861	82,526
2026/27	153,218	2,588	57,507	596	15,520	73,027	5,861	78,888
2027/28	153,218	2,588	57,507	596	16,116	73,623	5,861	79,483
2028/29	153,218	2,588	57,507	596	16,711	74,218	5,861	80,079
2029/30	153,218	2,588	57,507	596	17,307	74,814	5,861	80,674
2030/31	153,218	2,588	57,507	596	17,902	75,409	5,861	81,270

**TWU report annual trade flow*
at Rye Meads of:
1,775,751 m3/year
Divide by 303 to exclude Sundays
5,861 m3/day

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-15,816.31	17,902.49	2,086.19

2021 Change in DWF of existing dwellings	2021 Total Increase from new dwellings	06/07 to 2021 total DWF Increase
m3/day	m3/day	m3/day
-7,716.62	11,914.63	4,198.01

Worst Case

Type East Herts Option:	e2
E1	Least
E2	Most

Choose Stevenage Option	sx
	s1
	s2
	s3
	sx

Choose Welwyn Option	w1
W1	Most
W2	Least

	Harlow						East Herts.					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*			*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	35,051	419	16,921.72	160.69	160.69	17,082.41	35,123	419	17,100.18	162.06	162.06	17,262.25
2008/09	35,051	465	16,921.72	178.33	339.01	17,260.74	35,123	235	17,100.18	90.78	252.84	17,353.02
2009/10	35,051	621	16,921.72	238.15	577.17	17,498.89	35,123	208	17,100.18	80.38	333.22	17,433.41
2010/11	35,051	679	16,921.72	260.40	837.56	17,759.29	35,123	87	17,100.18	33.60	366.82	17,467.01
2011/12	35,051	612	16,921.72	234.70	1,072.27	17,993.99	35,123	341	17,100.18	131.80	498.63	17,598.81
2012/13	35,051	1,354	16,921.72	519.26	1,591.53	18,513.25	35,123	341	17,100.18	131.80	630.43	17,730.62
2013/14	35,051	1,354	16,921.72	519.26	2,110.78	19,032.51	35,123	341	17,100.18	131.80	762.24	17,862.42
2014/15	35,051	1,354	16,921.72	519.26	2,630.04	19,551.77	35,123	341	17,100.18	131.80	894.04	17,994.22
2015/16	35,051	1,354	16,921.72	519.26	3,149.30	20,071.03	35,123	341	17,100.18	131.80	1,025.85	18,126.03
2016/17	35,051	1,354	16,921.72	519.26	3,668.56	20,590.28	35,123	341	17,100.18	131.80	1,157.65	18,257.83
2017/18	35,051	1,354	16,921.72	519.26	4,187.82	21,109.54	35,123	341	17,100.18	131.80	1,289.46	18,389.64
2018/19	35,051	1,354	16,921.72	519.26	4,707.08	21,628.80	35,123	341	17,100.18	131.80	1,421.26	18,521.44
2019/20	35,051	1,354	16,921.72	519.26	5,226.34	22,148.06	35,123	341	17,100.18	131.80	1,553.06	18,653.25
2020/21	35,051	1,354	16,921.72	519.26	5,745.60	22,667.32	35,123	341	17,100.18	131.80	1,684.87	18,785.05
2021/22	35,051	800	16,921.72	306.80	6,052.40	22,974.12	35,123	288	17,100.18	111.38	1,796.25	18,896.43
2022/23	35,051	800	16,921.72	306.80	6,359.20	23,280.92	35,123	288	17,100.18	111.38	1,907.64	19,007.82
2023/24	35,051	800	16,921.72	306.80	6,666.00	23,587.72	35,123	288	17,100.18	111.38	2,019.02	19,119.20
2024/25	35,051	800	16,921.72	306.80	6,972.80	23,894.52	35,123	288	17,100.18	111.38	2,130.40	19,230.59
2025/26	35,051	800	16,921.72	306.80	7,279.60	24,201.32	35,123	288	17,100.18	111.38	2,241.79	19,341.97
2026/27	35,051	800	16,921.72	306.80	7,586.40	24,508.12	35,123	288	17,100.18	111.38	2,353.17	19,453.35
2027/28	35,051	800	16,921.72	306.80	7,893.20	24,814.92	35,123	288	17,100.18	111.38	2,464.56	19,564.74
2028/29	35,051	800	16,921.72	306.80	8,200.00	25,121.72	35,123	288	17,100.18	111.38	2,575.94	19,676.12
2029/30	35,051	800	16,921.72	306.80	8,506.80	25,428.52	35,123	288	17,100.18	111.38	2,687.32	19,787.51
2030/31	35,051	800	16,921.72	306.80	8,813.60	25,735.32	35,123	288	17,100.18	111.38	2,798.71	19,898.89

	Broxbourne						Stevenage					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*			*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	14,910	148	7,442.17	58.68	58.68	7,500.85	35,397	692	16,871.53	262.01	262.01	17,133.54
2008/09	14,910	118	7,442.17	46.59	105.27	7,547.44	35,397	543	16,871.53	205.59	467.60	17,339.14
2009/10	14,910	195	7,442.17	77.12	182.39	7,624.56	35,397	581	16,871.53	219.98	687.58	17,559.12
2010/11	14,910	156	7,442.17	61.66	244.05	7,686.22	35,397	685	16,871.53	259.36	946.94	17,818.47
2011/12	14,910	106	7,442.17	42.03	286.07	7,728.25	35,397	722	16,871.53	273.37	1,220.31	18,091.84
2012/13	14,910	108	7,442.17	42.82	328.90	7,771.07	35,397	970	16,871.53	367.27	1,587.57	18,459.11
2013/14	14,910	108	7,442.17	42.82	371.72	7,813.89	35,397	1,480	16,871.53	560.37	2,147.94	19,019.47
2014/15	14,910	108	7,442.17	42.82	414.54	7,856.71	35,397	1,380	16,871.53	522.50	2,670.44	19,541.98
2015/16	14,910	108	7,442.17	42.82	457.36	7,899.53	35,397	1,380	16,871.53	522.50	3,192.94	20,064.48
2016/17	14,910	108	7,442.17	42.82	500.18	7,942.36	35,397	1,190	16,871.53	450.56	3,643.51	20,515.04
2017/18	14,910	108	7,442.17	42.82	543.01	7,985.18	35,397	1,110	16,871.53	420.27	4,063.78	20,935.32
2018/19	14,910	108	7,442.17	42.82	585.83	8,028.00	35,397	1,110	16,871.53	420.27	4,484.06	21,355.59
2019/20	14,910	108	7,442.17	42.82	628.65	8,070.82	35,397	1,110	16,871.53	420.27	4,904.33	21,775.86
2020/21	14,910	108	7,442.17	42.82	671.47	8,113.64	35,397	1,110	16,871.53	420.27	5,324.60	22,196.14
2021/22	14,910	140	7,442.17	55.51	726.98	8,169.15	35,397	960	16,871.53	363.48	5,688.08	22,559.62
2022/23	14,910	140	7,442.17	55.51	782.49	8,224.66	35,397	960	16,871.53	363.48	6,051.56	22,923.10
2023/24	14,910	140	7,442.17	55.51	838.00	8,280.17	35,397	960	16,871.53	363.48	6,415.04	23,286.58
2024/25	14,910	140	7,442.17	55.51	893.51	8,335.68	35,397	960	16,871.53	363.48	6,778.52	23,650.06
2025/26	14,910	140	7,442.17	55.51	949.02	8,391.19	35,397	960	16,871.53	363.48	7,142.00	24,013.54
2026/27	14,910	140	7,442.17	55.51	1,004.53	8,446.70	35,397	960	16,871.53	363.48	7,505.48	24,377.02
2027/28	14,910	140	7,442.17	55.51	1,060.04	8,502.21	35,397	960	16,871.53	363.48	7,868.96	24,740.50
2028/29	14,910	140	7,442.17	55.51	1,115.55	8,557.72	35,397	960	16,871.53	363.48	8,232.44	25,103.98
2029/30	14,910	140	7,442.17	55.51	1,171.06	8,613.23	35,397	960	16,871.53	363.48	8,595.92	25,467.46
2030/31	14,910	140	7,442.17	55.51	1,226.57	8,668.74	35,397	960	16,871.53	363.48	8,959.40	25,830.94

	Welwyn Hatfield						North Herts.		Epping Forest	
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	DWF from 06/07 dwellings	06/07 Existing Dwellings	DWF from 06/07 dwellings
			m3/day	*m3/day*	*m3/day*	*m3/day*		*m3/day*		*m3/day*
2007/08	24,985	586	11,959.90	222.67	222.67	12,182.57	4,406	2,064.01	3,346	1,601.67
2008/09	24,985	368	11,959.90	139.93	362.61	12,322.50	4,406	2,064.01	3,346	1,601.67
2009/10	24,985	298	11,959.90	113.16	475.77	12,435.66	4,406	2,064.01	3,346	1,601.67
2010/11	24,985	430	11,959.90	163.66	639.43	12,599.32	4,406	2,064.01	3,346	1,601.67
2011/12	24,985	226	11,959.90	86.09	725.52	12,685.41	4,406	2,064.01	3,346	1,601.67
2012/13	24,985	171	11,959.90	65.10	790.62	12,750.51	4,406	2,064.01	3,346	1,601.67
2013/14	24,985	240	11,959.90	91.26	881.88	12,841.77	4,406	2,064.01	3,346	1,601.67
2014/15	24,985	425	11,959.90	161.53	1,043.41	13,003.30	4,406	2,064.01	3,346	1,601.67
2015/16	24,985	425	11,959.90	161.53	1,204.94	13,164.83	4,406	2,064.01	3,346	1,601.67
2016/17	24,985	425	11,959.90	161.53	1,366.47	13,326.36	4,406	2,064.01	3,346	1,601.67
2017/18	24,985	425	11,959.90	161.53	1,528.00	13,487.89	4,406	2,064.01	3,346	1,601.67
2018/19	24,985	425	11,959.90	161.53	1,689.53	13,649.42	4,406	2,064.01	3,346	1,601.67
2019/20	24,985	425	11,959.90	161.53	1,851.06	13,810.95	4,406	2,064.01	3,346	1,601.67
2020/21	24,985	425	11,959.90	161.53	2,012.59	13,972.48	4,406	2,064.01	3,346	1,601.67
2021/22	24,985	400	11,959.90	152.10	2,164.69	14,124.58	4,406	2,064.01	3,346	1,601.67
2022/23	24,985	400	11,959.90	152.10	2,316.79	14,276.68	4,406	2,064.01	3,346	1,601.67
2023/24	24,985	400	11,959.90	152.10	2,468.89	14,428.78	4,406	2,064.01	3,346	1,601.67
2024/25	24,985	400	11,959.90	152.10	2,620.99	14,580.88	4,406	2,064.01	3,346	1,601.67
2025/26	24,985	400	11,959.90	152.10	2,773.09	14,732.98	4,406	2,064.01	3,346	1,601.67
2026/27	24,985	400	11,959.90	152.10	2,925.19	14,885.08	4,406	2,064.01	3,346	1,601.67
2027/28	24,985	400	11,959.90	152.10	3,077.29	15,037.18	4,406	2,064.01	3,346	1,601.67
2028/29	24,985	400	11,959.90	152.10	3,229.39	15,189.28	4,406	2,064.01	3,346	1,601.67
2029/30	24,985	400	11,959.90	152.10	3,381.49	15,341.38	4,406	2,064.01	3,346	1,601.67
2030/31	24,985	400	11,959.90	152.10	3,533.59	15,493.48	4,406	2,064.01	3,346	1,601.67

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
0.00	8,813.60	8,813.60

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
0.00	2,798.71	2,798.71

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
0.00	1,226.57	1,226.57

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
0.00	8,959.40	8,959.40

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
0.00	3,533.59	3,533.59

2031 Change in DWF of existing dwellings
m3/day
0.00

2031 Change in DWF of existing dwellings
m3/day
0.00

	Rye Meads Catchment Total							
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total Domestic DWF	Trade Flow*	Total DWF (including trade)
			m3/day	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	153,218	2,264	73,961	866	866	74,827	5,861	80,688
2008/09	153,218	1,728	73,961	661	1,527	75,489	5,861	81,349
2009/10	153,218	1,902	73,961	729	2,256	76,217	5,861	82,078
2010/11	153,218	2,037	73,961	779	3,035	76,996	5,861	82,857
2011/12	153,218	2,007	73,961	768	3,803	77,764	5,861	83,625
2012/13	153,218	2,944	73,961	1,126	4,929	78,890	5,861	84,751
2013/14	153,218	3,523	73,961	1,346	6,275	80,236	5,861	86,096
2014/15	153,218	3,608	73,961	1,378	7,652	81,614	5,861	87,474
2015/16	153,218	3,608	73,961	1,378	9,030	82,992	5,861	88,852
2016/17	153,218	3,418	73,961	1,306	10,336	84,298	5,861	90,158
2017/18	153,218	3,338	73,961	1,276	11,612	85,573	5,861	91,434
2018/19	153,218	3,338	73,961	1,276	12,888	86,849	5,861	92,710
2019/20	153,218	3,338	73,961	1,276	14,163	88,125	5,861	93,985
2020/21	153,218	3,338	73,961	1,276	15,439	89,400	5,861	95,261
2021/22	153,218	2,588	73,961	989	16,428	90,390	5,861	96,250
2022/23	153,218	2,588	73,961	989	17,418	91,379	5,861	97,239
2023/24	153,218	2,588	73,961	989	18,407	92,368	5,861	98,229
2024/25	153,218	2,588	73,961	989	19,396	93,357	5,861	99,218
2025/26	153,218	2,588	73,961	989	20,385	94,347	5,861	100,207
2026/27	153,218	2,588	73,961	989	21,375	95,336	5,861	101,197
2027/28	153,218	2,588	73,961	989	22,364	96,325	5,861	102,186
2028/29	153,218	2,588	73,961	989	23,353	97,315	5,861	103,175
2029/30	153,218	2,588	73,961	989	24,343	98,304	5,861	104,164
2030/31	153,218	2,588	73,961	989	25,332	99,293	5,861	105,154

**TWU report annual trade flow*
at Rye Meads of:
1,775,751 m3/year
Divide by 303 to exclude Sundays
5,861 m3/day

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	2031 Total Increase from trade	06/07 to 2031 total DWF Increase	2021 Change in DWF of existing dwellings	2021 Total Increase from new dwellings	06/07 to 2021 total DWF Increase
m3/day	m3/day	m3/day	m3/day	m3/day	m3/day	m3/day
0.00	25,331.87	0.00	25,331.87	0.00	15,439.13	15,439.13

Base Case

Type East Herts Option:	e2
E1	Least
E2	Most

Choose Stevenage Option	sx
s1	
s2	
s3	
sx	

Choose Welwyn Option	w1
W1	Most
W2	Least

	Harlow					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*
2007/08	35,051	419	16,776.48	160.69	160.69	16,937.17
2008/09	35,051	465	16,776.48	178.33	339.01	17,115.49
2009/10	35,051	621	16,776.48	238.15	577.17	17,353.65
2010/11	35,051	679	16,776.48	260.40	837.56	17,614.04
2011/12	35,051	612	16,082.55	193.81	1,031.37	17,113.92
2012/13	35,051	1,354	16,082.55	428.78	1,460.16	17,542.71
2013/14	35,051	1,354	16,082.55	428.78	1,888.94	17,971.49
2014/15	35,051	1,354	16,082.55	428.78	2,317.73	18,400.27
2015/16	35,051	1,354	16,082.55	428.78	2,746.51	18,829.06
2016/17	35,051	1,354	15,054.39	421.39	3,167.90	18,222.29
2017/18	35,051	1,354	15,054.39	421.39	3,589.29	18,643.68
2018/19	35,051	1,354	15,054.39	421.39	4,010.69	19,065.07
2019/20	35,051	1,354	15,054.39	421.39	4,432.08	19,486.46
2020/21	35,051	1,354	15,054.39	421.39	4,853.47	19,907.86
2021/22	35,051	800	14,701.02	246.79	5,100.26	19,801.28
2022/23	35,051	800	14,701.02	246.79	5,347.05	20,048.07
2023/24	35,051	800	14,701.02	246.79	5,593.85	20,294.87
2024/25	35,051	800	14,701.02	246.79	5,840.64	20,541.66
2025/26	35,051	800	14,701.02	246.79	6,087.43	20,788.45
2026/27	35,051	800	14,470.92	243.52	6,330.95	20,801.86
2027/28	35,051	800	14,470.92	243.52	6,574.46	21,045.38
2028/29	35,051	800	14,470.92	243.52	6,817.98	21,288.89
2029/30	35,051	800	14,470.92	243.52	7,061.49	21,532.41
2030/31	35,051	800	14,470.92	243.52	7,305.01	21,775.93

	East Herts.					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*
2007/08	35,123	419	16,953.41	162.06	162.06	17,115.47
2008/09	35,123	235	16,953.41	90.78	252.84	17,206.25
2009/10	35,123	208	16,953.41	80.38	333.22	17,286.63
2010/11	35,123	87	16,953.41	33.60	366.82	17,320.23
2011/12	35,123	341	16,185.05	108.39	475.21	16,660.26
2012/13	35,123	341	16,185.05	108.39	583.60	16,768.65
2013/14	35,123	341	16,185.05	108.39	691.99	16,877.04
2014/15	35,123	341	16,185.05	108.39	800.38	16,985.43
2015/16	35,123	341	16,185.05	108.39	908.77	17,093.82
2016/17	35,123	341	15,151.47	106.53	1,015.30	16,166.78
2017/18	35,123	341	15,151.47	106.53	1,121.83	16,273.30
2018/19	35,123	341	15,151.47	106.53	1,228.36	16,379.83
2019/20	35,123	341	15,151.47	106.53	1,334.89	16,486.36
2020/21	35,123	341	15,151.47	106.53	1,441.42	16,592.89
2021/22	35,123	288	14,731.22	88.85	1,530.26	16,261.48
2022/23	35,123	288	14,731.22	88.85	1,619.11	16,350.33
2023/24	35,123	288	14,731.22	88.85	1,707.95	16,439.17
2024/25	35,123	288	14,731.22	88.85	1,796.80	16,528.02
2025/26	35,123	288	14,731.22	88.85	1,885.64	16,616.86
2026/27	35,123	288	14,500.64	87.67	1,973.31	16,473.95
2027/28	35,123	288	14,500.64	87.67	2,060.98	16,561.62
2028/29	35,123	288	14,500.64	87.67	2,148.64	16,649.28
2029/30	35,123	288	14,500.64	87.67	2,236.31	16,736.95
2030/31	35,123	288	14,500.64	87.67	2,323.97	16,824.61

	Broxbourne					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*
2007/08	14,910	148	7,378.29	58.68	58.68	7,436.98
2008/09	14,910	118	7,378.29	46.59	105.27	7,483.56
2009/10	14,910	195	7,378.29	77.12	182.39	7,560.68
2010/11	14,910	156	7,378.29	61.66	244.05	7,622.34
2011/12	14,910	106	7,106.59	34.87	278.92	7,385.50
2012/13	14,910	108	7,106.59	35.53	314.44	7,421.03
2013/14	14,910	108	7,106.59	35.53	349.97	7,456.56
2014/15	14,910	108	7,106.59	35.53	385.50	7,492.09
2015/16	14,910	108	7,106.59	35.53	421.03	7,527.62
2016/17	14,910	108	6,628.53	34.79	455.82	7,084.35
2017/18	14,910	108	6,628.53	34.79	490.61	7,119.14
2018/19	14,910	108	6,628.53	34.79	525.40	7,153.94
2019/20	14,910	108	6,628.53	34.79	560.19	7,188.73
2020/21	14,910	108	6,628.53	34.79	594.98	7,223.52
2021/22	14,910	140	6,474.89	44.72	639.70	7,114.59
2022/23	14,910	140	6,474.89	44.72	684.42	7,159.30
2023/24	14,910	140	6,474.89	44.72	729.14	7,204.02
2024/25	14,910	140	6,474.89	44.72	773.85	7,248.74
2025/26	14,910	140	6,474.89	44.72	818.57	7,293.46
2026/27	14,910	140	6,404.07	44.34	862.91	7,266.98
2027/28	14,910	140	6,404.07	44.34	907.24	7,311.32
2028/29	14,910	140	6,404.07	44.34	951.58	7,355.65
2029/30	14,910	140	6,404.07	44.34	995.91	7,399.99
2030/31	14,910	140	6,404.07	44.34	1,040.25	7,444.32

	Stevenage					
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF
			m3/day	*m3/day*	*m3/day*	*m3/day*
2007/08	35,397	692	16,726.72	262.01	262.01	16,988.73
2008/09	35,397	543	16,726.72	205.59	467.60	17,194.32
2009/10	35,397	581	16,726.72	219.98	687.58	17,414.30
2010/11	35,397	685	16,726.72	259.36	946.94	17,673.66
2011/12	35,397	722	15,891.28	223.72	1,170.66	17,061.93
2012/13	35,397	970	15,891.28	300.56	1,471.22	17,362.49
2013/14	35,397	1,480	15,891.28	458.59	1,929.80	17,821.08
2014/15	35,397	1,380	15,891.28	427.60	2,357.40	18,248.68
2015/16	35,397	1,380	15,891.28	427.60	2,785.00	18,676.28
2016/17	35,397	1,190	14,802.91	360.61	3,145.61	17,948.52
2017/18	35,397	1,110	14,802.91	336.36	3,481.97	18,284.88
2018/19	35,397	1,110	14,802.91	336.36	3,818.33	18,621.25
2019/20	35,397	1,110	14,802.91	336.36	4,154.70	18,957.61
2020/21	35,397	1,110	14,802.91	336.36	4,491.06	19,293.97
2021/22	35,397	960	14,386.30	286.98	4,778.04	19,164.34
2022/23	35,397	960	14,386.30	286.98	5,065.02	19,451.32
2023/24	35,397	960	14,386.30	286.98	5,351.99	19,738.29
2024/25	35,397	960	14,386.30	286.98	5,638.97	20,025.27
2025/26	35,397	960	14,386.30	286.98	5,925.95	20,312.25
2026/27	35,397	960	14,220.57	284.36	6,210.30	20,430.87
2027/28	35,397	960	14,220.57	284.36	6,494.66	20,715.23
2028/29	35,397	960	14,220.57	284.36	6,779.02	20,999.59
2029/30	35,397	960	14,220.57	284.36	7,063.38	21,283.94
2030/31	35,397	960	14,220.57	284.36	7,347.73	21,568.30

	Welwyn Hatfield						North Herts.		Epping Forest	
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total DWF	06/07 Existing Dwellings	DWF from 06/07 dwellings	06/07 Existing Dwellings	DWF from 06/07 dwellings
			m3/day	*m3/day*	*m3/day*	*m3/day*		*m3/day*		*m3/day*
2007/08	24,985	586	11,857.24	222.67	222.67	12,079.92	4,406	2,046.30	3,346	1,587.93
2008/09	24,985	368	11,857.24	139.93	362.61	12,219.85	4,406	2,046.30	3,346	1,587.93
2009/10	24,985	298	11,857.24	113.16	475.77	12,333.01	4,406	2,046.30	3,346	1,587.93
2010/11	24,985	430	11,857.24	163.66	639.43	12,496.67	4,406	2,046.30	3,346	1,587.93
2011/12	24,985	226	11,414.52	71.39	710.82	12,125.34	4,406	1,951.91	3,346	1,528.64
2012/13	24,985	171	11,414.52	53.98	764.80	12,179.32	4,406	1,951.91	3,346	1,528.64
2013/14	24,985	240	11,414.52	75.68	840.47	12,255.00	4,406	1,951.91	3,346	1,528.64
2014/15	24,985	425	11,414.52	133.95	974.42	12,388.94	4,406	1,951.91	3,346	1,528.64
2015/16	24,985	425	11,414.52	133.95	1,108.36	12,522.89	4,406	1,951.91	3,346	1,528.64
2016/17	24,985	425	10,683.98	131.63	1,239.99	11,923.97	4,406	1,817.68	3,346	1,424.50
2017/18	24,985	425	10,683.98	131.63	1,371.62	12,055.60	4,406	1,817.68	3,346	1,424.50
2018/19	24,985	425	10,683.98	131.63	1,503.24	12,187.22	4,406	1,817.68	3,346	1,424.50
2019/20	24,985	425	10,683.98	131.63	1,634.87	12,318.85	4,406	1,817.68	3,346	1,424.50
2020/21	24,985	425	10,683.98	131.63	1,766.50	12,450.47	4,406	1,817.68	3,346	1,424.50
2021/22	24,985	400	10,432.79	122.85	1,889.35	12,322.14	4,406	1,758.01	3,346	1,384.74
2022/23	24,985	400	10,432.79	122.85	2,012.20	12,444.99	4,406	1,758.01	3,346	1,384.74
2023/24	24,985	400	10,432.79	122.85	2,135.05	12,567.84	4,406	1,758.01	3,346	1,384.74
2024/25	24,985	400	10,432.79	122.85	2,257.90	12,690.69	4,406	1,758.01	3,346	1,384.74
2025/26	24,985	400	10,432.79	122.85	2,380.75	12,813.54	4,406	1,758.01	3,346	1,384.74
2026/27	24,985	400	10,315.14	121.76	2,502.50	12,817.64	4,406	1,729.30	3,346	1,356.63
2027/28	24,985	400	10,315.14	121.76	2,624.26	12,939.40	4,406	1,729.30	3,346	1,356.63
2028/29	24,985	400	10,315.14	121.76	2,746.02	13,061.16	4,406	1,729.30	3,346	1,356.63
2029/30	24,985	400	10,315.14	121.76	2,867.78	13,182.91	4,406	1,729.30	3,346	1,356.63
2030/31	24,985	400	10,315.14	121.76	2,989.54	13,304.67	4,406	1,729.30	3,346	1,356.63

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-2,305.56	7,305.01	4,999.45

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-2,452.77	2,323.97	-128.79

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-974.22	1,040.25	66.03

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-2,506.15	7,347.73	4,841.58

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-1,542.11	2,989.54	1,447.43

2031 Change in DWF of existing dwellings
m3/day
-316.99

2031 Change in DWF of existing dwellings
m3/day
-231.30

	Rye Meads Catchment Total							
	06/07 Existing Dwellings	Yearly Dwelling Increase	DWF from 06/07 dwellings	Annual DWF increase from new dwellings	Cum. Increase from new dwellings	Total Domestic DWF	Trade Flow*	Total DWF (including trade)
			m3/day	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
2007/08	153,218	2,264	73,326	866	866	74,192	5,861	80,053
2008/09	153,218	1,728	73,326	661	1,527	74,854	5,861	80,714
2009/10	153,218	1,902	73,326	729	2,256	75,582	5,861	81,443
2010/11	153,218	2,037	73,326	779	3,035	76,361	5,861	82,222
2011/12	153,218	2,007	70,161	632	3,667	73,828	5,861	79,688
2012/13	153,218	2,944	70,161	927	4,594	74,755	5,861	80,615
2013/14	153,218	3,523	70,161	1,107	5,701	75,862	5,861	81,722
2014/15	153,218	3,608	70,161	1,134	6,835	76,996	5,861	82,857
2015/16	153,218	3,608	70,161	1,134	7,970	78,130	5,861	83,991
2016/17	153,218	3,418	65,563	1,055	9,025	74,588	5,861	80,449
2017/18	153,218	3,338	65,563	1,031	10,055	75,619	5,861	81,479
2018/19	153,218	3,338	65,563	1,031	11,086	76,649	5,861	82,510
2019/20	153,218	3,338	65,563	1,031	12,117	77,680	5,861	83,541
2020/21	153,218	3,338	65,563	1,031	13,147	78,711	5,861	84,571
2021/22	153,218	2,588	63,869	790	13,938	77,807	5,861	83,667
2022/23	153,218	2,588	63,869	790	14,728	78,597	5,861	84,457
2023/24	153,218	2,588	63,869	790	15,518	79,387	5,861	85,248
2024/25	153,218	2,588	63,869	790	16,308	80,177	5,861	86,038
2025/26	153,218	2,588	63,869	790	17,098	80,967	5,861	86,828
2026/27	153,218	2,588	62,997	782	17,880	80,877	5,861	86,738
2027/28	153,218	2,588	62,997	782	18,662	81,659	5,861	87,519
2028/29	153,218	2,588	62,997	782	19,443	82,441	5,861	88,301
2029/30	153,218	2,588	62,997	782	20,225	83,222	5,861	89,083
2030/31	153,218	2,588	62,997	782	21,006	84,004	5,861	89,864

**TWU report annual trade flow*
at Rye Meads of:
1,775,751 m3/year
Divide by 303 to exclude Sundays
5,861 m3/day

TWU advise that they predict no increase in trade effluent
due to the changing trends in business use away from high water uses

2031 Change in DWF of existing dwellings	2031 Total Increase from new dwellings	06/07 to 2031 total DWF Increase
m3/day	m3/day	m3/day
-10,329.10	21,006.50	10,677.40

2021 Change in DWF of existing dwellings	2021 Total Increase from new dwellings	06/07 to 2021 total DWF Increase
m3/day	m3/day	m3/day
-7,762.91	13,147.43	5,384.52